THE SETTLEMENT GEOGRAPHY OF THE SACRAMENTO-SAN JOAQUIN DELTA, CALIFORNIA

A DISSERTATION
SUBMITTED TO THE COMMITTEE ON GRADUATE STUDY
OF STANFORD UNIVERSITY
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN
GEOGRAPHY

By
John Thompson
December 1957

I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

E. Louis Peffer

I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Paul F. Griffin

I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Joseph E. Williams

Approved for the University Committee on Graduate Study:

[illegible]

Dean of the Graduate Division

PREFACE

This study of the Sacramento-San Joaquin Delta is an attempt to apply geographical principles to the settlement of a delta area in a highly advanced technological society. This is one of the first delta areas of the world to be developed with modern machinery and reclamation methods instead of under the primitive methods which have been applied to other deltas of the world. Among the delta's serious physical handicaps to permanent settlement and agricultural productivity were river and tidal floods, levee and soil subsidence, salt-water incursion, and wind erosion. Periodically the attempted corrective measures in engineering and legislation have added to the physical problems.

The nature of the delta as it appears today is the product of changes wrought by physical and cultural agencies chiefly in the past century. To understand the problems of settlement of this delta under modern conditions one must analyze the physical setting as well as the many human activities which have been essential in winning the delta area for agricultural production. Reminders of this cultural imprint are most evident in the levees, the land cover, local relief, soils, and the outline of islands and channels. The Sacramento-San Joaquin Delta does not fit the usual deltaic pattern of such areas in other parts of the world. The Sacramento and San Joaquin rivers enter two of the corners of the triangle and form many distributaries which are confined in a single drainage channel to Suisun Bay and subsequently into San Pablo and San Francisco bays and eventually through the Golden Gate Channel into the Pacific Ocean.

Although the Sacramento-San Joaquin Delta is unique among world deltaic regions, there are physical similarities with the Fens of east coastal England and the reclaimed North Sea fringes of the West European Plain. The paper is offered as a basis for comparative study of the settlement geography of other deltas.

The research on the Sacramento-San Joaquin Delta began in the spring of 1955. Intensive field work was performed during that summer and frequent visits in all seasons continued to the present. In addition to field observation and interrogation, research in primary materials was conducted in the Bancroft Library and General Library of the University of California, the California State Library at Sacramento, the College of the Pacific Library, the Stanford University Library, and the Sacramento, San Francisco, and Stockton city libraries. Unpublished material of considerable value to this study was made available also by such United States agencies as the Bureau of Reclamation and the Bureau of Land Management in Sacramento, the District Court in San Francisco, and the Soil Conservation Service. The Division of Water Resources, the Reclamation Board, the University of

California Agricultural Extension Service, and the University of California Department of Soils and Plant Nutrition also permitted access to their files or libraries. The courtesies which the various agencies extended to this writer were, together with advice and a "feeling" for the delta, realized through the aid of a number of individuals among whom Messrs. John McKeag, W. C. Fleming, John Spurlock, Alan Carlton, R. S. Baskett, John P. Underhill, John Golden, and Dr. Stanley W. Cosby are recalled as being particularly generous of time and effort. This writer also wishes to express gratitude to Mr. F. Hal Higgins, Mr. J. R. Morrison, Dr. J. N. Bowman, and Mr. William Q. Wright for their initiative in bringing information to his attention.

Deep appreciation is due to Professors Joseph E. Williams, E. Louise Peffer, and Paul F. Griffin for shaping the perspective and guiding the exposition of facts and ideas in this paper. The writer also wishes to thank the following students who executed most of the cartographic work: Sabina M. Pyzell, Nancy S. Johnson, Janet M. O'Hara, Nicholas A. Vaksvik, Barbara Westinghouse, Wayne R. Irvin, V. Kay Vinson, and Hugh N. March. A final acknowledgment is due to Miss Liselotte B. Hofmann and Mrs. Jean S. Thompson for their editorial suggestions and typing.

TABLE OF CONTENTS

PART TWO: THE DELTA BEFORE RECLAMATION

PART THREE: RECLAMATION AND LAND USE

LIST OF TABLES

LIST OF MAPS

Map

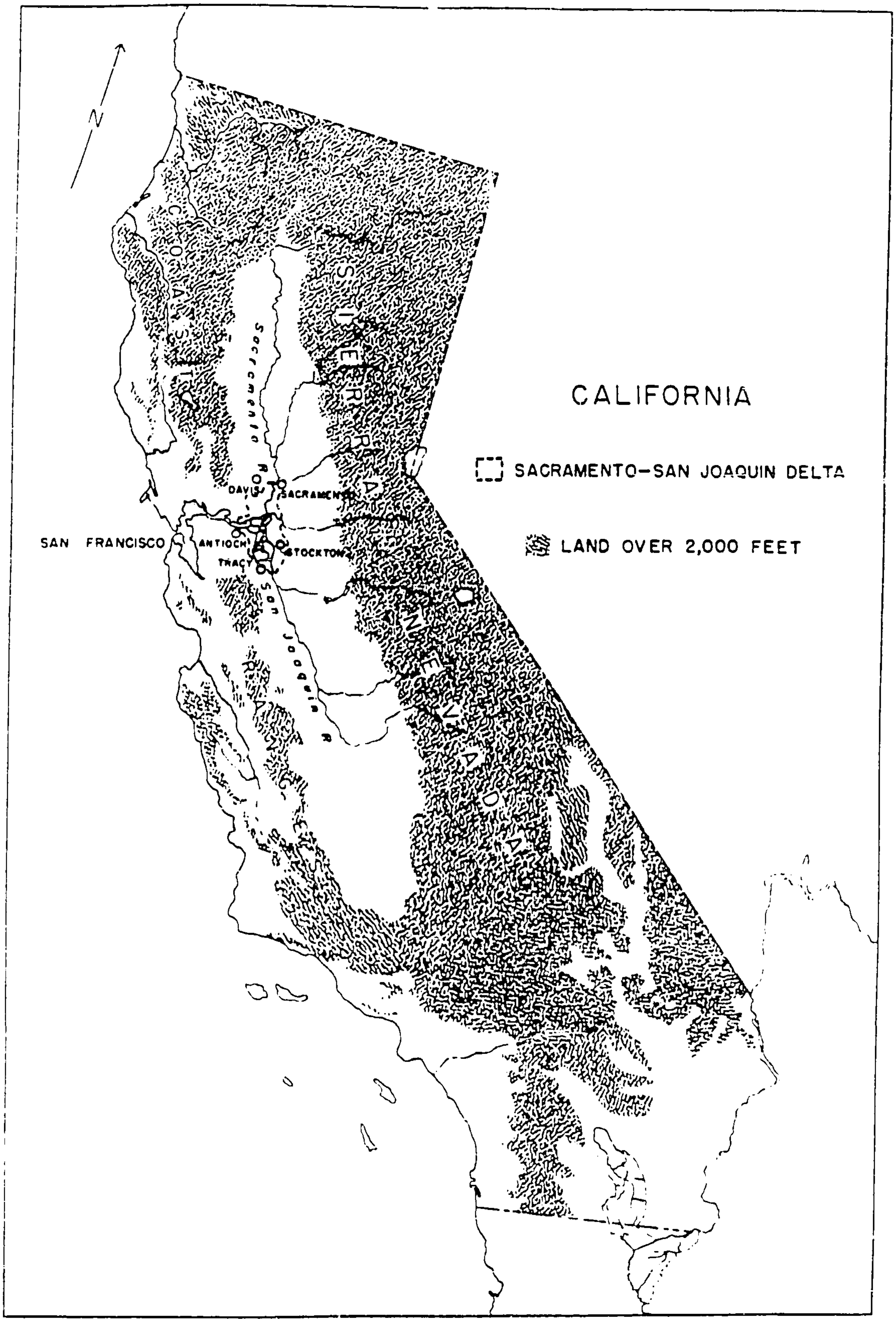
LIST OF PLATES

LIST OF MAP PLATES

LIST OF ABBREVIATIONS

BLS	*Bancroft Library Scrapbooks*
BS	*Bancroft Scraps*
DWR	Division of Water Resources
MSP	*Mining and Scientific Press*
PRP	*Pacific Rural Press*
SDI	*Stockton Daily Independent*
SWI	*Stockton Weekly Independent*
USDA	U.S. Department of Agriculture

Map 1

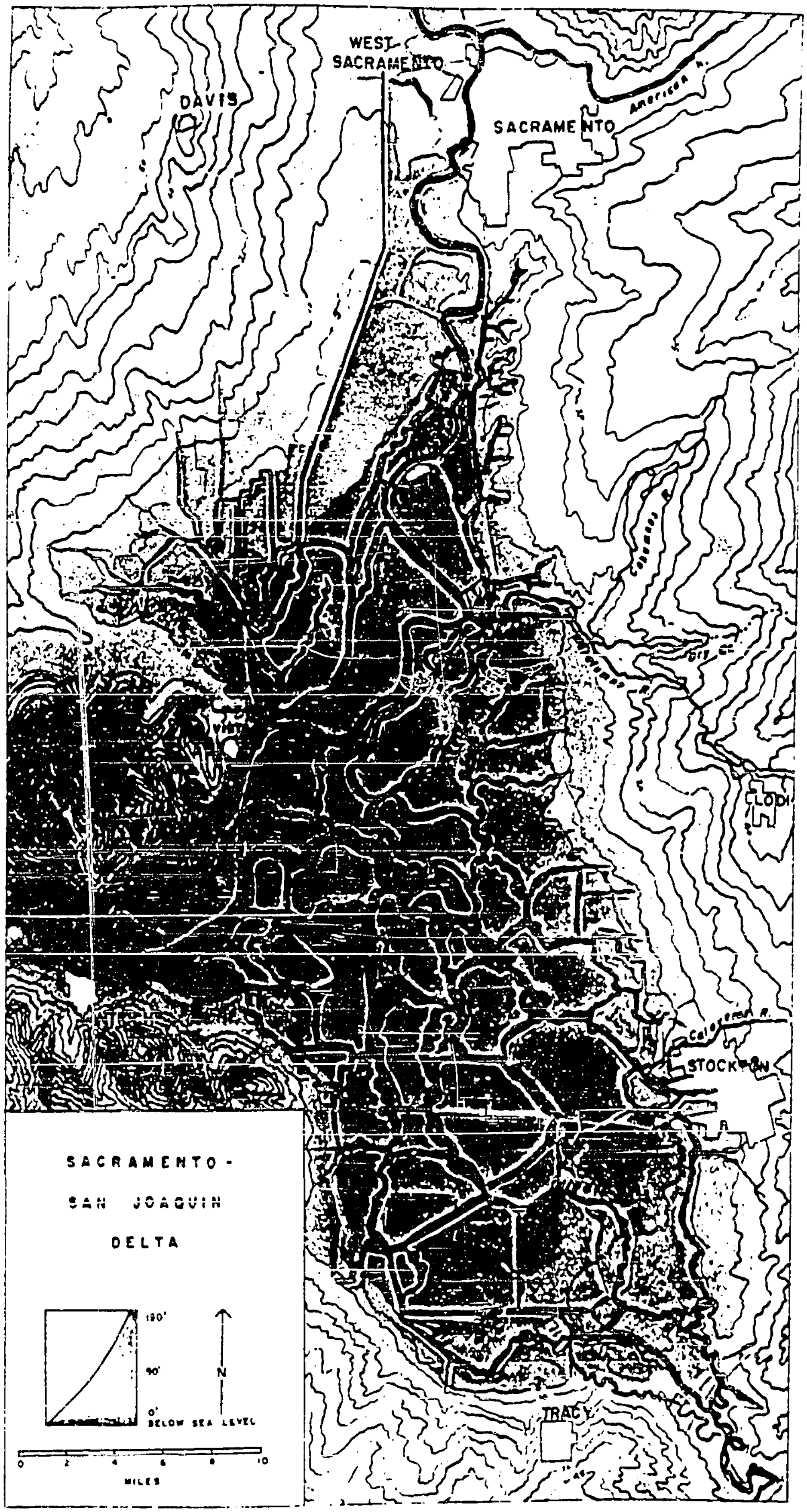

CALIFORNIA
SACRAMENTO–SAN JOAQUIN DELTA
LAND OVER 2,000 FEET
N
SAN FRANCISCO
DAVIS
SACRAMENTO
ANTIOCH
TRACY
STOCKTON
Sacramento R
San Joaquin R

INTRODUCTION

The drainage from more than one-third of California arises in the basins of the Sacramento and San Joaquin rivers. The floodplains of these arterial streams merge about 50 miles northeast of San Francisco, and the rivers pass through a complex network of interconnecting channels before discharging into the easternmost of the chain of bays which breaches the Coast Ranges (see Map 1, p. 1). The segment of the Central Valley where the two rivers merge and enter Suisun Bay is the Sacramento-San Joaquin Delta (see Map 2, p. 3). About 56 per cent of its 535,000 acres of peat and alluvial land is at or below sea level; this area and the higher river overflowed land are preserved from returning to a deltaic swamp by about 1,100 miles of channel front levees.

Maximum dimensions of the Sacramento-San Joaquin Delta are nearly 24 miles, east to west, and 48 miles, north to south. Roughly delimiting the region are the cities of Sacramento, Stockton, Tracy, and Antioch; the administrative subdivisions of the state within which it lies are the counties of Sacramento, San Joaquin, Contra Costa, Solano, and Yolo (see Map 3, p. 5).

MAP 2

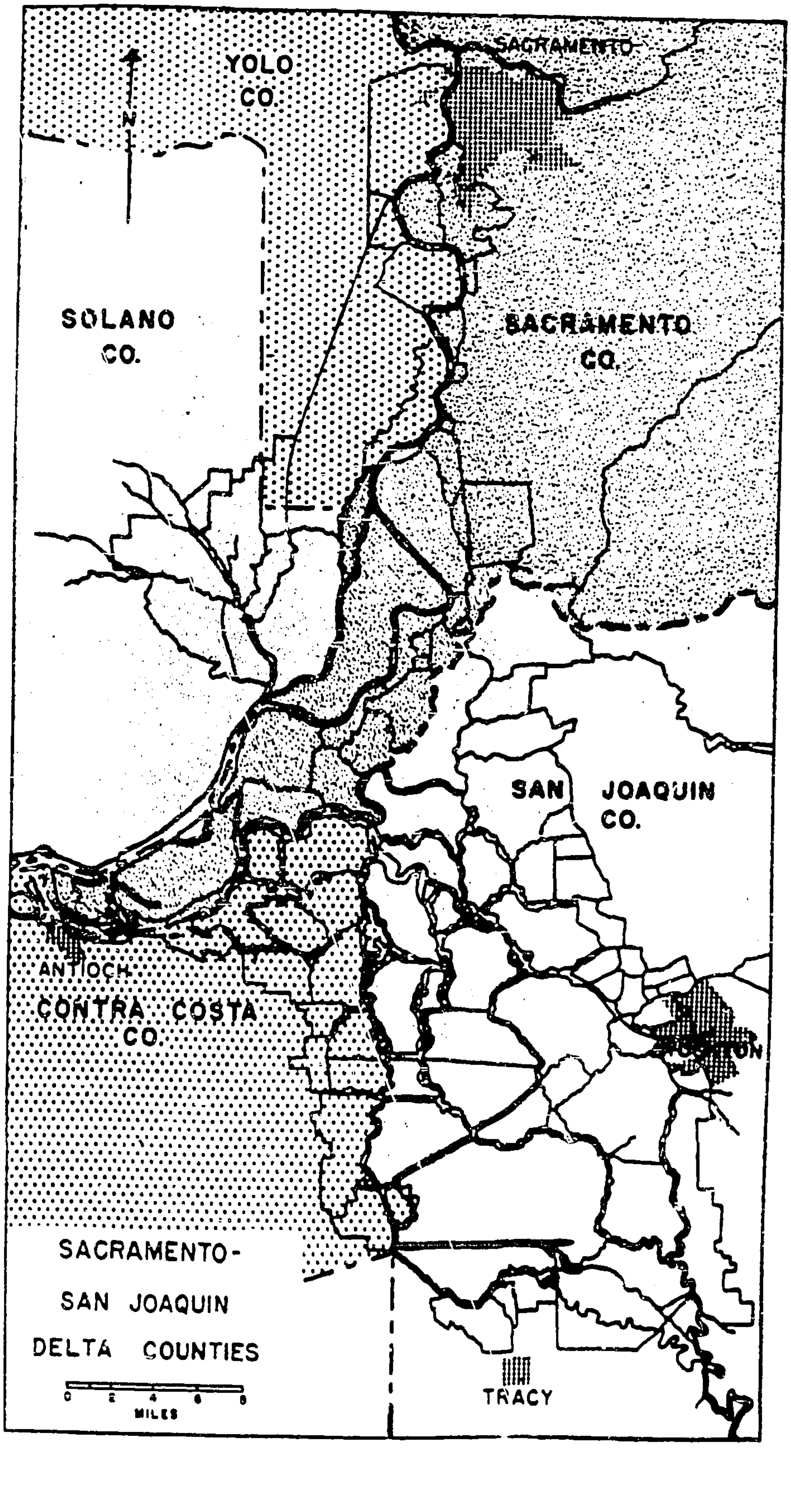

WEST SACRAMENTO
DAVIS
SACRAMENTO
American R.
STOCKTON
LODI
TRACY
SACRAMENTO - SAN JOAQUIN DELTA
190'
90'
0' BELOW SEA LEVEL
N
0 2 4 6 8 10
MILES

Before the Gold Rush the delta was a tidal swamp frequented by Indians, a few trappers, and an occasional group of transient Californians or Mexicans. While the gold fever continued strong a few men settled on the natural levees. These and later arrivals undertook the first of uncounted levee-building projects which ultimately transformed the delta from an imperfectly drained floodplain to a productive farming region.

The plexus of delta channels which links the main rivers of the Central Valley with the bays and the Golden Gate has performed an important role in central California communications. Along the waterways moved shiploads of Argonauts to and from the mines. Later, when bonanza wheat growing spread cultivated fields through the Central Valley, the delta affluents floated scores of steamboats and barges seaward. For years packets and freight boats carried thousands of people and large volumes of produce, grain, and other freight between Sacramento, Stockton, other delta points, and the San Francisco Bay cities. While bulky through traffic still moves by barge between bay points, Sacramento and above, and Stockton, the automobile and good roads ended the dependence of the delta on water communications.

With productive soils, a nearly drought-free situation, waterway or highway access to the major urban communities of central California, and transcontinental rail links, the delta has been ideally adaptable for commercial agricultural

MAP 3


YOLO CO.
SACRAMENTO
SOLANO CO.
SACRAMENTO CO.
SAN JOAQUIN CO.
ANTIOCH
CONTRA COSTA CO.
TRACY
SACRAMENTO - SAN JOAQUIN DELTA COUNTIES
MILES

development. Fortunes were made and lost by speculators and farmers intent upon capitalizing on the increase in land values and the improved agricultural potential which reclamation promised. Commercial farming, the major economic activity for many years, has been characterized by a constant search for more remunerative land uses. The products emphasized change from time to time but an attention to small grains, high labor requirement row crops, and livestock feeding has prevailed for over a century.

PART ONE: PHYSICAL GEOGRAPHY

CHAPTER I

THE DELTA, ITS HYDROGRAPHY AND LAND FORMS

To understand the cultural geography of the Sacramento-San Joaquin Delta, one must understand the physical geography of the region. The delta occupies the central part of the structurally depressed Central Valley, a physical unit the formation of which has been ascribed to faulting or geosynclinal sag, although recent torsion balance studies suggest that the underlying basement complex represents a westward extension of the tilted Sierra Nevada block.[1] Core samples from wells drilled to the east of the delta appear to substantiate the latter theory.

---

[1]Bruce L. Clark, "Tectonics of the Valle Grande of California," American Association of Petroleum Geologists, Bulletin, XIII (March 1929), p. 202; Andrew C. Lawson, "The Sierra Nevada in the Light of Isostasy," Geological Society of America, Bulletin, XLVII (Nov. 1936), p. 1698; F. E. Vaughan, "Geophysical Studies in California," Geologic Formations and Economic Development of the Oil and Gas Fields of California, Calif. Dept. of Natural Resources, Div. of Mines, Bull. No. 118 (Sacramento: 1943), p. 68; J. C. May and R. L. Hewitt, "The Basement Complex in Well Samples from the Sacramento and San Joaquin Valleys, California," California Journal of Mines and Geology, XLIV (April 1948), p. 130.

Samples of Sierra complex rocks have been reached at depths of 9,400 feet and 6,450 feet, respectively, 7 miles south and about 9 miles southeast of Sacramento (see Map 4, p. 9). About 19 miles due north of Stockton the basement was found at 5,750 feet depth.[2] To the east of Stockton, at 8½ and 14 miles, respectively, are well holes that floored in crystallines at about 8,500 feet and 6,300 feet depth.[3]

A basement of igneous and metamorphic rocks is mantled by Cretaceous and Cenozoic strata which dip from the east and west toward a longitudinal axis that lies nearer the Coast Ranges than the topographic center of the Central Valley.[4] This sag of the sedimentary rocks is attributed to the forces which produced the folds and overthrusts of the Coast Ranges. Perhaps the depression deepens as the delta area is approached; Kirk Bryan observed that the thickness of the Sacramento Valley Tertiary and later formations increased from north to south.[5]

Some agency of depression appears to have operated in the area of the delta but not to the north or south.

---

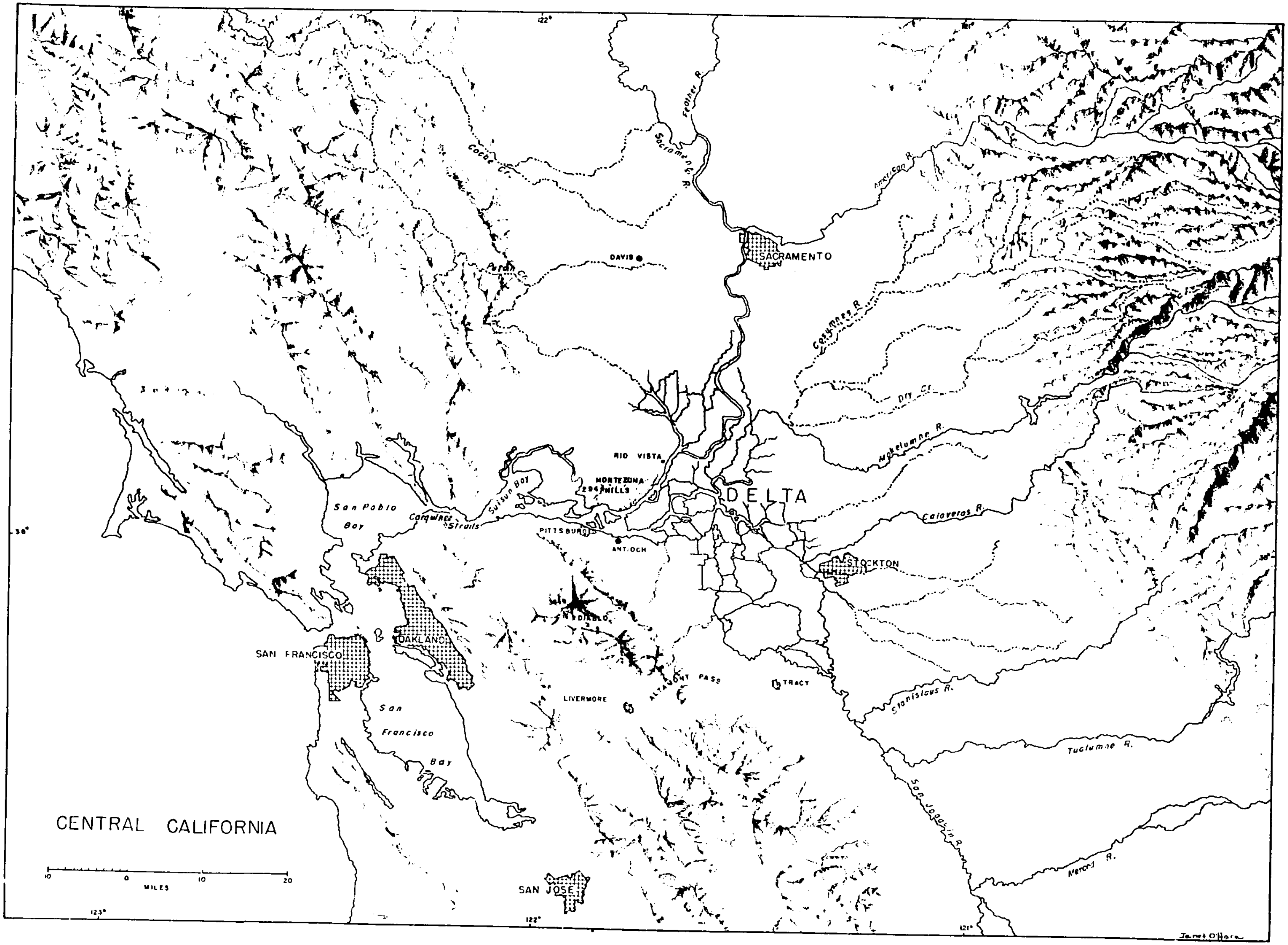
[2]William B. Clark, "Mines and Mineral Resources of San Joaquin County, California," California Journal of Mines and Geology, LI (Jan. 1955), p. 28.

[3]May and Hewitt, loc. cit., p. 155.

[4]Olaf P. Jenkins, "Geomorphic Provinces of California," Geologic Formations and Economic Development of the Oil and Gas Fields of California, p. 83.

[5]Geology and Ground-Water Resources of Sacramento Valley, California, U.S. Dept. of the Interior, Geological Survey, Water-Supply Paper No. 495 (Washington: 1923), pp. 77-78.

MAP 4


CENTRAL CALIFORNIA
MILES
10 0 10 20
123°
122°
121°
38°
Janet O'Hara
Feather R.
Sacramento R.
American R.
Cache Cr.
Putah Cr.
DAVIS
SACRAMENTO
Cosumnes R.
Dry Cr.
Mokelumne R.
Calaveras R.
RIO VISTA
MONTEZUMA HILLS
DELTA
Suisun Bay
San Pablo Bay
Carquinez Straits
PITTSBURG
ANTIOCH
STOCKTON
DIABLO
OAKLAND
SAN FRANCISCO
ALTAMONT PASS
TRACY
LIVERMORE
San Francisco Bay
Stanislaus R.
Tuolumne R.
San Joaquin R.
Merced R.
SAN JOSE

Andrew C. Lawson and F. Leslie Ransome associated the subsidence with the same movement which submerged San Francisco Bay. Sedimentary loading was considered to be insufficient to produce the depression although such accumulations may explain delta subsidence elsewhere.[6]

Comparatively recent evidence of regional subsidence is afforded by an extensive body of peat which thickens toward the western apex of the delta from the north, east, and south. The organic materials have a maximum vertical development of 50 feet or more.[7] The surface peat layer, generally less than three feet thick, was derived from tules (Scirpus lacustris L.). The underlying column of decomposed organic matter was produced by reeds (chiefly Phragmites communis Trin.); it rests upon a massive and somewhat impervious mineral substratum of alluvial and lacustrine origin.[8]

---

[6] Lawson, "The Geomorphogeny of the Coast of Northern California," University of California, Dept. of Geology, Bulletin, I (Nov. 1894), pp. 265-66; Ransome, "The Great Valley of California," ibid., I (April 1896), p. 415.

[7] Report of Sacramento-San Joaquin Water Supervisor for the Period 1924-1928, Calif. Dept. of Public Works, Div. of Water Resources, Bull. No. 23 (Sacramento: 1930), p. 361 (hereinafter cited as DWR Bull. No. 23); Geology and Water Resources of the Mokelumne Area, California, by H. T. Stearns, T. W. Robinson, and G. H. Taylor, U.S. Dept. of the Interior, Geological Survey, Water-Supply Paper No. 619 (Washington: 1930), p. 32.

[8] Soil Survey of the Sacramento-San Joaquin Delta Area, California, by Stanley W. Cosby, U.S. Dept. of Agriculture (hereinafter cited as USDA), Bur. of Plant Industry, and University of California Agricultural Experiment Station, Series 1935, No. 21 (Washington: 1941), pp. 17, 18.

A prolonged general subsidence is suggested for the area because the plants could not have grown except in relatively shallow water.[9] A. P. Dachnowski-Stokes dates the beginning of plant accumulation at the close of the glacial period.[10] Perhaps a postglacial general rise in sea level fostered the accumulation of the hydrophytic remains. Moderate depression of a block lying to the southeast of the scarp-edged Montezuma Hills also could have been involved in developing the peat column. Several cases of vertical displacement of strata have been revealed in core samples from gas fields in the Rio Vista to Walnut Grove vicinity.[11] No single explanation for the regional subsidence has gained general acceptance with scientists, but there is a developing record of measured data, primarily from well cores, which may eventually resolve the problem.

---

[9] *Ibid*., p. 17. Viewed in another light, the vertical dimension of the organic remains developed while canopies of living hydrophytes extended themselves across water from the margins of natural levees or other land. Dead plant matter and silt gradually thickened to the point of resting upon the mineral substratum. This explanation for peat accumulation suggests itself from cases in which dammed sloughs were blanketed by plant growth to the depth of 15 feet in 35 years. *Letter* of William Q. Wright, Los Gatos, California, n.d. [1950], pp. 7-8 (in Wright's files).

[10] *Peat Land in the Pacific Coast States in Relation to Land and Water Resources*, USDA, Bur. of Chemistry and Soils, Misc. Pub. No. 248 (Washington: 1936), p. 19.

[11] D. W. Carlson, "Mines and Mineral Resources of Sacramento County, California," *California Journal of Mines and Geology*, LI (Jan. 1955), pp. 149-50.

The Delta Characteristics

The Sacramento-San Joaquin Delta has the subaerial features generally associated with deltas developed by low-gradient rivers upon entering tidal water. Distributary channels, natural levees, and island or mainland tracts of tidal marshland are present. There is, however, little suggestion of the presence of top-set, fore-set, and bottom-set beds which are frequently associated with deltaic deposits. It is an unusually large volume of indigenous organic fill, peat, that occupies the core area of the delta. Alluvium rich in organic matter merges with the peat toward delta and channel margins. The peat rests upon a zone of soft muck which overlies the continuous hardpan bed of light gray mineral sediment that dips toward the valley outlet. The hardpan slopes from depths of 14 to 20 feet along the eastern edge of the peat areas to 40 and 60 feet below the surface near the river outfall.[12]

A deltoid outline is possessed by the Sacramento-San Joaquin Delta, but the orientation of this land form differs from the common conception of an estuarine delta. Estuarine deltas, like true, arcuate, and digitate forms, are land features which broaden seaward. This compound delta diminishes in breadth seaward. Its trunk stream distributaries

---

[12]Cosby, op. cit., p. 43; Marsden Manson and C. E. Grunsky, "Report of Consulting Engineers," Report of the Commissioner of Public Works to the Governor of California (Sacramento: 1895), p. 26.

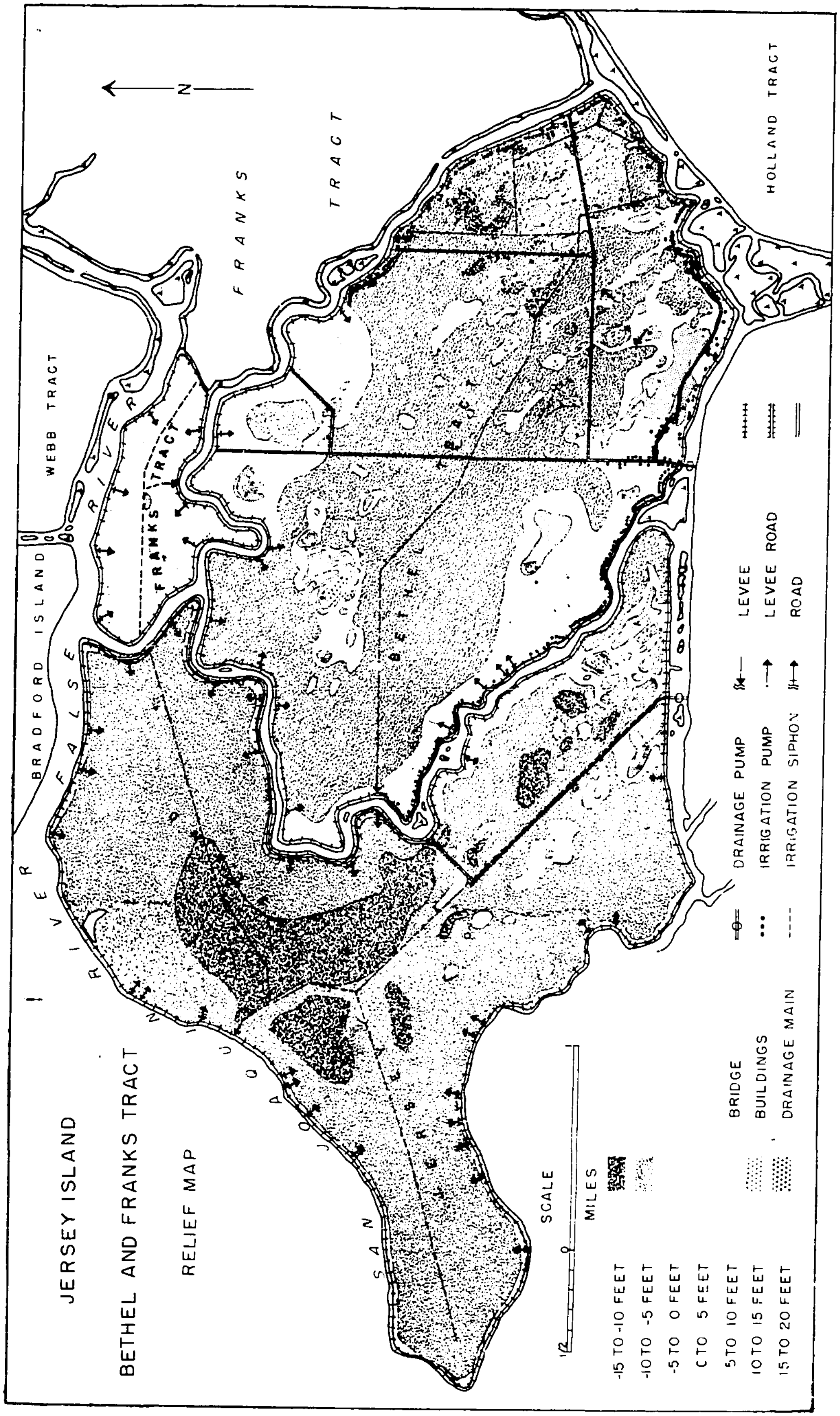
merge rather than diverge as the outlet between the Mount Diablo Range and the Montezuma Hills is reached.

In the undisturbed state of a century ago about three-fifths of the delta was awash with an ordinary tide. Spring tides could submerge all of the backswamp. River floods were capable of overflowing the entire delta, particularly when crests, high tides, and westerly winds created a congestion above the outlet into Suisun Bay.

Local relief was slight. Typical asymmetrical natural levees, narrow meandering ridges of alluvium that splayed into backswamps from distributaries, and occasional hummocks of sand were the features which rose above the general plane of the sea level swamp. The elevation of the alluvial ridges increased headward, but the aeolian hummocks were best developed about 10 miles east of Antioch. For the most part, the various features were less than 10 feet high.

The relief has been increased markedly by a century of reclamation and agricultural activity. The natural levee-rimmed tidal swamps have had a saucer-like profile intensified by oxidation and deflation of the drained peat. This local subsidence of peat has resulted in island surfaces shrinking from sea level elevations to minus 5, 10, or 15 feet. On reclaimed tracts which have poorly defined natural levees the transition to depressed floors from island margins is abrupt (see Map 5, p. 14); artificial levees form the saucer rim. As the natural levees become better defined a more shelving slope separates the artificial rim from the

MAP 5


JERSEY ISLAND
BETHEL AND FRANKS TRACT
RELIEF MAP
SCALE
0
1/2
MILES
-15 TO -10 FEET
-10 TO -5 FEET
-5 TO 0 FEET
0 TO 5 FEET
5 TO 10 FEET
10 TO 15 FEET
15 TO 20 FEET
BRIDGE
BUILDINGS
DRAINAGE MAIN
DRAINAGE PUMP
IRRIGATION PUMP
IRRIGATION SIPHON
LEVEE
LEVEE ROAD
ROAD
N
SAN JOAQUIN RIVER
FALSE RIVER
BRADFORD ISLAND
WEBB TRACT
FRANKS TRACT
HOLLAND TRACT
BETHEL

island interior. This backslope is not the simple depositional feature that a cursory view might indicate. In the first place, organic matter is proportionately greater in volume toward the interior of a tract; hence the oxidation rate and subsidence have been greater away from the levee crest. Secondly, the slope has been affected by the accumulation of materials derived from flood-eroded artificial levees or deposited when floods poured placer mining debris into the reclaimed tracts.

Artificial levees are the most prominent relief features. They top, and in some instances virtually conceal, the original natural levee or bank. The mass and elevation of the man-made banks provide a more apparent cultural imprint upon the terrain than do the culturally induced oxidation of peat and alteration of natural levee backslopes. Without the artificial levees the man-made landscape which is the present Sacramento-San Joaquin Delta could not exist (see Plate I, p. 16).

Delimiting the Delta

There is ample discussion of the physical characteristics of deltas in contemporary and recent texts in geology and physical geography, but the literature barely touches upon the problem of defining headward or landward limits of the deltas.[13] A convenient and arbitrary designation of the

[13]The following texts were consulted: Ralph S. Tarr, <u>Elementary Physical Geography</u> (New York: The Macmillan Co.,

PLATE I

Air view of the delta's western apex

The Sacramento (left) and San Joaquin (right) rivers outline Sherman Island. Existing and abandoned levees, the drainage ditches, and relationship of water and land elevations are noted readily in center and left center. Abandoned land is partially covered with spoil dredged from the rivers. Antioch is in foreground; Montezuma Hills and Rio Vista appear at left in the distance. (Sunderland Photo) former point is the fork made by the uppermost distributary.[14] The edge of the pre-reclamation backswamps approximates the landward limit of the Sacramento-San Joaquin Delta.

By projecting the pre-reclamation mean tidal basin, which coincides with most of the organic soil area, a pedological definition of the delta is made.[15] The area so conceived does not fit the residents' opinions of what constitutes the delta. Nor does it include all of the land which lies downstream of the first Sacramento and San Joaquin distributaries.[16] This larger area is closer to the concept of the delta as it has been expressed by state, federal, and private engineers familiar with the area.

1896); Israel C. Russell, Rivers of North America (New York: G. P. Putnam's Sons, 1898); Rollin D. Salisbury, Physiography (2d ed., rev.; New York: Henry Holt and Co., 1909); Philip G. Worcester, A Textbook of Geomorphology (New York: D. Van Nostrand Co., Inc., 1939); O. D. von Engeln, Geomorphology (New York: The Macmillan Co., 1942); Norman E. A. Hinds, Geomorphology (New York: Prentice-Hall, Inc., 1943); C. A. Cotton, Geomorphology (4th ed.; New York: John Wiley and Sons, Inc., 1945); L. Don Leet and Sheldon Judson, Physical Geology (New York: Prentice-Hall, Inc., 1954); and William D. Thornbury, Principles of Geomorphology (New York: John Wiley and Sons, Inc., 1954).

[14]Salisbury, *op. cit.*, p. 200.

[15]Cosby includes within the delta "all important areas of the highly organic soils that distinguish this relatively flat, sea-level district and . . . exclude/s/ as much as possible the mineral soils that lie on the margins of the encircling valley plains." *Op. cit.*, p. 1.

[16]*Variation and Control of Salinity in Sacramento-San Joaquin Delta and Upper San Francisco Bay*, Calif. Dept. of Public Works, Div. of Water Resources, Bull. No. 27 (Sacramento: 1932), p. 152 (hereinafter cited as DWR Bull. No. 27).

Official engineering and reclamation literature on the lower Sacramento and San Joaquin basins generally shows agreement as to the terminal apexes of the delta. The juncture of both rivers with Suisun Bay is uniformly accepted as the western tip. The northern extremity is traced to within 10 miles of Sacramento.[17] The southern delta extremity is variously located at points lying within two miles above or below the multiple bridge crossings of the San Joaquin.[18] The northern and southern limits as viewed in the engineering reports are essentially the same as the physiographic designation of the first distributary fork.

---

[17]George A. Atherton, "Irrigation Developments in the Sacramento-San Joaquin Delta," in Proceedings of the Sacramento River Problems Conference, Calif. Dept. of Public Works, Div. of Water Rights, Bull. No. 3 (Sacramento: 1924), p. 91 (henceforth referred to as DWR Bull. No. 3); Report on Salt Water Barrier, Calif. Dept. of Public Works, Div. of Water Resources, Bull. No. 22 (Sacramento: 1929), p. 44 (hereinafter cited as DWR Bull. No. 22); DWR Bull. No. 23, p. 359; DWR Bull. No. 27, p. 17; "Allocation of Costs; Problems 8-9," Appendix E in Report of Subcommittee on Salinity, U.S. Dept. of the Interior, Bur. of Reclamation, Central Valley Project Studies (Washington: 1947), p. 167.

[18]Report of the Examining Commission on Rivers and Harbors to the Governor of California (Sacramento: 1891), p. 84; DWR Bull. No. 22, loc. cit.; DWR Bull. No. 27, loc. cit.; George S. Nickerson, "Discussion," DWR Bull. No. 3, p. 96; Partial Report from the Chief of Engineers on Sacramento, San Joaquin, and Kern Rivers, California, Concerning Navigation, Flood Control, Power Development, and Irrigation, U.S. 71st Cong., 3d Sess., H. Doc. 791 (1931), p. 35; "Allocation of Costs . . . ," loc. cit.; Marsden Manson, "The Swamp and Marsh Lands of California," Technical Society of the Pacific Coast, Transactions, V (Dec. 1888), p. 97; George A. Atherton, "Reclamation and Development in the Sacramento-San Joaquin Delta," Agricultural Engineering, XII (April 1931), p. 129.

There is reasonable agreement among the engineers in precisely designating landward limits of the delta. A private consulting engineer included peat and higher sedimentary lands, in approximately equal proportions, none of which would have been as much as 10 feet above mean sea level (see Map 6, p. 20).[19] The State Surveyor General, writing in 1869, observed that the extreme flood height in the delta then reached 10 feet above low tide.[20] The Governor's Examining Commission on Rivers and Harbors accepted the 10-foot contour above low tide as the edge of the delta.[21] This slightly exceeds the Bureau of Reclamation's designation of the delta to "include all islands and adjoining lands lying below the five foot contour" and certain lands above the contour.[22]

---

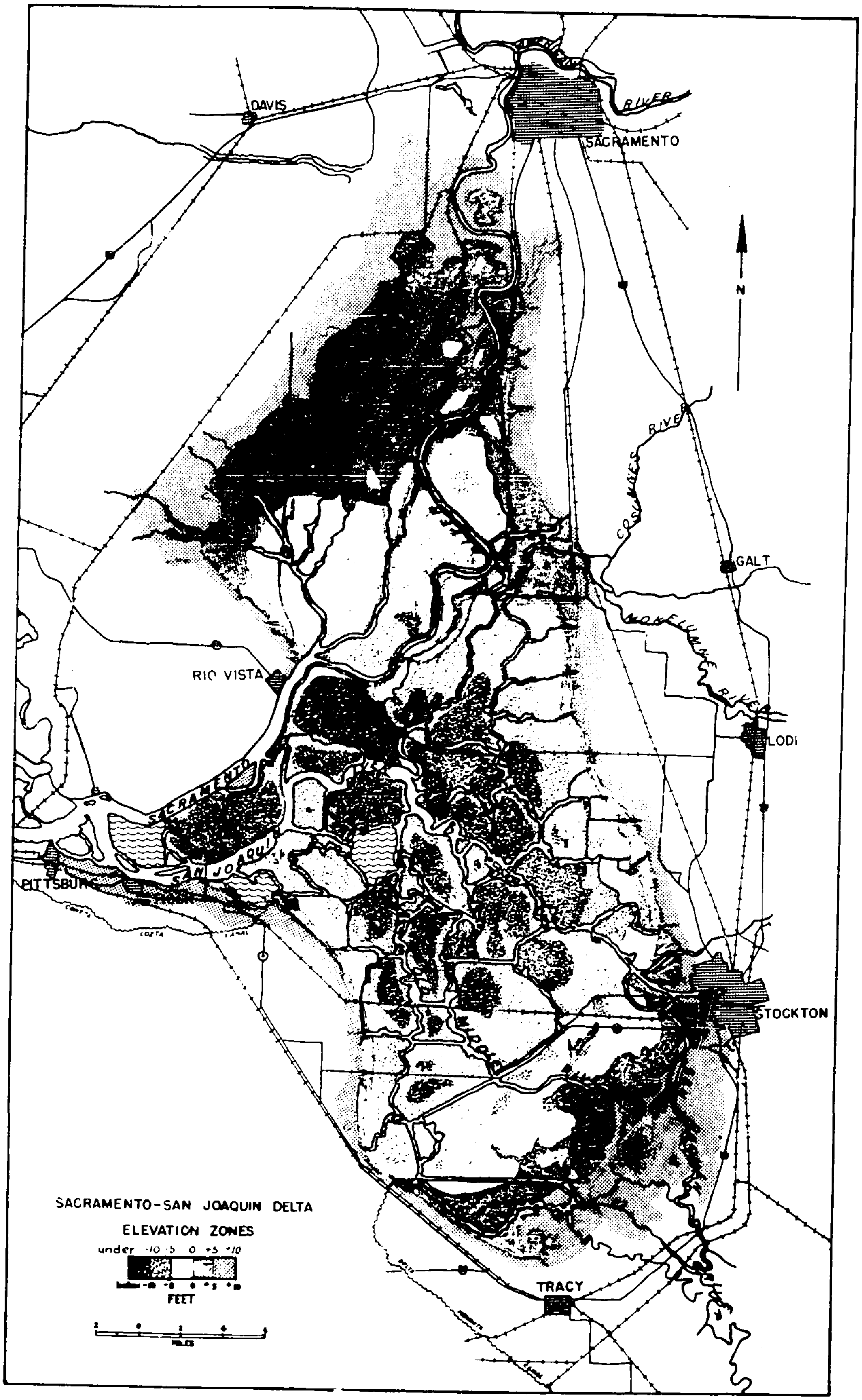
[19]Ibid.

[20]"Report" of Sherman Day, in Tide Land Reclamation Company, Fresh Water Tide Lands of California (San Francisco: M. D. Carr and Co., 1869), p. 15.

[21]Report of the Examining Commission . . ., p. 8.

[22]The complete statement makes a number of qualifications based on cultural activities rather than on physical criteria. The Bureau, to facilitate investigations of water use in the lower Sacramento and San Joaquin valleys, regards the delta as including "all islands and adjoining lands lying below the five foot contour . . . and additional lands above this elevation limited to: areas that have been irrigated from the delta channels, areas included within designated places of use described in applications, permits, or licenses issued by the State for appropriation of water from delta channels, and separate landholdings either contiguous to the five foot contour or located above that elevation and abutting a delta channel (portions of these holdings, in some instances, were excluded by consideration of swamp and overflowed land survey boundaries)." John A. McKeag, "Delta Report," prepared for the U.S. Dept. of the Interior, Bur. of

MAP 6



DAVIS
SACRAMENTO
RIVER
N
RIVER
COSUMNES
GALT
MOKELUMNE
RIVER
LODI
RIO VISTA
SACRAMENTO
SAN JOAQUIN
PITTSBURG
STOCKTON
TRACY
SACRAMENTO-SAN JOAQUIN DELTA
ELEVATION ZONES
under -10 -5 0 +5 +10
FEET

These views are essentially in agreement as to the superficial extent of the delta. The maze of distributary channels and leveed islands of near sea-level elevation are clearly understood to be deltaic. Mainland swamp and overflowed tracts that drain directly into tidal sloughs or channels likewise seem to be recognized as deltaic. Topographic and edaphic similarities, together with land use patterns, strengthen the concept of the delta as being distinct from the adjoining valley plains.

The Tidal Basin

Approximately 320,000 acres of the delta lay within the estimated mean pre-reclamation tidal basin. More than half of this swamp was inundated at high tide.[23] Another 205,000 acres of the delta were subject to river flooding primarily, although extreme tides may have backed over some of the area.[24]

Reclamation, Project Development Division (7 folios; Sacramento: 1954), not paginated (typewritten and handwritten).

[23]Tide Land Reclamation Co., *loc. cit.*; *Report of the Examining Commission . . .*, *loc. cit.*; DWR Bull. No. 27, pp. 153, 160.

[24]Acreage estimate based on map measurements made by this writer. Maximum recorded flood stages have been about 6.5 feet above mean sea level at Collinsville, the mid-delta junction of the San Joaquin and Old River distributary, and Stockton. The flood-plane elevation at Walnut Grove is 16.5 feet; at the southern apex of the delta it is 23.2 feet. *Report to the Water Project Authority of the State of California on Feasibility of Construction by the State of Barriers in the San Francisco Bay System*, Calif. Dept. of Public Works, Div. of Water Resources (Sacramento: 1955), p. 46.

Swampland reclamation has reduced the mean tidal basin to about 39,000 acres.[25] The contraction from 320,000 acres modified the tidal prism. The modification has not been steady. Levee breaks have returned large acreages to the tidal basin, some of them permanently. The enlargement of existing channels or the excavation of new ones has aided tidal diffusion.[26] On the other hand, alluviation in the channels between the 1860's and 1900's resulted in an appreciable reduction of the tidal basin's water-holding capacity. The loss of floodplain and tidal basin water storage area through reclamation accelerated runoff delivery to the bay and facilitated the penetration of saline water into the delta channels.

Salinity in the Delta

Although the delta waters are tidal, they are not saline except during late summer and fall. The extent to which this seasonal salinity penetrates depends upon the volume of flow which the Central Valley rivers discharge into Suisun Bay.[27] The bay, largely fresh in winter and spring, usually becomes salty by mid-July. By September 1 the salt water reaches its maximum penetration of the delta.[28]

---

[25]DWR Bull. No. 27, p. 160. [26]*Ibid*., pp. 34, 39.

[27]For a comprehensive report on salinity in the delta see DWR Bull. No. 27.

[28]T. H. Means, "Water Supply and Salinity in the Sacramento-San Joaquin Delta," DWR Bull. No. 3, p. 106.

Salinity in delta waters has not impaired reclamation as it has elsewhere in the San Francisco Bay area.[29] It was not necessary to flush virgin reclaimed tracts, and there is no evidence that summer levee breaks resulted in salt-water damage to the land. Nevertheless, salt water has resulted in inconveniences for residents of the delta.

The water has been brackish enough on occasion to prevent its use for farm or domestic purposes. Such a situation was noted in the Antioch vicinity during August 1841, and in the 1860's and 1870's.[30] In the early 1870's Twitchell Island settlers had to go upstream to the mouth of the Mokelumne to collect potable water.[31] During several years between 1920 and 1942 the penetration of salt water became serious. In such critical years as 1920, 1924, 1926, 1931, 1934, and 1939, 20 per cent to 70 per cent of the channels contained water with 100 parts or more of chlorine per 100,000 parts of water.[32] The water was considered unfit for irrigation,[33] so late-season waterings had to be curtailed.

---

[29]DWR Bull. No. 27, pp. 60-61.

[30]*Ibid*., pp. 28, 46-47.

[31]C. E. Grunsky, Jr., "Discussion," DWR Bull. No. 3, p. 117.

[32]DWR Bull. No. 27, p. 28; *Economic Aspects of a Salt Water Barrier Below the Confluence of Sacramento and San Joaquin Rivers*, Calif. Dept. of Public Works, Div. of Water Resources, Bull. No. 28 (Sacramento: 1932), p. 87.

[33]*Ibid*. Water with 100 to 200 parts may be used with precautions. With over 200 parts it is safe to use

Average annual losses attributed to salt-water interference with irrigation during the period 1924-42 were 0.82 per cent of the total value of crop production, or a little over $203,000.[34] In the extreme years of salinity, 1924 and 1931, losses were estimated at 3.52 per cent and 5.28 per cent, respectively, of crop value. Farmers had to haul water to various of the central delta islands to meet domestic and livestock requirements.[35]

Salt-water penetration into the delta was aided by other factors beside the seasonal flow pattern of the rivers, reduction of swamp area, and the deepening and widening of channels. Diversions of water from Central Valley rivers increased with the expansion of irrigation agriculture and the growth of urban requirements. From 1910 to 1929 the area irrigated from the valley rivers increased at a rate of over 36,000 acres per year. Gross annual irrigation diversions increased from less than 3,000,000 acre-feet to over 5,000,000 acre-feet. Return flow of diversions amounted to an estimated 35 or 40 per cent; but only 75 per cent or less became available for use downstream during the irrigation season.[36]

---

except occasionally on such resistant crops as pears and asparagus. Subsequent heavy fresh-water irrigation is important. Means, <u>loc. cit</u>., p. 107.

[34] "Report of Committee on Problem 10" (1944), in <u>Payments by Beneficiaries; Problems 10 to 13</u>, U.S. Dept. of the Interior, Bur. of Reclamation, Central Valley Project Studies (Washington: 1947), Table 6, p. 33.

[35] DWR Bull. No. 22, <u>loc. cit</u>.

[36] DWR Bull. No. 27, p. 31.

Diversions of fresh water for irrigation intensified in the Central Valley during dry years, the years in which the seasonal river flow was below normal. Between 1917 and 1929 there were only two years of normal or greater flow.[37] In the summer of 1931, when about 70 per cent of the delta channels contained water with 100 or more parts chlorine per 100,000 parts of water, the minimum river discharge was less than 500 cubic feet per second.[38] It was estimated that at least another 4,100 cubic feet per second was required to keep the entire delta fresh.[39]

The inflow of Central Valley drainage to the delta for the period 1871 to 1956 was an estimated mean of 30,323,000 acre-feet per year. Approximately 74 per cent of the mean flow came from the Sacramento watershed, 21 per cent from the San Joaquin system, and 5 per cent from lesser delta affluents.[40] The proportion of summer flow from the northern basin was greater. Thus, the fresh water supply in the delta comes largely from the Sacramento system.[41]

---

[37] _Ibid._, p. 30.

[38] _Ibid._, p. 31.

[39] Joseph S. Gorlinski, "Supplement to Comprehensive Survey Report of the District Engineer," in _Sacramento-San Joaquin Basin Streams, California_, U.S. 81st Cong., 1st Sess., H. Doc. 367 (1950), p. 28.

[40] _Report to the Water Project Authority . . ._, p. 22; _San Joaquin County Investigation_, Calif. State Water Resources Board, Bull. No. 11 (Sacramento: 1955), Table 9, p. 34.

[41] DWR Bull. No. 27, Tables 38 and 39, pp. 428-29, 432.

This was reflected in the proportionately greater and more persistent development of salinity that occurred in the San Joaquin delta before the start of the Central Valley Project's program of controlled river discharge.[42]

The Sacramento River

The Sacramento River, main affluent of the delta, drains the more humid northern half of the Central Valley. Its peak monthly flows occur from January to May, inclusive.[43] Flood stages, generally the product of winter rains, usually happen between mid-November and mid-April.[44] These floods become especially critical when the watershed is visited by intense winter rains while yet in a saturated state from earlier storms.[45] The rain-produced floods have relatively high peaks, but they are of short duration.[46] Snow-melt floods rarely are damaging in the valley, but snow-melt runoff may augment the runoff from the short and intense rainfall periods that occur intermittently over the 3- to 10-day rainstorm periods.[47]

---

[42]*Ibid.*, p. 37. [43]*Ibid.*, Table 38, pp. 428-29.

[44]Between 1910 and 1950 there were 42 winter rain floods recorded in the Sacramento basin, and no damaging snow-melt floods. H. M. Rich, "Comprehensive Survey Report of the District Engineer," *Sacramento-San Joaquin Basin Streams, California*, U.S. 81st Cong., 1st Sess., H. Doc. 367 (1950), p. 106.

[45]R. C. Hunter, "Interim Survey of Sacramento River from Collinsville to Shasta Dam, California," *Sacramento River and Tributaries, California, from Collinsville to Shasta Dam*, U.S. 78th Cong., 2d Sess., H. Doc. 649 (1944), p. 25.

[46]Rich, *loc. cit.* [47]Hunter, *loc. cit.*

Storms may distribute precipitation generally over the Sacramento watershed, or the full impact may be restricted to one or two tributary basins. The disturbances often result in synchronized runoff peaks for the tributaries in the northern part of the Sacramento watershed. The crests of the more southerly Feather and American rivers normally reach the Sacramento before the upper valley flood peaks pass their mouths.[48] Nevertheless, the Sacramento channel is notoriously underequipped to handle the flows discharged into it.

Frequently the winter flow of the Sacramento system exceeds the capacity of the main channel. The river's constrictions which affected the development of the delta were continuous from above the Feather River mouth to Sherman Island. A 34-mile segment above the Feather River mouth possessed a capacity of only about 53 per cent of the cross section of the next segment headward.[49] Below the Feather River mouth the Sacramento channel capacity was one-seventh of the estimated flow which floods could bring to it.[50] Downstream from Sacramento the river had a 110,000 second-feet capacity; the tributary American River alone was

---

[48] Ibid.

[49] Committee on Flood Control, "Supplemental Report," Control of Floods on the Mississippi and Sacramento Rivers, U.S. 64th Cong., 1st Sess., H. Rept. 616 (1916), p. 33.

[50] C. E. Grunsky, "The Relief Outlets and By-Passes of the Sacramento Valley Flood-Control Project," American Society of Civil Engineers, Transactions, XCIII (Jan. 1929), p. 798.

capable of discharging more than that.[51] During floods of exceptional magnitude much more than half of the Sacramento's water spilled into backswamps.[52] In effect, natural levees formed great spillways. The section of these spillways which most conditioned the development of the delta lay along the right bank of the river from just west of the Feather River mouth to the outlet of Cache Slough. Over this strip of levee, water flowed into the Yolo Basin. A number of intermittent creeks from the Coast Range also emptied into the depression. Water delivered in this manner usually entered the basin when it already contained backwater to the plane of the Sacramento at the mouth of Cache Slough.[53]

The overflow into the pre-reclamation Yolo Basin was capable of developing an inland sea of 50,000,000,000 cubic feet.[54] When filled the basin had a four- to six-inch slope toward the mouth of Cache Slough.[55] During the 1862 flood more than double the volume of the main stream poured through this outlet.[56] The immensity of later flows from Yolo Basin

---

[51] *Ibid.*; Committee on Flood Control, *loc. cit.*

[52] *Hydraulic-Mining Debris in the Sierra Nevada*, by Grove Karl Gilbert, U.S. Dept. of the Interior, Geological Survey, Professional Paper 105 (Washington: 1917), p. 50.

[53] *Report of the Examining Commission . . .*, p. 67.

[54] Grunsky, "The Relief Outlets . . . ," *loc. cit.*, p. 797.

[55] *Report of the Examining Commission . . .*, *loc. cit.*

[56] Grunsky, *loc. cit.*

can be imagined by comparing the lower Sacramento's 110,000 second-feet channel capacity with an estimated pre-1916 maximum discharge of 660,000 second-feet.[57]

Yolo Basin waters surged through Cache Slough and across the Sacramento. In the process a "water dam" was formed which checked the current of Steamboat Slough and the Sacramento Old River.[58] The waters of the latter would spill over the levees and join the Yolo Basin discharge in deluging the central delta's virgin and reclaimed swamp. The river added fresh alluvium to natural levees and tule swamps. Bars formed in the channels.

The build-up of water in the Sacramento above the Cache Slough outlet was partially relieved by backing up or overflowing into a backswamp area which lay to the east of the river. This narrow depression, the Sacramento Basin,

---

[57] V. S. McClatchy, "Flood Control and Reclamation in California," paper presented at annual meeting of National Drainage Congress, in Cairo, Ill., Jan. 20, 1916 (Sacramento: 1916), p. 5.

[58] "Is the Sacramento Valley Inhabitable?" Sacramento Union, Feb. 1862 (n.d.), in Bancroft Scraps, Set W 34, "California Floods," Bancroft Library, University of California, Berkeley, p. 19 (hereinafter cited as BS, Set W 34); I. N. Hoag, "Farmers' Gardens," California State Agricultural Society, Transactions During the Years 1870 and 1871 (Sacramento: 1872), p. 346; Isaac W. Smith, "Chief Engineer's Report," Report of the Board of Commissioners of the Sacramento River Drainage District to the Governor (Sacramento: 1879), p. 20; The Committee of Twenty-Four of the River Improvement and Drainage Association of California, "Report," Report of the Commissioner of Public Works and Engineers to the Governor of California, 1901-1902 (Sacramento: 1902), pp. 23, 25.

also received the discharge of the Mokelumne River. The overflow trough performed a reservoir function. Like its counterpart Yolo Basin, it helped keep the delta channels fresh through the dry season.

The San Joaquin River

Arterial drainage of the subhumid southern half of the Central Valley is carried by the San Joaquin River. This system is fed primarily by winter rains and snow-melt from the Sierra Nevada. Unlike the Sacramento, which carries peak monthly flows during the period January to May, the San Joaquin River monthly peak flows usually occur during the period March to June, inclusive.[59] The major flow periods arise from winter rain runoff and, later in the season, snow-melt. Rain-produced crests are high and quick to pass; the snow-melt floods have lower crests of prolonged duration.[60]

Flood flows reach the delta along a front restricted to the center of the valley by aggrading piedmont plains. There are no broad floodways to the delta in the sense of the Yolo Basin. As a rule, the rain runoff results in the shallow covering of these bottomlands. The inundation may be lengthy, but velocities are low. Snow-melt runoff

---

[59]DWR Bull. No. 27, Table 38, loc. cit.

[60]In the period 1910 to 1950 there were 15 damaging winter rain floods and 6 damaging snow-melt runoff seasons in the San Joaquin system. Rich, loc. cit., pp. 106, 108.

converges upon the bottomlands and the delta over a 30- to 60-day period in late spring,[61] but crests usually are moderate.

Upon reaching the head of the delta, floodwaters may spread across distributary interfluves as well as follow the channels. Today artificial levees usually contain the flow, but extensive areas of alluvial soil in this vicinity and on Upper Roberts and Union islands are a reminder of the nature of past overflows. Backswamps paralleling the mainland levee of both the San Joaquin and Old River distributaries were minor features compared to the Yolo and Sacramento basins.

Lesser Delta Affluents

A number of creeks and rivers carry runoff to the delta from the east and west. Most of the creeks are seasonal. The Mokelumne and Calaveras are perennial rivers which usually are treated as east-bank tributaries to the San Joaquin.

Like other right-bank tributaries of the San Joaquin, the Mokelumne has peak months of flow in the spring and early summer.[62] It follows a slightly incised channel cut

---

[61] Ibid., p. 108.

[62] The estimated mean monthly distribution of natural flow of the Mokelumne River, at a point 11 miles east of Lodi (Clements), between 1894-95 and 1951-52 was: October, 0.7 per cent; November, 2.0 per cent; December, 3.6 per cent; January, 5.9 per cent; February, 8.3 per cent; March, 12.1 per cent; April, 17.8 per cent; May, 26.1 per cent;

into a floodplain which, for the most part, is below the level of the valley plain. The floodplain emerges in the Woodbridge vicinity as a fan over which water has spread toward the delta periodically. Several sloughs that enter the Mokelumne South Fork from the east are the lower ends of former flood channels.[63] These sloughs also drained off the accumulations of water which the flows of converging Mokelumne and Cosumnes systems built up.

Besides overflowing or backing into the pre-reclamation swamp to the south, the Mokelumne system flowed into the Sacramento Basin along the line of Snodgrass Slough. Tyler Slough, prior to its closure, and the two forks of the Mokelumne also distributed peak flows. The extent of mineral soils and of natural levee developments in this vicinity is exceeded only along the Sacramento and San Joaquin rivers.

The Calaveras watershed drains into the delta via the Calaveras River and Mormon Slough, respectively north and south of Stockton. Between these two stream courses a number of lesser drainage lines "finger" out as swales to the east of Stockton.[64] The channels are capable of producing widespread flooding.

June, 18.5 per cent; July, 4.2 per cent; August, 0.5 per cent; September, 0.3 per cent. The mean seasonal runoff for the 53-year period was 780,000 acre-feet. San Joaquin County Investigation, p. 31.

[63] Stearns, Robinson, and Taylor, op. cit., p. 23.

[64] C. E. Grunsky, "Some Factors Affecting the Problem of Flood Control," American Society of Civil Engineers,

Other minor watercourses convey seasonal flows to the delta from the valley plains and flanking uplands like the Coast Ranges and Montezuma Hills. The creeks' lower reaches are marked by slight levee development.

Natural Levees

The delta is both the beneficiary and victim of the behavior pattern of the Sacramento, San Joaquin, and lesser affluents. The quality of its water, the nature of its original vegetation and soil, and the character of pre-reclamation land forms are closely related to stream behavior.

Among the contributions of the rivers to the delta are the natural levees. These depositional land forms are composed of the fine to sandy sediments carried by streams with slight gradient.[65] Tidal scour as well as river deposition shaped the incipient banks,[66] to which hydrophytic vegetation ultimately became anchored. Where cover developed, the velocity of sediment-laden water was checked,

---

Transactions, XXCV (May 1922), p. 1498; George H. Tinkham, _A History of Stockton_ (Stockton: W. M. Hinton and Co., 1880), p. 7.

[65]From the heads of the delta to the outlet the low water gradient is less than an inch per mile. DWR Bull. No. 22, pp. 51, 52; _Report of the Examining Commission . . . ,_ p. 84.

[66]At low-river stages the tide is felt as far as the Feather River mouth, on the Sacramento, to the southern apex of the delta, and to above Thornton on the Mokelumne. DWR Bull. No. 22, p. 52.

causing nascent natural levees to accumulate greater masses of sediment, which in turn accelerated plant growth, a mutually fostering cycle. Growth of the natural levees was lateral as well as parallel to waterways.[67]

Since topographic surveys of the delta were not made until after reclamation of the swamplands was well under way there is no accurate information about the dimensions and extent of the natural levees. In view of such inadequate data, the following picture has been reconstructed:

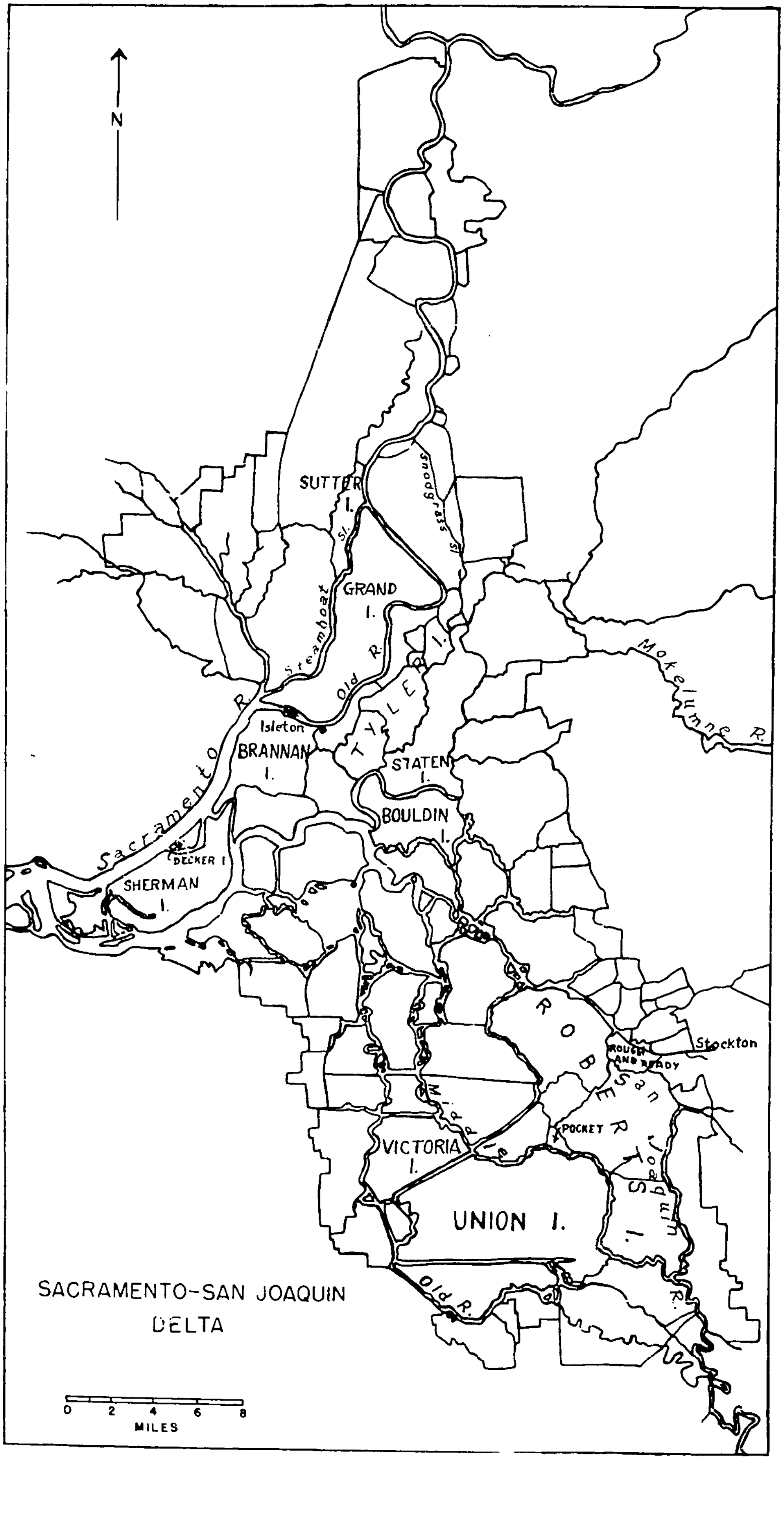
In the central portion of the delta the channel and slougn-outlined swamps had slightly elevated banks. The definition of the features became more pronounced south of the latitude of Stockton, where the San Joaquin River entered its distributaries. Along the Sacramento from Sherman Island headward the levees increased in size. A parallel levee development occurred on either side of Staten Island, which is outlined by the forks of the Mokelumne (see Map 7, p. 35).[68]

---

[67]As a result of more than 100 deep samplings made in the organic mantle, Cosby states that "there is no evidence of buried stream channels, only of infrequent thin strata of mineral material that /have/ been washed in locally on some former land surface. It appears highly probable that all the major streams and most of the minor ones have occupied essentially their present positions during the entire period of organic accumulation. As the mineral base subsided and the organic deposits accumulated, the streams simultaneously built up their bordering alluvial ridges." Cosby, *op. cit.*, p. 43.

[68]*Report of the Examining Commission . . .*, p. 9.

Map 7


N
SUTTER I.
Snodgrass Sl.
Steamboat Sl.
GRAND I.
Old R.
Mokelumne R.
Sacramento R.
Isleton
TYLER I.
BRANNAN I.
STATEN I.
BOULDIN I.
DECKER I
SHERMAN I.
ROBERTS I.
Stockton
ROUGH AND READY
San Joaquin R.
Middle R.
POCKET
VICTORIA I.
UNION I.
Old R.
SACRAMENTO-SAN JOAQUIN
DELTA
0 2 4 6 8
MILES

On western Sherman Island the Sacramento River levees appear to have been at the level of the Suisun Bay low-tide low-water stage. Below Grand Island the natural levees possessed tree growth,[69] which suggests that dry land conditions prevailed most of the time along the western edge of Brannan Island. Broader and higher levees appear to have commenced in the vicinity of Isleton.[70] They would not have averaged more than 660 feet wide along Old River nor would they have exceeded 400 feet along Steamboat Slough.[71] The natural levees were about 14 feet above the low-tide low-water level of Suisun Bay near the head of Grand and Sutter islands; they approached an elevation of 24 feet near Sacramento.[72]

Where the Mokelumne bifurcates near the heads of Staten and Tyler islands, levees stood about 10 or 11 feet above the Suisun Bay reference plane, or four feet lower

---

[69] Frederick J. Teggart (ed.), "Diary of Nelson Kingsley, a California Argonaut of 1849," Academy of Pacific Coast History, _Publications_, III (Dec. 1914), p. 322; Theodore T. Johnson, _California and Oregon; or Sights in the Gold Region, and Scenes by the Way_ (Philadelphia: J. P. Lippincott and Co., 1865), p. 192.

[70] _BS_, Set W 34, _loc. cit_.

[71] _First Annual Report of Swamp Land Commissioners, December 15, 1861_ (Sacramento: 1862), pp. 15, 16; "Field Notes of the Subdivision Lines and Meanders of Township 5 North, Range 4 East, Mount Diablo Meridian, California," by William J. Lewis, U.S. Dept. of the Interior, General Land Office (Sacramento: 1859), p. 25 (handwritten).

[72] _BS_, Set W 34, _loc. cit_.; _Report of the Examining Commission . . ._, _loc. cit_.; Manson and Grunsky, _loc. cit_.

than the nearby Sacramento levees. The height of the Staten Island natural levees reportedly remained more or less constant in relation to the Sacramento levees. A downstream decline of one foot per mile is suggested for the Tyler Island levees,[73] and an approach to mean sea level probably began near the head of Bouldin Island.

The relationship of the levee to tidal water levels at Bouldin Island prevailed downstream along the San Joaquin; and headward to about Rough and Ready Island.[74] Southward along Roberts Island the levees rose to approximately 18 feet above the Suisun Bay reference plane.[75] The banks of the Old River distributary of the San Joaquin seem to have been fairly well developed along the present Union and Victoria islands to about the latitude of Rough and Ready Island.[76]

As riverside land gained height and broadened, the tide-free bank area increased (see Map 8, p. 38, which shows a representative case). During extreme river flood stages the higher levees were likely to become submerged, with occasional Indian mounds or sand hummocks remaining as

---

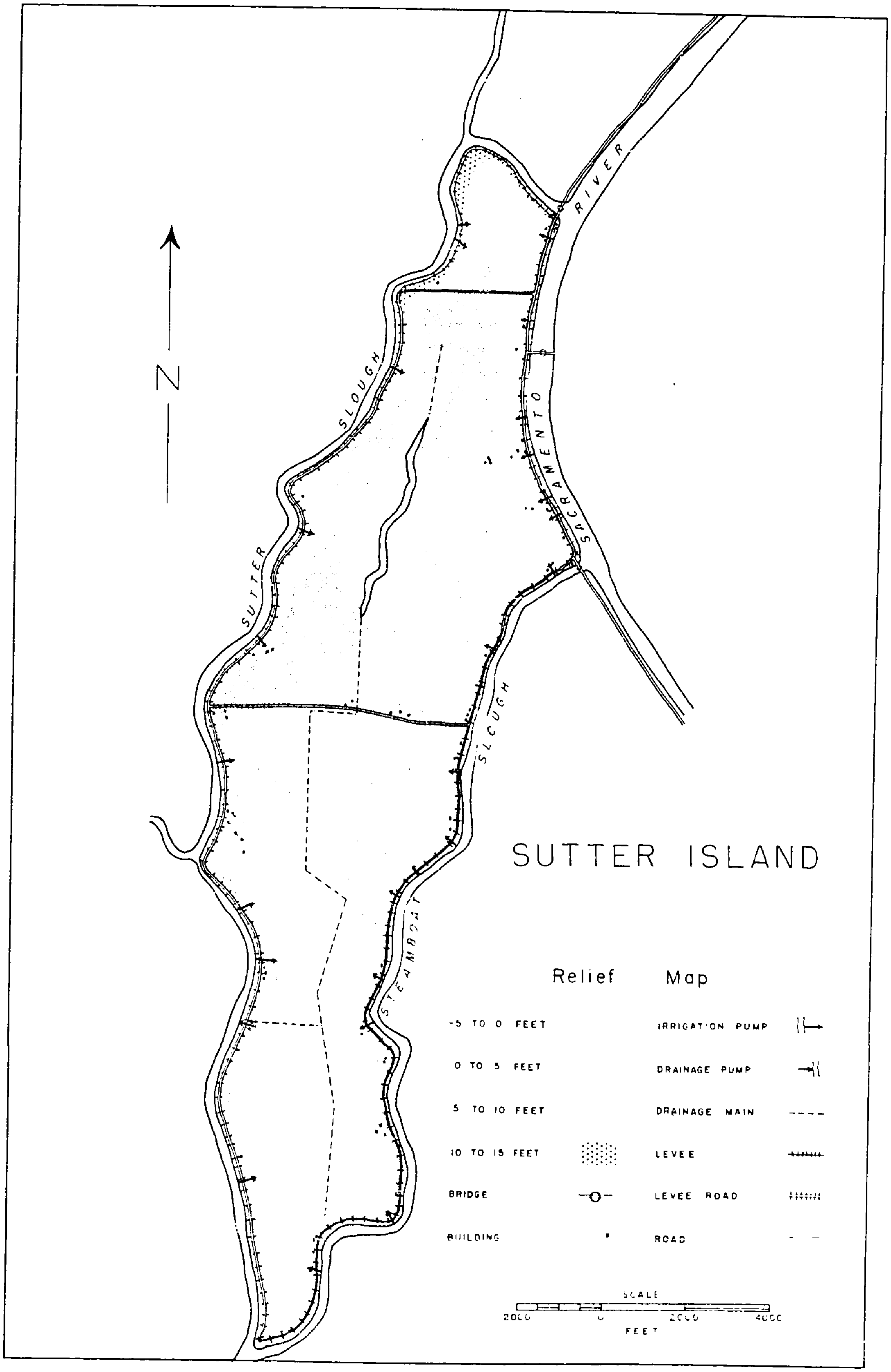
[73] BS, Set W 34, loc. cit.; First Annual Report of Swamp Land Commissioners, p. 15.

[74] Report of the Examining Commission . . . , pp. 91, 92.

[75] Manson and Grunsky, loc. cit.

[76] Report of the Examining Commission . . . , p. 112.

MAP 8


SACRAMENTO RIVER
SUTTER SLOUGH
STEAMBOAT SLOUGH
N
SUTTER ISLAND
Relief Map
-5 TO 0 FEET
0 TO 5 FEET
5 TO 10 FEET
10 TO 15 FEET
BRIDGE
BUILDING
IRRIGATION PUMP
DRAINAGE PUMP
DRAINAGE MAIN
LEVEE
LEVEE ROAD
ROAD
SCALE
2000 0 2000 4000
FEET

islands.[77] The water cover usually lasted for only a few days.

Natural levees in the delta had abrupt river faces.[78] The vegetable matter contained and supported by the mineral material generally made it non-erosive.[79] The levee back-slopes dipped rapidly inland. On Union Island, for instance, transition from the levee crown to the general island level was completed in from 50 to 100 yards, with a vertical range of from one to seven feet.[80]

Natural levees separated the main channels from pre-reclamation tidal or river overflowed areas. The continuity of river front levees was broken by lateral sloughs which drained the backswamp.[81] These lesser waterways also had levees. (The sinuous drainage ditches and fingers of high land, shown in Map 9, p. 40, indicate some of the pattern of

---

[77] Tom Gregory et al., History of Yolo County, California (Los Angeles: Historic Record Co., 1913), p. 67. It is reported that in January 1875 water rose 8 to 12 inches above the natural levees at the head of Roberts Island. At the head of Burn's Cut-off, lower on the island, banks were topped by 4 or 5 inches of water. "General Report of Charles D. Gibbs, Civil Engineer, on the Examination of Roberts Island, San Joaquin County, for the Purpose of Reclamation," Stockton Weekly Independent, April 17, 1875, p. 7 (further references to the newspaper will appear: SWI).

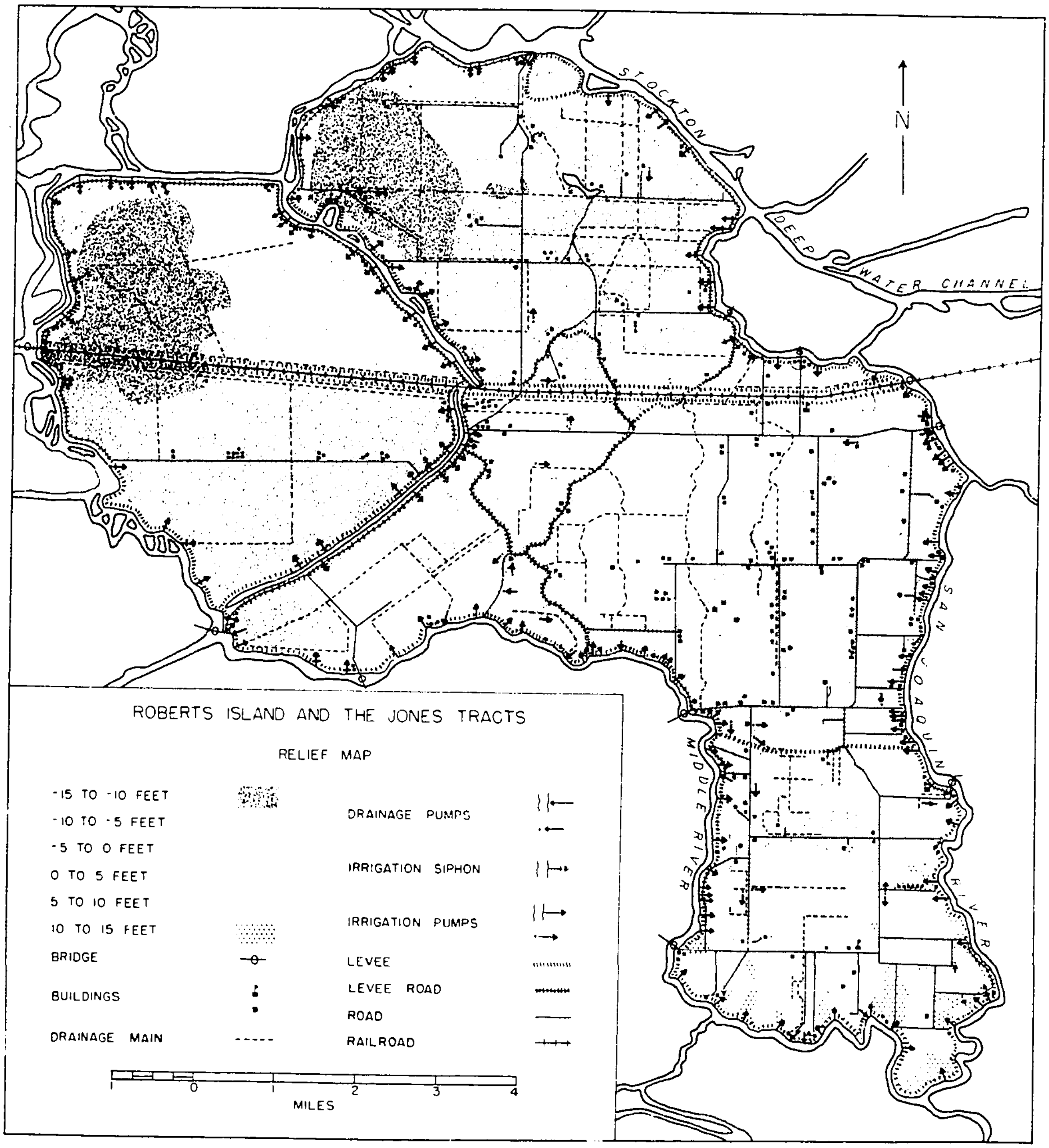
[78] First Annual Report of Swamp Land Commissioners, loc. cit.; Report of the Examining Commission . . . , p. 91.

[79] Manson and Grunsky, loc. cit.

[80] First Annual Report of Swamp Land Commissioners, loc. cit.; Report of the Examining Commission . . . , p. 112.

[81] "Field Notes of the Subdivision Lines and Meanders . . . ," p. 27.

MAP 9


STOCKTON
DEEP WATER CHANNEL
N
SAN JOAQUIN RIVER
MIDDLE RIVER
ROBERTS ISLAND AND THE JONES TRACTS
RELIEF MAP
-15 TO -10 FEET
-10 TO -5 FEET
-5 TO 0 FEET
0 TO 5 FEET
5 TO 10 FEET
10 TO 15 FEET
BRIDGE
BUILDINGS
DRAINAGE MAIN
DRAINAGE PUMPS
IRRIGATION SIPHON
IRRIGATION PUMPS
LEVEE
LEVEE ROAD
ROAD
RAILROAD
1 0 1 2 3 4
MILES

sloughs and levees.) In most of the delta the natural levees so enclosed a backswamp that islands were suggested. Peripherally the strips of levee flanked backswamps that merged with the adjacent valley plains.

The Basins

The shallow backswamp troughs of the Sacramento Valley are winter and spring floodways. The eastern depression is the Sacramento Basin and the western the Yolo Basin.

The Sacramento Basin is a long and narrow depression confined between the river levee and the partially dissected margin of the eastern valley plain. For the most part, the basin lies to the south of a corridor of high land that approaches the river to the north of Freeport; the small remainder is between Freeport and Sacramento.[82]

Approximately 35 square miles of the Sacramento Basin is less than 10 feet above the low-water level of Suisun Bay, and from 10 to 15 feet below the level of extreme high water in the river.[83] Occupying the lowest parts of the flat depression, and about one-half to one mile east of the river, are Beach and Stone lakes. They drain to the south, through tidal Snodgrass Slough, into the Mokelumne River. Since the construction of substantial levees along the Sacramento and Snodgrass Slough the shallow depression has

---

[82]Bryan, op. cit., p. 43.

[83]Manson and Grunsky, loc. cit., p. 43.

functioned as a flood basin only in the exceptional years when the artificial levees were breached.

Yolo Basin is about 40 miles long by 7 miles wide. The pre-reclamation slough-fretted tule swamp adjoined a piedmont plain crossed by numerous double-crested alluvial ridges.[84] This flanking channel ridge plain terminates on the south in the larger swells that rise into the Montezuma Hills.

Perhaps 90 square miles of the Yolo Basin is less than 10 feet higher than the low-water level of Suisun Bay.[85] The trough is lowest along a belt that is about two to five miles west of the river. Prior to reclamation there was a tidal lagoon, Big Lake, at the southern end of the basin. The lake's existence is recalled on those occasions when a flood flow in the Sacramento requires the diversion of water through weirs into the Yolo Basin.

The Islands[86]

In addition to the skirting natural levees, the islands of the pre-reclamation delta displayed relief in low alluvial ridges, sandy mounds, and in the banks of

---

[84] Bryan, op. cit., p. 29.

[85] Manson and Grunsky, loc. cit.

[86] The island section is based on: Tide Land Reclamation Co., loc. cit.; "General Report of Charles D. Gibbs, . . . ," SWI, April 17, 1875, p. 7; "A Tule Farm," ibid., May 5, 1877, p. 7; "Tule Farming," ibid., March 3, 1877, p. 7; and soil map and topographic quadrangle study.

dendritic tidal sloughs. Low water increased the relief somewhat. At such times the banks and flat floors of tidal lagoons were revealed.

The highest features in the landscape were single and clustered sandy mounds which were most numerous in the west-central part of the delta, near Old River and Knightsen-Oakley. These areally small features rose up to 17 feet above the average level of the swamp (see Map 5, p. 14). They were less general in distribution than alluvial ridges such as those that outlined "The Pocket" on Roberts Island, which were two or three feet in height and 100 to 300 feet in breadth.

Hydrography and Cultural Modifications of the Delta

The hydrographic situation which produced the primeval delta landscape has been an important conditioner of the cultural landscape. Water excesses, always dangerous, usually are damaging. When the river crests are abetted by high tide and westerly winds, flooding of some tract is probable.

A number of major flood disasters have struck the delta over the past century. All or large segments of the total improved land were overwhelmed by Sacramento and San Joaquin flows in the spring of 1852, in mid-winter of 1861/62, and during the spring of 1878, 1881, 1904, and 1907. (See Appendix A, "Floods in the Delta," for a more detailed discussion.)

Damaging, although less widespread, floods have occurred so often that it seems reasonable to estimate that no three-year period passed between 1852 and 1911 during which some improved land was not inundated. Between 1911 and 1925 the delta was free of floods, but the prevailing condition of low river discharge accelerated salt-water penetration of normally fresh channels.

While years of low water were factors in levee safety, it also was the case that from 1908 until the 1920's the reclamation districts maintained their levees with a four-foot freeboard above the high-water mark of the 1907 flood. In the latter 1920's some districts permitted their levees to deteriorate.[87]

Since 1925 damaging river floods occurred in 1928, 1936, 1940, 1950, and 1955; and, if levee breaks regardless of cause were added to the list of river floods, disaster visited some part of the delta on an average of once every three and a half to four years during the last third of a century.

The lesser floods may be the product of high river flow, high tide, or human error. In the case of river floods the damaged area usually is restricted to a tract or two near the delta affluent's channel. The incidence of levee breaks caused by high tide is greatest in the central delta, where peat levees rest on peat foundations. These

---

[87] DWR Bull. No. 22, p. 45.

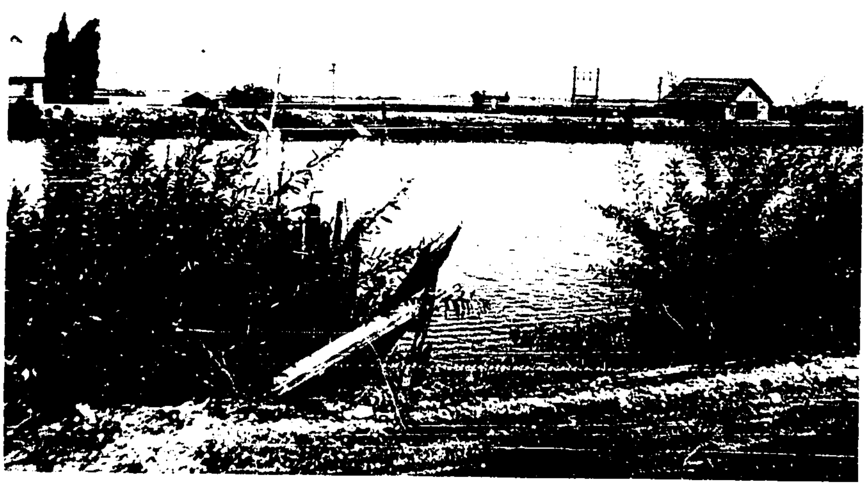
defenses rupture when exposed to prolonged high water levels, unless construction and maintenance are carefully attended to. The infrequent floodings of particular tracts owing to human error may be attributed to mismanagement in bringing irrigation water onto the land.

The persistent threat of floods has caused delta residents to seek the protection of massive levees and straightened and enlarged channels; traditionally they have placed their towns, homes, and barns on the levees or on natural and artificial prominences (see Plate II, p. 46). Houses, barns, and pumps also may be perched on piling (see Plate III, p. 48).

Large artificial levees, some of them 200 feet broad at the base and 30 feet high, dominate the landscape. Sometimes they conceal most of the natural rim which alluviation produced on delta islands. The natural levees are partially gone in other places because channel improvement or leveeing required their removal by dredge. The dredging operations have added massive spoil banks to Decker, Brannan, and Grand islands, and they have built up elevations on Roberts and Sherman islands and in the swamps which once skirted the southeastern margin of the Montezuma Hills.

Levees, spoil banks, and altered channels are not the only cultural modifications to the physical geography of the delta. The soil and a number of water- and wind-deposited land forms have been altered. Some land-form and soil alterations have resulted from post-reclamation

PLATE II



Cultural adaptations to the delta terrain I

Natural or artificial platforms are used as building sites for flood insurance. Upper view shows barn and house resting on a sandy mound (Upper Roberts Island). Lower view shows house, shed, transformers, and pump house resting on the levee and/or piling. Land beyond has an elevation of less than minus five feet (McDonald Island).

oxidation of peats. Soil development and land subsidence are part of the same process. Land forms and soils have been changed by flood conditions which could not have occurred without the aid of some major equilibrium-disturbing agency such as man. Debris from hydraulic gold-mining areas shoaled channels and fanned through crevasses to mantle a number of reclaimed and unreclaimed backswamps.[88] Soils and relief were changed thereby. Flood and tide water scoured depressions of 20 to 40 feet depth across the line of artificial and natural levees. The levees are rebuilt, but it is impracticable to drain the scoured depressions (see Plate IV, p. 49); they and the incipient crevasses would not develop without the gradient created by artificial levees and subsidence and without the concentrated flow of water which occurs only when an artificial levee is breached. Unreclaimed natural levees and tidal swamps change imperceptibly as high water spreads across them.

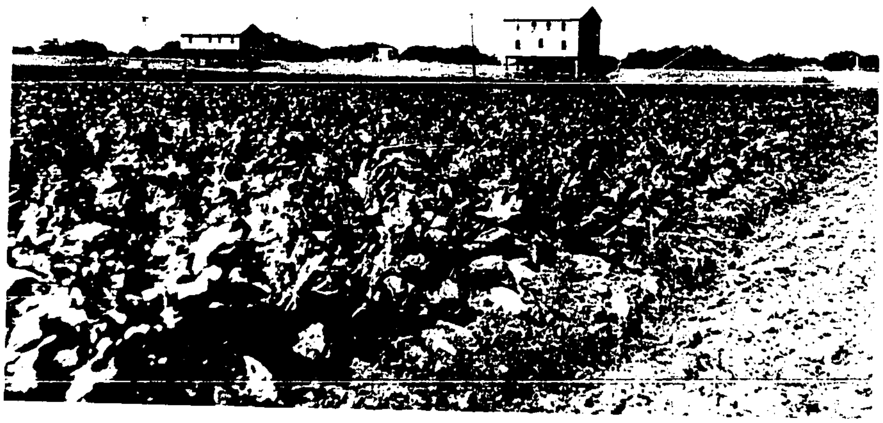
The plow and other mechanical means of moving the soil have altered the contours of many depositional features.[89] The process continues today, but the location of

---

[88]Sacramento River districts in particular have been affected. For instance, the flood of 1878 resulted in a three-inch accumulation of debris over the lower end of Grand Island. "The Flooded Regions," San Francisco Alta, Feb. 24, 1878, in BS, Set W 34, p. 123.

[89]In his field notes, Cosby recorded that on the Middle Division of Roberts Island surface soils were transported and modified to a very great degree as a result of leveling for alfalfa and other crops. The natural levees of small sloughs within the district were "largely lost." Cosby, "Delta Field Notes" (1934), p. 38; entry of Aug. 20, 1934.

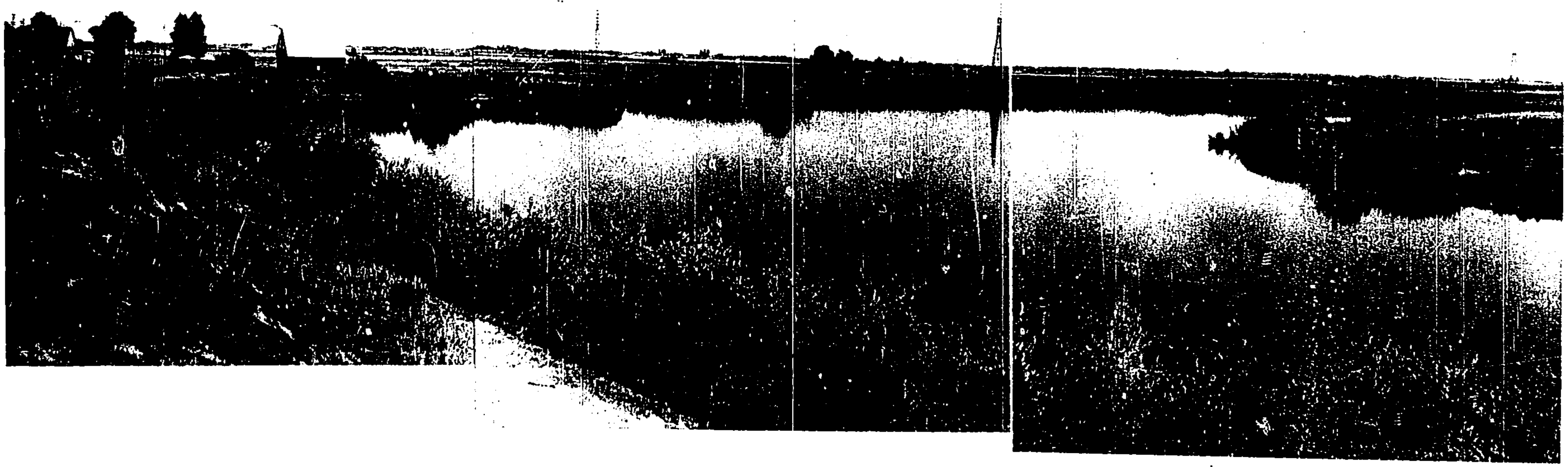
PLATE III



Cultural adaptations to the delta terrain II

Upper view shows piling-supported bunkhouses (Liberty Island). Crop is sugar beets. Lower view is of a piling-supported barn of the type built two or three decades ago when this land was producing asparagus (Brannan Island). Crop is field corn.

PLATE IV



Flood scour pond

View of a pond and landscape on Sherman Island. The basin was excavated when the Sacramento River broke the levee at this point. Stubble fields are interrupted by dark patches of weeds which mark the drainage ditches. Power lines are of the Central Valley Project. Land elevation is about minus five feet.

the earlier land forms is permanently recorded in the soil texture. Differences in the color and vigor of growing crops also identify the outline of buried sloughs or planed natural levees. Replacing many of the natural drainage channels are trellised networks of drainage ditches.

CHAPTER II

DELTA VEGETATION, CLIMATE, SOILS, AND FAUNA

In the Sacramento-San Joaquin Delta slight relief and a perennially high water table resulted in the development of hydrophytic and water-tolerant vegetation. The water preserved a great mass of vegetal remains from oxidation. The resulting peat and mineral-organic material formed the raw base from which delta soils have weathered since reclamation, drainage, and cultivation.

Vegetation

The delta's dominant native cover during recorded time has been the tule (*Scirpus lacustris*). It is a fresh-water marsh plant that develops dense stands of erect, unjointed stalks which may average six to eight feet in height. The annual growth of green stalks rises from perennial roots. Usually the lower plant is partially submerged, but it may grow on sunny levee surfaces. On such higher land the slightly drier edaphic conditions favor the growth of reeds, herbaceous annuals, and perennial shrubs and trees. A natural levee's vegetation is distinct from the backswamp cover.[1]

[1]Cosby, *Soil Survey of the Sacramento-San Joaquin Delta, . . .*, p. 3 (hereinafter cited as *Soil Survey . . .*).

Areal distribution of the virgin tule coincided with the extent of pre-reclamation tidal or river backswamps. The tule cover was somewhat taller and more luxuriant in the Sacramento part of the delta than to the south.[2] The monotony of the green or brown canebrake-like vegetation was broken by channel and pond surfaces and by strips of alluvial land where woody shrubs and trees and herbaceous annuals grew.[3] This natural levee cover consisted of coarse bunch grasses, willows, blackberry and wild rose thickets, and galleries of oak, sycamore, alder, walnut, and cottonwood.[4] The shrubs appeared among the tules of Sherman, Lower Roberts, and other centrally located islands; but a continuity of woody growth probably did not develop until the latitude of Brannan Island and Stockton. This cover became a belt of heavy oak timber on the upper four miles of Union Island, and probably on Roberts Island. Fine groves occupied

---

[2]"Reclamation of Swamp and Overflowed Lands in California," Report of the Commissioner of Agriculture for the Year 1872, USDA (Washington: 1874), p. 184.

[3]Cosby, loc. cit.

[4]Teggart, loc. cit., p. 327; A Returned Californian, /J. M. Letts/, California Illustrated . . . (New York: Wm. Holdredge, Pub., 1852), p. 58; Johnson, loc. cit., p. 120; "Field Notes of the Subdivision Lines and Meanders . . . ," p. 22; Titus Fey Cronise, The Natural Wealth of California (San Francisco: H. H. Bancroft and Co., 1868), p. 309; The Western Shore Gazetteer and Commercial Directory for the State of California, Yolo County, comp. by C. P. Sprague and H. W. Atwell (Woodland, Calif.: Sprague and Atwell, 1870), pp. 49, 55; Report of the Commissioner of Agriculture for the Year 1872, loc. cit.; Report of the Examining Commission . . . , p. 92; DWR Bull. No. 27, p. 17.

the more southerly San Joaquin River distributary banks.[5] Similar stands of woods occupied the Sacramento River levees upstream from about the lower end of Grand Island. In places this timber belt so overhung the river that it interfered with the rigging of passing ships.[6] (Sketches of the vegetation at the lower end of Grand Island and in Steamboat Slough /Middle Fork/ appear on Plate V, p. 54.)

Vegetation in the bottomland of the various streams that entered the delta was similar to that of the higher delta levees. Plains interfluves were occupied by grass-carpeted open woods of evergreen and deciduous oaks to the north of the Calaveras and from somewhat north of the present Byron to beyond the western apex of the delta. Southeast of the Calaveras a prairie extended to the Stanislaus.[7] Nearly

---

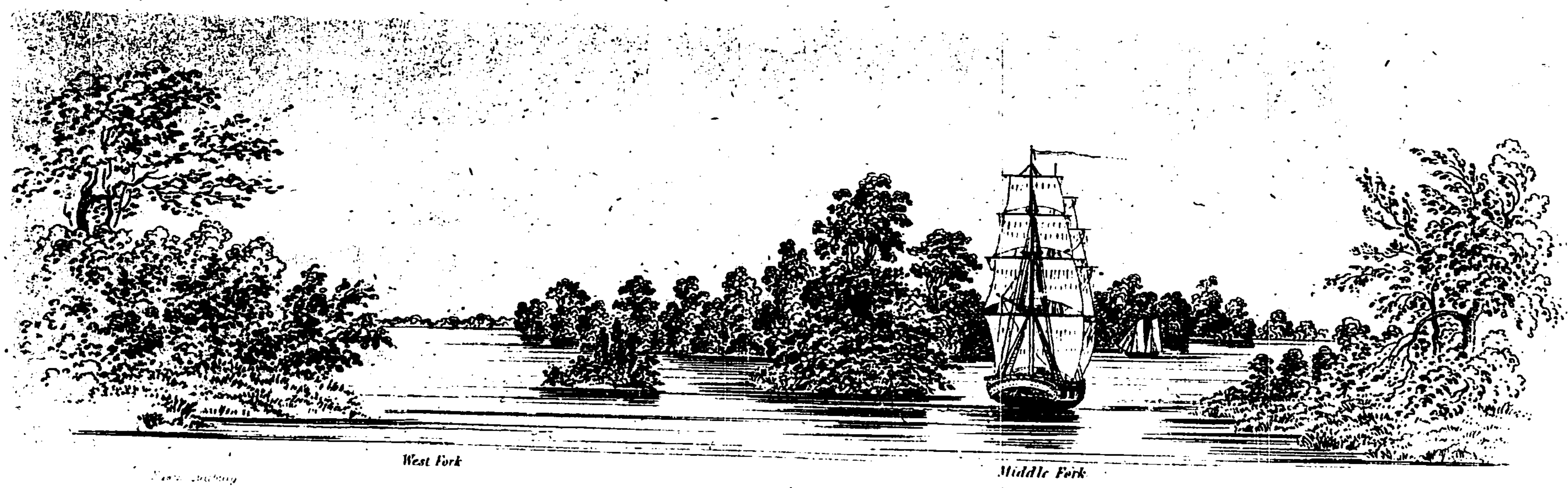
[5]Charles Edward Chapman (ed.), "Expedition of the Sacramento and San Joaquin Rivers in 1817; Diary of Fray Narciso Duran," Academy of Pacific Coast History, Publications, II (Dec. 1911), p. 335; Cadwalader Ringgold, A Series of Charts, with Sailing Directions . . . (3d ed.; Washington: J. T. Towers, 1852), Chart of the Sacramento River; L. M. Schaeffer, Sketches of Travels in South America, Mexico and California (New York: James Egbert, Printer, 1860), pp. 31-32; Report of the Commissioner of Agriculture for the Year 1872, loc. cit.; "Great Antelope Hunt on the San Joaquin," San Francisco Alta, Sept. 8, 1864 (henceforth cited as Alta), in Bancroft Scraps, Set W 73, "California Hunting and Fishing," p. 2; "Union Island Reclamation," SWI, March 24, 1877, p. 7; "Among the Tules," California Illustrated, Dec. 25, 1877, in Bancroft Scraps, Set W 3, "Placer to San Diego," p. 1069 (hereinafter cited as BS, Set W 3); Report of the Examining Commission . . . , loc. cit.

[6]Statement based on same sources appearing in footnote No. 4.

[7]John Charles Fremont, Oregon and California (Buffalo: Geo. H. Derby and Co., 1851), p. 354; idem., Geographical Memoir upon Upper California (Washington: Wendell and Van Benthuysen, 1848), p. 16; Tinkham, loc. cit.

PLATE V

Upper view shows Cache and Steamboat sloughs and the Sacramento from the south. Lower view shows Sutter and Steamboat sloughs from the south.



Views of the Sacramento River in the early 1850's. (Ringgold) treeless prairies also occupied the land which sloped toward the delta from the southwest, from the Montezuma Hills, and from the westerly channel ridge plain. (Views of the terrain adjacent to the western apex of the delta are shown in Plate VI, p. 56.)

The tule turned brown during the autumn and winter low-water season.[8] Indians set it on fire as an adjunct to hunting,[9] and the Argonauts burned it as a form of amusement on the tedious journey to Sacramento and Stockton.[10] Settlers continued the practice to facilitate clearing the land. Campers' fires and the sparks from steamers also touched off the conflagrations which came to be nearly annual occurrences.[11] Sometimes the smoke so reduced visibility that navigation was hampered.[12] The columns of smoke and ash darkened the valley atmosphere by day, while at night the whole sky would seem to be illuminated.[13]

---

[8]Cronise, op. cit., p. 314.

[9]"Early Times," SWI, Sept. 14, 1872, p. 5.

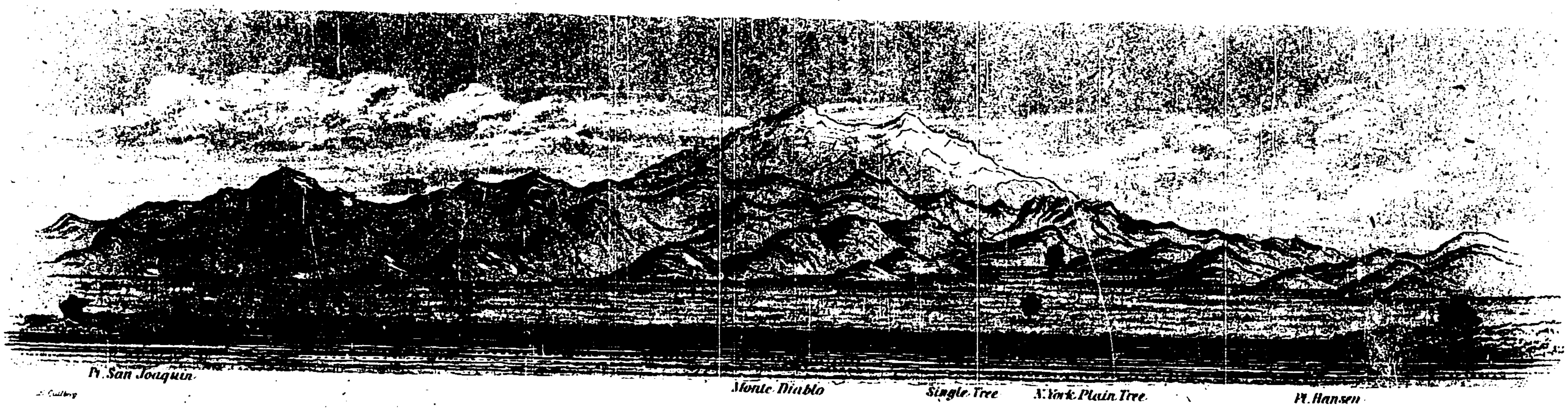
[10]Theodore H. Hittell, History of California (San Francisco: Pacific Press Pub. House and Occidental Pub. Co., 1885), IV, 865.

[11]William Ingraham Kip, The Early Days of My Episcopate (New York: Thomas Whittaker, 1892), p. 119.

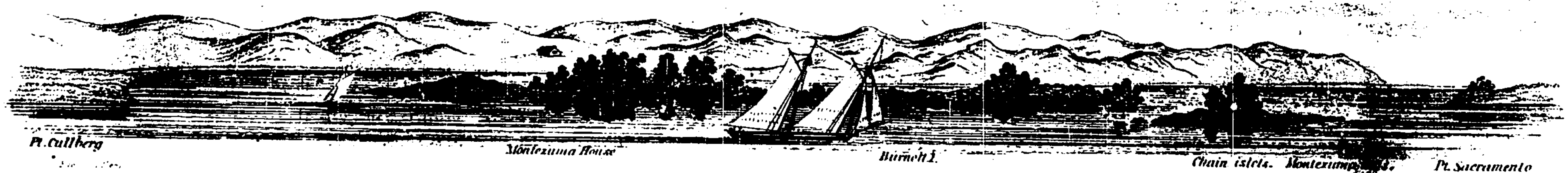
[12]John Leale, Recollections of a Tule Sailor (San Francisco: George Fields, 1939), p. 65.

[13]Bayard Taylor, El Dorado . . . (London: Richard Bentley, 1850), I, 73; J. M. Hutchings, Scenes of Wonder and Curiosity in California (San Francisco: Hutchings and Rosenfield, Pub., 1860), p. 31; Johnson, op. cit., p. 111; Mary Cone, Two Years in California (Chicago: S. C. Griggs and Co., 1876), p. 112.

PLATE VI



Mark for Tongue Shoal



Entrance to the Sacramento River

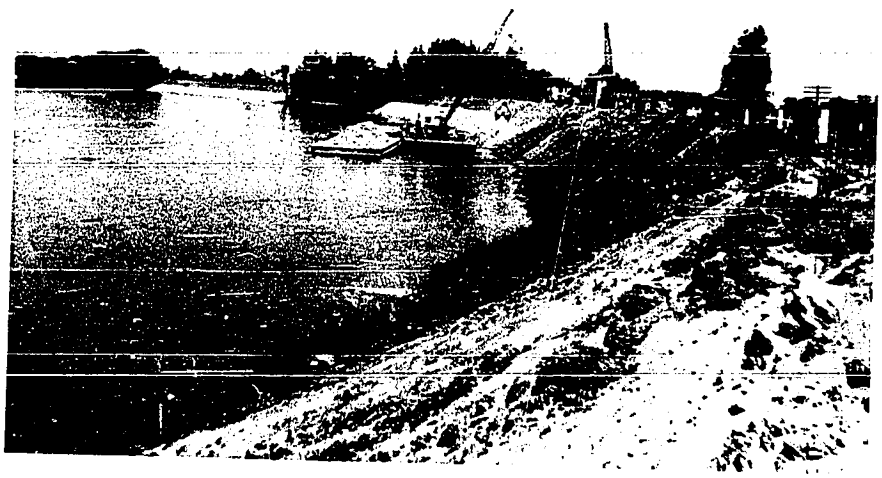
View made from the west apex of the delta in 1851 toward the south, Mount Diablo Range (upper), and north, Montezuma Hills (lower). (Ringgold)

Since reclamation began in the delta, the areal extent of all types of natural vegetation has been steadily reduced. Such tule as remains is restricted to waterway margins, overflowed tracts, unreclaimed islets, and sloughs and drainage ditches within leveed districts. Willows, oaks, cottonwoods, masses of blackberry bushes, and various weed annuals are found along the outer edge of many of the artificial levees in the San Joaquin part of the delta. Undeveloped land outside of the levees often bears a dense growth of brush and small trees above the fringe of tules. Along the outer face of Sacramento River levees, and on the berms, there are formed willow thickets and narrow groves of deciduous trees and bushes. Occasional clusters of trees and shrubby vegetation also appear along sealed-off sloughs within reclaimed districts. In most parts of the delta the inner levee slopes are covered with weeds and grass (see Plate VII, p. 58). The browsing of sheep is permitted on some levees but not where the structures adjoin government-maintained waterways. Denuded levees fronting upon these major navigable channels are cleared and faced with riprap. The rock surface affords protection from wave erosion. Plants are uprooted to allay any possibility of seepage entering and weakening the levee along the line of root cavities (see Plate VIII, p. 59).

PLATE VII

View toward the northeast, across South Fork of the Mokelumne River and the New Hope District. Staten Island is in the foreground. Along the water, tules and willows are common; evergreen oaks, grass, and weeds occupy drier parts of the levee. Fields contain barley stubble (light), tomatoes (dark), alfalfa (gray).

PLATE VIII



Facing the Sacramento River
levee with riprap

Before facing the area with rock the levee surface is cleared and grubbed. Clusters of vegetation are preserved where landowners object to removal. Such groves frequently lie in front of the older homes. Two-story house appearing in center distance is on an artificial mound.

Climate

Climatic conditions under which the delta's vegetation and soils evolved are, or approach, what R. J. Russell designates as the cool and dry summer Mediterranean (Csb) of the Köppen classification.[14] This climate is cooler than to the north or south because of the greater exposure to the marine air which funnels through Carquinez Strait and over Suisun Bay.

Extremes of temperature are conditioned in winter and summer by the presence of large areas of water within the delta, as well as by the marine influence. In summer the humid air crosses the delta as stiff westerly breezes. They are sensed clearly as far as 12 to 20 miles inland from the western apex of the delta. This cool flow differs from the flows that enter the Central Valley over land surfaces to the north and south because it has been affected by little adiabatic heating and by little admixture with heated air.[15] The winter development of tule or radiation fog is facilitated by the relatively high atmospheric humidity.

Killing frosts may be expected to set in between November 28 and December 10; the last frosts for the season

---

[14] "Climates of California," University of California Publications in Geography, II (Oct. 1926), p. 81.

[15] Horace R. Byers, "Summer Sea Fogs of the Central California Coast," University of California Publications in Geography, III:5 (1930), p. 307.

generally occur between February 6 and 18. January temperatures average near 45°F., and July temperatures average around 75°F. Minimal readings of 13°F. to 17°F. are recorded, and maxima of 110°F. to 114°F. can be expected.[16]

Precipitation amounts vary in the different parts of the delta. In the lee of the Mount Diablo Range about 10 inches of rain falls. The average precipitation increases generally from there to the north and northeast. (Map 10, p. 62, shows the distribution of seasonal precipitation.)[17] Cyclonic winter rains account for most of the delta record, about 57 per cent of annual averages falling in the period December through February, and about 82 per cent November through March. (Table 1, p. 63, gives the mean monthly distribution of precipitation for the delta.)

Precipitation in the delta has not been as significant a factor in natural cover development as have been the prevalence of high water tables and the frequency of floods. The character of the water levels has resulted from Central Valley runoff and tidal fluctuations. Neither is rainfall the critical factor in the growing of winter field crops that it is elsewhere in California; there always is seepage from local waterways to make up for any shortcoming in delta

---

[16] Climate and Man, USDA, Yearbook of Agriculture (Washington: 1941), pp. 783, 786, 787.

[17] San Joaquin County Investigation, Plate 3, is the source for the map.

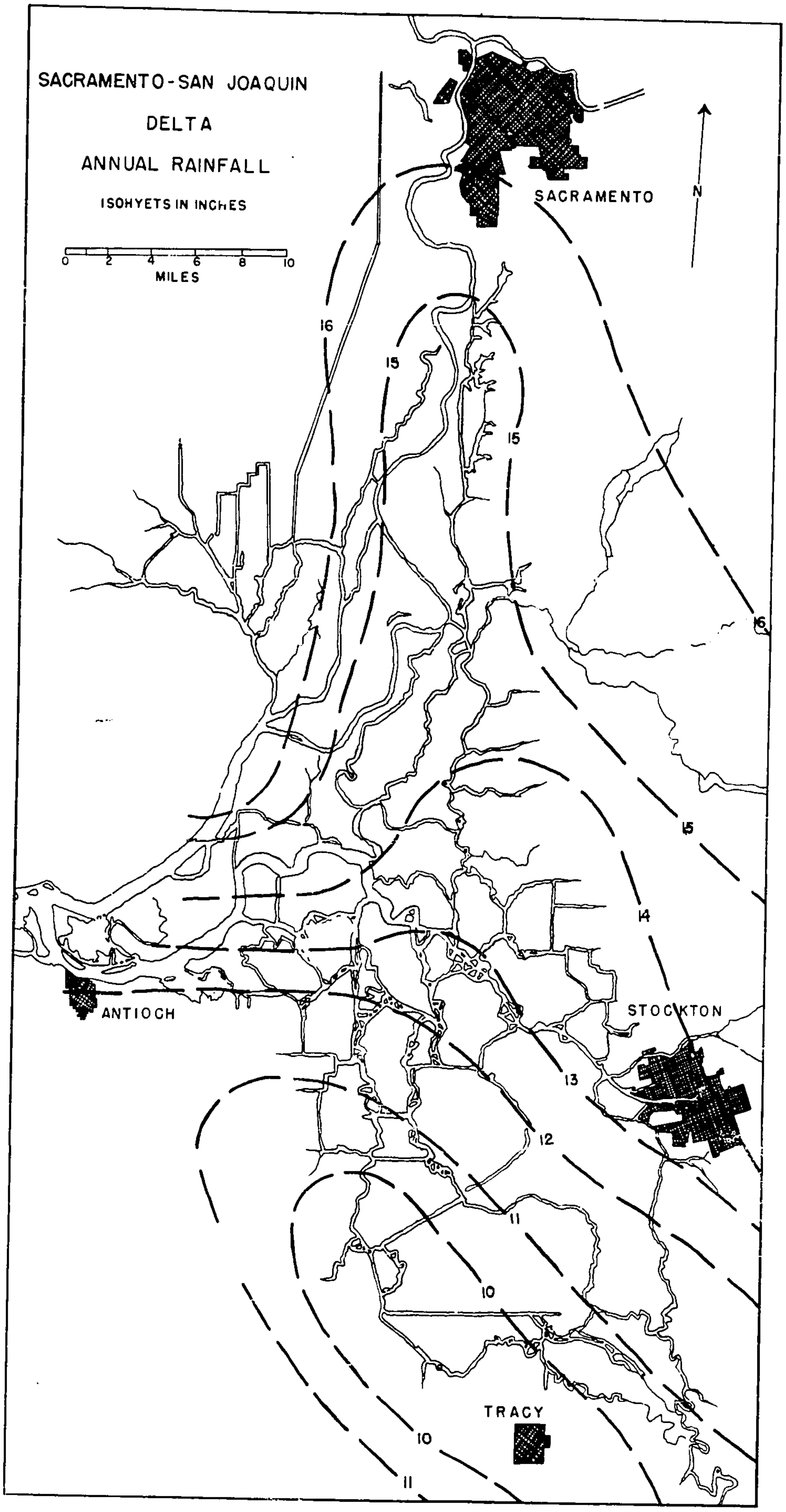

SACRAMENTO-SAN JOAQUIN
DELTA
ANNUAL RAINFALL
ISOHYETS IN INCHES
0 2 4 6 8 10
MILES
N
SACRAMENTO
ANTIOCH
STOCKTON
TRACY
16
15
15
16
15
14
13
12
11
10
10
11

TABLE 1

MEAN MONTHLY DISTRIBUTION OF PRECIPITATION STOCKTON, 1867-68 THROUGH 1951-52[a]

Month	Precipitation	
	Inches	Per Cent of Seasonal Total
January	2.93	20.8
February	2.43	17.3
March	2.06	14.6
April	1.03	7.3
May	0.56	4.0
June	0.11	0.8
July	0.00	0.0
August	0.01	0.0
September	0.23	1.6
October	0.68	4.8
November	1.41	10.0
December	2.65	18.8
Total	14.10	100.0

[a]Precipitation varies from less than 50 per cent to over 200 per cent of the seasonal mean. DWR Bull. No. 11, pp. 27, 28.

rainfall. Irrigation needs are met from runoff delivered by Central Valley river systems. In one respect, the amount of winter precipitation is important to delta farmers because of its leaching effect upon the salts which have accumulated in the soil as a result of cultural practices.

Delta Soils

Soils in the lower Sacramento and San Joaquin valleys belong to the basin, alluvial, and terrace series. Delta soils are predominantly basin types, although alluvial series occur on the natural levees. The basin soils have been subjected to frequent and prolonged flooding and are organic or mineral-organic in type. Even the fine-textured alluvial soils contain higher percentages of organic remains than do their valley plains equivalents. Delta soils range from slightly acid for the organic basin series to neutral with calcareous subsoil for the mineral series of the natural levees.[18]

---

[18]The entire soils discussion is based primarily on Cosby, Soil Survey . . . . Other works consulted, some of which are cited in the text, are: Soil Survey of the Dixon Area, California /hereinafter the name California will be omitted from titles cited in footnotes when it is deemed superfluous for this dissertation/, by S. W. Cosby and E. J. Carpenter, USDA, Bur. of Chemistry and Soils, in cooperation with the Univ. of Calif. Agricultural Experiment Station, Series 1931, No. 7 (Washington: 1935); Soil Survey of the Lodi Area, by S. W. Cosby and E. J. Carpenter, USDA, Bur. of Chemistry and Soils, in cooperation with the Univ. of Calif. Agric. Exper. Sta., Series 1932, No. 14 (Washington: 1937); Soil Survey of the Suisun Area, by E. J. Carpenter and S. W. Cosby, USDA, Bur. of Chemistry and Soils, in cooperation with the Univ. of Calif. Agric. Exper. Sta., Series 1930, No. 18 (Washington: 1930); Soil Survey of

The high water table in the delta fostered growth of hydrophytic cover and enabled plant remains to accumulate as a column of peat, the parent material from which basin soils are derived. Weathering of the peat, a continuing process, has produced organic soil series which are differentiated on the basis of degree of alteration.[19]

The development of soils from peat occurred after reclamation. With the removal of water from the swamp, oxidation and other subaerial processes of soil formation could function. The rate of organic matter disintegration is accelerated by soil burning, cultivation, and manipulation

---

Contra Costa County, by E. J. Carpenter and S. W. Cosby, USDA, Bur. of Chemistry and Soils, in cooperation with the Univ. of Calif. Agric. Exper. Sta., Series 1933, No. 26 (Washington: 1939); Soil Survey of the Sacramento Area, by Ralph C. Cole, USDA, Soil Conservation Service, in cooperation with the Univ. of Calif. Agric. Exper. Sta., Series 1941, No. 11 (Washington: 1954); Soil Survey of the Tracy Area, by Ralph C. Cole et al., USDA, Bur. of Plant Industry, Soils, and Agricultural Engineering and Soil Conservation Service, in cooperation with the Univ. of Calif. Agric. Exper. Sta., Series 1938, No. 5 (Washington: 1943); Soil Survey of the Woodland Area, by C. W. Mann et al., USDA, Bur. of Soils (Washington: 1911); Soil Survey of the Stockton Area, by John L. Retzer et al., USDA, Agricultural Research Administration, Bur. of Plant Industry, Soils, and Agricultural Engineering, in cooperation with the Univ. of Calif. Agric. Exper. Sta., Series 1939, No. 10 (Washington: 1951); Soils of Sacramento County, by Walter W. Weir, Univ. of Calif. Agric. Exper. Sta., Div. of Soils (Berkeley: 1950); Soils of San Joaquin County, by Walter W. Weir, Univ. of Calif. Agric. Exper. Sta., Div. of Soils (Berkeley: 1952).

[19]The genetic classification of peat soils, a departure from the then accepted practice of soil grouping, was introduced by the pedologist Stanley W. Cosby who substantiated his approach by work in the delta. Cosby, "The California Peat Lands" (Seminar Report, Soil Technology 104, University of California, Oct. 18, 1934); "Peat Soils of California" (MS, Nov. 21, 1934; in Cosby's files).

of field water tables. Both the burning and sub-irrigation result in an accumulation of mineral salts near the soil surface. Collectively, the cultural disturbances of the soil and the fluctuation of water levels keep the soil profiles youthful.[20]

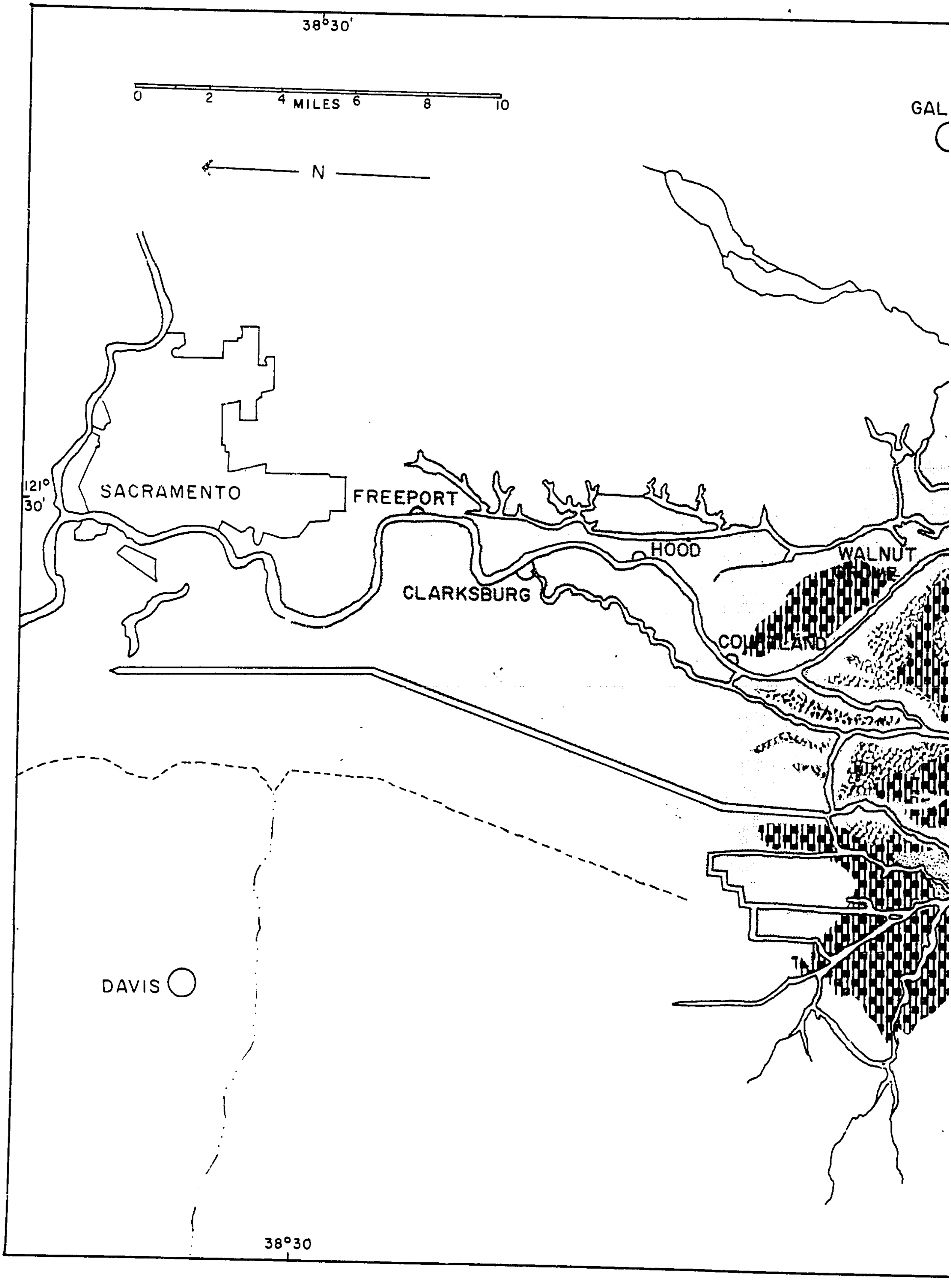
Alluvial soils were developed on the natural levees prior to reclamation, but superimposition of alluvial material upon backswamp peats, as happened along the Sacramento after the 1850's, is in large measure attributable to the gold-mining debris and eroded levee materials. Soil oxidation also increased the volumetric mineral content of soils. In either the case of debris deposition or oxidation it is apparent that soil development in the delta is a by-product of cultural activity. Even wind erosion, a factor of some importance in delta soil formation, was insignificant until after reclamation.

Delta Soil Classification

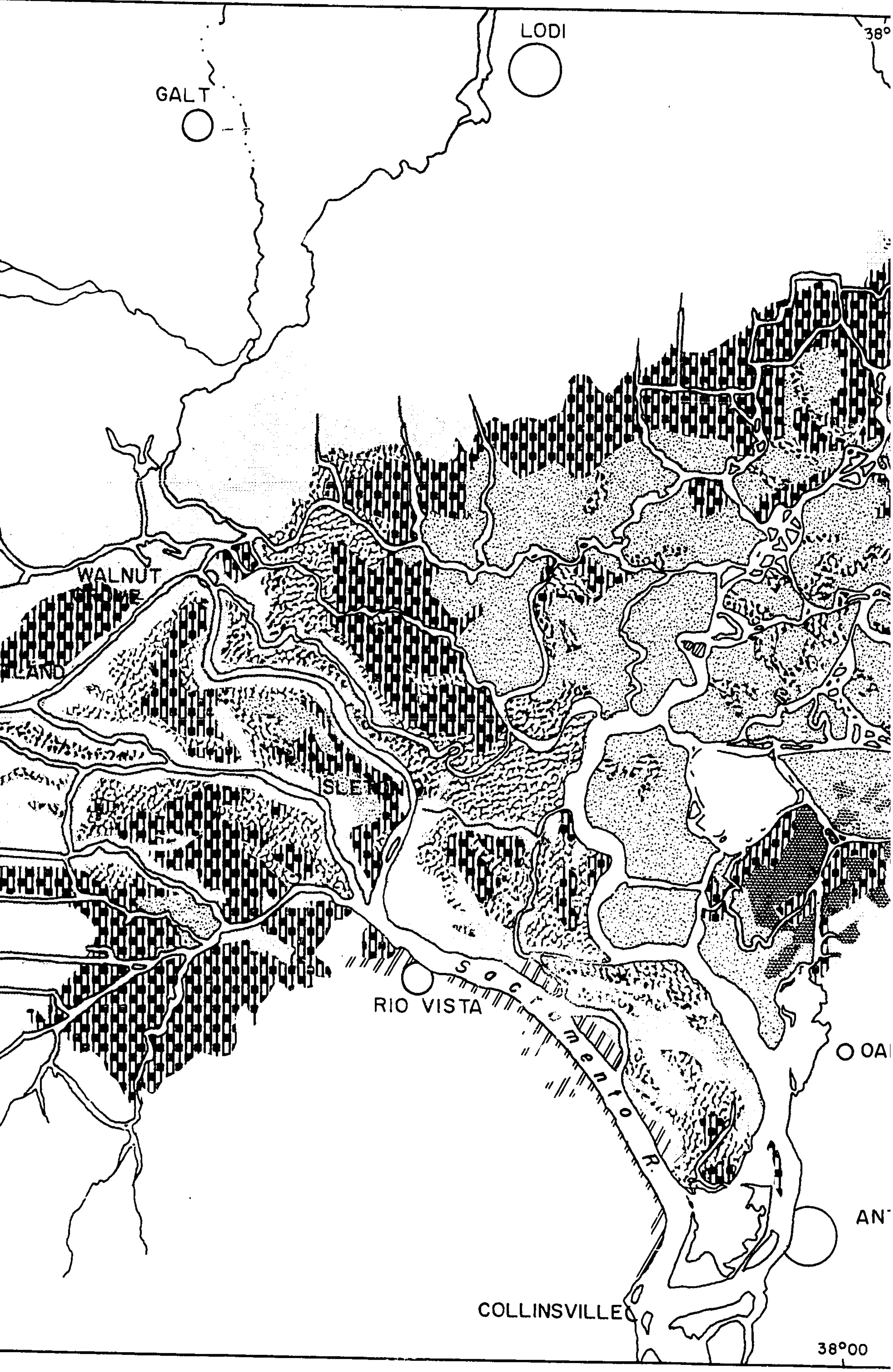
Delta soils, which range in composition from predominantly organic through predominantly mineral, are classified into organic, mineral-organic, and mineral series (see Map 11, p. 67). Although they differ from one another physically, and although there is some variation in their suitability for particular crops, the delta soils are distinguishable as a group from the valley plains soils.

---

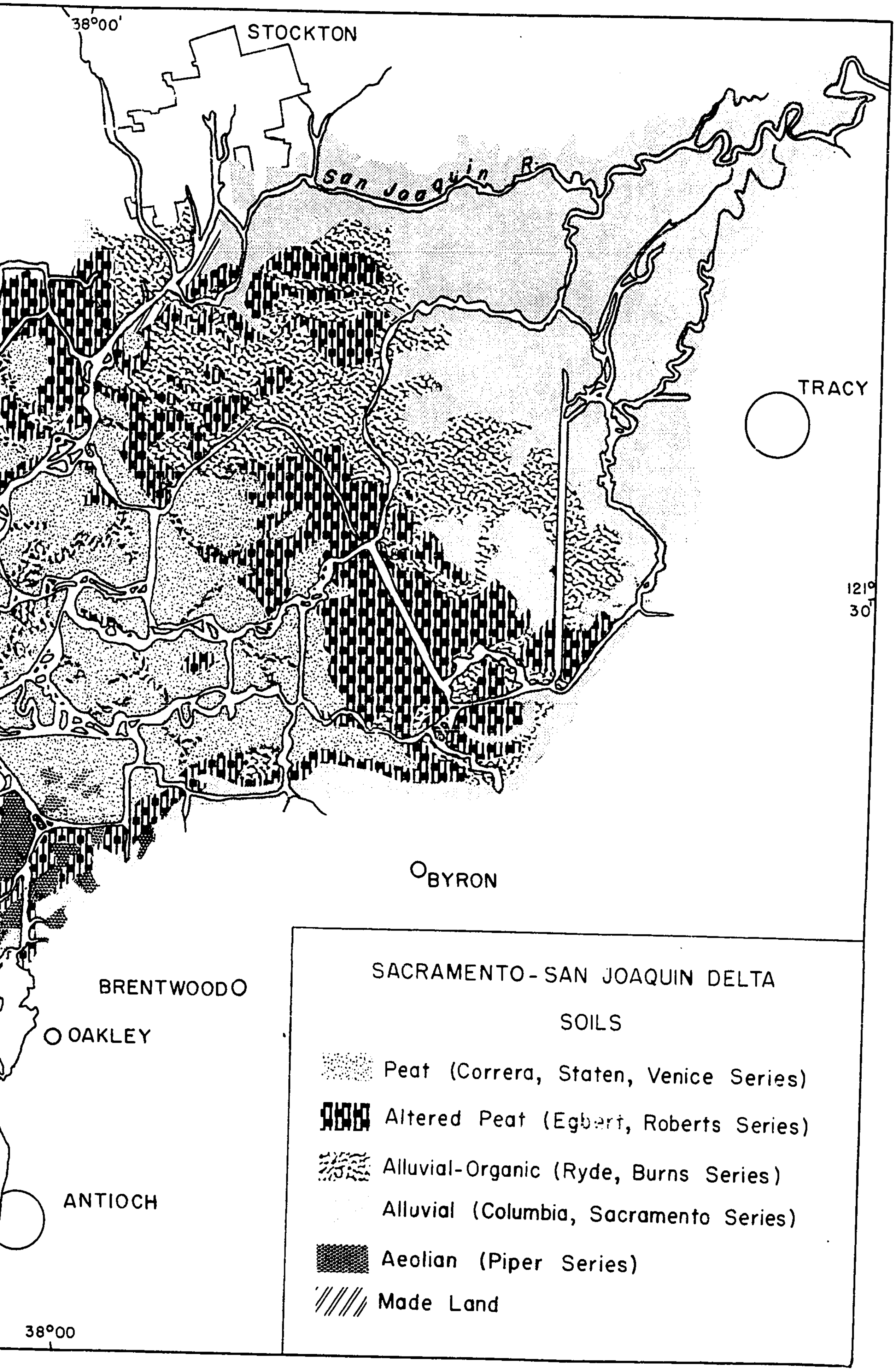
[20] Dachnowski-Stokes, loc. cit.


38°30'
0 2 4 MILES 6 8 10
N
GAL
121°
30'
SACRAMENTO
FREEPORT
HOOD
WALNUT
CLARKSBURG
DAVIS
38°30

Map 11



LODI
38°
GALT
WALNUT GROVE
ISLETON
RIO VISTA
Sacramento R.
OA
AN
COLLINSVILLE
38°00


38°00'
STOCKTON
San Joaquin R.
TRACY
121°
30'
BYRON
BRENTWOOD
OAKLEY
ANTIOCH
38°00
SACRAMENTO-SAN JOAQUIN DELTA
SOILS
Peat (Correra, Staten, Venice Series)
Altered Peat (Egbert, Roberts Series)
Alluvial-Organic (Ryde, Burns Series)
Alluvial (Columbia, Sacramento Series)
Aeolian (Piper Series)
Made Land

The organic soils, called the Roberts Family by Cosby,[21] have as their least altered component the areally unimportant Correra peat. Also resting on virgin subsoil is the finer textured, partly altered Venice peaty muck. A further stage in alteration of organic raw material is recognized as Staten peaty muck, which gives evidence of some subsoil decomposition. Marked alteration of topsoil and subsoil and the admixture of some alluvial strata distinguish the Egbert soils. These, like Staten, Venice, and Correra soils, occupy naturally undrained areas at or very near sea level. A little higher, Roberts muck is found. It has a mineralized surface soil; moreover, soil-forming processes have penetrated into the underlying mineral substratum. Burns and Piper soils have had their surface horizons so altered that the organic matter almost has been destroyed; subsoils are modified.

The Ryde mineral-organic family of soils evolved on levee backslopes and on the banks of small sloughs. Their position is intermediate between the organic soils of former backswamps and the mineral soils of natural levees. The composition of Ryde soils reflects exposure to alternate accumulations of alluvial and organic materials. The Burns and Piper series are similar in composition to the Ryde soils.

Columbia, Sacramento, and Ramada soils are mineral. The first are the principal natural levee and ridge soils.

---

[21]Cosby, "Peat Soils of California," p. 11.

The Sacramento soils developed in backswamp areas where turbid flood water deposited a fine-textured overlay of alluvium. The Ramada soils are grouped with the Columbia and Sacramento soils which they overlie. These reddish or yellow-reddish-brown soils are described for the San Joaquin levees south of Rough and Ready Island. They may be derived from material transported to the delta during the period of placer mining in the Sierra Nevada foothills.[22]

Organic Soils

Parcels of the practically unaltered Correra peat are small and widely distributed. They lie as unreclaimed swamp in channels and in reclaimed tracts. The dark, coarse, fibrous material is 80 per cent organic. Tule remains predominate in the upper three feet of the peat, but fibrous reed remnants comprise the bulk of the "buckskin" material beneath.[23]

Successive developmental stages from the virgin peat are the Venice, Staten, Egbert, and Roberts series. The first two series are centrally located; the Egbert and Roberts series are peripheral. These acid soils are about 40 to 50 per cent organic in content. Their capacity for moisture retention is high; their permeable nature permits

---

[22] Retzer _et al._, _op. cit._, pp. 76, 103.

[23] Cosby, _Soil Survey . . ._, p. 17; DWR Bull. No. 23, p. 361.

water to move laterally and downward with ease. But the soils have a low capillarity and are drought-susceptible when ground-water levels are lower than three feet from the soil surface.[24] When dry, the surface materials are prone to wind erosion. Subsoil rests on the massive and comparatively impervious light gray or light bluish-gray mineral substratum of the delta.

Broadly, the proportion of organic matter in the basin soils decreases as island or delta margins are approached. The nature of alluvial deposition and mineralization of soils through oxidation, and the narrow vertical development of peat that occurs toward the delta periphery, both are responsible for the phenomenon. Although all of the organic soils are undergoing alteration, it is in the shallow Egbert series that change is most noticeable. The areas of this series mapped for the Cache Slough vicinity[25] 20 years ago now contain only 6 to 8 per cent organic matter. The shallow-phase Egbert series, which occupies a zone between Staten and Rough and Ready islands, along the eastern side of the delta, has been altered so much that probably not more than 25 per cent of the mapped area could now be considered organic.[26]

---

[24]Dachnowski-Stokes, loc. cit.; Cosby, Soil Survey . . ., pp. 17-23; Carpenter and Cosby, Soil Survey of Contra Costa County, pp. 37, 42.

[25]Hastings and Egbert tracts and Liberty and Prospect islands.

[26]Information obtained in correspondence with Alan Carlton, Coordinator, Univ. of Calif. Peat Soil Conservation and Dust Abatement, May 2 and 21, 1957.

There have been comparable changes to the south, where Burns and Sacramento soils adjoin, and to the north, where Ryde and Sacramento soils merge with the Egbert series.

Mineral-organic Soils

The mapped mineral-organic soils contain up to 30 per cent organic matter. Among these soils the Ryde series is areally the most important. Burns and Piper series are highly localized.

Ryde soils were identified with the Sacramento series in early studies.[27] They are loose and permeable soils which evolved at elevations and locations intermediate to the mineral and the organic soils. As a rule, the Ryde soils abruptly overlie organic materials which are classified in the Egbert series.[28] The nature and location of this series suggest plant accumulation and overflow deposition.

Burns clay loam is a low ridge and minor elevation soil of about 20 per cent organic content, well decomposed; it is found chiefly in the San Joaquin portion of the delta. Cosby reports an original covering of peat. The well-drained situation of this series, plus its reduced organic content, suggest a grouping with the Ryde series as a transitional soil between the mineral and organic series.[29]

---

[27] Retzer _et al_., _op. cit_., p. 81.

[28] Cosby, _Soil Survey . . ._, p. 27.

[29] _Ibid_., pp. 23-25; Cole, _op. cit_., p. 27.

Piper soils are associated with low sandy mounds and ridges that "have a roughly aeolian configuration and appear to represent a comparatively recent emergence of dunes and similar wind-modified bodies of sands . . . ."[30] Upper zones of the pervious and loose soils show an organic content of less than 15 per cent. The presence of soluble salts and a relatively low water-holding capacity reduce their attraction for cultivation, but the elevation of these pieces of land has made them attractive for barn and house sites.

Mineral Soils

The mineral soils of the delta, the azonal Columbia and Sacramento series, are water-deposited.[31] They are the natural levee and basin margin soils upon which the first white settlers of the delta gardened.

Columbia soils are light to medium textured, loose, and permeable. They contain moderate quantities of organic matter (less than 5 per cent) and in reaction are neutral to slightly acid. Along the rivers they generally rest upon mineral substrata; some areas of the series represent mantles of alluvium which have buried organic soil and the other mineral series. The evidence is quite strong that the Columbia soils are recent in development and probably

---

[30]Cosby, Soil Survey . . . , p. 25.

[31]The Ramada series, sometimes classified as Columbia soils, are so mapped and discussed here.

take much of their mineral character from transported hydraulic mining waste.[32] Brannan, Sherman, and Grand islands exhibit particularly extensive distributions of the soils, a result of Yolo Basin water, the constricted river channel, and of breached artificial levees.

The Sacramento soils are fine-textured and somewhat bumpy or cloddy. Members of the series occurring in the delta differ from their counterparts elsewhere in California in that they contain more organic material and are more acid in reaction. These slightly basic or neutral soils contain about 10 per cent of well-decomposed organic material. On the delta periphery these basin soils are transitional between organic and valley plains soils. Where marginal to the plains they are better suited to pasture and small grain; where there is a gradation into a more organic material the Sacramento series are suitable for a wide variety of field crops.

Experience of settlers with the Sacramento series began along the Sacramento at and above Grand Island, where garden and general farming had an early start. At least one contemporary recognized in 1860 that the "tule" east of the river was being transformed rapidly from "muck-beds" to alluvial bottoms by an annual deposition of "slum" transported from the mining districts.[33]

---

[32] _Ibid_., pp. 35-37; Cole, _op. cit_., p. 30; Cole _et al_., _op. cit_., p. 64.

[33] F [Wilson Flint], "Reclamation of Tule Lands," _The California Culturist_, III (Sept. 1860), p. 111.

Soil Conservation

Although periodic alluviation occurred on reclaimed lands, the more widespread and persistent form of soil and topographic alteration was and is subsidence. Almost from the earliest attempts at reclamation, settlers recognized that levees and soils lost volume with time. Oxidation and wind erosion, particularly, and shrinkage and compaction are involved in the subsidence (see Plate IX, p. 75). Dissipation of the organic matter is an especially serious situation because the parent material, peat, is a non-regenerative resource. Assuming no public aid, it is conceivable that the exhausting peat will cause land to subside to the point where drainage and levee maintenance costs will make continued operations impracticable.

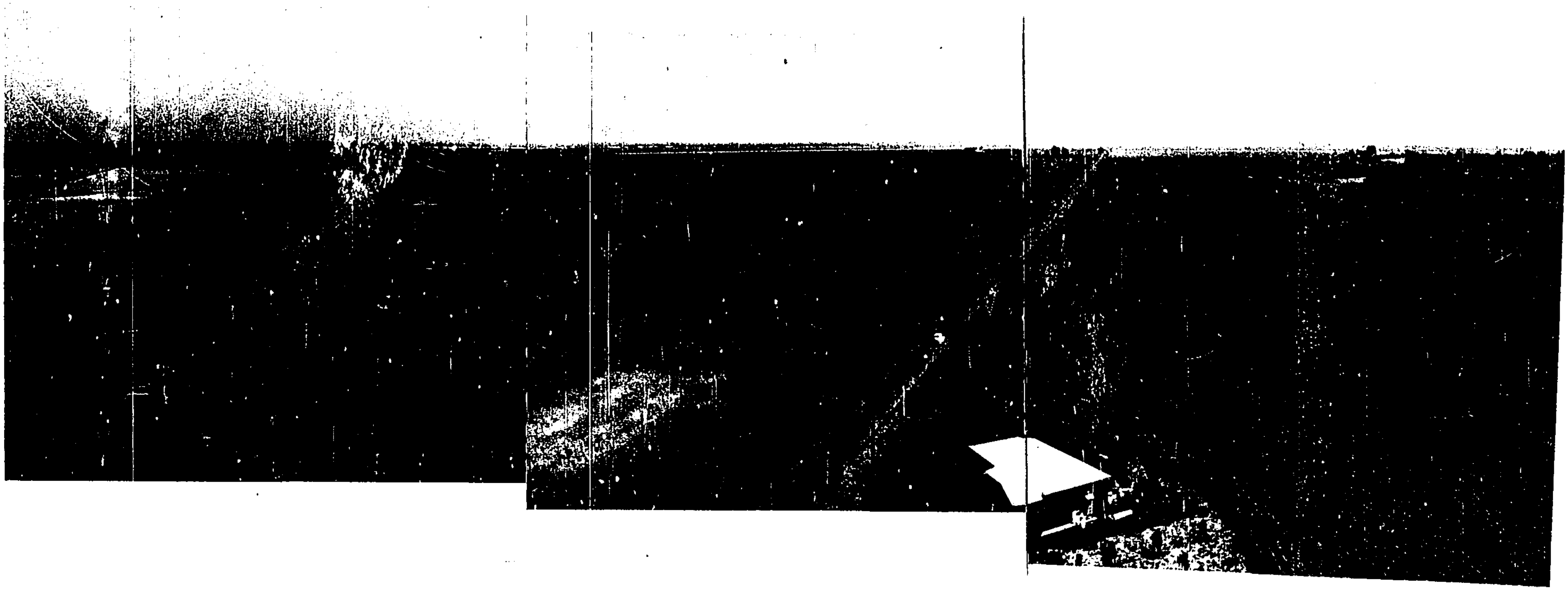
The first methodical investigations of subsidence were undertaken in 1922. Lower Jones Tract and Bacon and Mildred islands were selected to test the prevailing beliefs that compaction by heavy farm equipment was a cause of subsidence and that the rate of compaction decreased with time.[34]

The study revealed that compaction and shrinkage were minor factors in subsidence. Sinking of the land was discovered to be inversely related to time elapsed since reclamation was first undertaken. The newest land subsided most.

---

[34]Walter W. Weir, "Subsidence of Peat Lands of the Sacramento-San Joaquin Delta, California," Hilgardia, XX (June 1950), pp. 43-44.

PLATE IX



Panoramic view of Staten Island from the north, showing the relationship of the tidal Mokelumne River forks to the subsided land. Most of the land is below minus five feet elevation. Foreground crops are wheat and field corn; light color in wheat field is barley, and reveals location of sheep bedding area of preceding year.

By 1848, when the three tracts were depressed to between 10 and 11 feet below sea level, the area as a whole was measured to be subsiding at a rate of 0.25 to 0.30 feet per year.[35] Measurements made in 1955 revealed that the average annual subsidence had decreased. The 33-year average on the Lower Jones Tract was 0.21 feet; it was 0.27 feet on Bacon Island (19-year average); and 0.28 feet on Mildred Island (14-year average).[36]

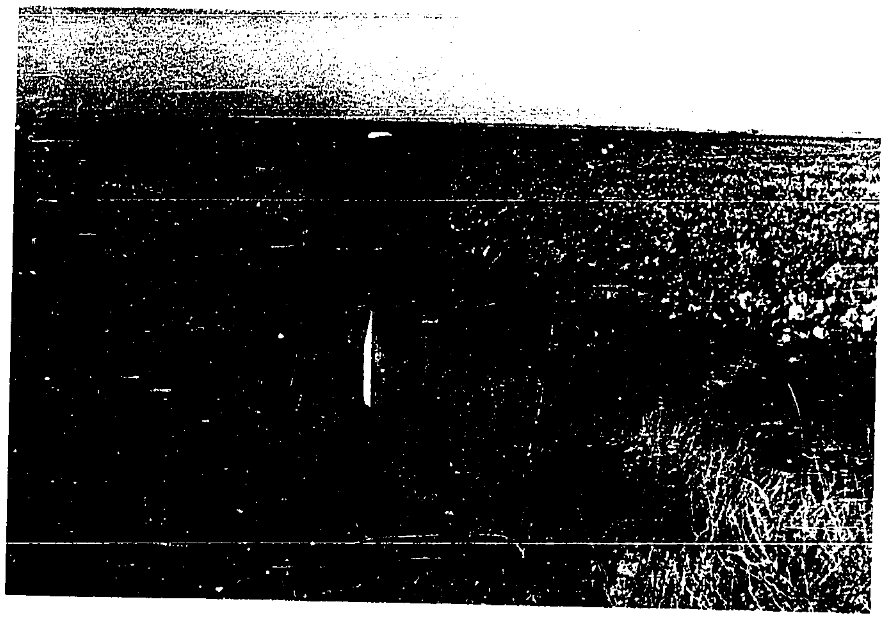
Oxidation, the process by which organic matter is decomposed, is the chief cause of subsidence. It operates in all materials that lie above the water table. The rate of transformation increases with tillage; when fire is employed the change is sudden. (A full discussion of the role of fire in agriculture occurs in Chapter XII.) Fire was the cheapest and most effective means of breaking the tough tule sod before mechanized farm equipment was introduced, and accidental and intentional burnings of broken soil have been common occurrences for 60 or 75 years (see Plate X, p. 77). It appears that burning the soil as a regular cultural practice, especially associated with potato farming, developed by the first decade of this century. Every peat tract in the delta has been burned at least once. Commonly it is the upper three to five inches of soil in

---

[35]Ibid., pp. 47-48.

[36]The recent measurements were secured from Alan Carlton; interview of Feb. 25, 1957.

PLATE X



A reminder to motorists that peat soils are inflammable (Bouldin Island). Crop is sugar beets.

individual fields which is so treated once every 5 or 10 years. While sentiment against the practice was strong in the 1930's, the World War II demand for potatoes and sugar beets led to increased frequency of burns. Since the war many owners and operators have given it up, but an average of about 500 acres a year is still ignited. Mandeville, Bacon, McDonald, and Bouldin islands and the Bishop Tract are the usual districts where fire is used as a cultural tool.[37]

The soil destruction and subsidence that result from burning are accepted as the price of remunerative agriculture. Ash produces fine-looking potato crops. Benefits ascribed to the practice are that it controls weeds, fertilizes the soils, and facilitates seedbed preparation. However, weeds and pests can survive the shallow soil fires.[38] Fertilization and seedbed preparation by burning lead to salt accumulation and wind erosion.

Wind erosion, the second major causative agent of subsidence, was estimated by Weir to remove as much as one-quarter to one-half inch of peat dust and ashes annually.[39] The dry cushion-like surface of organic soils releases dust

---

[37]Weir, _loc. cit._, pp. 52-53; Walter W. Weir, "Peat Lands of the Delta," _California Agriculture_, III (July 1949), p. 6; Doyle Loman Roberts, "A History of the Reclamation of the Delta Lands of California" (unpublished Master's thesis, Dept. of History, College of the Pacific, 1951), p. 94.

[38]Weir, "Subsidence of Peat Lands . . . ," _loc. cit._

[39]_Ibid._, p. 53.

puffs with every step; moving agricultural equipment may be concealed in the billowing envelopes of dust which it activates. Spirals of dust devils are common dry-season sights, and rolling waves of dust may sweep toward Stockton or the south during particularly strong spring winds.[40] The dust is a skin irritant that readily penetrates clothing and shoes. It is damaging to machinery.

The lands most susceptible to the early dry-season wind erosion are the powdery, completely bare, producing asparagus fields in the San Joaquin delta. This type of land use in the central and southern delta expanded considerably after World War II, and extension of the asparagus acreage was paralleled by outcries in Stockton for dust control.

Effective April 1, 1955, local businessmen and officials succeeded in obtaining the appointment of a University of California Coordinator of Peat Soil Conservation and Dust Abatement. The coordinator, together with local operators and the Agricultural Extension Service, is experimenting with dust abatement techniques. Inter-row planting of barley in the asparagus fields and watering from large fixed

---

[40] During a flight over the San Joaquin Valley on April 1, 1957, a Navy pilot traced a cloud of red dust from Bakersfield to the delta. Although some dust was added to the cloud from sources south of the delta, the pilot, Lt. Owen Henry Oberg, firmly states that the peat islands were the principal dust source. The dust was seen to rise from the delta with a gentle slope of 15 to 20 degrees to 1,000 feet, where it leveled off. At times the valley floor could not be seen through the cloud; at 800 feet elevation horizontal visibility in the cloud was limited to one-quarter of a mile.

rotating sprinklers appear to offer the most promising solution. Cover crops, chemical soil stabilizers, windbreaks, and new cultivation techniques are being tried also. For its long-run objective, the investigation seeks a stable form of husbandry which will minimize erosion and oxidation rates.[41]

Subsidence, which emphasizes the saucer-shaped cross section of delta islands, increases crop production costs in several ways. Ditches must be deepened periodically to conduct surplus water from island centers to the sumps located immediately inside of the artificial levees. Power consumption rises as the greater lifts become necessary for discharging water into the surrounding channels. The situation is illustrated by the Sherman Island experience. In building the first system of levees (1869), 30 tidegate-equipped open flumes were emplaced to control the flow of irrigation and drainage water.[42] Today, virtually all of the island is below sea level. Irrigation is by gravity but excess water must be lifted 10 or 15 feet to reach sea level, and

---

[41]Alfred Zuckerman, "Peat Soil Area Project--San Joaquin County" (Peat Dust Committee, Stockton Chamber of Commerce, Feb. 14, 1955), p. 1 (typewritten); Technical Committee, Peat Land Conservation and Peat Dust Abatement Project, "Interim Report" (July 20, 1955), pp. 1-8 (typewritten); W. C. Fleming, "California's San Joaquin River Delta Has Great Production Potential" (MS, Aug. 31, 1955), p. 2 (MSS in the files of Fleming, Farm Advisor, San Joaquin County, Stockton).

[42]"Sherman Island Improvements," Mining and Scientific Press, May 22, 1869, p. 330 (hereinafter cited as MSP).

additional lift is required to get the water over the levees. (See Map 12, p. 82, which shows the nature of relief and irrigation and drainage system on Sherman Island.) The growing differential between water levels on either side of the levees results in added pressures, which increase seepage.[43] More water must be removed from the islands to keep them productive. Subsidence accounts for much of the expense of recovering flooded tracts. New reclamations could be drained by gravity almost immediately after levee breaks; the present below sea level basins must be pumped out.[44] Such costs and the expense of restoring levees and land improvements have prevented the recovery of Franks Tract from its 1938 flooding.[45]

There is a minor element problem in some of the delta soils. A high molybdenum content, characteristic of some soils derived from peat, is detrimental to the health of livestock unless corrected. Zinc, manganese, and potash deficiencies are corrected for optimum growth of some crops.[46]

---

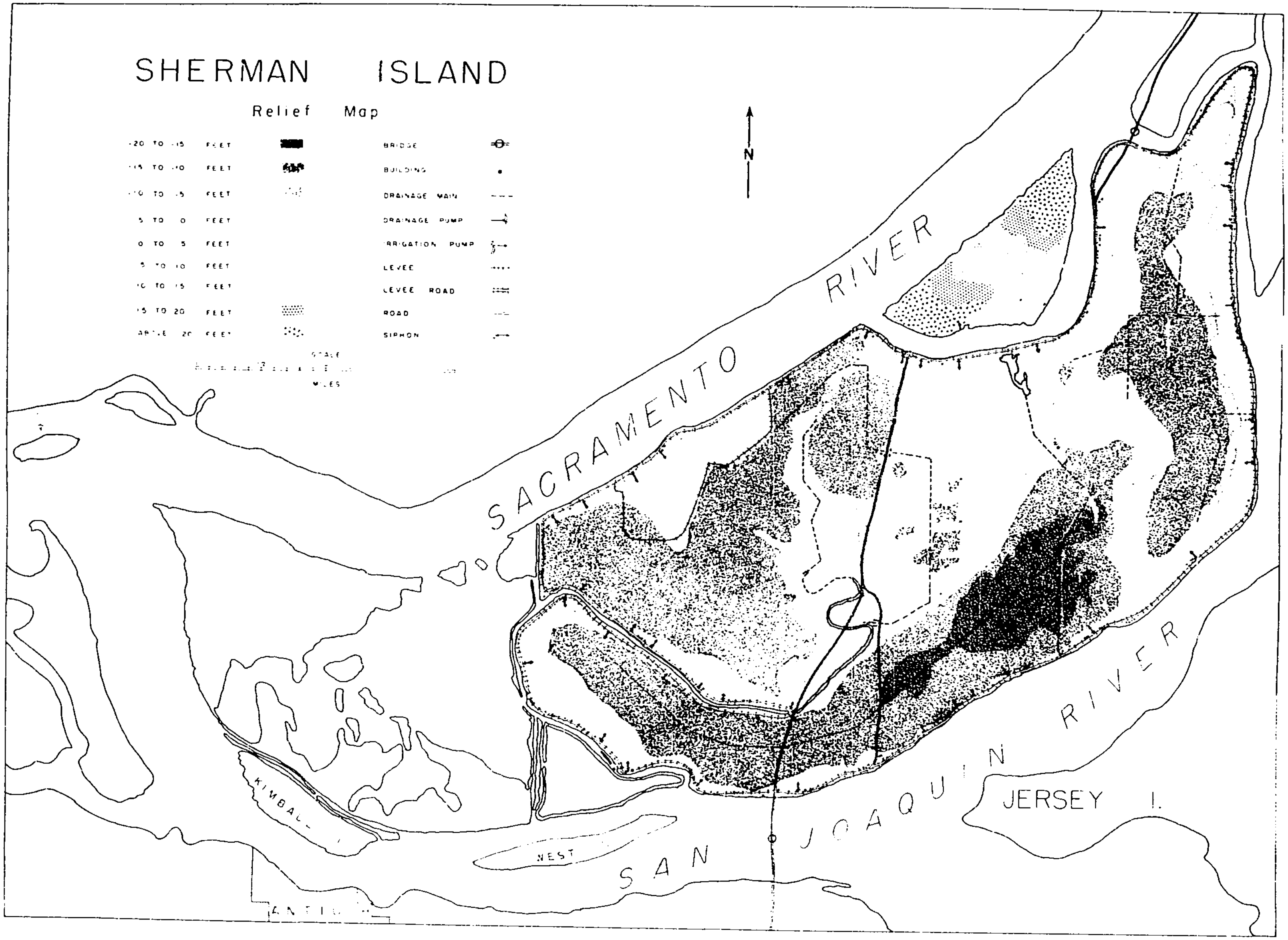
[43]Weir, "Subsidence of Peat Lands . . . ," loc. cit., p. 54.

[44]Letter of William Q. Wright to Jack Williams.

[45]The tract is not a total loss. Appreciative sports fishermen swarm over it in small boats. For some years peat has been dredged from the submerged tract, processed nearby, and sold to garden supply houses of central California.

[46]Fleming, loc. cit.; Weir, "Peat Lands of the Delta," loc. cit.

MAP 12


SHERMAN ISLAND
Relief Map
5 TO 0 FEET
0 TO 5 FEET
BRIDGE
BUILDING
DRAINAGE MAIN
DRAINAGE PUMP
IRRIGATION PUMP
LEVEE
LEVEE ROAD
ROAD
SIPHON
MILES
N
SACRAMENTO RIVER
SAN JOAQUIN RIVER
JERSEY I.
KIMBALL I.
WEST

In spite of their deficiencies, delta soils are overwhelmingly classed as Grade 1 or 2, "Excellent" or "Good," in the Storie Index. Such classification factors as profile characteristics, texture, and slope place the delta soils among the finest of California. They differ from the adjacent valley plains pedocals in that the latter are rated predominantly Grade 3 or 4, "Fair" or "Poor." The dry land soils are apt to be affected by adobe, claypan, or alkali conditions.[47]

Delta land use is intensive. Almost all of the land is developed for irrigation; it supports a variety of feed, food, and industrial field crops. The land use is distinct from the surrounding valley plains pattern. Natural and irrigated pasture and some dry-farmed grain characterize the adjacent plains except for town growth or intensively farmed outwash strips of Columbia and Sacramento soils.

Fauna

Pre-Gold Rush visitors to the Central Valley invariably noted the abundance of game animals and birds in their recorded observations of the fauna of plains and swamp. Charles Wilkes[48] was struck by the predominance of elk.

---

[47]Weir, Soils of Sacramento County, pp. 4, 9; idem., Soils of San Joaquin County, pp. 6, 9.

[48]Narrative of the United States Exploring Expedition During the Years 1838, 1839, 1840, 1841, 1842 (Philadelphia: Lea and Blanchard, 1845), V, 206.

Deer, antelope, and grizzly bears frequented the tules and thickets as well as the more open country of the surrounding plains. Glimpses of the grizzlies were a daily, almost hourly, experience for John Bidwell;[49] John Marsh, who owned a grant near the present Antioch, was able to have one caught by his cowboys any time he so desired.[50] Elk and antelope "went in droves by the thousands," while deer were numerous.[51] Lansford W. Hastings, an accomplished embellisher of fact, reported substantially what others have since said concerning fowl of the Sacramento Valley and San Francisco Bay waters:

> I have frequently been greatly annoyed, by the almost deafening, tumultuous and confused noises, of the innumerable flocks, of geese and ducks, which were continually flying to and fro, and at times, blackening the very heavens with their increasing numbers, and making the aerial region ring, with their tumultuous croaking and vehement squeaking. During the winter season, California is truly, a noisy, turbulent region; all the northern world, seems to have given up, its millions of the feathered tribes, which are here in universal convention, having complete possession, of the country.[52]

---

[49]Rockwell D. Hunt, John Bidwell, Prince of California Pioneers (Caldwell, Idaho: The Caxton Printers, 1942), p. 75; An Illustrated History of San Joaquin County (Chicago: The Lewis Pub. Co., 1890), p. 33.

[50]Illustrations of Contra Costa Co., with Historical Sketch (Sacramento: The Sacramento Lithograph Co., 1952 reproduction of ed. by Smith and Elliott, Oakland, 1879), p. 18.

[51]An Illustrated History of San Joaquin County, loc. cit.

[52]Lansford W. Hastings, The Emigrants' Guide to Oregon and California, ed. Charles Henry Cany (Princeton: Princeton University Press, 1932, reproduced in facsimile from ed. of 1845), p. 99.

At least as far as the Wilkes' party was concerned, the fowl "scarcely claimed attention" because elk and other large meat animals were so abundant.[53]

Gold Rush travelers noted thousands of antelope, elk, and horses on the grassy plains which lay between the San Joaquin River and the Mount Diablo Range.[54] Elk and wild cattle were common about what is the present site of Antioch.[55] Large herds of elk and deer frequented the Stockton vicinity until the flood of 1852 when "immense" numbers of them were trapped in stock corrals after high water had forced them out of the tules.[56] Until that time this favored meat animal was hunted in the early morning as it grazed in bands of 40 or 50 along the edge of the swamps. Sometimes native cowboys lassoed their victims, but commonly they were shot.[57] Elk and deer, as well as the occasional grizzly, were shot along the Sacramento,[58] but infrequently, judging from travelers' accounts. Possibly Sutter's hunters had thinned out the herbivores in the vicinity and caused

---

[53]Wilkes, _op. cit_., p. 207.

[54]Frederick J. Teggart (ed.), "The Gold Rush; Extracts from the Diary of C. S. Lyman, 1848-1849," California Hist. Soc., _Quarterly_, II (Oct. 1923), p. 200.

[55]_Illustrations of Contra Costa Co., . . . ,_ _loc. cit_.

[56]Tinkham, _op. cit_., p. 22.

[57]Taylor, _op. cit_., p. 76; _Illustrations of Contra Costa Co., . . . ,_ _loc. cit_.; Kip, _op. cit_., p. 165.

[58]Teggart, "Diary of Nelson Kingsley, . . . ," _loc. cit_., pp. 328, 333.

the survivors to retreat to the seclusion of swamp and valley plains margins away from traveled routes. Big game flourished to the west of the San Joaquin River until the middle 1860's, when drought and hunters gained the upper hand.[59] By 1870 only remnant bands of antelope remained on the plains.[60] A few elk still occupied unreclaimed lands in the delta as late as 1874.[61] It is doubtful that any of the large game animals survived the devastating flood of 1878.

Lesser mammals of the delta and bottomlands were the golden beaver, river otter, raccoon, and mink. Coyotes, badgers, skunks, ground squirrels, gophers, cottontails, and jack rabbits were more at home on the drier peripheries, although they were mentioned as being in the tule area.[62]

---

[59]Hunting antelope was a more complicated exercise than the term implies. One expedition, described in 1864, affords an idea of how a hunt was conducted. A party of 41 horsemen divided into four groups, each of which proceeded westward across the plain. The groups were spaced at three-mile intervals. The wing divisions fanned out toward the hills, then circled back toward the center. In the space of two and a half hours of chase perhaps three or six antelope would be shot down or captured. The latter outcome was possible when the quarry became exhausted from the chase carried out by a succession of horsemen. "Great Antelope Hunt on the San Joaquin," loc. cit.

[60]An Illustrated History of San Joaquin County, p. 217.

[61]Charles Nordhoff, Northern California, Oregon and the Sandwich Islands (New York: Harper and Bros., 1874), p. 133.

[62]Wilkes, loc. cit.; Taylor, loc. cit.; Lyman Belding, "Autobiography" (MS, n.d. /pre-1917/), pp. 30, 33 (in the files of the San Joaquin County and Stockton Public Library); Kip, op. cit., pp. 115-16; Leale, op. cit., p. 37; W. Egbert Schenck and Elmer J. Dawson, "Archaeology of the Northern San Joaquin Valley," Univ. of Calif. Publications in American Archaeology and Ethnology, XXV:4 (1929), p. 304.

Geese, ducks, cranes, doves, and quail were plentiful.[63] The hunters who preyed upon them became themselves preys of "all the mosquitoes in California."[64]

Such native land animals as survived the 1878 flood soon disappeared from the delta. Subsequent inundations and the maintenance of channels and ditches created barriers to migration and repopulation. The various aquatic game birds common to the delta afforded fine commercial or amateur hunting in the early twentieth century. Duck ponds and stocked pheasant preserves still draw the sportsman. The smaller aquatic mammals, and the more recently introduced muskrat, survive in the delta in spite of the inroads made by hunters, trappers, and levee builders.

---

[63]Teggart, "The Gold Rush . . . ," *loc. cit.*; Taylor, *loc. cit.*; Schaeffer, *op. cit.*, p. 32; Samuel C. Upham, *Notes of a Voyage to California via Cape Horn, Together with Scenes in El Dorado in the Years 1849-50* (Philadelphia: By the author, 1878), p. 233.

[64]*Ibid.*

PART TWO: THE DELTA BEFORE RECLAMATION

CHAPTER III

EXPLORATION OF THE DELTA

To the Spanish and the early Californians the Sacramento-San Joaquin Delta was a communications barrier. The earliest arrivals by land considered it to be an extension of the moatlike greater San Francisco Bay, and as difficult to cross. They generally avoided it for that reason, even after the outlines of the delta waterways and its dry periphery became known. The physically difficult task of crossing a slough-fretted, flood-prone, tidal swamp discouraged transit. Also, expeditions could anticipate a hostile reception from the renegade Christian and other Indians who had taken refuge in the delta.

Preliminary Discoveries, 1772-76

The first documented account of the discovery of the delta by Europeans was that of a party of 16 led by Captain Pedro Fages, which had come from the south in 1772 to explore

Drake's Bay.[1] En route to the bay the group skirted the eastern shores of San Francisco and San Pablo bays (see Map 4, p. 9). From Carquinez Strait they proceeded toward the interior until the broader expanse of Suisun Bay was reached. The eastward prolongation of the water barrier discouraged Fages, who redirected the route of the party southeast in the direction of Mount Diablo. From a spur of this landmark the explorers were able to see the interior extent of the water body which had checked their plans.[2]

Suisun Bay was seen to be the terminus of two large rivers, each of which had a breadth of one one-quarter league.[3] The southern river displayed a winding, braiding pattern in its course toward junction with the bay. Where the union of rivers occurred there was a sizable island. Beyond, "the land opened into a great plain as level as the palm of the hand."[4]

Descending to the north, the party is believed to have reached the shores of the southern river somewhat west

---

[1]Donald Colgett Cutter, "Spanish Exploration of California's Central Valley" (unpublished Ph.D. dissertation, Dept. of History, University of California, 1950), pp. 3-4.

[2]Herbert Eugene Bolton, Fray Juan Crespi: Missionary Explorer on the Pacific Coast, 1769-1774 (Berkeley: Univ. of Calif. Press, 1927), pp. 290 ff.

[3]In California the league was about 3.95 English miles. The United States land surveys adopted 2.6 miles as the length of a league. Robert G. Cowan, Ranchos of California . . . (Fresno: Academy Library Guild, 1956), p. 148.

[4]Bolton, op. cit., pp. 295-96.

of the present Antioch (see Map 13, p. 91). The stream (now the San Joaquin) was named the San Francisco in honor of the patron who would "intercede with His Divine Majesty for the conversion of all the immense body of heathen that no doubt must be on the banks of the great stream, which it seems must be the largest that has been discovered in New Spain."[5]

Fages and Father Crespi then returned to Monterey, passing to the west of Mount Diablo, through a portion of the Livermore Valley, and southwestward over Mission Pass into the southern part of the San Francisco Bay lowlands.[6] Their visit to the outfall of the San Joaquin River was repeated during the summer by small punitive expeditions seeking a party of deserters from Monterey, which was trapped about 14 leagues above the river mouth.[7]

A water-borne counterpart to the land explorations of the delta vicinity was made in 1775 by a subordinate leader of Juan de Ayala's San Francisco Bay charting expedition. The headward shoaling of fresh-water Ensenada del Santo Evangel (Suisun Bay) was noted. The broader of its affluents was entered, but movement along the southern waterway was so interrupted by bars that it was deemed unnavigable. The stream, christened the San Juan Bautista, was the same which had been called the San Francisco by the Fages party.[8]

---

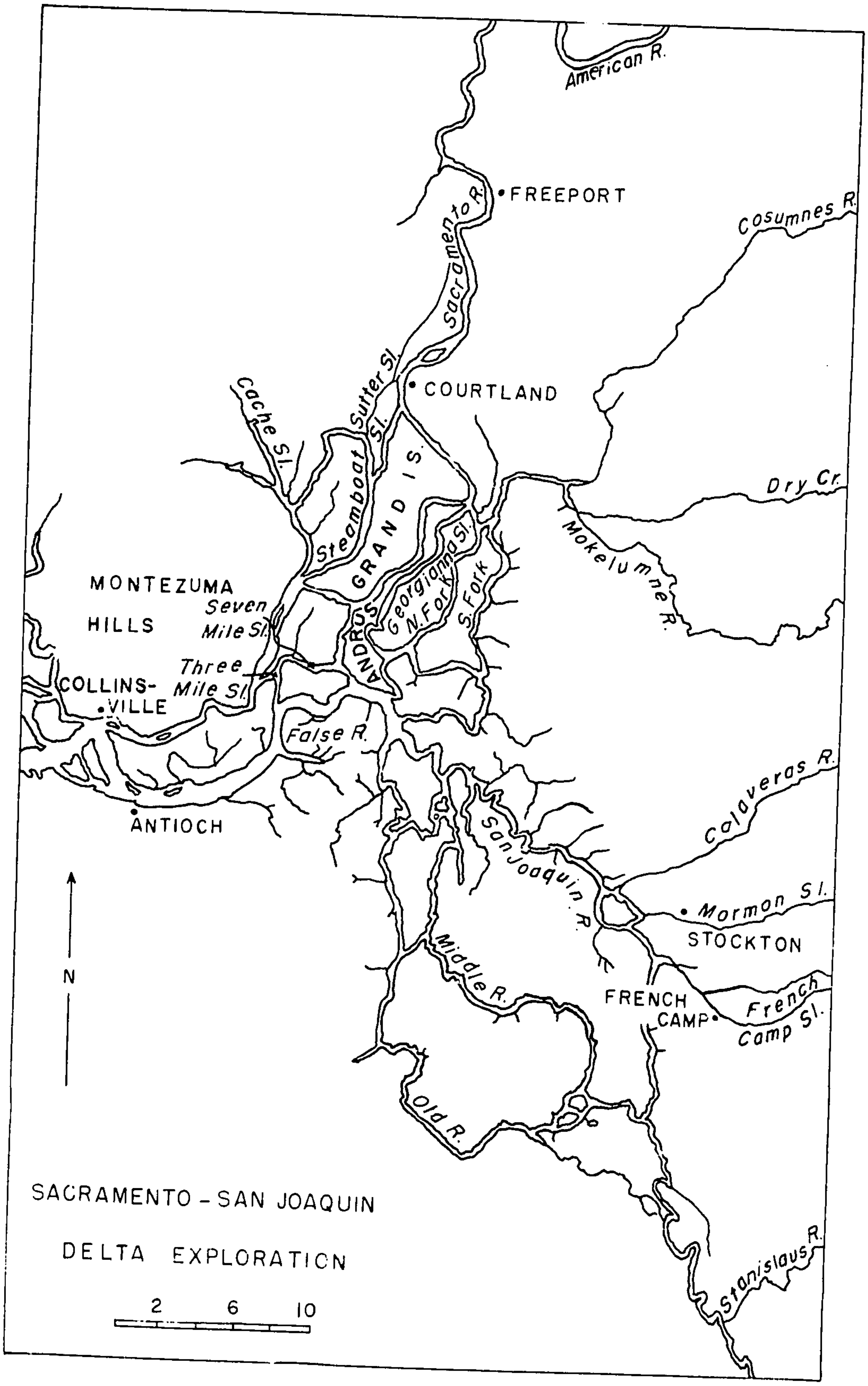
[5] *Ibid.*, pp. 296-97.

[6] *Ibid.*, pp. 298-300.

[7] Cutter, *op. cit.*, p. 10.

[8] *Ibid.*, pp. 11-13.

MAP 13


American R.
FREEPORT
Cosumnes R.
Sacramento R.
Sutter Sl.
COURTLAND
Cache Sl.
Sl.
GRAND IS.
Steamboat
Dry Cr.
Mokelumne R.
Georgiana Sl.
N. Fork
S. Fork
MONTEZUMA
HILLS
Seven
Mile Sl.
ANDRUS
Three
Mile Sl.
COLLINS-
VILLE
False R.
ANTIOCH
Calaveras R.
San Joaquin R.
Mormon Sl.
STOCKTON
N
Middle R.
FRENCH
CAMP
French
Camp Sl.
Old R.
Stanislaus R.
SACRAMENTO - SAN JOAQUIN
DELTA EXPLORATION
2
6
10

In the year following the charting expedition, Lieutenant Colonel Juan Bautista de Anza and Padre Pedro Font re-explored much of the terrain visited by Fages and Crespi in 1772. The many-branched deltaic rivers and the low, long, and narrow islands were remarked upon. Padre Font was so impressed by the plains that he "never expected to see another horizon with so extended a view."[9] His party penetrated about 20 miles along the western edge of the swamps.

Shortly after Anza left the San Joaquin delta the expedition of Jose Joaquin Moraga set out for the same destination by traveling directly overland from the southern tip of San Francisco Bay. The Moraga party apparently reached the river at a point two or three days' march to the southeast of Antioch, frustrating the scheduled rendezvous near the present town with the water-borne expedition of Francisco Quiros. Without fresh supplies Quiros had to limit his waterways survey to a mapping of the lower San Joaquin to about False River.[10] In November and December of 1776 another party entered the delta, crossing the Rio del Pescadero (Old River), the San Francisco Javier (Middle River), and the San Miguel (still another name for the San Joaquin). It reported that nowhere between the channels were trees to be seen.[11] However, the party appears to have

---

[9]Herbert Eugene Bolton, Font's Complete Diary; a Chronicle of the Founding of San Francisco (Berkeley: Univ. of Calif. Press, 1933), pp. 380, 381, 386.

[10]Cutter, op. cit., p. 25.

[11]Ibid., p. 28.

entered a wooded area at least by the time the Rio de la Pasion (Calaveras River) was reached.[12]

Comparative Inactivity, 1777-1806

Nearly 25 years elapsed before a major exploring party again penetrated the delta. There may have been reconnaissance or punitive forays during the interim but there is virtually no confirmation of such activity save for a marginal visit by the small vessels of Francisco Eliza in 1795, and an expedition which may have penetrated to the Sacramento River in 1798 or 1799.[13]

The Spaniards' preoccupation with consolidating their position in the immediate vicinity of San Francisco Bay apparently accounted for the comparative inactivity in the interior. Among the problems they had to cope with were the escape of numbers of neophytes, disappearance of unbaptized Indians from villages upon which the Spanish depended for work forces, and the rising rate of attrition on European livestock.[14] These developments reflected a mounting antipathy toward the intruders. The sentiment was strengthened by such actions as the successful punitive campaigns

---

[12]*Ibid.*; W. Egbert Schenck, "Historic Aboriginal Groups of the California Delta Region," *Univ. of Calif. Publications in American Archaeology and Ethnology*, XXIII:2 (1926), p. 126.

[13]Cutter, *op. cit.*, pp. 29-30, 88.

[14]*Ibid.*, pp. 78, 83, 85. Cutter regards 1795 as the beginning of the period when the Indians became enthusiastic about horseflesh.

which, by 1804-6, rendered the terrain between San Francisco Bay and the delta unsafe as an Indian refuge area.[15]

The right-bank country of the San Joaquin was barely known to the Spanish prior to 1806.[16] Indian fugitives retreated there and into the delta.[17]

Mission-Site Reconnaissance, 1806-12

Between 1806 and 1812 the Spanish missionaries made several reconnaissance expeditions into the Central Valley. They were looking for suitable mission sites in the areas to which the Indians had withdrawn. The first expedition, led by Ensign Gabriel Moraga and Padre Munoz, departed from San Juan Bautista Mission, named and crossed the San Joaquin River,[18] and continued northward to the Calaveras River.[19]

Moraga visited the delta vicinity again in September 1808. His party went overland from San Jose to Old River, followed the San Joaquin southward, forded it and visited the

---

[15] Ibid., pp. 83, 88.

[16] Thomas C. Russell (ed. and trans.), Langsdorff's Narrative of the Rezanov Voyage to Nueva California in 1806 (San Francisco: By the editor, 1927), p. 118.

[17] Cutter, op. cit., pp. 83, 94. The river and the valley were apt to be referred to then as the Tulare. Hubert H. Bancroft, History of California, II (San Francisco: The History Co., Pub., 1886), p. 56.

[18] Bancroft knew of no instance in which the name was used earlier than 1806. Ibid., p. 47.

[19] Schenck, loc. cit.; Cutter is inconsistent in identifying the Calaveras (see pp. 28, 107, 126).

lower Stanislaus and Calaveras rivers. Then the group penetrated the Sacramento Valley to the Marysville Buttes area before returning to explore the delta margin between the Mokelumne and Stanislaus rivers. No suitable mission sites were found near the delta.[20]

In August-October 1810, Moraga and Father Jose Viader surveyed the plains to the southwest of the delta for possible mission sites, with no success.[21] In the fall of 1811, Father Ramon Abella engaged in a similar mission, sailing in two or three small boats up the Old River and into the main channel of the San Joaquin, then downstream until Sevenmile Slough was reached. The latter was followed to its junction with Threemile Slough; and this was traced to the present Sacramento River. The main stream was followed on the return to Suisun Bay. In the latter part of the voyage, several large villages were seen along the shores, suggesting the possiblity of establishing a mission in the area.[22]

The essentially peaceful exploratory work of the period 1806-11 did much to extend the findings recorded by discovery work conducted between 1772 and 1776. Aside from this, the Spaniards gained nothing from the effort. The contemplated interior missions failed to materialize, and with

---

[20] Cutter, op. cit., pp. 121-35.

[21] Bancroft, loc. cit.; Cutter, op. cit., p. 155.

[22] Ibid., pp. 180-81; Bancroft, op. cit., pp. 321-22.

them the hope of establishing peaceful relations with Central Valley Indians through the stabilizing effects of mission settlements.

Frontier Warfare, 1813-45

Attempts to subdue the Indians followed a more belligerent course for the next quarter of a century. Spanish expeditions assumed the character of purely military campaigns designed to capture fugitives and to punish malefactors. One such foray occurred in the fall of 1813 when Sergeant Francisco Soto sailed to the northern end of Andrus Island with troops and convert auxiliaries in the hope of making a surprise attack upon a large force of Indians residing there. In late 1815 or early 1816 punitive expeditions lashed at a village which stood in the vicinity of the present Collinsville.[23]

A strong party sailed from San Francisco for the Sacramento River on May 13, 1817 with punitive and exploratory objectives. It was led by Luis Arguello and Fathers Ramon Abella and Narciso Duran. The expedition camped to the south of Cache Slough, made a water reconnaissance of the shores of the tidal basin which it drained, and returned to the Sacramento through what may have been Sutter Slough. By May 20, the party had moved upstream to a point near or

---

[23]Cutter, op. cit., pp. 183-85, 187, 195.

north of the present Freeport, where it reversed its direction.[24]

Riding with the current, the small armada sailed to the vicinity of the present Courtland and camped. Then it followed the river to the east of Grand Island, negotiated either Tyler or Georgianna Slough, and traced the North Fork of the Mokelumne to the San Joaquin. The party split here. Arguello set off to find escaped Indians and to explore the interconnecting sloughs of the Sacramento and San Joaquin. The priests sailed toward a village of friendly Indians at the site of the present Stockton.[25] Such a community was rare. The expedition usually found that Indian villages were evacuated by all residents but the aged and infirm before their arrival. Between villages the navigators were confronted at "every turn" by armed warriors.[26]

With the completion of the Arguello expedition, the Spaniards had acquired a reasonably comprehensive knowledge of the main delta waterways, and must have had a fairly clear understanding of the nature and extent of the swampy area.

---

[24]Ibid., pp. 187-94; Charles Edward Chapman (ed.), "Expedition on the Sacramento and San Joaquin Rivers in 1817; Diary of Fray Narciso Duran," Academy of Pacific Coast History, Publications, II (Dec. 1911), pp. 335-43.

[25]The Passasimas village was visited. Although he was not certain that the name did not apply to a larger group than the rancheria alone, Schenck understood that a village with this name lay to the south of the Calaveras River and probably within the city limits of the present Stockton. Schenck, loc. cit., p. 140.

[26]Chapman, loc. cit., pp. 343-47; Cutter, op. cit., pp. 255-56.

They had explored, in some cases during different seasons, most of the land areas which are considered today to be within the Sacramento-San Joaquin Delta. Furthermore, Father Duran had concluded that the firm ground in the Freeport vicinity could be used as the starting point for the exploration of the Sierra Nevada.[27]

Well-armed boat parties appear to have continued roundup visits to the delta at least into the middle 1820's. Bloodless excursions such as Arguello's seem to have been the exception. Forays by Indian converts unaccompanied by Europeans afforded the opportunity to settle tribal differences and to kidnap women and children. Supplementing these efforts to increase the baptized flock and to overcome opposition was the clerical policy of stationing Christian Indians at interior points, or of permitting them to make periodic visits with unconverted relatives or friends still in the interior.[28]

Overland sorties into the interior were made on more occasions than are recorded. Among the known campaigns was that of Sergeant Jose Sanchez, who left San Jose in early October 1819 for the purpose of recovering horses. A battle

---

[27]Ibid., p. 194.

[28]F. W. Beechey, Narrative of a Voyage to the Pacific and Beering's Strait . . . (London: Henry Colburn and Richard Bently, 1831), II, 23-24; August C. Mahr, The Visit of the "Rurik" to San Francisco in 1816, Stanford Univ. Publications in History, Economics, and Political Science, II:2 (Stanford Univ., Calif.: Stanford Univ. Press, 1932), p. 26.

was fought at the Calaveras River crossing, near the present Stockton.[29] Similar clashes occurred near the Cosumnes in 1820 and in late 1826.[30]

Spanish activity upset the somewhat sedentary and non-warlike existence of the Indians. By the decade 1820-30 the Indians had clearly begun to follow a policy of strong resistance. Able leaders arose among them. One, Estanislao, a former convert at the San Jose Mission, demonstrated remarkable prowess in devising defensive tactics. By fighting battles to inconclusive ends, he and his contemporaries were able to maintain effective control of the trans-riverine areas. The Indian leader may even have contemplated aggressive action; the San Jose and Santa Clara missions attributed an incipient general revolt to his planning. To nip the anticipated uprising, Mariano G. Vallejo led a strong expedition, with cavalry and cannon, into the lower reaches of the Stanislaus River, and managed to force the Indians out of prepared positions. The Vallejo party was cheated of what might have been a decisive victory when the Indians escaped under the cover of night from their second defensive position.[31]

---

[29]Cutter, _op. cit._, pp. 256-57; Schenck, _loc. cit._, p. 129.

[30]_Ibid._; Beechey, _op. cit._, pp. 26-29; Bancroft, _History of California_, III (San Francisco: The History Co., Pub., 1886), p. 109.

[31]S. F. Cook, _The Conflict between the California Indian and White Civilization_ (Berkeley: Univ. of Calif. Press, 1943), II, 32, 33; Bancroft, _loc. cit._, pp. 109, 110, 112.

The Vallejo campaign was a success to the extent that depredations against mission herds were insignificant in 1830 and 1831. By 1833 complaints had become more numerous. An era of intensive cattle and horse stealing began. So serious was the situation in 1836 that the community of secularized San Jose petitioned the governor for aid. In 1839 Santa Clara was raided.[32] Sonoma, too, had its troubles with raiders from the Sacramento Valley, among them the Indians of the Mokelumne River area.[33]

Numerous informal counterattacks were made against the Indians, progressively exhausting the material resources of the natives. The Indian society and economy were disrupted; Indians who were not killed or captured for farm labor were forced to disperse. Their mischief-making had passed its peak by 1845 and diminished rapidly thereafter.[34]

Indian energies were dissipated by several developments in addition to the war of attrition carried on with the Californians. As elsewhere in the Americas, internecine fighting and the penetration of Anglo-American and other foreign elements, venereal disease, smallpox, and other epidemic plagues took their toll.[35]

---

[32]Cook, _op. cit_., pp. 5, 35.

[33]Bancroft, _History of California_, IV (San Francisco: The History Co., Pub., 1886), p. 72.

[34]Cook, _op. cit_., pp. 5, 25, 36.

[35]_Ibid_., pp. 6, 7, 28.

CHAPTER IV

TRAPPER EXPLOITATION OF THE DELTA

The first Anglo-Americans entered the Sacramento-San Joaquin Delta as trappers of beaver and fresh-water otter. The activity was pursued so intensively by these men, Hudson's Bay Company trappers, and employees of delta vicinity land grantees that the peltry virtually was ruined in about 15 years.

Jedediah Smith's Discovery, 1827-28

At about the time that the Central Valley Indians were developing formidable opposition to the penetration of Spanish authority into the interior, the first of the American trapping parties from the Rocky Mountain area entered the great lowland. The noted Jedediah Strong Smith opened the trail into the San Joaquin Valley from the south. His party reached the Mokelumne-Cosumnes river vicinity in May 1827 and established a base camp. There the party awaited the leader while Smith made the hazardous first crossing of the Sierra Nevada and the central Great Basin.[1]

---

[1]The base camp site and the route across the Sierra Nevada are disputed. Cleland presumes the Stanislaus River

The Smith party appears to have been peaceable in its conduct. Padre Duran of Mission San Jose charged that it induced converts to desert, an allegation which the local military commandant disclaimed.[2] Nevertheless, the intruders were recognized as forerunners of a movement having the potential for much harm to the Spanish position in California.

In 1828 Smith's company found the beavers plentiful in the river and delta swamps, but operations were hampered by high water and an inadequate supply of traps. Thereupon the party broke camp and, skirting the delta, headed north. The journey through the Sacramento Valley and along the California north coast ended in a disastrous ambush in Oregon. Smith escaped, and reached the Hudson's Bay Company post at Fort Vancouver. His reports of the quantity and quality of the furs to be obtained in California caused the British company to take immediate action to exploit the new

---

area to have been selected, while Warner's recollections placed the camp on the American River. Schenck thought that the camp might have been made near the Calaveras. Chaffee, however, has been able to document the Mokelumne-Cosumnes vicinity as the site with contemporary letters. Robert Glass Cleland, This Reckless Breed of Men, The Trappers and Fur Traders of the Southwest (New York: Alfred A. Knopf, 1952), pp. 80-81; J. J. Warner, "Reminiscences of Early California from 1831 to 1846," Historical Society of Southern California, Publications, VII (1909), p. 181; Schenck, loc. cit., p. 131; Everett Barker Chaffee, "Jedediah Smith in California" (unpublished Master's thesis, Dept. of History, University of California, 1929), p. 23.

[2] Bancroft, History of California, III, 156.

fur area before American trappers could establish competition.[3]

McLeod and Ogden Brigades, 1828-30

The Hudson's Bay Company instructed Peter S. Ogden to take an expedition already planned for the Snake River country southward through the Colorado River basin and into California along Smith's route. As planned, this brigade was to reach and trap along the San Joaquin River before Smith could assemble a group of Mountain Men and return to the valley. Meanwhile, the "Southern Party" set out from Fort Vancouver for the south. It was to retrieve Smith's lost pelts and to retrace his path into the Sacramento Valley.[4]

The "Southern Party," under Alexander Roderick McLeod, conducted its foray in 1828-29. It spent most of the summer of 1829 in the Sacramento Valley,[5] but proceeded as far south as Stockton.[6] The trappers discovered that Smith's reports of the beaver to be found had not been exaggerated.[7]

---

[3] Cleland, *op. cit.*, pp. 101-2; Alice Bay Maloney, "John Work of the Hudson's Bay Company," Calif. Hist. Soc., *Quarterly*, XXII (June 1943), p. 98; John Scaglione (ed.), "Ogden's Report of His 1829-1830 Expedition," *ibid.*, XXVIII (June 1949), p. 119.

[4] *Ibid.*, p. 120; Warner, *loc. cit.*, pp. 182, 183.

[5] E. E. Rich (ed.), *The Letters of John McLoughlin, from Fort Vancouver to the Governor and Committee; Third Series, 1844-46* (Toronto: The Champlain Society, 1944), p. xix.

[6] *Ibid.*; Alice Bay Maloney, "Fur Brigade to the Bonaventura," Calif. Hist. Soc., *Quarterly*, XXIII (June 1944), p. 125.

[7] Maloney, "John Work . . . ," *loc. cit.*

Ogden's brigade completed its circuitous route to the San Joaquin Valley by early 1830, and swept along the river to its mouth by late April or early May. On the eve of its departure for the Sacramento it was overtaken by an American party under Ewing Young. The two groups joined company until the Pitt River was reached; here the Americans turned back virtually empty-handed.[8] That their take was so poor suggests that the "Southern Party" of McLeod was as successful in trapping as Ogden had been in the San Joaquin Valley.

Laframboise and Work Brigades, 1832-33

After the lapse of a year, another Hudson's Bay Company trapping party headed toward California. Michel Laframboise and a company of 65 followed McLeod's trail and reached San Francisco Bay in October 1832, visiting the mission establishments at San Jose, San Francisco, San Rafael, and Solano, while conducting a fine hunt along the bay margins. With the approach of winter, the party made camp near the Marysville Buttes, where it joined a second brigade, numbering 100, which had entered the Sacramento Valley from the north under the leadership of John Work. The groups remained together until May 1833, at which time Laframboise and company returned north along the coast and Work's brigade proceeded to trap in the Sacramento Valley and delta.[9] By

[8]Scaglione, loc. cit., pp. 121-22.

[9]E. E. Rich (ed.), The Letters of John McLoughlin, from Fort Vancouver to the Governor and Committee; First Series, 1825-38 (Toronto: The Champlain Society, 1941), p. 112.

mid-June Work's party was passing through the inundated Sacramento and Mokelumne delta area. During the next six weeks camps were made near the Mokelumne, near Stockton, at French Camp, about five miles below the junction of the Stanislaus and the San Joaquin, and near the latter confluence.[10]

Trapping results fell far below Work's expectations. In one period of a dozen days five canoe parties secured only 45 beaver pelts and 14 otter; and for the period June 11 to July 24 only 249 beaver and 85 otter pelts were taken. The poor catch was attributed to a scarcity of animals, bait wariness, tidal variations, and trap pilferage by the Indians. Confronted with poor results and poor prospects, furs of indifferent quality, belligerent Indians, and depleted stocks of ammunition and staples, the brigade decided to withdraw to the Columbia River.[11]

A Decade of Complications, 1834-43

In spite of modest catches the Hudson's Bay Company continued sending brigades into California. Unfortunately

---

[10]Maloney, "Fur Brigade . . . ," loc. cit., XXII (Dec. 1943), pp. 332 ff.; XXII (June 1943), p. 99; XXIII (March 1944), pp. 36-38; XXIII (June 1944), pp. 123-29.

[11]Ibid., XXII (Dec. 1943), p. 331. Work thought that the Indian hostility had come about as a result of Spanish influence. The reaction may be related to friction which had developed at Solano a little earlier and which is related below. The brigade's expectation of trading for furs in the interior was balked because Ewing Young's party had just carried on a large trade in the area. William S. Lewis and Paul C. Phillips (eds.), The Journal of John Work (Cleveland: The Arthur H. Clark Co., 1923), p. 59.

for the company, the operations in California were opposed by various local elements. Priests and California merchants were hostile on occasion. The attitude of government authorities was such that the hunting parties at first felt insecure and they therefore hunted by stealth.[12]

Difficulties with the Californians of the San Francisco Bay region arose at least as early as 1833. In April Padre Gutierrez of Solano complained that the Work party, then at Suisun, was buying stolen cattle and corrupting Mission Indians. In 1835 Vallejo warned Laframboise to suspend his operations.[13] By the winter of 1838-39 Laframboise was kept in a constant state of uneasiness by Vallejo's repeated orders to leave the country under penalty of seizure. In addition, the party was subjected to the constant irritations of petty traders. Before the harassment was over Laframboise allowed himself to be induced by Governor Alvarado to use his men in a chastising raid upon Central Valley Indians who had stolen livestock from Sonoma.[14]

Thereupon the Hudson's Bay Company initiated a program to gain official approval of the trapping parties and to increase the efficiency of the existing operation. The key

---

[12] E. E. Rich (ed.), The Letters of John McLoughlin . . . ; Second Series, 1839-44 (Toronto: The Champlain Society, 1943), p. 207.

[13] Bancroft, History of California, III, 392-93.

[14] Rich, loc. cit., p. 218.

to the venture was to have been a post at the eastern extremity of greater San Francisco Bay. It was hoped that the energies saved by eliminating the tedious overland journeys to the Columbia River could be turned to a more thorough coverage of the still well-stocked bay and rivers. An annual yield of 4,000 beaver and otter pelts was anticipated, an optimistic belief in the light of a cumulative central California take of 10,860 beaver and 3,234 otter pelts in the decade 1830-39.[15]

The decisive step was made in late 1840, when the Hudson's Bay Company representatives and Governor Alvarado agreed on licensing of trappers, duties on pelts, and the formalities of establishing a trading post.[16] In the following year the company opened a mercantile house at San Francisco.[17] Besides handling pelts, the post traded for hides, tallow, wheat, and salted salmon.[18] The trade in livestock products and grain compensated for diminishing peltries revenue.

To some of the Californians, notably Sutter, the new concessions made to the Hudson's Bay Company were displeasing. The squire of New Helvetia, the most powerful of the

---

[15] _Ibid._, pp. 218, 257. [16] _Ibid._, p. 239.

[17] Bancroft, _History of California_, IV, 216.

[18] Anson S. Blake, "The Hudson's Bay Company in San Francisco," Calif. Hist. Soc., _Quarterly_, XXVIII (Sept. 1949), p. 248; Rich, _The Letters of John McLoughlin . . . ; Second Series, 1839-44_, p. 123. Marguerite Eyer Wilbur (ed.), _Duflot de Mofras' Travels on the Pacific Coast_ (Santa Ana, Calif.: The Fine Arts Press, 1937), p. 246.

independent-minded land grantees in the Central Valley, peremptorily ordered company trappers to discontinue Sacramento Valley operations during the 1840-41 season.[19] He wanted no competition. On the other hand, the Governor of California must have appreciated the value of strong, cooperative, licensed trapping parties in an interior peopled with inflamed Indians, would-be empire builders, and an unknown number of transient whites. Company officials, who were reluctant to have the brigades employed as Mexican auxiliaries in a possible Indian war, instructed the parties to refrain from violence; to show sympathy for the government cause, but to avoid being identified with it.[20]

By the end of 1842 the governing board of the Hudson's Bay Company decided that the California operation should terminate. Although instructions were issued to close the San Francisco post at the end of 1843, it was not until the end of 1845 that the action was taken. In the interim, Laframboise led his final, unrewarding trapping expedition into California (1842-43). A dry spell reduced receipts of tallow and hides (1843); and the company's agent committed suicide (January 1845).[21]

---

[19]Bancroft, History of California, III, 213; Rich, The Letters of John McLoughlin . . . ; Second Series, 1839-44, pp. 240-41.

[20]Ibid., pp. 219-20.

[21]Blake, loc. cit., pp. 245-47, 251-53.

Trapping was continued in the delta and vicinity by independent hunters and by Sutter's men at least until the Gold Rush. It has remained a minor activity ever since.

CHAPTER V

SEDENTARY OCCUPATION OF THE DELTA AND VICINITY

Prior to the upheaval which the Gold Rush precipitated, the sedentary population of the delta vicinity included a thin scattering of whites and an unknown number of Indians. Both groups all but lost their identity within a short time after California began to swarm with the Argonauts.

Indians of the Delta

Schenck has estimated that the number of Indians which occupied the rectangular area bound by Carquinez Strait, the latitudes of Courtland and Tracy, and a north-south line located approximately 12 miles east of Stockton ranged from between 3,000 and 15,000.[1] The centrally located delta was one of several habitats used by each of the various tribes that occupied the rectangular area. The islands were sparsely occupied because they offered an unvaried and wet habitat. Testimony of a much greater population density to

[1]The area described by Schenck extended from Carquinez Strait to Range 8 East and from Township 2 South to Township 5 North, Mount Diablo Base Point.

the east of the delta is afforded by the concentration of middens in the vicinity of the Cosumnes, Mokelumne, and Calaveras rivers. The location afforded such diverse food-procuring situations as tidal swamp, river bottomland, oak-studded grassy plains, and wooded Sierra foothills. Comparatively few Indians lived on the thinly wooded and water-short plains to the west of the delta.[2] Regardless of the area, midden dimensions usually indicated comparatively short periods of occupation for each village.[3]

As a rule, Indian villages were found on natural levees or banks. Their average size and distribution for any one period is difficult to arrive at, but communities of 200 persons situated at 5- to 10-mile intervals appear to have been common to the south of the Calaveras and east of the San Joaquin.[4] Villages of similar size, with 35 or 40 huts, were seen by Father Duran in the Cache Slough area and on the Sacramento near the head of Steamboat Slough.[5] Exceptionally large villages of 1,000 and 1,200 persons were observed in what must have been the Sherman to Staten Island vicinity.[6] Their size and location suggest that they were places of refuge.

---

[2]Schenck, loc. cit., pp. 132-34.

[3]Schenck and Dawson, loc. cit., pp. 317, 323, 328.

[4]Schenck, loc. cit., p. 131.

[5]Chapman, loc. cit., pp. 338-39, 343.

[6]Cutter, op. cit., p. 181.

Tules of the swamp and overflowed land were more than hiding places. They provided the thatch which covered the low circular huts; tight bundles were used in building the cigar-shaped rafts with which waterways were crossed; and fiber was also obtained from the stem. Roots and pollen of the tule plant were used as food. The Indians also consumed the staple acorns and the fruit or seeds of other wild plants. They cultivated no crops.[7] Fish and game were taken. Meat became more plentiful after the introduction of cattle and horses by land grantees, and as beaver and other game were trapped or shot by white pelt and hide collectors.

Delta Vicinity Land Grants

Mexican land grants in the delta vicinity performed stabilizing and buffer functions on the Indian frontier. Although most of them were awarded to native-born citizens of California, their effective occupation was accomplished primarily by foreigners.

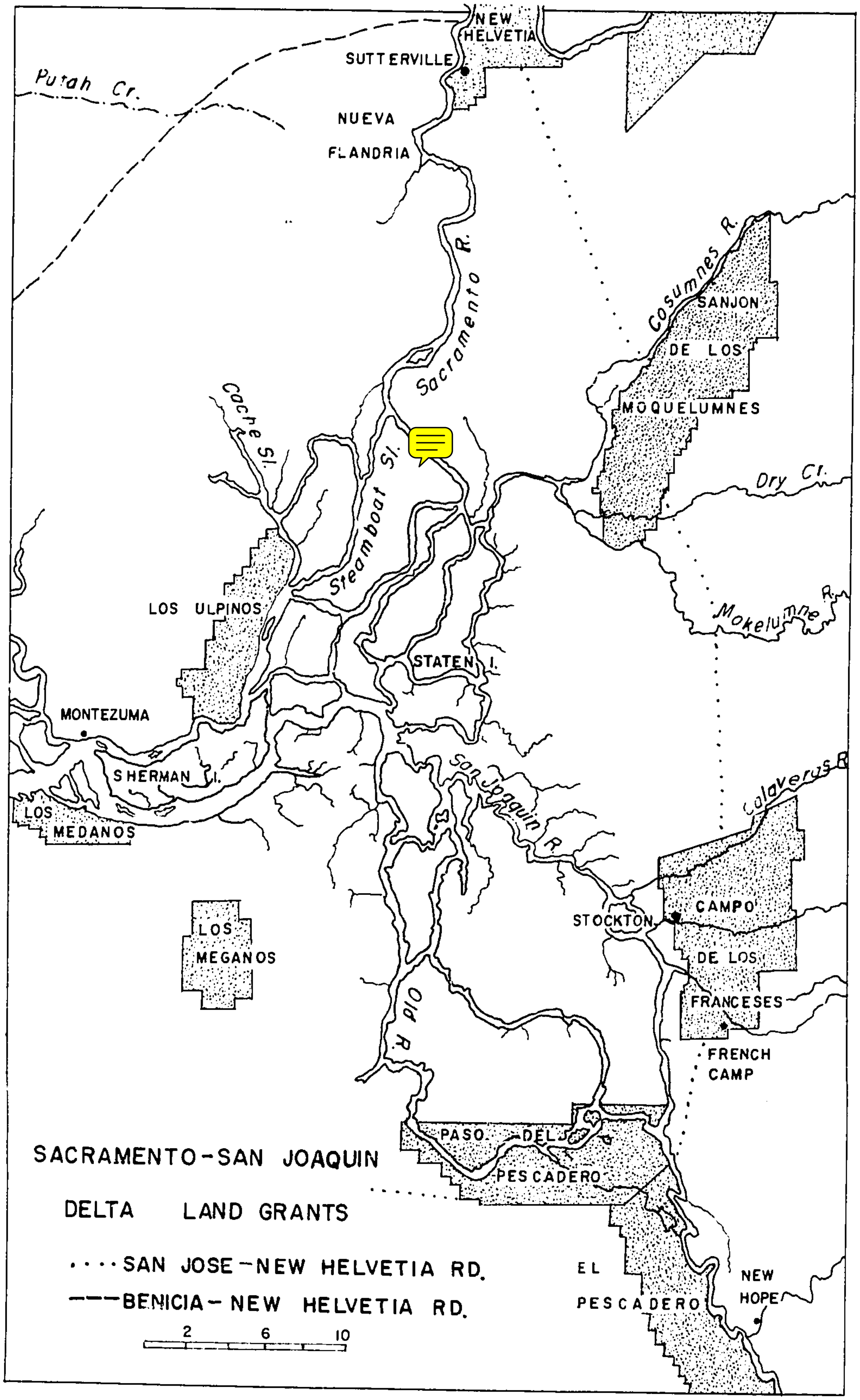
Los Meganos

The earliest Californian to establish residence in the delta vicinity was Jose Noriega, who occupied and stocked the four-league Los Meganos ranch sometime prior to receiving it as a grant in late 1835 (see Map 14, p. 113). He maintained a subsistence garden to help feed his family and seven or

---

[7]Schenck and Dawson, loc. cit., p. 303.

MAP 14


NEW HELVETIA
SUTTERVILLE
Putah Cr.
NUEVA FLANDRIA
Sacramento R.
Cosumnes R.
SANJON DE LOS MOQUELUMNES
Cache Sl.
Steamboat Sl.
Dry Cr.
LOS ULPINOS
STATEN I.
Mokelumne R.
MONTEZUMA
SHERMAN I.
San Joaquin R.
Calaveras R.
LOS MEDANOS
LOS MEGANOS
STOCKTON
CAMPO DE LOS FRANCESES
FRENCH CAMP
Old R.
PASO DEL PESCADERO
SACRAMENTO-SAN JOAQUIN DELTA LAND GRANTS
···· SAN JOSE-NEW HELVETIA RD.
---BENICIA-NEW HELVETIA RD.
EL PESCADERO
NEW HOPE
2
6
10

more hands who were always employed. The men were regarded as a minimum defense force by Noriega, although he appears not to have been seriously troubled by the Indians.[8]

In late 1837 Noriega sold the property to Doctor John Marsh, a Massachusetts-born physician and former Indian Service official who found it expedient to leave the United States. He settled on the property the following April[9] and became the first naturalized Californian to take up residence in the sensitive middle ground between the mutually antagonistic Indians and Californians.

Marsh was respected and feared by his white contemporaries and seems to have got along fairly well with the Indians. At least, no evidence has been discovered to indicate otherwise. The bulk of the physician's wealth derived from the multiplication of cattle and horses which he received in payment for professional services. He also competed with Sutter and the Hudson's Bay Company for the pelts which independent and organized trappers collected in the Great Valley.[10] His gardens and vineyard provided subsistence for his household and his Indians and for the inevitable

---

[8]U.S. District Court, San Francisco, Private Land Claim Cases (Spanish and Mexican), Case No. 107 N.D., Transcript of the Proceedings, deposition of Jose Noriega (Feb. 26, 1853), p. 9.

[9]*Ibid.*, deposition of John Marsh (Feb. 25, 1853), p. 7.

[10]Sutter's chief hunter was selling pelts to Marsh and others in 1842. Bancroft, *History of California*, IV, 228.

transients who appealed to his hospitality.[11] The Marsh adobe became a haven for the pioneer immigrant parties of Bartleson (1841) and Chiles (1843).[12]

Los Medanos

Perhaps as early as 1836 or 1837, Jose Miguel and Jose Antonio Mesa became Noriega's western neighbors. The families of these two men settled in modest houses on what became the Los Medanos grant in November 1839. Some cropland was enclosed, but the main activity of the ranch was caring for the herd formed about a nucleus of 150 breeding cows.[13]

The two-league ranch was sold in 1848 to Colonel Jonathan D. Stevenson. This Mexican War veteran came to California with the expectation of settling.[14] (Subsequent developments identify the Medanos area with some of the economic activities of the Sacramento-San Joaquin Delta,

---

[11]Private Land Claim Case No. 107 N.D., deposition of John Marsh, p. 7; deposition of Ephraim Fravel (Feb. 26, 1853), p. 9; deposition of James A. Forbes (Oct. 24, 1853), p. 15; Wilbur, op. cit., p. 243.

[12]George H. Tinkham, California Men and Events (2d ed. rev.; Stockton: Record Publishing Co., 1915), pp. 40, 41. The grant, called Pulpunes by Marsh, covered 13,316 acres; it was patented by the United States on Aug. 19, 1867. Cowan, op. cit., p. 47.

[13]U.S. District Court, San Francisco, Private Land Claim Cases (Spanish and Mexican), Case No. 364 N.D., Transcript of the Proceedings, deposition of Robert Livermore (Feb. 2, 1854), p. 369; Expediente, p. 393.

[14]The grant was patented by the United States on Oct. 8, 1872. Cowan, loc. cit.

but in terms of soil and topography the ranch land is distinct.)

New Helvetia

John A. Sutter was the first foreigner to be granted land in the delta vicinity. In August 1839 he occupied New Helvetia, a grant to which he received title in 1841 when he became a Mexican citizen. It is an interesting commentary upon the imperfect spread of geographic knowledge that, after "diligent inquiry," the Captain was unable to find anyone who had seen or who could describe where to find the mouth of the Sacramento River, and this after so many trapper and punitive expeditions had operated in the area. It took the Sutter party eight days to find the river mouth. Passage upstream was interrupted about 10 miles below the ultimate site of Sutter's Fort by a large Indian war party. Sutter convinced the group that he harbored none of the hated Mexicans.[15] His peaceful contact was an important step in creating stability in the area, one of the requirements that had to be met prior to confirmation of his 11-league land grant, only 2 leagues of which were located in the vicinity of the fort.[16]

On several occasions Sutter was obliged to resort to force against the Indians, but these were exceptions. He

---

[15] Petition of John A. Sutter, U.S. 39th Cong., 1st Sess., S. Misc. Doc. 38 (1866), p. 2.

[16] Wilbur, op. cit., p. 241.

made local alliances, and protected the Indians from raiding parties of San Jose Mission Indians intent upon stealing women and perpetrating other outrages. In fulfilling commitments to his Indian neighbors, Sutter shielded horse thieves, thereby probably earning exemption for his animals.[17]

In the course of building his empire at New Helvetia, Sutter contracted formidable debts with the white community of the coastal area. He was heavily committed for stock secured from herds that roamed the range between the Marsh ranch and San Jose.[18] He also bought a number of livestock on credit when he purchased the costly Russian properties of Fort Ross.[19] In the interim before natural increase would make his herds remunerative, Sutter showed great industry in trying to turn a profit by engaging in other enterprises. Wheat, corn, and vegetable crops were raised and cotton planted. The river yielded quantities of salmon to Sutter's Indians. The fish were salted for export to the Sandwich Islands (Hawaii) and the eastern United States.[20] The natural levees provided the wild grapes from which brandy was manufactured after 1840. Some fat (and probably hides) was secured from slaughtered deer.[21]

---

[17]Bancroft, History of California, IV, 74; Petition of John A. Sutter, p. 3.

[18]Bancroft, loc. cit., p. 134.

[19]Fremont, Oregon and California, p. 353.

[20]Wilbur, op. cit., p. 246; Upham, op. cit., p. 560.

[21]Bancroft, loc. cit., pp. 134, 228.

For the greatest immediate profits, the Captain counted on the sale of beaver pelts to be secured by his own hunters and by trading with independent trappers. Sutter's hunting parties were small. They consisted of a few whites, who shot or trapped the beaver, and pack Indians with horses. Otter, deer, elk, and antelope were also sought for their pelts or hides. Not much was accomplished in the business during 1840 and 1841, for Sutter's men lacked experience and suitable traps. Moreover, at that time the frontier merchant lacked the articles suitable for trading with the independent trappers. Also, he had to compete with the more experienced trappers of the Hudson's Bay Company; and these men were forbidden to trade their catch. Sutter had reason to order them out of the valley. Their continued appearance in the area did not disconcert the resourceful Swiss for long. It is averred that the liquor from his distillery was instrumental in diverting from normal company channels "the greater part" of the pelts taken by Hudson's Bay Company hunters. It seems that Sutter found this form of trapping furs so profitable that he had no need to maintain a large hunting establishment of his own. Such methods were in the spirit of the times. The Hudson's Bay Company men were thought to be stealing or buying furs from Sutter's trappers; and Marsh and others were believed to be buying furs from Sutter's chief hunter.[22]

---

[22]*Ibid*., pp. 134-35, 228; Upham, *op. cit*., p. 561.

With the failure of the Hudson's Bay Company to return its men to California in 1843, Sutter appears to have anticipated large pelt harvests. As many as 40 men were sent into the field, although, for want of animals or of loyalty, a lot of pelts did not reach New Helvetia.[23]

El Pescadero Grants

At the southern extremity of the delta two eight-league grants were designated in November 1843. The southern tract, El Pescadero, extended headward along the west side of the San Joaquin from the vicinity of the crossing place. Its original owners were Valentin Higuera and Rafael Feliz. Higuera may have had stock on the grant in 1843; there is no doubt that the place was unoccupied from November 1843 to the spring or summer of 1846. By the latter time the frontier had become fairly well stabilized, and the presence of some cattle and horses might reasonably be expected. The northern grant, El Pescadero or Paso del Pescadero, faced upon Old River. It was owned, but not occupied, by Antonio M. Pico.[24]

---

[23]Taylor, _op. cit_., II, 47-48.

[24]U.S. District Court, San Francisco, Private Land Claim Cases (Spanish and Mexican), Case No. 137 N.D. and Case No. 170 N.D., Transcript of the Proceedings, deposition of Jose Romero (137 N.D.; Sept. 3, 1853), p. 15; deposition of I. M. Murphy (137 N.D.; Aug. 18, 1853), p. 13; opinion by Commissioner Alphons Felch, p. 44; deposition of Antonio Sunol (170 N.D.; June 15, 1853), p. 5; Index of Maps. The southern grant, consisting of 34,446 acres, was patented on Jan. 18, 1858 to Hiram Grimes and other American claimants. The northern grant was patented by the United States on March 10, 1865. Pico and one of the pioneer reclaimers in the delta, Henry M. Naglee, were the claimants of the 35,546-acre tract. Cowan, _op. cit_., p. 59.

Los Ulpinos

Less exposed than the southern grants was Los Ulpinos or Sillac rancho, a four-league grant to which John Bidwell received title in November 1844. The grantee and some hands landed on the Sacramento right bank below Cache Slough to take possession of the land. They erected an adobe where an English foreman remained over the winter. A small parcel of land was cultivated for the next year or so, but with no notable success.[25]

Campo de los Franceses

In January 1844 Rancho Campo de los Franceses, an 11-league tract located mostly to the south of the Calaveras River and east of the San Joaquin, was designated to the naturalized Mexican Guillermo Gulnac, a San Jose merchant.[26]

Three Americans were employed to fulfill the residence requirement of the grant after Gulnac failed to secure Mexicans or Californians for the purpose. These men possessed some horses, mules, and tame cows, and also were

---

[25]U.S. District Court, San Francisco, Private Land Claim Cases (Spanish and Mexican), Case No. 86 N.D., Index of Maps, Transcript of the Proceedings, deposition of Samuel J. Hensley (Feb. 3, 1853), p. 5. Bidwell received a United States patent to 17,726 acres in Aug. 1866. Cowan, *op. cit.*, p. 106.

[26]Tinkham, *A History of Stockton*, pp. 35-36, 65; U.S. District Court, San Francisco, Private Land Claim Cases (Spanish and Mexican), Case No. 298 N.D., petition of Charles M. Weber (May 31, 1852), p. 7.

given charge of about 100 head of Gulnac range cattle. The stock probably was confined to the north of the present Stockton Channel, for the men settled near its base. A residence and corral were established also at French Camp during the year, but the rebellion of Californians against the last Mexican governor, Micheltorena, drew all but one of the Americans away. In February or March of 1845 the remaining American foreman was murdered by raiding Indians, who confiscated all stock and tools. In the circumstance, it is not surprising that Charles M. Weber, a business associate of Gulnac, was able to buy out Gulnac's interest in the 48,747-acre ranch for $200.[27]

Weber, the new owner of Campo de los Franceses, entered California four years earlier with the Bartleson immigrant party. While employed by Sutter, and while self-employed in San Jose as a merchant and stock raiser, Weber became familiar with the property. Recognizing that there was an abundance of pasture and good water, and that navigable water and the San Jose to Sutter's Fort trail served it, he encouraged Gulnac to petition for it.[28]

Through 1845 and 1846 men traveled over the area only in armed groups. The Indian peril prevented Weber from

---

[27]*Ibid.*, deposition of James Williams (Sept. 5, 1853), pp. 17, 19, 20; deposition of Willard Buzzell (Sept. 5, 1853), p. 13; deposition of Daniel Murphy (Nov. 16, 1853), pp. 31-32; translation of the Conveyance, p. 98.

[28]Tinkham, *loc. cit.*; Tinkham, *California Men and Events*, pp. 40, 41.

persuading Americans to settle on the property until the fall of 1847.[29]

Sanjon de los Moquelumnes
and Rancho Moquelamo

Situated at about equal distances from New Helvetia, Los Ulpinos, and Campo de los Franceses was the Sanjon de los Moquelumnes grant. This eight-league tract was situated outside of the delta. Although it was granted in 1844 to Anastacio Chabolla, and was patented to his heirs in May 1865, there is little evidence of its occupation.[30] (Between it and Campo de los Franceses, and lying to the east of the delta swamps, was the 11-league Moquelamo claim of Andres Pico which the United States failed to patent.)[31]

Other Settlement

In 1846 there were an estimated 150 Americans in the Central Valley,[32] with the largest concentration at Sutter's

---

[29]Private Land Claim Case No. 298 N.D., deposition of Willard Buzzell, p. 13; deposition of W. Herron (May 31, 1852), p. 11. The grant was patented by the United States on March 18, 1861.

[30]Cowan, <u>op. cit</u>., p. 49.

[31]U.S. District Court, San Francisco, Private Land Claim Cases (Spanish and Mexican), Case No. 184 N.D., Transcript of the Proceedings, opinion of Commissioner S. B. Farwell, p. 15.

[32]Letter from John Marsh to Lewis Cass, written at Farm of Pulpunes, near St. Francisco, Upper California, 1846; as reproduced in <u>Illustrations of Contra Costa Co., . . .</u>, pp. 5-6.

Fort. A Dutchman living on the unconfirmed Nueva Flandria grant below Sutter's landing and on the Sacramento west bank was the only certain delta resident. Other foreigners were dispersed at the Marsh Ranch, where the San Jose to Sutter's Fort trail forded the Mokelumne and Calaveras rivers and Dry Creek and on the banks of Cache and Putah creeks where the streams leave the hills.[33]

It is assumed that subsistence gardens were tended by these people or by Indians in their employ, and that pelts, dried meat, and the hides of elk, deer, and antelope were prepared for trading purposes. Salmon caught by the Indians were dried or pickled under the direction of such whites as Schwartz at Nueva Flandria.

Settlement and Politics, 1846-47

Foreign settlers in the delta vicinity of the Central Valley were nominally loyal to the Mexican governor, but were actually beyond the effective reach of Mexican authority. Sutter and Weber were notably successful in maintaining relations with the Mexican officials and residents of the coastal regions and their Indian adversaries of the

---

[33]Sprague and Atwell, The Western Shore Gazetteer . . . , pp. 9-10. "Reminiscences of a California Pioneer," SWI, Aug. 4, 1877, p. 5; Bancroft, History of California (San Francisco: The History Company, 1888) VI, 11-12; An Illustrated History of San Joaquin County . . . , pp. 31-32; William O. Russell et al., History of Yolo County, California (Woodland, Calif.: By the authors, 1940), p. 27.

interior, being useful to both and in turn using both to their own material advantage. Their behavior was largely apolitical, but their motivations were not.

Among other reasons, Weber was interested in a grant to the east of the San Joaquin River because he foresaw the possibility of a show of force by non-Californians against the Mexican government. The separatists viewed the San Joaquin as the western boundary of the land aspired to.[34] The property held by the better-known separatist, Sutter, possessed even greater advantages for harboring the movement; it was far from the nearest administrative center which was thoroughly Californian in allegiance. Sutter contemplated giving land away to settlers in the early 1840's,[35] and he urged his neighbors to share their property with later arrivals because in doing so the neighbors' interests and land values would be advanced. He expected that by late 1846 there would be thousands of emigrants who should be given land in the "Tulares."[36] Americans who had come to know the Sacramento and San Joaquin valleys were enthusiastic about the land and they hoped to share its possession with their countrymen.

Letters, pamphlets, and other publications extolling the virtues of California received wide attention in the

---

[34] Tinkham, A History of Stockton, p. 36.

[35] Wilbur, op. cit., p. 247.

[36] Bancroft, History of California, IV, 610, footnote quoting letter of Sutter to Larkin, Oct. 8, 1845; original in Larkin's Doc., MS, iv. 228.

United States during the 1840's. Suggestive of their tenor is the following description of the Sacramento Valley settlement in 1843:

> They all have fine herds of cattle and horses, with farms, under a good state of cultivation, upon which they grow a great abundance of wheat, corn, oats and flax, as well as a great variety and superabundance of vegetables, and that too, with very little labor or expense. Many of these settlers are in very prosperous circumstances, and they are all doing extremely well, considering the very short period, of their residence in that country. They usually sow annually several hundred acres of wheat from which they supply themselves, all the emigrants who are annually arriving, as well as to furnish much for exportation.[37]

A more sober view of the Sacramento Valley, one particularly applicable to the delta, was expressed by Wilkes:[38]

> The part that is deemed good soil, is under water annually, not for any great length of time, yet sufficiently long to make it unfit for advantageous settlement. The high prairie is spoken of as being in general barren, and as affording but little good pasture.

Publicity emanating from California accelerated the rate of overland migration after 1845. Many soldiers who had enlisted for service in California in the Mexican War had done so with the intention of settling there after the war ended. Capitulation of California to the United States removed the possibility of restraints being placed upon American settlement.

---

[37]Hastings, The Emigrants' Guide to Oregon and California, p. 110.

[38]Wilkes, Narrative of the United States Exploring Expedition . . ., V, 206.

In 1846 and 1847 colonies and towns were founded with an increasing awareness that there was considerable growth potential for trade centers founded near the outlet of the Central Valley rivers or on firm ground near convenient heads of navigation. Weber's Campo de los Franceses, Bidwell's Ulpinos ranch, Montezuma, and the New Helvetia vicinity provided sites where hopeful entrepreneurs envisioned the rise of river capitals.

Colony Development, 1846-47

Campo de los Franceses

Weber's Campo de los Franceses was reoccupied in the fall of 1847. Corrals were built for the stock and between 1,000 and 2,000 head of cattle were driven in from San Jose. Overland travelers were offered inducements of seed, equipment, arable and townsite land if they would settle on the property. Weber opened a store and ordered a townsite surveyed to the south of Stockton Channel.[39]

In October 1847 there were 20 or 25 people on the ranch.[40] It may be that the number included only non-Californians, for numerous Indian laborers and Mexican

---

[39]Private Land Claim Case No. 298 N.D., deposition of W. Herron, p. 10; deposition of J. M. Murphy (Nov. 19, 1853), pp. 26-27; Tinkham, A History of Stockton, pp. 68-70; "Reminiscences of a California Pioneer," SWI, Aug. 4, 1877, p. 5.

[40]Private Land Claim Case No. 298 N.D., deposition of W. H. Fairchild (Nov. 14, 1853), p. 28.

cowboys were employed by Weber at the time.[41] An estimated 40 or 50 acres, most of them located north and east of Stockton Channel, were cultivated, some of them in wheat.[42] Perhaps some of the fields lay on the delta side of a stockade and outer ditch which was constructed across the base of the peninsula lying to the north of the channel.[43] By the end of 1848 the acreage cleared must have mounted appreciably for there were 100 families living in the vicinity.[44]

Despite losses of livestock to Indian cattle rustlers, Weber and the community prospered. The main economic activity was slaughtering cattle and processing hides and tallow for delivery to San Francisco. Weber's sailing vessel, the _Maria_, carried merchandise on return trips to the settlement on the French Camp grant.[45]

Los Ulpinos

In 1846 Bidwell was urged by one Jacob D. Hoppe to develop the Ulpinos ranch into a settlement for immigrants from the United States. The townsite of Brazoria, or Sacramento Brazoria, was surveyed and a party was lured there from

---

[41]Tinkham, _op. cit._, pp. 108, 115.

[42]Private Land Claim Case No. 298 N.D., deposition of W. H. Fairchild, p. 27; deposition of W. Buzzell, pp. 14, 15.

[43]Tinkham, _op. cit._, p. 69.

[44]Private Land Claim Case No. 298 N.D., deposition of W. Buzzell, p. 13.

[45]Tinkham, _op. cit._, pp. 57, 314.

Sutter's Fort. Its stay was of short duration; after an unpleasantly wet winter and a near-starvation diet, the people departed for other points in northern California.[46] Bidwell gave up the unpromising project and proceeded to break up his ranch and sell it in smaller pieces.

Montezuma and New Hope

During the year that gave brief life to Bidwell's colony a Mormon settlement was founded on the narrow band of dry land that lies between the Montezuma Hills and the junction of the Sacramento and San Joaquin rivers. Because of the absence of timber, the Montezuma site was abandoned in favor of one on the lower Stanislaus River.[47]

The New Hope colony was located on the north bank of the Stanislaus about one and a half miles east of the San Joaquin River. The 10 or 12 colonists had sown and enclosed 80 acres by mid-January 1847; and by April, log houses and a sawmill had been constructed. The colony was abandoned that fall when the men were called back to Salt Lake City.[48]

New Helvetia and Sutterville

The most successful of the river settlements in 1846-47 was New Helvetia. Although Sutter's colony was located to

---

[46] Hunt, John Bidwell . . ., p. 240; Bancroft, History of California, VI, 18, 500.

[47] Ibid., p. 18.

[48] Ibid., p. 11; Bancroft, History of California, V (San Francisco: The History Company, 1886), pp. 552-53.

the north of the delta its growth had a profound effect upon the lower area. The role of the Captain as stockman, farmer, and merchant, and of his fort as a haven for immigrants is familiar.

Since it was the head of regular navigation and the ferry point for people using the Benicia trail, many travelers visited Sutter's Embarcadero on the Sacramento. Much of the traffic moved in Sutter's vessels, among them the sluggish and short-lived Sitka which initiated steam navigation on the inland waterways in November 1847.[49] The steamboat reached Sacramento from San Francisco Bay in six days and seven hours.[50]

Sutterville became a port of call for vessels which moved between Sutter's landing, three miles upstream, and San Francisco Bay. The townsite was laid out in 1846 on ground that was less flood-prone than the site of the future Sacramento. Sutterville flourished in 1847 as a result of an encampment made by two companies of troops; but it was soon overshadowed by the lusty growth of Sacramento.[51]

Effects of Sedentary Occupation

To recapitulate: The delta was one of several habitats used by Central Valley Indians. The swamp became an

---

[49]Jerry MacMullen, Paddle Wheel Days in California (Stanford Univ., Calif.: Stanford Univ. Press, 1944), pp. 4-5.

[50]Russell et al., op. cit., p. 187.

[51]Bancroft, History of California, VI, 15; Erwin G. Gudde (ed. and trans.), "The Memoirs of Theodor Cordua," Calif. Hist. Soc., Quarterly, XII (Dec. 1933), p. 300.

Indian refuge area during the period of border warfare with the Mexicans and their Indian mercenaries. Under this pressure the tribal domains within the delta apparently broke down rapidly. In the hope of creating stability in the interior, and to build a buffer zone for the more valued coastal areas, California's governors awarded land grants. The confirmed and occupied grants of the delta vicinity included Los Meganos, in the undulating plains land of the Brentwood area; Los Medanos, which lay to the south of easternmost Suisun Bay and the San Joaquin River mouth; the ranchos El Pescadero and Paso del Pescadero, along the left bank of the San Joaquin and the Old River distributary; Campo de los Franceses, largely to the south and east, respectively, of the Calaveras and San Joaquin rivers; Los Ulpinos, hemmed in by the right banks of Cache Slough and the Sacramento River; and New Helvetia, between the left banks of the Sacramento and American rivers.

Land grantees appear to have been little interested in the tidal swamps of the delta. At least, the terms of the grants seem not to have included these areas, and it was not the practice to include them in later government surveys. River overflow areas were another situation; confirmed grants did include such land. To commercial society of the time, the swamp and overflowed land had little or no resource function. The delta might therefore have remained a survival area for the Indians for a considerably longer time had settlement proceeded at even the stepped-up pace of 1847.

However, Indian society as such vanished soon after the Argonauts arrived.

The deterioration of the Indian way of life had begun with the exposure to the Spanish culture. Introduced diseases and wars of attrition were disruptive; but the twilight of the Indian's existence came with the usurpation of his land by immigrants. As Cook pointed out, American settlement either destroyed the Indian's food resources or else drove him away from them. Settlers began to take lands along streams for their farms. Either through malice, by the fencing off and clearing of lands, or by introduction of stock that competed for the grass seeds and acorns which were such important items in the Indian diet, the settlers interfered with the collection, preparation, and storage of food by the native.[52]

To the extent that the Indians adapted themselves to the commercial economy that evolved about them, they had only menial roles as field laborers, stock tenders, domestics, or fishermen. Some village residents became associated with nearby ranches and farms.[53] At the Calaveras and San Joaquin crossings their village life virtually ceased by 1852.[54] By 1870 Indians had disappeared from the banks of

---

[52] Cook, The Conflict between the California Indian and White Civilization, III, 26-28, 34-35.

[53] F. P. Wierzbicki, California as It Is and as It May Be, Or a Guide to the Gold Region (San Francisco: The Grabhorn Press, 1933), p. 18.

[54] An Illustrated History of San Joaquin County, p. 28.

the Sacramento;[55] in another decade they were unknown in the Stockton vicinity except as infrequent visitors.[56]

Although native Californians had initiated ranching activity in the vicinity of the delta, naturalized foreigners were more successful at the enterprise. These people developed modest agricultural improvements on their land, but the Gold Rush brought a change to the pace of rural growth. The delta, hitherto of marginal interest to settlers, was to attract a lot of people after 1848.

---

[55]Leale, Recollections of a Tule Sailor, p. 37.

[56]Tinkham, op. cit., p. 25.

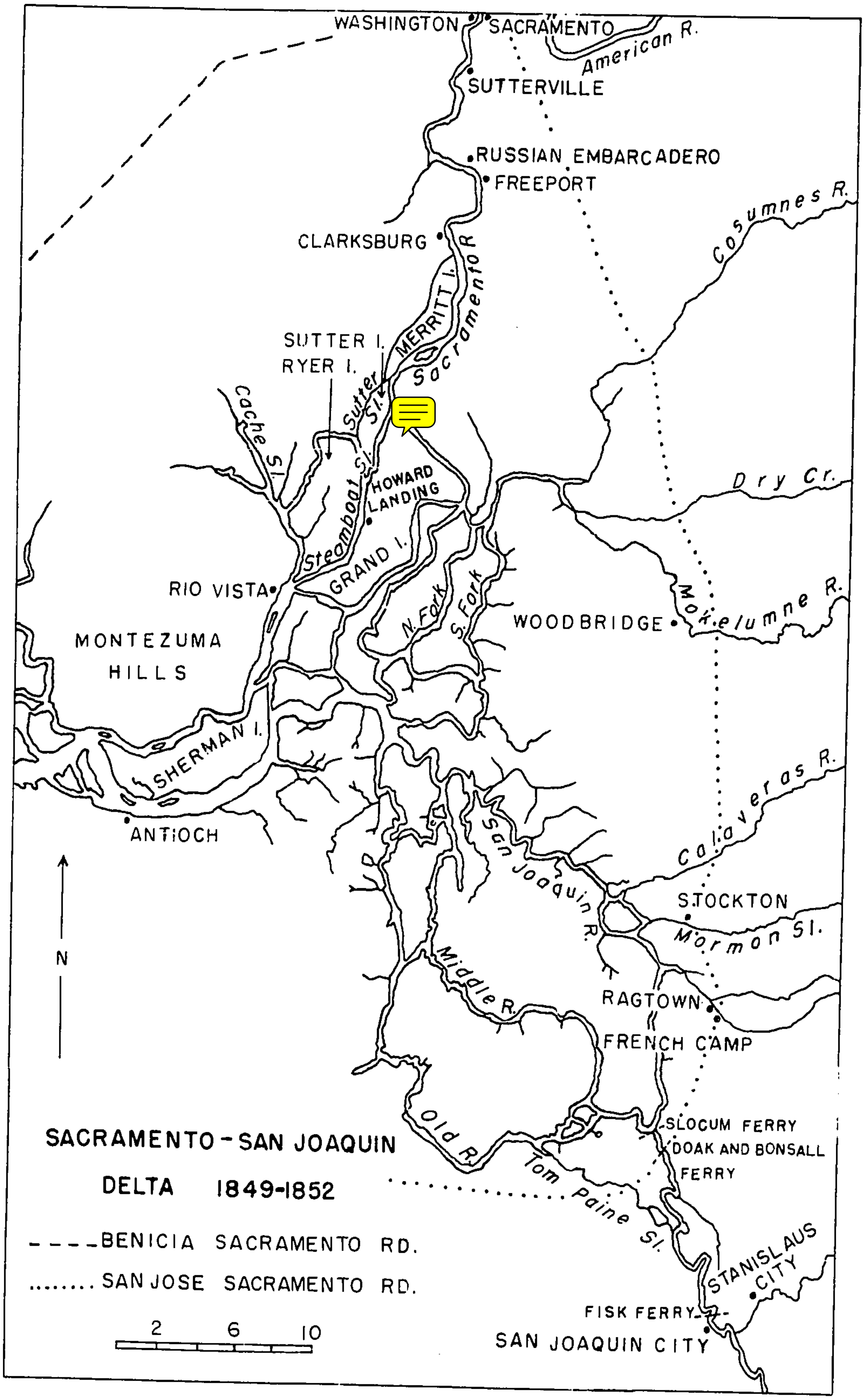
CHAPTER VI

THE GOLD RUSH AND THE DELTA

The furor produced by the discovery of gold at Sutter's Mill is a matter of common knowledge. Within weeks of the January 1848 find, settlements near the coast had all but emptied. The disruption of the existing way of life was completed as tens of thousands of people poured into California during the next decade. Markets created by the inrush of people stimulated growth of a more intensive and diversified agriculture than had existed earlier.

Gold-seeking residents of coastal California converged upon Sutter's Fort by the trails which had been known for some years. A northern route from San Jose and San Francisco crossed Suisun Bay at Benicia and, approximating the present U.S. Highway 40, led to the Sacramento River crossing at Washington (Broderick) (see Map 15, p. 134). The southern approach to Sacramento and the mines from San Francisco Bay followed the general route of the present U.S. Highway 50 through Livermore Valley, French Camp, and Stockton. As the mining districts were extended to the south of the Mokelumne

MAP 15


WASHINGTON
SACRAMENTO
American R.
SUTTERVILLE
RUSSIAN EMBARCADERO
FREEPORT
Cosumnes R.
CLARKSBURG
Sacramento R.
MERRITT I.
SUTTER I.
RYER I.
Sutter Sl.
Cache Sl.
Steamboat Sl.
HOWARD LANDING
GRAND I.
Dry Cr.
RIO VISTA
N. Fork
S. Fork
WOODBRIDGE
Mokelumne R.
MONTEZUMA HILLS
SHERMAN I.
ANTIOCH
Calaveras R.
San Joaquin R.
STOCKTON
Mormon Sl.
N
Middle R.
RAGTOWN
FRENCH CAMP
SLOCUM FERRY
DOAK AND BONSALL FERRY
Old R.
Tom Paine Sl.
STANISLAUS CITY
FISK FERRY
SAN JOAQUIN CITY
SACRAMENTO - SAN JOAQUIN DELTA 1849-1852
BENICIA SACRAMENTO RD.
SAN JOSE SACRAMENTO RD.
2 6 10

River, Stockton and French Camp became departure points for the mines.[1]

Once the inrush of Argonauts had begun, the water routes to Sacramento, Stockton, and landings upstream became the major lines of transit. The Sacramento River maintained an early lead in sail and steam transportation.

Water Travel through the Delta

Viewed from the deck of a ship the tule and willow thickets of the central delta offered little of interest. The trip to Stockton on the San Joaquin seemed particularly dull. Ships followed a shoaling serpentine course between canebrake-like masses of tule. Clumps of shrubbery broke the continuity, but there were no trees. When the tule wall was burned away views were afforded of Mount Diablo and of the Sierra Nevada. Other breaks in the monotonous tule skyline were provided by the sails and topmasts of other ships, sometimes visible for miles.[2] The margins of the lowermost Sacramento also were lined by tules and shrubs.[3] The western backdrop, formed by the low and treeless Montezuma Hills, evoked little comment.

Sacramento-bound travelers from more humid lands than California appreciated the appearance of wooded natural

---

[1]Tinkham, op. cit., p. 303.

[2]California Sketches with Recollections of the Gold Mines (Albany: Erastus H. Pease & Co., 1850), p. 16.

[3]Johnson, California and Oregon, p. 111; Teggart, "Diary of Nelson Kingsley, . . . ," loc. cit., p. 322.

levees, probably first encountered at Brannan Island.[4] The banks abounded with a scraggy white oak;[5] these oaks, the sycamores, and other trees became larger upstream.[6] Beyond the line of thickets and timber, the tule backswamps[7] looked like a succession of lakes at high water.[8] They were drained by small sloughs which cut through the wooded riverbank.[9] Steamboat Slough[10] and the Sacramento proper were walled in by thickly wooded strips.[11] Overhanging branches and trees were a constant hazard to spars and rigging on vessels that had to proceed near the banks to avoid strong currents.[12]

---

[4]Ringgold's charts represent the banks with hachures and the lower shore line with a line backed by swamp symbols. Ringgold, op. cit., chart of Suisun and Vallejo bays with the Confluence of the Rivers Sacramento and San Joaquin.

[5]Teggart, loc. cit.

[6]Johnson, loc. cit. Clusters of mistletoe, pendant moss, and wild grape vines added their particular hues and form to the color and texture of the woody plant foliage. Charles Camp (ed.), "An Irishman in the Gold Rush--The Journal of Thomas Kerr," Calif. Hist. Soc., Quarterly, VIII (March 1929), p. 21.

[7]Taylor, El Dorado . . . , p. 218.

[8][Letts], California Illustrated . . . , p. 58.

[9]Johnson, op. cit., p. 117.

[10]Steamboat Slough was known by several names: "Middle Fork" (Ringgold, loc. cit.), "Merritt Slough" (Johnson, op. cit., p. 118), and "The Slough" or "narrows" to various writers (Teggart, loc. cit.; Camp, loc. cit., p. 18; Taylor, loc. cit.).

[11]Teggart, loc. cit., pp. 322, 323, 327; Johnson, op. cit., p. 193.

[12]Ibid., p. 111; [Letts], loc. cit.

The water voyage from San Francisco to Sacramento usually required six or eight days of sailing.[13] At least until the lee of the Montezuma Hills was reached, winds were dependable enough. Thereafter movement upstream was accomplished by taking advantage of tides, or by use of kedge anchor or warping. Sometimes a rowboat was used to tow larger vessels.[14] The tides eased keeled vessels over shoals that lay between the river outlet and Grand Island, to either side of the island, and for a short distance above the present site of Freeport.[15] The kedge anchor and warping were employed when currents were strong and winds weak. The tows were tried when calm prevailed and currents remained weak.

Most difficulty was encountered in Steamboat Slough, the favored channel for passing Grand Island. It was a seven-mile short cut which smaller ships and steamboats followed but which northbound larger sailing vessels avoided because the current was too strong.[16] The shallower-draught sailing ships warped through "The Slough" or "narrows." Warping involved taking a coil of rope upstream from one's ship in a canoe or small boat, securing the strand to a

---

[13] Johnson, op. cit., p. 126; Camp, loc. cit., pp. 18 ff.

[14] Ibid., p. 18; Johnson, op. cit., p. 117; Teggart, loc. cit., p. 322.

[15] Ringgold, op. cit., p. 39; Johnson, op. cit., p. 111.

[16] Ibid., p. 113.

stump or tree near the water's edge, and bringing the line aboard, where the hands proceeded to pull. The slow progress was punctuated with the shocks attendant upon striking shoals and snags and overhanging trees. Passengers alternately aided in the laborious operation, hiked or hunted on the shore, and visited with settlers. Once the main stream was reached, sailing was possible again, assuming a south wind.[17]

San Francisco-bound traffic, steam and sail alike, favored Steamboat Slough. Schooners and brigs drifted with the stream, stern foremost.[18]

From two to three days to as many weeks were consumed in sailing between San Francisco and Stockton.[19] The eccentricities of the low-gradient channel, the wind, and the tide could make the trip most tedious. Sails were often of little use because the meanders constantly altered the relationship of course to wind. In such circumstances, more progress was made by rowing or, where the channels were narrow and the levees offered a footing, by manual towing. As a rule, there was no navigation at night.[20]

Wood-burning steamers appeared on the Sacramento and San Joaquin rivers in August and September 1849. Almost

---

[17] Ibid., p. 117; Camp, loc. cit., pp. 18, 21; Teggart, loc. cit., pp. 322-23.

[18] Camp, loc. cit., p. 18.

[19] Tinkham, op. cit., p. 317.

[20] California Sketches . . . , loc. cit.; Lewis C. Gunn and Elizabeth Le Breton Gunn, Records of a California Family, ed. Anna Lee Marston (San Francisco: Johnck & Seeger, 1928), p. 60.

immediately, regular service was established between San Francisco and Benicia, and Stockton or Sacramento. By early 1850 a number of steamers were providing highly competitive service. The expresses reached Sacramento in 14 hours and returned to San Francisco as quickly as a little over 5½ hours.[21] The Stockton trip took between 7 hours and a day.[22] Shoals and sharp meanders occasioned the delays. The Sacramento's Steamboat Slough required a "considerable nicety" of navigation. At least one steamboat lost wheelhouse planking to overhanging trees while backing and filling around bends.[23] Although trees presented no problem to San Joaquin River navigation, there were numerous times when power had to be cut and the vessel fended through river bends.[24]

Delta Settlement

Frustrated miners dropped from the erratic procession that filed through the mining camps, Stockton, and Sacramento, as they realized that surer fortunes could be gained by tilling the soil than by turning gravel. They took up farming in various parts of central California; their

---

[21]Tinkham, op. cit., pp. 314, 319; MacMullen, op. cit., pp. 11-12, 17-18, 42; Frank Lecouvreur, From East Prussia to the Golden Gate, trans. and comp. Julius C. Behnke (New York: Angelina Book Concern, 1906), p. 262.

[22]Tinkham, op. cit., p. 320.

[23]Taylor, op. cit., II, 47-48.

[24]Enos Christman, One Man's Gold; The Letters and Journal of a Forty-Niner, ed. Florence M. Christman (New York: Whittlesey House, 1930), p. 114.

foodstuffs commanded prices which have become legendary. Many miners selected land fronting on the arterial waterways or near streams close to heavily traveled trails. They found that the soils of wooded natural levees and bottomlands worked easily. Such sites had the further advantage of immediate access to water during the annual dry seasons.

Settlement in the northern delta followed the line of higher levees which flanked the arterial Sacramento River. To the south, few attractive residence sites appeared except near the delta apex and on those mainland fringes that had deep water access, firm ground, and timber. As with the Sacramento banks, the southern sites were near focal centers of trade and travel: Stockton, French Camp, and the San Joaquin crossing. The Antioch vicinity also attracted settlers, although it had modest timber resources. It was more of a port of call than a point for transferring cargo and passengers.

As far as has been learned, settlers avoided other parts of the delta at this time. The western and southwestern margins lacked adequate perennial supplies of good water. The banks of central and southern islands usually lacked the elevation, area, and arboreal cover of the Sacramento banks. Moreover, the highest and best wooded land was held in a land grant. Most of the south and central part of the delta was off-center from the traveled San Joaquin channel. The eastern margin of the delta had water, trees, and good riverbank soils. Prior to 1851, however, the immigrants seem to have been more interested in taking up land with similar qualities located nearer to Sutter Fort and the mining country road from Stockton.

The Argonauts who set up shanties or tents along the Sacramento in 1849 were wood choppers or gardeners. The wood choppers followed the trade as an interim occupation before returning or going to the mines. They sold the fuel to steamers for $12-$15 a cord. The men who cleared gardens intended claiming pre-emption rights to the land. These people found a cluster or two of huts at the Indian village which stood upstream and opposite the head of Steamboat Slough,[25] and on the west bank a mile or so northwest of the present Freeport.[26]

In 1850 the settlement pattern along the river had intensified. A few houses and fields were in evidence at Washington and Sutterville; but southward, into the delta country, there was little or no activity until a mile or so below the present Freeport. There were huts and fields here and across the river from Clarksburg, also a half-mile north of Clarksburg on the east bank and for a mile along the east bank near the head of Sutter Slough. A similar pattern of fields and houses occurred along the east bank opposite

---

[25]Taylor, _op. cit._, I, 218, II, 47; Johnson, _op. cit._, pp. 119, 123, 125; Teggart, _loc. cit._, pp. 322, 324. Among the settlers was the Argonaut, later judge, Clark who settled near the town which preserves his name. Russell _et al._, _op. cit._, p. 216.

[26]Taylor, _op. cit._, I, 219; Peter H. Burnett, _An Old California Pioneer_ (Oakland: Biobooks, 1946), pp. 201-2.

Sutter Island, and for a half-mile opposite the head of Grand Island. Sutter Island was farmed only at its eastern tip. Across Steamboat Slough, small fields covered much of the upper end of Grand Island. Other Grand Island farms, including orchards, extended from the junction of Steamboat and Sutter sloughs downstream to the present Howard's Landing. No improvements are known for the remainder of the island, nor for Merritt, Ryer, Brannan, and Sherman islands. There appears to have been some tilled land along the riverbank where Rio Vista now stands.[27]

Descriptions of farmsteads and their production are few, and they seem to be of those located at the head of Steamboat Slough and along the Sacramento bank opposite. The land was tilled with a spade. Winter vegetables grown in 1849 were reported as varying from indifferent to "thrifty" (vigorous) in appearance, depending upon the skill and luck of the settler.[28] In May 1850 maize, turnips, potatoes, and young grapevines looked promising. Table peas, then ripening, were being offered at $4 per pound.[29]

---

[27]Ringgold, op. cit., chart of the Sacramento River. The delineation of channels inspires confidence in the faithfulness of the Ringgold charts; however, island names are not in accord with present terminology. Schoolcraft Island has become Sutter Island; Grand Island was called Taylor Island; and Ryer Island was shown as Sutter and Priest islands.

[28]Taylor, op. cit., II, 47; Johnson, op. cit., pp. 118-19.

[29]Camp, loc. cit., p. 21.

Clearings, log houses, and shanties on piles remained scattered along the natural levees for some years.[30] Claims were being established to most of the bank land despite the threat of danger and destruction from winter flooding.[31] Perhaps some of the farmers were motivated by the desire to earn enough money to return to the East. Audubon, noting conditions at Sutter's Fort in April 1850, reported that fever and ague were "very prevalent" in the valley and that dysentery was feared by all. Some farmers told him that nothing would induce them to settle.[32]

Cattle were raised and fattened for the mines' market in the backswamps and on the valley plains. The Yolo Basin and adjacent plains and the country to the north of the Calaveras were particularly active areas as slowly receding waters bared lush growth which could be grazed at the time the winter range was drying up. The old tule growth was burned off in the fall.[33]

---

[30]Frank Marryat, Mountains and Molehills (reprinted in facsimile from 1st ed.; Stanford, Calif.: Stanford Univ. Press, 1952), p. 202; Lecouvreur, op. cit., p. 263.

[31]The flood of December 1849-January 1850 topped the natural levee by a foot or more in the Courtland to Walnut Grove vicinity, at least so one may judge on reading the careful account of Lyman's experience. Teggart, loc. cit., pp. 327-34.

[32]John W. Audubon, Audubon's Western Journal: 1849-1850, ed. Frank Heywood Hodder (Cleveland: The Arthur H. Clark Co., 1906), pp. 234, 237.

[33]Sprague and Atwell, The Western Shore Gazetteer . . . , p. 24; Russell et al., op. cit., p. 133; An Illustrated History of San Joaquin County, p. 220; W. C. Fleming, "History of Beef Cattle in San Joaquin," Holt's San Joaquin Gazette (April 1952), p. 1.

By 1850 or 1851 there were several farm families located near the Cosumnes, Dry Creek, and Mokelumne crossings of the Stockton to Sacramento road.[34] Closer to the delta, farming activity had been resumed near Stockton and on banks near the Stanislaus River mouth.[35] Otherwise, comparatively little interest was shown the swamp and overflowed lands bordering eastern and southern delta distributaries.[36]

Trade and Transportation Nodes

Trade and transportation nodes developed about the southern delta during the Gold Rush, but not along the Sacramento. Stockton was where deep water and firm land came together nearest the southern mines. French Camp offered less attractive water facilities but it was more successful than river towns established farther south. The latter places were hampered in their growth by the flow extremes of the San Joaquin, by the expanse of inhospitably dry country to the west of the river, and by being off the main line of land travel between the coast and the southern mining country. That route crossed the San Joaquin below the uppermost distributary fork. The equivalent northern land route to the mines crossed the river at Sacramento, north of the delta.

---

[34] Bancroft, History of California, VI, 484.

[35] Ibid., p. 513; ibid., V, 552-53; An Illustrated History of San Joaquin County, p. 33.

[36] Alta, Nov. 15, 1852, in Bancroft Scraps, Set W 18:1, "California Agriculture," p. 18 (hereinafter cited as BS, Set W 18:1).

There were no places within the delta which had the combination of advantages possessed by the site which Sutter had obtained downstream from the outlet of the American River. Backswamps of the Sacramento and Yolo basins were narrowest here, and there was deep water the year-round.

Stockton

On the Campo de los Franceses land grant Weber's Settlement or Tuleberg, later Stockton, was flourishing by mid-1849 as a debarkation and forwarding port for traffic to the gold camps.[37] Store ships and inactive vessels were beginning to choke the channel. Cargoes, a few warehouses, numerous frame and canvas dwellings, and commercial houses were spreading from the head of Stockton Channel across the townsite. Catastrophic fires swept the flimsy town in December 1849 and in May 1851. More sturdy edifices were built when the settlement was reconstructed, and this encouraged the opening of several brickyards in the vicinity.[38]

---

[37]The Weber ranch headquarters has been called French Camp /Private Land Claim Case No. 298 N.D., deposition of Peter Lassen (Nov. 19, 1853), pp. 24-25/; but the term properly designates the place to the south which preserves the name. The Weber colony center was known as Weber's Settlement, Tuleberg, and Castoria before the designation of Stockton was selected. The present name, chosen to honor Commodore F. Stockton, appears on official documents after July 23, 1850. Tinkham, op. cit., pp. 2, 3, 113.

[38]Ibid., pp. 113, 189, 307; California Sketches . . . , p. 18; Audubon, op. cit., p. 186; Hutchings, Scenes of Wonder and Curiosity in California, p. 34.

Residents of the town may have numbered 1,000 in September 1849, and about 2,400 in May 1850. The floating population may have amounted to another 2,000.[39] Regardless of the number, the people were largely engaged in wholesaling and retailing supplies, teaming and packing, hosteling, and other services.[40]

At first, Stockton's important goods-forwarding function was performed by mule teams, some ox teams, and, when conditions required, by men. Stage and freight wagons were active by 1850.[41] Goods and carriers destined for gold camps in the Stanislaus and Tuolumne basins generally went through French Camp. As long as dry road conditions prevailed, Stockton was busy with freighters. With the onset of winter rains, however, the streets became a mire and the road connection with French Camp, along with other approaches to Stockton, soon became impassable too. Adobe earth and water-filled sloughs were so prevalent about the town that the early traveler was pressed to decide whether it was mud, mire, or water through which he trudged.[42] Weber had

---

[39] Ibid.; Upham, Notes of a Voyage to California . . . , p. 237.

[40] Tinkham, op. cit., pp. 307, 309, 313; California Sketches . . . , p. 19.

[41] The freight wagons or prairie schooners carried 5,000 to 20,000 pounds each. They often operated in tandems of three, with 14-mule teams for motive power. Many of them were constructed in Stockton. Tinkham, op. cit., pp. 309, 311, 313, 320; Hutchings, op. cit., p. 36.

[42] Audubon, op. cit., p. 187; "San Joaquin Intelligence," Alta, March 8, 1852, in Bancroft Scraps, Set W 4, "San Diego to Santa Cruz," p. 1389 (hereinafter cited as

intended to eliminate the hazard by building and grading a road, but some time elapsed before such improvements were made. Meanwhile, several short-lived riverside towns were laid out to the south of Stockton with the intention of supplanting the mud-bound San Joaquin port.[43]

French Camp

Stockton businessmen surveyed the site of French Camp in the fall of 1849 with an eye to establishing a winter freight depot there. A public house and store were constructed shortly, and at least by early 1850 a yawl was carrying passengers and cargoes from Stockton to French Camp.[44] The hamlet had a physical advantage over Stockton. The sandy soils of the valley plain here approached to the very edge of the deep, high banks of French Camp Slough. Because of soil porosity it was possible for teams and wagons to operate between French Camp and the mines at any season.[45]

In December 1850 a small steamer and a miniature stern-wheeler were put on the Stockton to French Camp run. Larger vessels also ventured up the slough; but only

---

BS, Set W 4); "Pioneer Teaming Boosts Demand for Roads in San Joaquin," Stockton Record, Nov. 5, 1832, in Bancroft Library Scrapbooks, No. 28, "California Counties; San Joaquin," Bancroft Library, University of California, Berkeley, p. 13 (henceforth referred to as BLS, No. 28).

[43]Tinkham, op. cit., pp. 311, 315.

[44]Ibid., p. 374; An Illustrated History of San Joaquin County, p. 205.

[45]Tinkham, loc. cit.

as far as Ragtown, the outport which rose about a half-mile to the northwest of French Camp. Water-borne activity, augmented by whaleboats and small ships, was largely a phenomenon of the season when wagons and stages could not get through to Stockton.[46]

Traffic through French Camp also arrived over the grassy plains from the San Joaquin crossing, some 8 or 10 miles to the southwest. The intervening trail was waterless except for a slough that lay within three-quarters of a mile of the river.[47] The wooded French Camp oasis must have appeared a pleasant haven after an eight-hour march from the river.

The San Joaquin Crossing

In 1850 a sheep raiser, one H. Banta, purchased an inn that had been built in the previous year to cater to travelers who moved to and from the mines and San Jose by way of the San Joaquin crossing. The hostelry was situated in a thickly timbered area where the trail met Tom Paine Slough.[48] It was the first shelter that a transient came upon after crossing 10 to 15 miles of treeless, and usually

---

[46]Ragtown was so named because it was a tent city. Ibid., pp. 374-75.

[47]Teggart, "The Gold Rush . . . ," loc. cit., p. 184.

[48]"Early Events in Willow District School as Told by Ellen L. Parker," Stockton Record, Feb. 13, 1932, in BLS, No. 28, p. 9; An Illustrated History of San Joaquin County, p. 219.

waterless, plains from the mean Mount Diablo Range oasis at Mountain House.[49] The hot and dry plain merged with the backswamp quagmire along Old River where the air seethed with mosquitoes.[50] Land travel was an unpleasant experience.

About five miles east of Banta's Inn, approximately where the Western Pacific railroad bridge now crosses the San Joaquin, was the Pescadero crossing, seasonally a ford. The establishment of a ferry here occurred sometime between June and the fall of 1848.[51] The enterprise, begun by former miners, was known as the Doak and Bonsall Ferry. Initially the passage was made in two small boats, although a yawl may have been employed before a flatboat ferry was warped up the river and installed. This manually operated rope ferry charged $2 or $3 for a man and horse, $8 for a wagon, and $1 per single person carried. The receipts may have reached between $500 and $1,000 a day in the dry season. A tavern, general store, and grazing camp maintained by the ferry operators earned additional revenue.[52]

---

[49]Teggart, loc. cit., p. 183.

[50]Teggart, "Diary of Nelson Kingsley, . . . ," loc. cit., pp. 261-62; Taylor, op. cit., II, 73.

[51]Teggart, "The Gold Rush . . . ," loc. cit., pp. 184, 200.

[52]Tinkham, op. cit., p. 316; Taylor, op. cit., p. 75.

In 1849 the ferry became Bonsell and Scott's,[53] and in 1850 was referred to as Bonsal's.[54] After 1849 it shared the river crossing trade with Slocum's Ferry, about one and a half miles to the north.[55] Another rival, Fiske or Durham's Ferry, was operating by 1850 near San Joaquin City, about eight miles to the south of the main crossing.[56]

Antioch

In December 1849 two brothers located on public land about four miles to the southeast of the junction of the Sacramento and San Joaquin rivers. The settlement, Smith's Landing, received a handful of new arrivals nine months later, the people having been promised a lot each in the newly surveyed town.[57] A garden was set out sometime in 1850 on Smith's Point, to the northeast of the village. It

---

[53] An Illustrated History of San Joaquin County, loc. cit.

[54] Report of the Secretary of War, in Further Compliance with the Resolutions of the Senate Calling for Copies or Reports on the Geology and Topography of California, Report of Philip T. Tyson, U.S. 31st Cong., 1st Sess., S. Exec. Doc. 47 (1850), p. 15.

[55] An Illustrated History of San Joaquin County, pp. 219-20; Jacob Wright Harlan, California '46 to '88 (Oakland: By the author, 1896), p. 209.

[56] San Joaquin City was one of twin hamlets that straddled the river near the mouth of the tributary Stanislaus. The second community, Stanislaus, occupied the site of the earlier Mormon colony. Both of the late rivals to Stockton date from 1849. Bancroft, History of California, VI, 513.

[57] J. P. Munro-Fraser, History of Contra Costa County, California (San Francisco: W. A. Slocum & Co., 1882), pp. 481-82.

was irrigated by windmill lift from a delta slough. Protection from stock and lesser animals was accomplished after the spring of 1851 with a fence and ditch. The garden crops and hay cut on the islands of the delta were the community's chief support. The feed, and presumably surplus produce, were sailed to San Francisco for disposal.[58] The contacts between the city and the landing, rechristened Antioch on July 4, 1851, were maintained regularly thereafter.[59]

---

[58]"History of Antioch," Stockton Record, Feb. 18, 1935, in Bancroft Library Scrapbooks, No. 8, "California Counties--Contra Costa," p. 51.

[59]Munro-Fraser, op. cit., pp. 482-83.

PART THREE: RECLAMATION AND LAND USE

CHAPTER VII

HYDROGRAPHIC PROBLEMS AND SOLUTIONS IN THE DELTA

For over a century there has been a constant effort to convert the Sacramento-San Joaquin Delta into a flood-free agricultural land. Reclamation was hampered by a number of interrelated physical obstacles, some of which were made more difficult to overcome because of cultural activities which changed the behavior of the watershed.

Hydrographic Problems

Floodplain Shrinkage

The fundamental difficulty in reclaiming the delta was that for every acre of land leveed there was an acre less of floodplain to hold the excess flow of the Central Valley rivers.[1] Reclamation further increased the flood potential because the enclosure of backswamps removed them from the tidal basin, thereby diminishing the volume and scouring

---

[1]Gilbert, Hydraulic-Mining Debris in the Sierra Nevada, p. 26.

power of tidal water.[2] The reduction of tidal scouring capacity occurred at the same time that the drainage system was being charged with tremendous loads of debris from the gold placers and mines of the Sierra Nevada foothills.

Alluviation

Alluviation in the river channels intensified the flood incidence and contributed to the elevation of water tables in reclaimed tracts. The problems were particularly serious between 1860 and 1914, when more than 800,000,000 cubic yards of mining debris were estimated to have passed through the delta.[3] The debris raised and constricted the floors of all channels, thereby elevating flood planes. Higher flood planes were accompanied by increased seepage through artificial levees, which weakened the structures. The elevated stream beds prolonged the period of seepage and, even in the dry seasons, produced high water tables in the reclaimed districts. When levees held, thus preventing direct flooding and alluviation of farm land, the floods hampered agriculture. Growing seasons were shortened by standing seepage water, and root development zones in the soil were narrowed by high water tables. The water-table problem was compounded by subsidence of the reclaimed land.

---

[2] _Report of the Examining Commission on Rivers and Harbors to the Governor of California_, p. 10.

[3] Gilbert, _op. cit_., p. 46.

These aspects of alluviation received little public attention compared to the more obvious effect of the debris on inland navigation. Shipping was disrupted by river shoaling, a condition that was eased by the Corps of Engineers, whose activity represented the first commitment of the United States in Central Valley water problems.

The build-up of debris in the Sacramento had been developing serious proportions after the floods of 1861-62 when an accumulation of tailings from a decade and a half of mining flushed into the waterway. The rapid expansion of the hydraulic mining industry after 1867 increased the volume of alluvium dumped into the river system.[4]

By 1891 alluviation had raised the low water plane of the Sacramento River about seven and a half feet at Sacramento, and to lesser heights downstream.[5] Maximum alluviation in the delta was reached in 1894-95, by which time 10 feet or more of filling had accumulated for some distance below Sacramento, although not all of the way to the river's outlet.[6]

The debris-caused rise in the low water plane diminished the range of tidal action. A suggestion of the prevailing situation is recorded in the tidal data for

---

[4]Hydraulic mining began in the basins of the Yuba and Bear during 1856. _Ibid._, p. 146; _Report of the Examining Commission . . ._, p. 17.

[5]_Mining Debris, California_, U.S. 51st Cong., 2d Sess., Exec. Doc. 267 (Washington: 1891), p. 19.

[6]DWR Bull. No. 27, p. 155.

Sacramento. Tidal fluctuations were reduced from a two-foot range at mid-century to about nine inches in 1871, and the tide was absent between 1883 and 1898. By the latter year, the limit of tidal action had retreated downstream to the Freeport vicinity,[7] a distance of about 10 miles. The alluviation had become so great along the Sacramento that the tide no longer assisted deeper draft vessels over certain shoals.

The debris problem was less serious in the San Joaquin system as a whole,[8] although shoaling was a nuisance that had stalled boat traffic ever since the Gold Rush.[9] The river's main channel underwent no major changes between 1860 and 1890, except for artificial cuts made as aids to navigation or in the process of building levees.[10]

However, alluviation of the Calaveras River had serious implications for the future of Stockton as a deep-sea

---

[7] Improvement of Sacramento and Feather Rivers, California, U.S. 55th Cong., 3d Sess., H. Doc. 48 (Washington: 1898), p. 4; DWR Bull No. 27, p. 156. Tidal action ceased as far downstream as Walnut Grove according to "Report of the Committee of Twenty-Four of the River Improvement and Drainage Association of California," Report of the Commissioner of Public Works and Engineers, to the Governor of California (Sacramento: 1902), p. 31.

[8] Approximately 80 per cent of the debris arose in the Sacramento watershed. Mining Debris, California, loc. cit.

[9] Johnson, California and Oregon . . . , pp. 11, 192; Schaeffer, Sketches of Travels . . . , p. 31; Upham, Notes of a Voyage to California . . . , p. 233; Hutchings, Scenes of Wonder . . . , p. 30; Tinkham, op. cit., pp. 330-31; Gilbert, op. cit., p. 42.

[10] Report of the Examining Commission . . . , pp. 91-92.

port. The river followed courses which entered the San Joaquin to the north and south of Stockton. Within the latter channel the town's harbor was situated. Evidence of the existence of a silting problem by 1870 is afforded by the fact that Stockton business interests wanted to build a ship canal with but a single point of water ingress--at the proposed outlet near Venice Island.[11] The separate scheme to develop a railroad terminal and deep-water port at Venice Island also reflects Stockton's harbor plight.[12]

Before the accelerated alluviation began, river navigators expected 10 feet of water on the Sacramento, and about 6 or 8 feet on the delta part of the San Joaquin.[13] At low river and low tide the lowest channel depths as far inland as the state capital was 7 to 8 feet, and at high tide vessels drawing 9 to 13 feet were floated at any season. In the fall larger side-wheel steamers awaited proper tides to cross the shoals in lower Steamboat Slough.[14]

---

[11]A company was incorporated to dig the canal during 1870. "Ship Canal," SWI, May 28, 1870, p. 5. Subscriptions could not raise the required $1,300,000. "Reclamation and Ship Canal," ibid., Sept. 25, 1875, p. 7.

[12]Tide Land Reclamation Co., Fresh Water Tide Lands of California (San Francisco: Carr, Dunn & Newhoff, 1872), pp. 30-31. (Later references to this edition of the brochure will be distinguished from the edition of 1869 by adding the date to footnote entry.)

[13]Ringgold, A Series of Charts, . . . , p. 39.

[14]Hutchings, Scenes of Wonder and Curiosity in California (New York: A. Roman and Co., 1870), p. 279; (henceforth distinguished from the edition of 1860 by adding the date to footnote entry). Mining Debris, California, loc. cit.; William Hammond Hall, Sacramento Valley River

The impaired navigability of the Sacramento was evident by 1866; deeper draft steamers could no longer reach the city of Sacramento, and the day when steamers could race side-wheel to side-wheel was passing.[15] By 1877, the effective navigable depth of the river at low water was reduced to five or six feet. Shoaling progressed so far in Steamboat Slough by 1874-76 that this shorter waterway between Sacramento and Rio Vista was being abandoned.[16] After 1879-80 Old River became the channel for passing Grand Island.[17] Nevertheless, it had bad shoals, as did parts of the river above Freeport and opposite Rio Vista. Vessels were restricted to

---

Improvement, Government Policy and Works, Reprint of letter addressed to the Board of Engineers for Improvement of the Sacramento and Tributary Rivers (1905), p. 12; W. H. Heuer, "What the Government Has Done for California's Waterways," Commonwealth Club of California, Transactions, VIII (Nov. 1913), pp. 553-54; Control of Floods on the Mississippi and Sacramento Rivers, p. 34.

[15] Testimony Taken by the Committee on Mining Debris as Reported to the Assembly (Sacramento: 1878), p. 7. Apparently the side-wheelers ceased to operate on the Sacramento after 1869, when the California Pacific Railroad absorbed the California Steam Navigation Company. The vessels were withdrawn for service on San Francisco Bay. H. J. Corcoran, "River Navigation in Early Days," Commonwealth Club of California, Transactions, VIII (Nov. 1913), p. 583; MacMullen, Paddle Wheel Days in California, p. 32; William D. Johnson, "Inland Steam Navigation in California" (unpublished Master's thesis, Dept. of History, Stanford University, 1952), p. 79; Control of Floods on the Mississippi and Sacramento Rivers, p. 41.

[16] Mining Debris, California, pp. 19-20; Testimony Taken by the Committee on Mining Debris . . . , loc. cit.; Mining Debris in California Rivers, U.S. 47th Cong., 1st Sess., Exec. Doc. 98 (Washington: 1882), p. 30.

[17] Mining Debris, California, p. 19.

relatively narrow channels. Even the four-foot draft sternwheelers which were introduced in response to changing river conditions were known to ground during the low-river stages of the 1890's.[18] By this time navigation on the San Joaquin above Stockton, never of much consequence, had passed its prime. The smaller flow of this braiding river was being sapped by expanded irrigation withdrawals that developed after 1871. Also, two railways offered year-round regular service to the valley residents, while the competing riverboats could only offer sporadic service during 3 to 10 months of the year.[19]

Salt-Water Penetration

The areal reduction of the floodplain through reclamation and alluviation facilitated the penetration of salt water into the delta, although it probably was only a matter of time before the diversion of water for irrigation of the Central Valley would have had the same effect during dry years. Loss of natural storage area for the excess water of winter meant that less water was available to retard penetration of salt water into the delta from Suisun Bay during the annual dry season. Salt-water penetration of

---

[18] Improvement of Sacramento and Feather Rivers, loc. cit.

[19] Heuer, loc. cit., p. 558; Macmullen, op. cit., pp. 82, 84; San Joaquin River, California, Up to Herndon, U.S. 65th Cong., 1st Sess., H. Doc. 332 (Washington: 1917), pp. 12, 25-26.

delta channels reached its peak in the period 1910-40 as a result of the pyramiding of dry seasons, increased irrigation diversion, and reclamation.

Reclamation, flood control, alluviation, and salt-water penetration are facets of a basin-wide problem that also includes the maintenance of navigation, but the policy of treating all in a comprehensive water management program was not formalized until a half century of floods and debris swept over the bottomlands of the Central Valley. Although action of this sort was delayed, the broad approach to basin problems was long entertained by private individuals and state and federal agencies, which built up a knowledge of the Sacramento-San Joaquin hydrography. The thinking on this matter gradually matured into the Central Valley Project.

Seeking Corrective Measures

Early Public Opinion

Winter, spring, and early summer floodings of the Sacramento and San Joaquin bottomlands are natural phenomena which debris and reclamation intensified during the latter nineteenth century. To most lowland residents, the debris was the prime cause of flood destruction, and it had to be eliminated. Another element of the populace held that the mine tailings brought into the lowlands should be diverted to fill in backswamp depressions. Such views had begun to be expressed at least as early as 1860.[20] In 1878 Tyler Island settlers reportedly cut ditches through the natural levees to obtain silt deposition within the island.[21] The San Francisco Chronicle, thinking on a grander scale, recommended editorially in 1878 that the state recover swamp property in the Yolo Basin and elevate the land by turning the debris-laden river onto it. The editor also suggested that dredges could pump debris out of the Sacramento channel and into the basin. Once the project was completed, said the editor, expenses would be recovered by selling the reclaimed land.[22] Two years later another metropolitan paper expressed the idea that unless sediments were admitted to the reclaimed areas, they would become depressed.[23]

A petition submitted to the legislature in 1878 by Henry M. Naglee, delta landowner and reclaimer, set forth the problems and frame of mind which had been developing among people who had seriously attempted reclamation:[24]

> Your petitioner would . . . represent, that the great floods of this winter have demonstrated the fact that individual enterprise, separately exercised,

---

[20]F /Wilson Flint7, "Reclamation of Tule Lands," The California Culturist, III (Sept. 1860), p. 110.

[21]"The Sacramento Delta," Ed. of San Francisco Bulletin, Feb. 26, 1878, in BS, Set W 34, p. 125.

[22]"A Pertinent Question," SF Chronicle, Feb. 14, 1878, in BS, Set W 34, p. 142.

[23]"Swamp Land Reclamation," SF Bulletin, Jan. 3, 1880, in BS, Set W 34, loc. cit.

[24]Petition of Henry M. Naglee (Sacramento: 1878), p. 1.

> cannot control the reclamation of these lands; that in order to do so there must be some intelligent central head, into which all the information that can be had on the subject should be concentrated. . . .
>
> As the navigation of these streams [is] involved it should be placed under the supervision and control of the Government of the United States, which, with its educated engineer corps, will not only be able to determine upon and agree as to the proper methods to be pursued, but should be clothed with power, in cooperation with the State, to enforce its authority in all parts of the work, and with full knowledge of the whole system, and every part thereof, can act intelligently and effectively under all circumstances. . . .
>
> The individual district system is a failure. Each district makes its own levees according to the ideas of its trustees. There are hundreds of such districts, each working in its own sphere, under the opinion of its own engineers, and frequently acting upon opposite theories and doing acts that obstruct instead of advancing the great reclamation problem.
>
> These individual districts have no intelligent information of the obstructions that lie either in their own districts or in the midst of other districts, and even if cognizant of these obstructions, are not clothed with power sufficient to control or remove them.

The section of the petition relating to navigation had wider implications than the phrasing suggests. Maintenance of inland navigation, a federal responsibility, afforded a means to control the debris flow as well as to establish order in reclamation procedure.

State Engineer's Investigations

By March of 1878 the State Legislature responded to public pressure to do something about the mining debris problem. The office of State Engineer was created[25] to "investigate the problems of irrigation of the plains, the condition and capacity of the great drainage lines of the State, and the improvement of the navigation of the rivers."[26] The investigation produced the first authoritative and thorough study of the problems of mining debris and flood control in the Central Valley of California. It dealt with the means of controlling debris, of improving and rectifying stream channels, or building levees, and of creating drainage districts.[27]

---

[25]429 Stat. Cal. (1877-78), p. 634. An invaluable reference on state action which guided readings for this chapter is "Historical Summary of State Legislative Action with Results Accomplished in Reclamation of Swamp and Overflowed Lands of Sacramento Valley, California," by E. A. Bailey, Appendix D in Sacramento Flood Control Project, Revised Plans, Calif. Dept. of Public Works, Div. of Engineering and Irrigation (Sacramento: 1927).

[26]The office of State Engineer was created, as the quotation indicates, to study a number of water problems. Irrigation of the drought-afflicted San Joaquin Valley was economically and politically important too; this problem was studied in 1874 by an appointive board under the leadership of Lt. Col. B. S. Alexander. Its report of a system for irrigation also recommended the formation of a State Engineer Office.

This report is available in a recent compilation of documents about United States and California activity in the water problems of the Central Valley, Central Valley Project Documents, Part I, Authorizing Documents, U.S. 84th Cong., 2d Sess., H. Doc. 416 (Washington: 1956), pp. 22-28. An earlier summary of United States action in the Sacramento Valley is to be found in "Historical Summary of Federal Action and Its Resulting Effect Upon the Sacramento Flood Control Project," by E. A. Bailey, Appendix C in Sacramento Flood Control Project, Revised Plans. (It will be distinguished from Bailey's summary of state action, Appendix D, as Bailey, Appendix C.)

[27]Report of the State Engineer to the Legislature of the State of California, Session of 1881 (Sacramento: 1881).

The first State Engineer, William Hammond Hall, proposed to check the movement of mining debris by building dams in the canyons of the foothill zone. He favored a state-controlled levee system along the trunk streams capable of confining ordinary floods. Natural relief channels like the Yolo Basin were to be abandoned eventually because he felt that diversions into them from the Sacramento River would add to rather than relieve debris deposition in the main stream. His plans contemplated the eventual closing of delta channels, among them the Old River branch of the Sacramento. The shorter Steamboat Slough was to become the main river channel.

Within a few days after creation of the office of State Engineer the formation of a Sacramento Drainage District was authorized.[28] The district was created in response to pressure of swampland owners and others who visualized an end to flood problems in the lower Sacramento Valley, relief from the cost of maintaining levees below Sacramento, as well as the forwarding of new reclamation, if a by-pass canal was dug from opposite the mouth of the Feather River to an outfall on Suisun Bay.[29] The costs of this Yolo Basin by-pass

---

[28] 642 Stat. Cal. (1877-78), p. 987.

[29] "A Canal for the Overflow," San Francisco Call, Feb. 14, 1878, in BS, Set W 34, p. 113; "The Flooded Regions," SF Alta, Feb. 24, 1878, ibid., p. 123; SF Bulletin, Feb. 27, 1878, ibid., p. 128; "One Thing That Seems Clear Now," Sacramento River Floods of 1878 and 1881, Collection of Sacramento Bee clippings, Bancroft Library, University of California, not paginated.

were to be borne by the benefited landowners. Engineers who surveyed the proposed route for the ditch concluded that the costs in cutting through the 33-foot saddle which separated the Montezuma Hills from the outliers of the northern Coast Ranges would be excessive. Also, they were dubious about being able to obtain enough gradient to prevent silting of the ditch.[30] The project was therefore rejected by officials.

The engineers concluded their negative report by stressing the need of a centralized authority and a comprehensive reclamation and flood relief program for the Sacramento Valley with powers and scope broad enough to handle the mining debris problem. This thinking is believed to have influenced subsequent executive and legislative action.[31]

Board of Drainage Commissioners

In a special message to the legislature in 1880 the Governor related mining debris both to the need for reclamation and to the difficulty of accomplishing it. He urged farmers and miners to settle their differences in the legislature rather than in courts.[32] The advice came at a time

---

[30]"Chief Engineer's Report," by Isaac W. Smith, Report of the Board of Commissioners of the Sacramento River Drainage District to the Governor of California (Sacramento: 1879), p. 6; Report of the Commissioner of Public Works to the Governor of California, 1895-1896 (Sacramento: 1897), p. 32.

[31]Comment of A. B. Nye in Edward F. Adams, "Swamp Land Reclamation," Commonwealth Club of Calif., Transactions, I (Oct. 15, 1904), pp. 13-14.

[32]Special Message of Governor George Perkins, to the Legislature of California (Sacramento: 1881), pp. 3-14.

when relations between the two factions were acutely disturbed. The farmers, threatened with ruin,[33] were contemplating legal action; and the miners were confronted with the complicated and costly proposition of withholding placer and shaft mine tailings from stream courses.

The legislature, in response to the Governor's message, created the Board of Drainage Commissioners which was authorized to find a solution to the debris problem.[34] Earlier legislation merely provided for investigation. The board, an operative agency of the state, was to supervise land drainage, debris containment, and the development of the Sacramento River so that it could carry the entire runoff of the northern Central Valley. The board was to create drainage basin planning districts. Costs of the work were to be borne by a state-wide land tax and by taxes on the hydraulic gold mines and the benefiting farm lands. This move to have the state assume responsibility for reclamation and debris control was invalidated by a State Supreme Court decision in 1881. The court ruled that the responsibility of the commissioner to organize the state into drainage districts represented the improper delegation of a legislative function to an executive agency.[35] In so ruling, the court postponed

---

[33]In 1878 and 1880 legislative concurrent resolutions requested the Governor to propose state-financed aid to indebted reclamation districts. Adams, loc. cit., pp. 12-13.

[34]117 Stat. Cal. (1880), p. 123.

[35]People v. Parks, 58 Cal., 624.

for some years a state-sponsored and -operated program combining flood control and reclamation.

Court Injunctions

Having lost a legislated advantage, the farmers instituted injunction proceedings against the hydraulic miners.[36] Delta interests held the "unanimous opinion" that the mining had to be stopped. Temporizers or apologists were branded enemies.[37] The valley farmers won celebrated decisions in the cases of People v. Gold Run Ditch and Mining Company (July 1881)[38] and Woodruff v. North Bloomfield Gravel Company (January 1884).[39] Hydraulic mining was enjoined until the tailings were impounded to prevent damage. Because restraining the debris was so costly, hydraulic mining had to be discontinued. Nevertheless, the tailings already in transit to the sea continued to plague navigation, flood control, and reclamation for years.

---

[36]Bailey, Appendix D, loc. cit., p. 149.

[37]"Down the River," Sacramento Bee, Feb. 26, 1881, in Sacramento River Floods of 1878 and 1881, not paginated; Julian Dana, The Sacramento: River of Gold (New York: Farrar and Rinehart, Inc., 1939), pp. 169-70.

[38]The suit was filed in the Superior Court of Sacramento County on July 29, 1881. A unanimous State Supreme Court decision on Nov. 24, 1884 affirmed the lower court's ruling. 66 Cal., 138.

[39]The decision of Judge Lorenzo Sawyer, U.S. Circuit Court, Northern District of California, was handed down on Jan. 7, 1884. 18 Federal Reports, 753.

The Federal Government
and Navigation

The interest of the United States in the physical condition of the Central Valley rivers was maintenance of navigation, over which primary responsibility is vested in Congress under the commerce clause of the Constitution.[40] In California the performance of this function was seriously hampered by the unique mining debris problem.

Channel improvement began in 1875 with snag removal work on the Sacramento and Feather rivers and jetty construction on the latter.[41] Five years later, and two years after the state was committed to action, Congress directed the Secretary of War to devise a system of debris-restraining works to prevent further damage to California's navigable waters.[42] In 1882 the report of the first investigation made in accordance with this directive was made by Lieutenant Colonel George H. Mendell of the Army Engineers.[43] Another investigation was authorized in 1888 and the report of its findings and recommendations, transmitted in 1891, was influential in shaping subsequent Congressional legislation.[44]

---

[40] U.S. Const., Art. I, sec. 8.

[41] Central Valley Project Documents, p. 31.

[42] Committee on Flood Control, "Supplemental Report," Control of Floods on the Mississippi and Sacramento Rivers, p. 48.

[43] Mining Debris in California Rivers, U.S. 47th Cong., 1st Sess., Exec. Doc. 98 (Washington: 1882).

[44] The Corps of Engineers' investigators were headed by Col. W. H. H. Benyaurd. Control of Floods on the Mississippi and Sacramento Rivers, p. 49.

The California Debris Commission

One of the first results of the reports was the passage, on March 1, 1893, of the Caminetti Act which authorized the federal government to cooperate with California in formulating plans to prevent mining debris from passing downstream.[45] The California Debris Commission, comprised of three Corps of Engineers officers, was delegated to represent the United States in this first authorized joint program with the state. The California counterpart to the group was the office of the Debris Commission, created by the legislature in March 1893.[46] The real end of the joint effort was to permit resumption of hydraulic mining and at the same time protect navigation and reclaimed lands from the inimical effects of mining waste.

The state's Debris Commission was created at the time that the administratively more important office of the Commissioner of Public Works was formed;[47] the agencies inherited the responsibilities of the defunct office of the State Engineer. During the latter 1880's the older organization had been throttled and finally closed by reduced appropriations.

---

[45]The Act was named after its sponsor, Congressman Anthony Caminetti of Amador County. 183 Rev. Stat. (1893).

[46]Contemporary reviews of official action may be seen in Reports on the Control of Floods in the River Systems of the Sacramento Valley and the Adjacent San Joaquin Valley, California, U.S. 62d Cong., 1st Sess., H. Doc. 81 (Washington: 1911); Fourth Biennial Report of the Reclamation Board of California (Sacramento: 1918).

[47]345 Stat. Cal. (1893), p. 345.

State Engineer Hall, a man of vision and of strong convictions, had alienated too many people.

The Debris and Public Works commissions were formed along the line recommended in 1890 by the Governor's Examining Commission on Rivers and Harbors.[48] This study group also proposed re-establishment of river and drainage districts as separate yet integrated operational units for flood control, reclamation, and navigation improvement. The Examining Commission felt that priority should be given to a Sacramento River project to include deepening and widening the channel downstream from Grand Island, converting Steamboat Slough into the principal channel around the island, and constructing high levees along the river. The commission believed that this course of action would make it possible for the river to transport debris and flood crests to the outlet. Also recommended were straightening of the San Joaquin below Stockton, improving scour conditions upstream, and repairing a dam and levee failure at the head of Paradise Cut. The dam failure on this second distributary entered by the San Joaquin had interrupted reclamation along the Tom Paine Slough distributary, to the southwest, and along Old River.[49]

---

[48] Report of the Examining Commission on River and Harbors to the Governor of California.

[49] Ibid., pp. 113, 114, 119, 121.

Manson and Grunsky Plan

Following a pattern that was by then routine, the newly created Commission of Public Works engaged two consulting engineers, Marsden Manson and C. E. Grunsky, to formulate a solution to the flood problems of the Sacramento River system. Their suggestions, the Manson and Grunsky Plan submitted in December 1894, incorporated a by-pass system to convey excess water through the Yolo Basin rather than by way of an enlarged and massively leveed Sacramento River. The impossibility of confining flood water to the river channel was recognized.[50] Although the Governor recommended legislative action on these suggestions,[51] little more was done than make appropriations for minor improvements to the Sacramento and San Joaquin channels. The Public Works agency remained the administrative and investigatory organization of river problems until 1907, when the State Department of Engineering was created.[52]

Implementing Correctives

Navigation Improvement by the Corps of Engineers

In the last quarter of the nineteenth century about a dozen floods visited the delta and adjacent Central Valley

---

[50]See Report of the Commissioner of Public Works to the Governor of California /1894/ (Sacramento: 1895), pp. 53-70.

[51]Sacramento Flood Control Project, Revised Plans, p. 32.

[52]Bailey, Appendix D, ibid., p. 156.

bottomlands, yet flood control measures barely advanced beyond the blueprint stage. Some ineffective debris-restraining work was done in the Sierra Nevada foothills. River improvement in the lowlands consisted of snag removal, jetty construction, and channel realignment by the United States Corps of Engineers, measures designed for navigation improvement.

Navigation improvement work on Stockton Channel and adjoining Mormon Slough was initiated by the federal government in 1885, about nine years after snag removal and channel straightening were started on the lower San Joaquin.[53] Meanwhile, the general condition of the Sacramento channel was being improved by snag boat operations and, after 1899, jetty construction to aid scouring of shoal areas.[54]

During most of the period 1899 to 1927 a seven-foot channel depth was maintained by the engineers between Suisun Bay and Sacramento. From 1927 to 1932 the channel was deepened to 10 feet.[55] In 1946 Congress authorized a project to convert Sacramento into a deep-water port;[56] although local

---

[53]The Commercial, Industrial, Agricultural, Transportation, and Other Interests of California, by Thomas J. Vivian, U.S. Treasury Department, Bur. of Statistics (Washington: 1891), p. 193.

[54]"Report of the Committee of Twenty-Four . . . ," loc. cit., pp. 31-32.

[55]Partial Report from the Chief of Engineers on Sacramento, San Joaquin, and Kern Rivers, California, Covering Navigation, Flood Control, Power Development, and Irrigation, U.S. 71st Cong., 3d Sess., H. Doc. 791 (Washington: 1931), pp. 47-48.

[56]Public Law No. 525, 79th Cong., 2d Sess. (1946), "River and Harbor Act," c. 595.

capital financed construction of initial port facilities in 1949, a Congressional appropriation for dredging a 30-foot channel along the eastern side of the Yolo By-Pass was not forthcoming until 1955.[57]

To reduce the ultimate cost of maintaining a silt-free Stockton Channel and to provide flood protection for Stockton, the Corps of Engineers dug a diversion ditch from Mormon Slough to the Calaveras River about three miles east of Stockton. The ditch was excavated and the river enlarged during the decade 1902-12; the earth was used to strengthen levees along the Calaveras and to build a levee between the ditch and Stockton.[58] The Corps of Engineers maintained a 9-foot channel from Suisun Bay to Stockton between 1913 and 1933, at which time a 26-foot channel was dredged so that the city might develop a modern deep-water port. The channel was deepened to 30 feet in 1950.[59]

---

[57]Joseph S. Gorlinski, "Supplement to Comprehensive Survey Report of the District Engineer," Sacramento-San Joaquin Basin Streams, California, p. 26; "The Sacramento Deep Water Channel" (Sacramento-Yolo Port District, April 18, 1956), pp. 1, 3. (Mimeographed.)

[58]Survey of San Joaquin River and Stockton and Mormon Channels, California, U.S. 55th Cong., 3d Sess., H. Doc. 152 (Washington: 1899), pp. 4-5; Heuer, loc. cit., p. 559.

[59]Corcoran, loc. cit., p. 582; Control of Floods on the Mississippi and Sacramento Rivers, p. 32; Partial Report from the Chief of Engineers on Sacramento, San Joaquin, and Kern River, p. 53; H. M. Rich, "Comprehensive Survey Report of the District Engineer," Sacramento-San Joaquin Basin Streams, California, U.S. 81st Cong., 1st Sess., H. Doc. 367 (Washington: 1950), p. 104.

There are very few lesser channels in the delta which do not have at least seven feet of water in them as a result of clamshell dredge activity.[60] Their navigability is a by-product of levee maintenance.

The Dabney Commission

Alarmed by the serious floods of 1902 and 1904, civic officials and prominent Central California businessmen decided that the time had come to impress the legislature with the urgency of developing a flood control program for the Central Valley.[61] From a mass meeting which they called for May 6, 1902 emerged the River Improvement and Drainage Association of California. The representations of this pressure group elicited the legislature's appointment of another commission to investigate and make recommendations on river problems.[62]

Major T. G. Dabney, an Army Engineer who had had considerable experience in the lower Mississippi Valley, was appointed to lead the survey. The report of his commission, made on December 15, 1904, recommended enlarging the Sacramento, to 3,000 feet across, realigning the channels, and raising the height of levees so that the river could conduct

---

[60]"Water Terminal and Transfer Facilities, Third San Francisco, Calif., District," Water Terminal and Transfer Facilities, U.S. 66th Cong., 2d Sess., H. Doc. 652 (Washington: 1921), p. 2042.

[61]See "Report of the Committee of Twenty-Four . . .," loc. cit.

[62]Bailey, Appendix D, loc. cit., p. 156.

an anticipated maximum discharge of 250,000 cubic feet per second below Rio Vista.[63] The by-pass of Manson and Grunsky's plan was eliminated.

There was one point of similarity between the recommendations of the Dabney Commission and those which preceded it: nothing came of them. The legislature made implementation of the report contingent upon assurance that the federal government would share costs. The assurance was not forthcoming because a board of Army Engineers refused to certify the project. The board found that landowners rather than navigation interests were behind the project.[64] Existing river improvements were deemed adequate for navigation purposes.[65]

The Minor Project

United States Engineers commenced a new series of investigations in 1905 to ascertain for Congress how federal assistance could most effectively be used to control the Sacramento.[66] The engineers recommended that, since the

---

[63] See Report of the Commissioner of Public Works to the Governor of California, . . . (Sacramento: 1905); Reports on the Control of Floods in the River Systems of the Sacramento Valley and the Adjacent San Joaquin Valley, pp. 5, 10-11.

[64] Although it should be noted that widening the Sacramento from 600 to 3,000 feet would have consumed a lot of fine orchard and other crop land in the delta.

[65] Fourth Biennial Report of the Reclamation Board of California, p. 12; Bailey, Appendix D, loc. cit., p. 159.

[66] 33 U.S. Stat. at L. (1905), p. 1143.

state and landowners were undecided upon any one program for flood and debris control, the United States limit itself to dredging and levee construction in the lower river.[67] In 1910 Congress appropriated $400,000, a sum matched by the state, for the construction of two hydraulic dredges for use between the mouth of the Sacramento and of Cache Slough.[68]

This particular operation in the lower Sacramento was known as the "Minor Project," and was part of a comprehensive basin-wide "Major Project" for flood control. The dredging widened the Sacramento to an average of 3,100 feet and gave it a mean flood stage depth of 35 feet. In the process, Horse Shoe Bend was cut off and Decker Island formed. A narrow midstream island in front of Rio Vista was removed also.[69]

The Major Project

In 1911 the Secretary of War submitted to Congress the California Debris Commission's comprehensive plan for the

---

[67] *Annual Report of the Chief of Engineers, U.S.A., for 1907* (Washington: 1908), pp. 2262-69; Bailey, Appendix D, *loc. cit*., p. 160.

[68] *Public Law* No. 382, 61st Cong., 2d Sess. (1910), p. 662; 147 *Stat. Cal*. (1909), p. 249; *Fourth Biennial Report of the Reclamation Board of California*, *loc. cit*. For a "Historical Summary of Federal Action and Its Resulting Effect upon the Sacramento Flood Control Project," by E. A. Bailey, see Appendix C, *Sacramento Flood Control Project, Revised Plans*, pp. 118-36.

[69] *Reports on the Control of Floods in the River Systems of the Sacramento Valley and the Adjacent San Joaquin Valley*, pp. 14-15, 21-23; "Report of Assistant Engineer H. H. Wadsworth," Appendix B in *Control of Floods on the Mississippi and Sacramento Rivers*, p. 114.

Sacramento. The proposed flood control project was scaled to handle a 600,000-second-foot discharge, more than twice the capacity of the earlier Dabney plan. The 1907 flood demonstrated the need for such a capacity for this Major Project. The plan was adopted by the California Legislature in a special session called during late 1911.[70] At the same time the Reclamation Board was created to implement and coordinate state reclamation, flood control, and navigation improvement plans with the federal program.[71] It was anticipated that Congress would adopt the Major Project too; but this development did not occur until 1917 when the state and landowners agreed to contribute a larger share of costs.[72]

The Federal Flood Control Act which grew out of the Debris Commission's study marked Congressional recognition of a responsibility for flood control as well as for improvement of navigation. Concerning the mechanics of the project, the United States accepted responsibility for costs of construction; state and local interests had to furnish rights-of-way and easements, assume the costs of relocating roads and railways, and maintain all works except those downstream

---

[70] 25 _Stat. Cal._ (Extra Session, 1911), p. 1170; _Fourth Biennial Report of the Reclamation Board of California_, _loc. cit._

[71] _Report of the Reclamation Board of California_ (Sacramento: 1914), p. 8; _Report of the Reclamation Board of California_ (Sacramento: 1916), pp. 3-4.

[72] _Public Law_ No. 367, 64th Cong., 2d Sess. (1916).

from Cache Slough, which are the responsibility of the federal government.[73]

The merit of the new plan was that it provided a technically acceptable basin-wide approach to the Sacramento's drainage problems. The phases of the plan which pertained directly to the delta included a by-pass project capable of delivering at least 500,000 cubic feet of water through Cache Slough. The Sacramento was improved to handle a flow of 100,000 cubic feet from Sacramento to Cache Slough. The work begun as the Minor Project prepared the lower river to conduct a 600,000-cubic foot discharge from the Cache Slough-Sacramento junction into Suisun Bay.

New and strengthened levees were required for all lands along the river and by-pass. The lower river levees had to be at least 5 feet above the 7-foot flood plane at Collinsville and the 15-foot plane at Cache Slough. To the north, along the Sacramento and Steamboat Slough, levees were required to be 3 feet higher than the flood planes of 15 feet

---

[73] Sacramento and San Joaquin Drainage District Refunding Act, Reclamation Board Act and Reclamation Board Bond Act of the State of California, . . . , compiled and annotated by Fred R. Pierce, Reclamation Board of the State of California (Sacramento: 1928), pp. 14, 27, 30-33, 47-48; "Interim Survey of Sacramento River from Collinsville to Shasta Dam, Calif.," by R. C. Hunter, Sacramento River and Tributaries, California, from Collinsville to Shasta Dam, U.S. 78th Cong., 2d Sess., H. Doc. 649 (Washington: 1944), p. 26. For a description of contracted obligations, regulations, and enforcement procedure regarding flood control see: State Legislation and Federal Regulations Governing Maintenance and Operation of Sacramento River Flood Control Project, Calif. Dept. of Public Works, Div. of Water Resources (Sacramento: 1947), particularly pp. 5-6.

at Cache Slough, 23.5 feet at the head of Grand Island, and 35 feet at the mouth of the American River.

In the by-pass, massive levees were constructed between Cache Slough and the overflow weirs located opposite the mouth of the Feather River and about two miles north of the American River mouth. The levees, spaced as much as 12,000 feet apart, were given 10-foot crowns, slopes of three to one, and heights 6 feet above the adopted flood plane.[74]

Construction of the Major Project was gradually carried to completion in 1948 by reclamation districts and state and federal agencies.[75]

With this assurance that the national and state governments were actually moving out of the planning into the action phase of dealing with river problems, private capital flowed into various delta reclamation projects that had been considered unpromising earlier. These developments aroused criticism that the Yolo By-Pass plan was a reclamation scheme. Proponents of the Major Project acknowledged that flood control benefited existing reclamation works and made new reclamation possible but that in the complex problem of flood control and navigation improvement it would have been impossible to eliminate any one phase or interest without damaging the rest. Moreover, assessments for improvements

---

[74]Reports on the Control of Floods in the River Systems of the Sacramento Valley and the Adjacent San Joaquin Valley, pp. 14-15, 21-23.

[75]Rich, loc. cit., p. 102.

were borne largely by landowners.[76] The economic well-being of the whole region advanced by completion of the project.

Salt-Water Invasion

The nature of salt-water invasions into the delta and the financial consequences are familiar; the relationship of the problem to the basin as a whole was far-reaching and requires some explanation. Delta interests, in the celebrated "Antioch Suit" of 1920,[77] attempted to prevent or curtail upstream irrigation diversions by injunction. The suit was filed by the city of Antioch under claim of riparian right. A temporary injunction was granted by the Alameda County Superior Court, but the decision was reversed by the State Supreme Court. The higher court ruled that the city did not have a riparian right and that water rights acquired under the doctrine of beneficial use did not confer upon first users the privilege of insisting that holders of upstream rights subsequently established "should have enough water flowing in the stream to hold the salt water" downstream from the prior user's point of diversion.[78]

Increased summer flows, resulting from wetter winters, eased the situation temporarily; in the winter of 1923-24, however, a very dry summer irrigation season was foreseen.

---

[76] Control of Floods on the Mississippi and Sacramento Rivers, p. 67.

[77] Antioch v. Williams Irrigation District, 188 Cal., 451.

[78] DWR Bull. No. 27, p. 23.

At the same time large numbers of new applications to use river water were placing the Division of Water Rights in an uncomfortable position.[79] In an effort to air the situation, the agency and private organizations arranged a River Problems Conference for January 1924. All parts of the valley were represented at the meeting which proposed that public subscription support a Sacramento-San Joaquin Water Supervisor who would take charge of research and administration of a cooperative water conservation program.[80] The new agency inherited appropriate duties and personnel from the Division of Water Rights, with which it remained closely allied.[81]

The Central Valley Project

One of the solutions to the salinity problem which was considered was the construction of an earth-filled salt-water barrier at some point west of the delta. It was discarded as impracticable by state engineers who for many years had been conducting research on a comprehensive State Water Plan.[82] This plan was antecedent to the Central Valley Project which

---

[79] In July 1921, the Department of Public Works was created. Its Division of Water Rights succeeded the State Water Commission, previously unmentioned. The Department of Engineering became the Division of Engineering and Irrigation. Both of the divisions were consolidated to form the Division of Water Resources in 1929. DWR Bull. No. 27, p. 438.

[80] See Biennial Report of the Division of Water Rights, Calif. Dept. of Public Works, Div. of Water Rights (Sacramento: 1925).

[81] DWR Bull. No. 27, p. 24.

[82] See DWR Bull. Nos. 22 and 28.

was approved by the legislature[83] and the voters in 1933. Efforts to finance the project were unsuccessful until direct Presidential action resulted in Public Works Administration funds being allotted to the Department of the Interior for certain construction projects. Subsequent Congressional authorizations have continued federal assistance.[84]

Among the objectives of the Central Valley Project was the permanent expulsion of salt water from the delta by controlled discharge from Shasta Reservoir and by diversion upstream from Walnut Grove of fresh water from the Sacramento into the Mokelumne and San Joaquin. The Delta Cross Channel, through which the diversion was accomplished, also feeds the Contra Costa and Delta-Mendota canals, facilities which were put into service in 1948 and 1951, respectively.[85]

The irrigation, power, and navigation aspects of the project were of less direct benefit to the delta. Its flood control facilities, moreover, are found to offer less than optimum protection for the delta. Levee failures continue to occur somewhere in the delta whenever the surface elevation

---

[83]1042 Stat. Cal. (1933).

[84]Central Valley Project Documents, Part I, Authorizing Documents, pp. 139-50, 256-349, 409-32.

[85]For a description of the project see Central Valley Basin, prepared by Dept. of the Interior, Bur. of Reclamation, U.S. 81st Cong., 1st Sess., S. Doc. 113 (Washington: 1949).

of channels exceeds four feet above mean sea level for more than 48 hours.[86]

Recent Salinity and Delta Flood Protection Investigations

Salinity and flood protection for the delta are among the benefits which proponents ascribe to various San Francisco Bay Area water barrier plans. The controversial proposals also envision water conservation, water and land transportation, industrial, agricultural, defense, and recreation benefits.

With the hope of determining the practicability of barrier projects, the legislature passed the Abshire-Kelly Salinity Control Barrier Act of 1953,[87] authorizing an investigation of all aspects of the barrier proposals.[88] Supplemental appropriations permitted a continuation of the studies during the 1956-57 fiscal year.[89] By March 1957,

---

[86] Report to the Water Project Authority of the State of California on Feasibility of Construction by the State of Barriers in San Francisco Bay System, Calif. Dept. of Public Works, Div. of Water Resources (Sacramento: 1955), p. 26.

[87] 1104 Stat. Cal. (1953).

[88] An account of the investigations is found in Report of the Water Project Authority . . . , and Report to the California State Legislature Pursuant to the Abshire-Kelly Salinity Control Barrier Act of 1953 on Feasibility of Construction by the State of Barriers in the San Francisco Bay System, Water Project Authority of California (Sacramento: 1955).

[89] See Interim Report of the California State Legislature on the Salinity Control Barrier Investigation, Calif. Dept. of Water Resources, Div. of Resources Planning, Bull. No. 60 (Sacramento: 1957).

the Department of Water Resources discarded all alternatives but the Biemond Plan,[90] which it recommended to the Governor and legislature as a comprehensive program to ease delta and San Francisco Bay Area water problems.

The Biemond Plan is expected to bring flood protection to the delta by reducing the present 1,100 miles of flood and tidal subject levees to a 450-mile system of master levees.[91] The master levees are to rest upon the mineral substratum of the delta rather than on peat; they will seal all channels from tidal water except the San Joaquin River, French Camp Slough, Stockton Channel, the Calaveras River, Franks Tract, the Sacramento River and Steamboat Slough to the latitude of Walnut Grove, and Cache, Lindsay, and Threemile sloughs.

The South Fork of the Mokelumne and the San Joaquin Old River will be the main components of a strongly leveed combined flood and cross-delta channel.[92] A siphon under the San Joaquin is to transfer sufficient water from the north to meet the requirements of the existing Contra Costa and Delta-Mendota canals and proposed South San Francisco Bay and Feather River Project aqueducts. Provisions are made also to lead water to the Lindsay Slough intake of a proposed North Bay Aqueduct.

---

[90] Ibid. The plan is named for Cornelius Biemond, a consulting engineer who was brought to California from the Netherlands by the Department of Water Resources.

[91] Ibid., p. 30; Report of the Water Project Authority . . . , p. 46.

[92] DWR Bull. No. 60, loc. cit.

The networks of captive channels which will lie inside of the master levees are expected to retain their present irrigation and recreation functions; however, only the Sacramento and Old River are expected to have barge locks.[93]

---

[93]*Ibid.*, pp. 28-31.

CHAPTER VIII

SWAMPLAND LEGISLATION

When the United States acquired California, it became the proprietor of all land in the state which was owned by the Mexican government at the date of transfer. In the Sacramento-San Joaquin Delta there was relatively little private land. The grants previously discussed, though individually quite large, formed an insignificant part of the total acreage. The rest became subject to the public land laws of the United States. California became eligible to certain tracts for education and internal improvements which were allotted to all states under those laws, but which were generally scattered throughout the state. From the standpoint of the delta, the most important transfer to California was received in consequence of a special piece of legislation, the so-called Arkansas Act of September 28, 1850.[1]

Under the Arkansas or Swamp Land Act, Congress voted to cede swamp and overflowed public lands to certain states

---

[1]Background for this chapter was obtained from Commonwealth Club forums, the contents of which were recorded in: "Our Great Reclamation Problem," _Transactions_, I (May 1904); "Swamp Land Reclamation," _ibid_., IV (Sept. 1909). Primary sources were consulted as indicated.

on condition that the proceeds of the sale of such lands would be used to reclaim them. The Secretary of the Interior was authorized to make surveys of the lands coming within the meaning of the grant, and to prepare lists and maps specifying locations in the respective states. Upon request from the state governments the Secretary was to have patent issued to each state for its swamp and overflowed land.[2]

California ultimately received 2,192,506 acres of swampland grants,[3] of which approximately 500,000 acres were in the Sacramento-San Joaquin Delta. The disposition of these lands was complicated by the failure of the state and the federal government to agree on segregation lines before selling the land to settlers. Reasonably effective cooperation between the United States Land Office and the State Surveyor General did not occur until after 1859;[4] and it was July 23, 1866 before Congress provided for a review of surveys contested by the state.[5]

---

[2]84 U.S. Stat. at L. (1845-51), IX, 519; First Annual Report of the Swamp Land Commissioners (Sacramento: 1862), p. 9.

[3]"Report of the Director of the Bureau of Land Management, Statistical Appendix" (Washington: 1950), Table 106, "Acreage Granted to States and Territories," p. 126. (Mimeographed.)

[4]Annual Report of the Surveyor General for the Year 1860 (Sacramento: 1861), pp. 14-15.

[5]W. W. Robinson, Land in California (Berkeley: Univ. of Calif. Press, 1948), p. 192.

Defining Swamp and Overflowed Land

Among the duties assigned to the State Surveyor General when the office was created in 1850 was the presentation of plans and suggestions for the drainage of marshes and the prevention of overflows.[6] The first legislation which was concerned solely with reclamation of swamp and overflowed land was an "Act to Provide for Reclaiming Certain Swamp or Tule Lands, and for Agricultural Experiments Thereon," dated May 1, 1851. It granted 640 acres of Merritt Island to two men who were expected to report to the lawmakers within three years on the progress of levee, drainage, and cultivation experiments.[7] The grant, first and last of its kind, appears not to have been accepted. "Swamplanders" established in the vicinity had reacted negatively.[8]

The legislature was reminded of its responsibilities in swampland affairs by Governor John McDougal who, in his annual message of January 7, 1852, requested that the State Surveyor General be authorized to select the swampland, and that settlers be given the opportunity to secure land on the condition that they reclaim it within a certain period. This course, said the Governor, would create productive land which would:

---

[6] 104 _Stat. Cal_. (1850).

[7] 99 _Stat. Cal_. (1851), p. 409.

[8] Dana, _op. cit_., p. 159.

> contribute largely to the state treasury and induce a further immigration and settlement of the Chinese--one of the most worthy classes of our newly adopted citizens--to whom the climate and the character of these lands are peculiarly suited. The draining of these lands would also add largely to the health of the country in the vicinity. When thus drained, the tule lands, . . . , will become the most desirable lands in the state and capable of producing, in the highest degree of perfection, rice, sugar cane and other staple products, which cannot be grown in other portions of the state.[9]

The legislature responded by adopting a joint resolution addressed to the Governor, asking him to apply to the Secretary of the Interior for the needed surveys, to the end that patents for the acreage designated might be obtained at the earliest feasible date. Duplicates of the survey's field notes and maps for the state were requested also.[10]

Meanwhile, "swamplanders" and the Stockton newspapers began to press the legislature to expedite title clarification for swamp and overflowed lands. The settlers desired to build levees, but they hesitated making permanent improvements until they were certain of enjoying the benefits.[11] Two years later, in December 1854, the Sacramento County Surveyor reported that many settlers were located on swamp and overflowed land "with the expectation of purchasing, when titles can be procured," but that "such a contingency seems not, as yet, to have been provided for, or even contemplated. . . ." He suggested that the state prepare to

---

[9]Hittell, History of California, IV, 84-85.

[10]Joint Resolution in Relation to Swamp Lands, Approved March Twenty-sixth (1852).

[11]"San Joaquin News," SF Alta, Aug. 20 and 26, 1852, in BS, Set W 4, p. 1403.

dispose of the anticipated gift of land by forming a department authorized to function as state land offices did elsewhere.[12]

In 1855 the legislature finally passed an act to provide for the sale of swamp and overflowed land.[13] It added to the confusion of establishing titles. No provision was made for the state to refuse or adjudicate areally overlapping patent applications, and there was no provision requiring that land applied for as swamp and overflowed was truly of that nature.[14] The shortcomings were corrected during 1858 by the same legislation that created a Land Office to manage the state's interests in land acquisition and sale.[15]

Although there was apprehension in the state that the natural levees might be rigidly classified as federal land, the situation did not arise. Rather, it was the definition of outer swamp margins that caused conflicting claims between the federal government and California. The United States deputy surveyors usually performed their work in the dry

---

[12]"Report of the Sacramento County Surveyor" (December 4, 1854), Annual Report of the Surveyor General of the State of California (Sacramento: 1856), p. 43.

[13]151 Stat. Cal. (1855), p. 189.

[14]Annual Report of the Surveyor General for 1857 (Sacramento: 1858), p. 14; Annual Report of the Surveyor General of California for the Year 1862 (Sacramento: 1863), p. 10; Report of the Surveyor General of California from November 1st, 1865, to November 1st, 1867 (Sacramento: 1868), p. 11.

[15]176 Stat. Cal. (1858), p. 127.

season; they did not distinguish lands as being swamp and overflowed unless the condition existed at the time the lines were being run. The surveyors were not required to secure testimony to establish the character of the land in other seasons; that it might become inundated a month or two after being surveyed went unreported by the surveyors, whose compensation was based on land surface measured. The deputy surveyor's report was accepted as final by his superiors.

This was a situation which state authorities found most vexing because to establish that a United States survey was in error, and their own correct, they had to present the testimony of responsible surveyors or long-time, disinterested residents familiar with the tracts in question.[16] To reduce the incidence of disagreement the legislature authorized the Land Office to assign responsible surveyors to accompany United States survey parties. In the event that the segregation lines were incorrectly drawn the state's representative was expected to secure affidavits immediately in support of the position that the land in question was swamp and overflowed.[17] Yet, the procedure was not adapted early enough; in June 1861 the United States offered for sale 13,590 acres in Yolo and San Joaquin counties which the state

---

[16] _Annual Report of the Surveyor General for 1857_, _loc. cit._

[17] _Annual Report of the Surveyor General for the Year 1859_ (Sacramento: 1860), pp. 22, 23.

had sold previously as swamp and overflowed.[18] Another aspect of the survey work which produced disagreement was the surveyors' inclusion, as federal public lands, areas which owed their dry condition to levees which settlers had erected.[19]

Settlers of swamp and overflowed tracts had no desire to be included within the United States' domain. They were limited to a 160-acre pre-emption claim on federal land, while the state allowed possession of up to 320 acres of swamp and overflowed land. Furthermore, some had raised the value of their land to between $20 and $40 per acre with levees and other improvements; they had no wish to forfeit such land because of a United States acreage limit.[20]

California's dissatisfaction with United States segregation lines resulted in the state making its own surveys. On December 5, 1871, the Secretary of the Interior decided that the state was entitled to the land which it had segregated as swamp and overflowed. Lists of such land were prepared by the state for the Department of the Interior;

---

[18] _Annual Report of the Surveyor General for the Year 1860_, p. 12.

[19] _Ibid._, p. 16; _First Annual Report of the Swamp Land Commissioners_, p. 14.

[20] _Annual Report of the Surveyor General for the Year 1860_, _loc. cit._; _Report of the Surveyor General of California from November 1st, 1865, to November 1st, 1867_, _loc. cit._

approval of the surveys stilled the conflict between the two levels of government.[21]

Early Swamp and Overflowed Land Policy

The 320-acre limitation on purchases of swamp and overflowed land was established by the legislature in 1855, at which time the price was set at $1 per acre. Buyers had the option of paying in cash or controller's warrants, or of buying the land on credit. Those who bought the land outright were not required to reclaim it, but credit purchasers were obligated to reclaim half of their land within five years. If the buyer on time failed to reclaim, or did not pay the annual 10 per cent interest in advance, or neglected to pay off the principal and interest in five years, he forfeited the land. The provision that failure to pay interest in advance constituted a breach of contract was not properly understood by many settlers;[22] the legislature gave them an opportunity to reactivate their contracts with the state in 1859.[23]

In 1858 the second major piece of California legislation dealing with the disposition of swamp and overflowed land retained the 320-acre limit, abolished the credit

---

[21] <u>Biennial Report of the Surveyor General of the State of California, from December 4, 1871, to August 1, 1873</u> (Sacramento: 1874), p. 12.

[22] <u>Report of the State Land Commission to the Legislature of the State of California</u> (Sacramento: 1878), p. 39.

[23] 177 <u>Stat. Cal</u>. (1859), p. 180.

system, and required affidavits that patentees were obtaining true swamp and overflowed land with the intention of settling and reclaiming. To prevent a monopoly being made of the natural levees the new law restricted the frontage of claims to one-half mile along a lake, bay, or navigable stream. The restriction checked the possibility that any landowner could gain control of a large tract by refusing backswamp owners access to the river or to the best land for levee building. The act directed that revenue from swampland sales be paid into a Swamp Land Fund, but there was no requirement that the purchasers should reclaim land or that the funds be so used.[24]

Apparently the 320-acre limit was short of the expectations held by an important number of landowners. The Surveyor General proposed in 1857 that it be repealed.

> This restriction is operating injuriously to a large body of settlers, who have improved and reclaimed these very lands, yet who are unable to obtain a title. Some of these lands are valued at $20, and even $40, per acre; and if a title was given, they would materially increase the amount of taxable property. The amount of acres permitted to be purchased might be increased with benefit to the interest of the state, affording, as such increase would, inducements to the purchase and redemption of large tracts, now in many places almost impossible, from the difficulty of a combination of capital and labor among the proprietors of small tracts.[25]

---

[24] 235 Stat. Cal. (1858), p. 198; Annual Report of the Surveyor General for the Year 1859, p. 22.

[25] Annual Report of the Surveyor General for 1857, p. 15.

No action was forthcoming on repeal of the acreage limitation. The pressures for change continued, however. The San Joaquin County Surveyor, a proponent of large-scale work being done by men of capital, maintained that existing limitations retarded the rate of development in his county, and that the capitalists could find ways of evading restrictive legislation anyway.[26] Part of the difficulty which the 320-acre and the half-mile limitations raised in the delta, where islands were drained by innumerable sloughs, was that it often happened that a 160-acre parcel had frontage exceeding the legal limit. Islands of 320 acres with mile-long frontages on navigable channels were said to exist.[27]

Although the act of April 18, 1859 did increase the acreage limit to 640, thereby improving the frontage problem slightly, the San Joaquin County assessor claimed that, of 95,000 acres of swampland applied for in his jurisdiction, only 10 claims could be located in accordance with the law. It was impossible to return surveys for 640 acres with one-half mile frontages.[28] The act reinstated the credit system of swampland purchase. Buyers paid 20 per cent of the principal in cash and remitted the balance over a five-year

---

[26] "Report of the San Joaquin County Surveyor," Annual Report of the Surveyor General for the Year 1859, pp. 46-47.

[27] Ibid., p. 22.

[28] "Report of the San Joaquin County Assessor," Annual Report of the Surveyor General for the Year 1860, pp. 48, 49.

period, with interest payable in advance at a rate of 10 per cent per annum. The swampland purchaser no longer was required to affirm that his purpose was settlement and reclamation.[29]

Locating Swamp and Overflowed Tracts

The legislature's act of 1855 which provided for the sale of swamp and overflowed lands required that land purchasers pay the costs of surveying to the county surveyor and that the plat and field notes be filed with the county recorder; but no provision was made for a systematic survey of the land which the state was entitled to sell.[30] The legislature's neglect of this matter deprived both the state and counties of revenue. Settlers who had to pay the cost of extending the United States rectangular survey to their lands were inclined not to have the property mapped when the costs exceeded the property value. When United States survey lines were extended piecemeal into the delta by the county surveyors, confusion often resulted. Errors in the base-point location and in extending lines caused overlapping measurements and descriptions of property. As mentioned earlier,

---

[29] _Report of the State Land Commission . . . , loc. cit._

[30] _Annual Report of the Surveyor General for the Year 1857_, pp. 14-15; "Report of the San Joaquin County Surveyor," _Annual Report of the Surveyor General for the Year 1858_ (Sacramento: 1859), p. 41.

state surveyors made segregation surveys after 1861,[31] bringing system into mapping.

Board of Reclamation Commissioners

In creating the Board of Reclamation Commissioners by the Act of May 13, 1861,[32] the legislature embarked upon a new swampland policy. For the first time the state was to assume the responsibility for reclamation. Previously reclamation was left largely to the discretion of the land purchaser.

The board was empowered to authorize the formation of a reclamation district upon receipt of a petition representing owners of one-third of the acreage in an area "susceptible to one mode or system of reclamation." The conscientious commissioners chose to interpret that "all of the land susceptible of being reclaimed together, and contained within natural boundaries," would constitute an acceptable reclamation district. It was expected that the interpretation would result in orderly and economical reclamation of islands rather than the protection of natural levees or select sites to the exclusion of backswamp.[33]

---

[31] _Ibid._, pp. 46-47; _Biennial Report of the Surveyor General of the State of California, from December 4, 1871, to August 1, 1873_, _loc. cit._

[32] 352 _Stat. Cal_. (1861), p. 355.

[33] _First Annual Report of the Swamp Land Commissioners_, p. 116.

The reclamation districts were assigned numbers in accordance with the order in which the petitions for formation were received at Sacramento. When a petition was representative of the prescribed proportion of landowners, and the district appeared to be satisfactory as a physical unit, the state appointed an engineer to survey and estimate the cost of levee protection. Provision was made for survey and reclamation expenses up to $1 per acre to be paid from the Swamp Land Fund; overage was expected to be subscribed by benefited landowners. When it was realized that $1 per acre was insufficient and that landowners could not or would not subscribe the overage,[34] the board secured legislation authorizing county boards of supervisors to levy reclamation taxes in those districts where one-third of the landowners petitioned that it be done. The legislation was reduced in effectiveness by the stipulation that levies for the entire overage had to be assessed against property during one year.[35]

Financing reclamation in accordance with the reclamation board's program was difficult. Some landowners were against paying total reclamation costs through a single year's assessment and others opposed the taxation in any form. The opposition developed because some people could not afford the assessments; some who wanted the benefits

---

[34] *Ibid.*, pp. 10-11.

[35] *Report of the Board of Swamp Land Commissioners for the Years 1864 and 1865* (Sacramento: 1866), pp. 4-5.

would not accept responsibility for obtaining them; others, holders of higher land, did not wish to subsidize the protection of neighbors' backswamp; and a few opponents of reclamation taxes preferred to keep the swamp as unimproved pasture. As an alternative the board proposed that districts be reclaimed, one at a time, at the expense of the Swamp Land Fund. Costs incurred above the authorized $1 per acre were to be recovered by a levy on the land after reclamation.[36]

Before completing its fifth year of operation, the board was dissolved by the legislature. State officials as well as private parties had taken strong stands in opposition to its procedure and expenditures.[37]

County Administration of Swamp and Overflowed Lands

The duties of the Board of Reclamation Commissioners were transferred to the various counties upon the dissolution of the organization in 1868. County boards of supervisors and county surveyor offices became the responsible agencies

---

[36]Annual Report of the Surveyor General of California for the Year 1862, pp. 12-13; Illustrations of Contra Costa Co., . . . , p. 30.

[37]Annual Report of the Surveyor General of California for the Year 1862, p. 21; Annual Report of the Controller of State, for the Fifteenth and Sixteenth Fiscal Years, 1864 and 1865 (Sacramento: 1866), p. 10; Second Annual Report of the Board of Swamp Land Commissioners, cited in "History and Present Status of Reclamation Districts in California," Financial and General Data Pertaining to Irrigation, Reclamation and Other Public Districts in California, Calif. Dept. of Public Works, Div. of Water Resources, Bull. No. 37 (Sacramento: 1931), p. 135.

for handling swampland sales and reclamation,[38] although the state was to be informed of land sales and district formations. The framework within which the county boards worked was similar to the earlier one, but a new atmosphere fostered large-scale swampland ownership and development. Acreage limits were removed.

County boards of supervisors were authorized to form reclamation districts when owners of one-half or more of a swampland tract so petitioned. Instead of requiring a landowner's petition prior to making a reclamation assessment, the supervisors were authorized to accept the plans, estimates, and assessment requests presented by the district's elected trustees.

The law retained the $1 per acre sale price established for swamp and overflowed land in 1855, but the proceeds were paid into county swampland funds. Although the 20 per cent down payment was retained for long-term purchases, the buyer could be credited with payment in full if a commission of three persons certified that the district had been reclaimed and successfully cultivated for three years. This feature was further liberalized in 1872, when owners were enabled to acquire titles by expending $2 per acre for reclamation work or by having district trustees certify that reclamation had been completed. Most titles

---

[38] 215 Stat. Cal. (1867-68), p. 507; DWR Bull. No. 37, p. 111.

issued in 1873 were given on the basis of a $2 per acre expenditure.[39]

In contrast to district formation under the Board of Reclamation Commissioners, the supervisors did not insist that reclamation districts conform to topographic units. Districts conformed to property lines. Inclusions of districts within districts, as well as overlapping boundaries, occurred.[40] Among the inclusions were districts organized for the sole purpose of avoiding assessments while benefiting from the protection of levees raised by surrounding districts.[41] Since the one area in the delta where a county boundary bisected a topographic unit was in the then unreclaimable Yolo Basin, there were no unnatural borders resulting from political subdivisions.

Practically all of California's swamp and overflowed land was sold by 1871.[42] The rapidity with which large tracts had come under the control of single individuals after 1868 provoked such a strong public reaction that the legislature appointed an investigative committee. The committee's work resulted in the establishment of a 640-acre ownership

---

[39] 570 Stat. Cal. (1871-72), p. 835.

[40] Biennial Report of the Surveyor General of the State of California, from August 1, 1873, to August 1, 1875 (Sacramento: 1876), p. 12.

[41] DWR Bull. No. 37, p. 119.

[42] Statistical Report of the Surveyor General of California, for the Years, 1869, 1870, and 1871 (Sacramento: 1872), pp. 6-7.

limit for future swampland sales, but by that time the state's holdings had been exhausted.[43]

There were quite a few cases of impropriety and fraud in the purchase of swamp and overflowed land. Specific instances within the delta have not been documented as fraudulent but an editorial appearing in the February 14, 1878 San Francisco Chronicle raises suspicions. Yolo Basin landowners were charged with never having spent a dollar "towards their purchase or reclamation, unless it was in the nature of a fee to witnesses who bore false witness that they were fully reclaimed."[44]

A case of remarkable business acumen is indicated for one land agent, George D. Roberts, who claimed to have accumulated 250,000 acres of land in the vicinity.[45] Other California land agents were able to secure areas of land aggregating 2,000 to 120,000 acres between 1868 and 1871.[46] For instance, B. F. Mauldin, for whom Roberts seems to have been an agent, applied for patents to 84,000 acres in San Joaquin County, 20,000 in Yolo County, 3,000 or 4,000 acres

---

[43]DWR Bull. No. 37, p. 135.

[44]"A Pertinent Question," SF Chronicle, Feb. 14, 1878, in BS, Set W 34, p. 113.

[45]Report of the Joint Special Committee to Investigate Chinese Immigration, U.S. 44th Cong., 2d Sess., S. Rept. 689 (Washington: 1877), p. 441.

[46]Report of Special Committee on Resolutions of Mr. Barker, of Nevada, Concerning Land Monopoly, Etc. (Sacramento: 1872), p. 9.

in Sacramento County, and 8,000 acres in Solano County.[47] A form of collusion commonly practiced was for two or more persons to file applications for the same land, knowing that the resulting contest would hold the title indefinitely in abeyance. If a third party appeared who was willing to pay a premium price the contest could terminate, thereby clearing the way for the third person to secure the title. Another abuse that developed because of legal loopholes was the slowness with which sales were verified to the state and to local assessors. Assessors were not the only individuals uncertain about the status of property within their counties; settlers seeking land found state land offices less rewarding sources of information than agents who made a business of securing the swampland for speculation.[48]

Large-scale corporate and cooperative reclamation proceeded in the delta after the removal of the acreage limit in 1868, but a number of floodings interrupted reclamation and farming. It was difficult to complete three years of successful reclamation and cultivation; moreover,

> The majority of purchasers were laboring under a very onerous burden in the payment of assessments for /reclamation/, and were without means to pay the State in full for their lands. The lands themselves could not be hypothecated until they were patented by

---

[47]"Testimony Taken by the Swamp Land Investigating Committee," Reports of the Joint Committees on Swamp and Overflowed Lands, and Land Monopoly (Sacramento: 1874), pp. 40-41.

[48]*Ibid.*, pp. 10-14.

> the State; and the State could not issue patents until payment in full was made.[49]

The slow progress made in reclamation was partially attributed to the frequent tendency to have the work "prosecuted rather as a job for fat contract." There were instances, too, of district officials not paying for work performed, knowing that delays in completion would "freeze out" small landholders who were short of capital.[50]

While such practices undoubtedly curtailed the success of reclamation and agriculture, it is also true that the technical skills and financial resources were inadequate for the task involved. Floods, mining debris, and poor levee-making material were district problems. The prolonged nature of reclamation difficulties is suggested by the assertion that of an estimated 2,000,000 acres of swamp and overflowed land which the state had sold by 1878, most of which was patented, not over one-sixth had had any kind of reclamation achieved on it.[51] Seven years later the delta was stated

---

[49] Biennial Report of the Surveyor General of the State of California, from December 4, 1871, to August 1, 1873, p. 15.

[50] Munro-Fraser, History of Contra Costa County, citing Contra Costa Gazette (1876), p. 58. The impression that large operators tried to eliminate small farmers was more widely held than one reference suggests. For example, at least one refugee from the Grand Island flood of 1878 was certain that the flood suited the acquisitive nature of a large landholder. Small operators, who lacked capital to sustain losses, were expected to be forced to sell out. "The Flood," SF Chronicle, Feb. 26, 1878, in BS, Set W 34, p. 127.

[51] "A Pertinent Question," SF Chronicle, Feb. 14, 1878, in BS, Set W 34, p. 113.

to have had only one 8,000-acre tract which was completely reclaimed and reasonably safe. Another 75,000 acres were reclaimed in part and occasionally cropped.[52] Scores of reclamation districts were formed, broken up, and reorganized in the delta. Only District 3 (Grand Island) and District 17 (east of the San Joaquin and south of French Camp Slough) have preserved their organizational identity since formation in 1861.

From 1868 to 1911 the reclamation districts continued to form and operate under the aegis of the county boards of supervisors. The state exercised no control. The districts operated much as they chose. The honestly conceived districts had one objective: self-preservation; they generally built levees as large as possible. A tract's survival of critical flood stages often resulted because neighbors' levees collapsed first, thereby producing an appreciable lowering of water levels in the vicinity.[53]

The Reclamation Board

In 1911, when the legislature adopted the Major Project as a basin-wide plan for flood control in the Sacramento Valley, the state's authority over reclamation was restored.[54]

---

[52]"Reclamation of Marsh Lands in California," Pacific Rural Press, May 30, 1885, p. 510 (hereinafter referred to as PRP).

[53]Bailey, Appendix D, loc. cit., p. 156.

[54]25 Stat. Cal. (1911), p. 117.

The Reclamation Board, formed to administer the flood control program, was given authority to prosecute owners of reclamation works who did not conform to flood control plans. Effective August 10, 1913, virtually all of the swampland in the Central Valley was brought into the Reclamation Board-supervised Sacramento and San Joaquin Drainage District.[55]

The Reclamation Board was created at a fortuitous time. Swampland reclamation was then being extended into the area where the projected Yolo By-Pass was to go. Condemnation of improved land and contemplated levees would have been costly.[56] The board was beneficial, too, in requiring rectification of engineering defects in existing levee systems. Concerning existing levee systems in the state the board stated:[57]

> There are some large reclamation districts whose lines of levee have been so unwisely planned or placed, or improperly constructed, that these districts must either entirely change their plans or meet heavy annual expense to repair wash. There are certain districts whose levees have been so placed that no repair or construction, reasonably practical, can in the future, while the levees remain in that location, protect the districts from inundation. Levees have been so constructed on overflow channels as to cause ensmallment and choke off the channel at certain points, making inevitable a breach of the levee in heavy flood, on one side or the other. ("Overflow channel" as used in this report has reference to the space left in places

---

[55]170 Stat. Cal. (1913), p. 2520.

[56]Report of the Reclamation Board of California (Sacramento: 1913), p. 4.

[57]Report of the Reclamation Board of California (Sacramento: 1916), p. 5.

> between the natural bank of the stream and the levee, to accommodate the excess flow in flood season.) Again, with the hope of saving an acreage of rich land, or because the river bank offered better foundation for a levee, levees have been constructed without proper berm on the water side, or without revetment, and are subject to such wave action and wash that they must be repaired every year at heavy expense, and perhaps ultimately moved further back.

The adoption of the Major Project ushered in a decade of accelerated land reclamation. Large amounts of private capital were invested in Yolo Basin properties which had been viewed as poor reclamation risks earlier. Egbert, Liberty, Hastings, and the Netherlands Farms tracts, and Reclamation District 999 were developed.[58] Other factors prompting the extension of reclaimed land were the local successes of such crops as asparagus, beans, and celery, and the profitable nature of agriculture before and during World War I.

A number of the reclamation districts were reorganized during this period of optimism. The purpose was to sell tax-free bonds on the existing ready market. Proceeds were used to reimburse the land developers generously for their reclamation improvements, many of which had been completed years earlier.

By January 1931 a number of the bond-issuing reclamation districts were in deep financial difficulty. Eleven of the mid-delta districts (Bouldin, Webb, Venice, Medford, Mandeville, Bacon, Empire, King, Bishop, Holland, and Orwood)

---

[58] Control of Floods on the Mississippi and Sacramento Rivers, p. 132.

had defaulted to the total extent of over $1,900,000 in either principal or interest payments, or both. The general agricultural depression, overcapitalization, unreasonable amortization programs, and management shortcomings precipitated the difficulties. Reorganization plans were worked out which provided for an exchange of district bonds for mortgage bonds of operating companies or for stock in new operating companies. The recovery programs were known as the Borden, Rindge, Empire, and Delta plans.[59]

Today the reclamation districts are primarily concerned with the mechanical problems of maintaining levees and drainage ditches. The vicissitudes of the past do not appear to be of much concern.

---

[59] DWR Bull. No. 37, pp. 137-41.

CHAPTER IX

RECLAMATION SEQUENCE

In choosing to alter the normal floodplain function of the Sacramento-San Joaquin Delta, reclaimers assumed a long-term task that was laborious, costly, and frequently disheartening. Many individuals were ruined in the process, but failures afforded the opportunity for others to apply fresh ideas and capital to the problem of achieving permanent reclamation.

The process of reclaiming the swamp and overflowed land began in the early 1850's with individual settlers who, acting independently, constructed low earth barriers to withstand seasonal flood crests. Gradually owner-operators of the natural levee farms pooled their resources to develop uniform river front levees. Between 1861 and 1866 the reclaimers formed districts which, with the technical assistance of a State Board of Reclamation Commissioners, attempted to enclose large areas bound by natural levees. The period of a centrally supervised approach to the problem was superseded by an era of strongly competitive, frequently irrational, independent levee building by reclamation districts. After 1868, when a repeal of the 640-acre ownership limit occurred, wealthy individuals and corporate speculators undertook extensive reclamation operation. Land developers overshadowed individual settlers as the moving force in bringing land into cultivation; their operations generally occurred in tidal backswamps or on islands where natural levee development was modest. Reclamation of such areas required labor, skills, and equipment which only the capitalists could underwrite. The projects were undertaken usually with the intention of leasing reclaimed land, although some developers participated in farming on a large scale and one or two sold property as family farms. The development of tenant farming was accompanied by a trend toward crop specialization; these characteristics persist in delta farming. They apply even in those first reclaimed higher alluvial lands which were developed by owner-operators.

Reclamation works have evolved from small ribbons of mounded earth to massive flat-top ridges 100 feet wide at the base and 25 or 30 feet high. Accessory features of these levees are drainage canals and large pumps. The canals have existed since reclamation began but pumps were introduced in the 1870's. Channel alluviation and farm land subsidence necessitated the introduction of mechanical means for land drainage.

A variety of techniques and tools have been employed in reclamation. They were devised during a constant search for cheaper and more effective ways of leveeing, ditching, and draining land. Their usefulness was seriously curtailed until about 40 years ago when comprehensive flood control measures were introduced to the Central Valley by the state and the federal government. Since virgin land reclamation ended in the early 1920's, the principal concern of districts has been with maintenance. This responsibility weakens as the governments become committed to engineering programs designed to alleviate California's water problems.

Reclamation Initiated

Julian Dana, in The Sacramento: River of Gold, published in 1939, states that Robert Kercheval was remembered to have constructed a levee on the northern end of Grand Island in 1850.[1] This was possible, for winter floods in 1849-50 demonstrated the need by covering virtually all of the lower Sacramento floodplain. The legislature contemplated such construction in May 1851 when it granted 640 acres on Merritt Island to two men so they might experiment in leveeing and farming.[2] Nevertheless, no contemporary evidence has been discovered that documents construction of levees in the delta prior to 1852.

In 1852 and 1853 the expediency of leveeing became generally recognized. A flood in June 1852 covered San

---

[1] Dana, loc. cit.

[2] The awarding of the grant neither confirms nor denies the pre-existence of man-made levees along the river, although it may suggest that there had been no local experience with such theretofore. In any case, the experiment did not materialize. Residents of the area were too aroused over the legislature's munificence. Ibid.; 99 Stat. Cal. (1851), p. 409.

Joaquin River banks, causing the local press to urge adoption of a reclamation plan to prevent the abandonment of the land.[3] During midwinter 1852/53, and in 1855, 1857, and 1859, inundations in the lower Sacramento Valley demonstrated the necessity for levee protection.[4] Yet there was reluctance to invest in costly permanent improvements like levees because of the legislature's failure to enact laws that would assure clear titles to swamp and overflowed land. Moreover, some people held the view that no matter how much cash and effort were expended to build dikes, the Sacramento floods would continue to be so great, so prolonged, and so difficult to carry off by artificial channels that the overflowed land was promising only for hay production.[5]

The earliest artificial leveeing was done on the higher natural levees first appropriated by settlers. In 1852 there were levees on Merritt Island[6] and on the east bank of the Mokelumne above its fork.[7] Levees were common along the Sacramento east bank in 1852-53; and they appeared

---

[3]"San Joaquin News," SF Alta, June 6, 1852, in BS, Set W 4, p. 1397.

[4]Tom Gregory et al., History of Solano and Napa Counties, California, with Biographical Sketches (Los Angeles: Historic Record Co., 1912), p. 67; testimony of Josiah B. Greene, Evidence Taken Before the Swamp Land Committee (Sacramento: 1861), p. 8.

[5]F [Flint], "Reclamation of Tule Lands," The California Culturist, III (Sept. 1860), p. 111.

[6]Dana, loc. cit.

[7]An Illustrated History of San Joaquin County, p. 222.

on upper Tyler and Grand islands.[8] By fall of 1853 a one-foot levee offered some protection to land in the vicinity of the Calaveras River mouth.[9]

Most of the low artificial mounds, appropriately named "shoestring" levees, were capable of withstanding little more than a high tide. The major exception was a substantial structure which was raised on the northern end of Grand Island by the customary shovel and wheelbarrow brigades of Chinese, Indians, and Hawaiians. The artificial levee which was superimposed upon the outer edge of the natural levee had a 13-foot base and a 3-foot height and crest. The earth for this 12-mile-long embankment was removed from the interior of the island. Total costs exceeded $12,000.[10]

After 1855 more industry was shown in levee construction. Grand Island led the way. By 1856 or 1857 an irregular ridge of varied proportions, aggregating 18 miles, enclosed the northern apex of the island.[11] The landowners, particularly the wealthier ones, were determined to enclose the entire island. Along the Sacramento east bank as far south as Brannan Island were discontinuous ridges two to four

---

[8] Evidence Taken Before the Swamp Land Committee, loc. cit., p. 2; Report of the Commissioner of Public Works [1894], p. 14; "Up the Sacramento," SF Call, Oct. 16, 1877, in BS, Set W 3, p. 1064.

[9] "San Joaquin News," SF Alta, Dec. 12, 1852, in BS, Set W 4, p. 1412.

[10] Dana, op. cit., p. 161; Report of the Commissioner of Public Works [1894], loc. cit.

[11] Ibid.

feet high and six or eight feet across the base. Sherman Island, first occupied in 1855, had some small dikes in place by 1859.[12] In the southern delta similar disconnected levees of irregular design appeared on Roberts and Union islands as early as 1856 and 1857, respectively.[13] Beginning in 1859 there were levees constructed near the mouth of Marsh Creek, about nine miles east of Antioch.[14] The east bank of the San Joaquin south of French Camp Slough was partially leveed by 1861.[15] Among the levees of the southern delta one on Union Island was probably remembered because its size was unusual. It had a 16-foot base width, 6-foot crown, and a height of 3 to 3.5 feet.[16]

Projects of the Board of Reclamation Commissioners

The reclamation activity of the early 1860's, well recorded by the supervisory Board of Reclamation Commissioners, was approached with a breadth of concept unequalled for decades afterward. A number of projects of some magnitude were undertaken. Plans were drawn for the protection of the Sacramento Basin, the Yolo Basin, and several islands.

---

[12] *History of Sacramento County, California* (Oakland: Thompson and West, 1880), p. 220; *Report of the Commissioner of Public Works* [1894], pp. 12-13.

[13] *Ibid.*, pp. 16, 17.

[14] *Illustrations of Contra Costa Co., . . . , loc. cit.*

[15] *First Annual Report of the Swamp Land Commissioners*, p. 13.

[16] *Report of the Commissioner of Public Works* [1894], *loc. cit.*

A project to protect Sacramento and to "very effectually" reclaim the Sacramento Basin was to incorporate 37 miles of levee and a floodgate with which to discharge gravity drainage to the south. The levee, to consist of segments varying from 2.5 to 8 feet high, was expected to cost $30,000.[17] Within four years it was necessary to raise estimates to $88,000.[18] Had expenses remained within the estimates, the per acre cost of leveeing and drainage would have been $1.86. However, the project died along with the board. Finances became so entangled thereafter that cumulative or per acre costs for the area can never be known.[19]

An integral part of the board's plans for the reclamation of the entire Yolo Basin north of Cache Slough and Ryer Island was a longitudinal drainage canal. Together with laterals that tapped the sinks of Cache and Putah creeks, this canal had an aggregate length of 25 miles. It was completed to tidewater at Cache Slough in November 1864. The expectation was that by accelerating flood runoff and swamp drainage the ditch would facilitate earlier use of the Yolo Basin pastures than existing conditions permitted. Also with the expectation of reducing the flood problem, contracts were let for the construction of a levee to follow

---

[17] _First Annual Report of the Swamp Land Commissioners_, p. 14.

[18] _Report of the Board of Swamp Land Commissioners for the Years 1864 and 1865_, p. 4.

[19] _History of Sacramento County_, pp. 187-88.

along the Sacramento west bank from Knight's Landing (west of the Feather River mouth) to just north of Ryer Island and Cache Slough. The structure contained an average of about one cubic yard of fill per linear yard. It was to have been completed by December 1, 1865, but the business failure of one of the major contractors ended the work before one-half had been completed.[20] Since the board was allowed to go out of existence the Yolo Basin project was never completed.

Ryer Island was another Yolo Basin area where levee construction was carried out under the aegis of the state organization. Four sloughs were dammed and perhaps 10 or 11 miles of levee constructed between June and December 1865.[21] Thereafter activity ceased for some years.

In the area to the south of the Mokelumne River and east of the South Fork a reclamation district was organized to levee an estimated 24,500 acres. In 1865 a drainage ditch was dug across the area from the Mokelumne to Beaver Slough so that the congestion caused by converging Mokelumne and Cosumnes flows could be alleviated. Levees and higher alluvial land were protected by the ditch at the same time that it drew water through the lower part of the basin. It was expected that the alluviation would facilitate eventual reclamation of the lower land.[22] Some 10 miles of low embankment

---

[20] Report of the Board of Swamp Land Commissioners for the Years 1864 and 1865, pp. 10-11.

[21] Ibid., p. 13.

[22] First Annual Report of the Swamp Land Commissioners, p. 16; Report of the Board of Swamp Land Commissioners for the Years 1864 and 1865, p. 6.

which had been under construction along the river since before 1861 were extended and strengthened during 1865. Beginning in the latter year, reclaimers started to levee the Mokelumne north bank and the adjacent lower Cosumnes.[23] Comparatively little success visited efforts in this area until recently. The reclaimers to the south have had better luck over the years, although flooding has been a frequent experience.

Bright spots of reclamation achievement during and after the board's existence were Grand Island and Reclamation District 17. In 1861 it was anticipated that the island was reclaimable for $1 per acre,[24] but a flood in 1861-62 caused the estimate to be revised upward. Levees were rebuilt, strengthened,[25] and extended into an earthen rampart which by 1868 averaged 27 to 30 feet base width, 6 feet high, and which possessed an outer slope of 2.5 to 1 and an inner slope of 1.5 to 1. The protection, elaborate for the period, was beginning to cost landowners about $5 per acre. It was completed in 1872. By then some parts of the levee were 8 feet high, 3 feet broad at the crown, and 30 to 40

---

[23]Ibid., p. 12.

[24]At the time, 15,074 acres had been purchased from the state, and 2,295 acres of swamp awaited buyers. First Annual Report of the Swamp Land Commissioners, p. 15.

[25]Report of the Commissioner of Public Works /1894/, loc. cit.

feet across from toe to toe.[26] Reclamation District 17, to the east of Roberts Island, was completely leveed under a program commenced earlier but completed under the supervision of the Board of Reclamation Commissioners. The 6,540-acre tract was surveyed, diked with 65,100 cubic yards of fill, and drained for $18,600. The levees were smaller than Grand Island's works but the 2.5 cubic yards that went into each linear yard of protection gave the district better than the average protection of the period.[27]

Although individual reclamation plans were prepared for Andrus, Brannan, Tyler, and Staten islands, and work was performed, no island enclosures were completed for six or more years.[28] An interesting aspect of the Staten Island work was the employment of a mechanically powered device to place fill onto the levee. The machine was developed in 1865 by J. T. Bailey, contractor in charge of the Staten Island reclamation.[29] As far as has been learned, this was the

---

[26]Ibid., p. 13; History of Sacramento County, p. 188; I. N. Hoag, "Farmer's Gardens," California State Agricultural Society, Transactions During the Years 1870 and 1871 (Sacramento: 1872), p. 340.

[27]First Annual Report of the Swamp Land Commissioners, p. 13; Report of the Board of Swamp Land Commissioners for the Years 1864 and 1865, pp. 9-10.

[28]First Annual Report of the Swamp Land Commissioners, p. 18; History of Sacramento County, loc. cit.; Report of the Commissioner of Public Works /1894/, loc. cit.; DWR Bull. No. 37, p. 116.

[29]Report of the Board of Swamp Land Commissioners for the Years 1864 and 1865, p. 4.

first case in which a mechanical device was used in delta reclamation.

The comprehensive leveeing program which was launched by the board resulted in some extension of reclaimed land, but it is doubtful that the aggregate of moderately flood-secure improved land exceeded 10,000 or 15,000 acres (see Map 16, p. 219).[30] The land occurred in thin strips along the higher natural levees of the major distributaries and in leveed pasture areas. Most of it is unmapped.

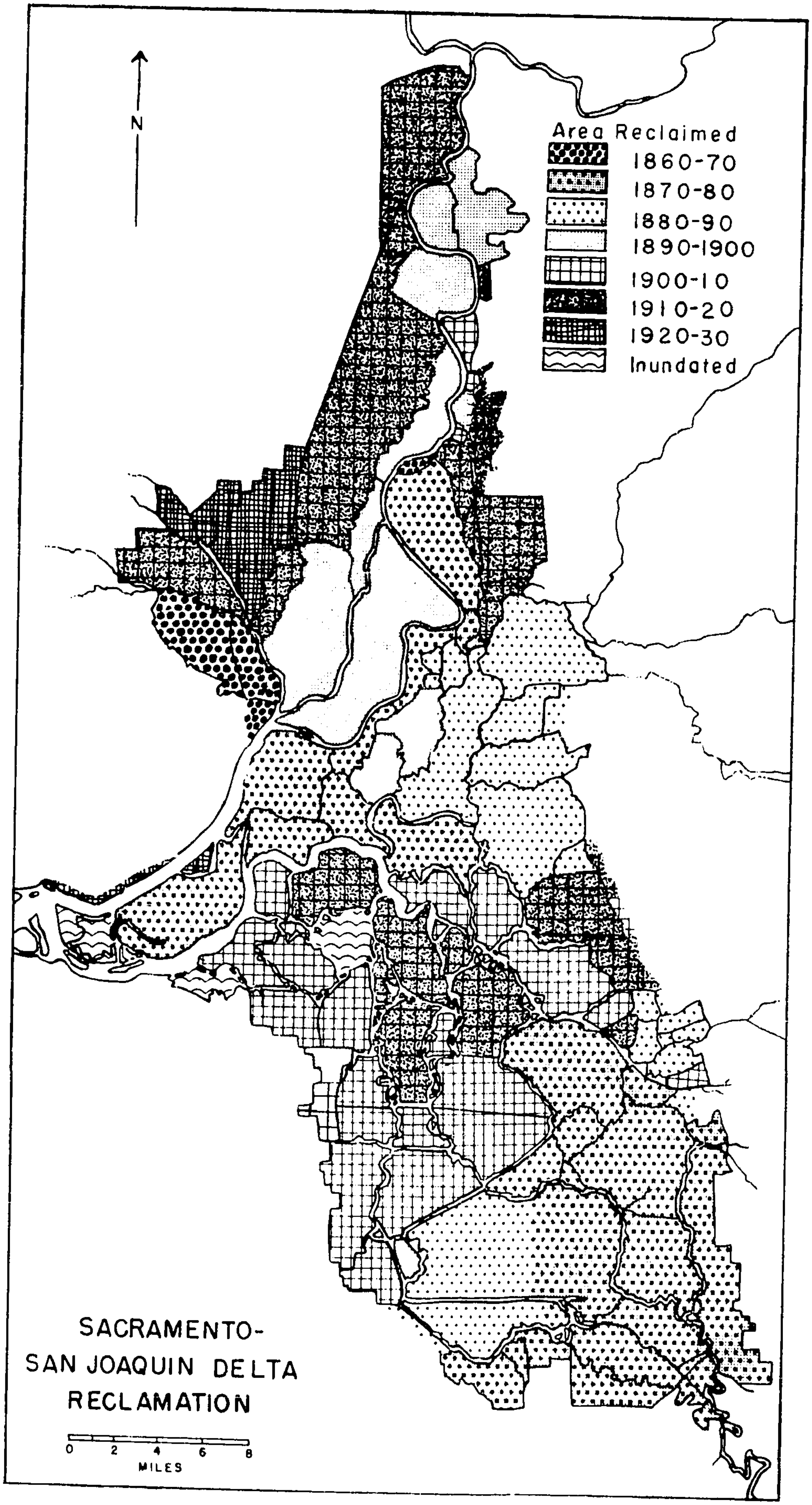
Independent Reclamation

Local control of reclamation activities characterizes the half-century after the dissolution of the Board of Reclamation Commissioners in 1866. A second characteristic of the period was the participation of land agents and of land development companies in most undertakings. Reclamation was a large-scale money-making proposition for absentee investors and for a few agents and entrepreneurs who directed work in the delta. In the course of the operations which these men financed and directed, important reclamation techniques and equipment were developed. Machine power was applied to dredging, levee building, ditching, and land clearing; and pumps were introduced to control water levels on the reclaimed land.

---

[30] DWR Bull. No. 27, p. 158. This writer, after evaluating materials in his personal files, is in reasonably close agreement with the Division of Water Resources estimate.

MAP 16


N
Area Reclaimed
1860-70
1870-80
1880-90
1890-1900
1900-10
1910-20
1920-30
Inundated
SACRAMENTO-
SAN JOAQUIN DELTA
RECLAMATION
0 2 4 6 8
MILES

Once land was ready for cultivation, the owners could expect to profit in the form of greatly enhanced land prices or high rentals. Few contemplated farming the land themselves, but counted on attracting the capitalistic type of agriculture which even in the earlier years had proven to be most adaptable to delta conditions.

There were several factors which aided the land developers in attracting farm operators to the delta. The soils were remarkably productive, and ample moisture was available in the growing season. In addition to being one of the few drought-free agricultural regions of California, the delta had the obvious advantages of access to miles of navigable channels and close proximity to the great trade centers of San Francisco, Sacramento, and Stockton. The California wheat boom fostered extensive grain farming, while completion of the transcontinental railroad expanded formerly restricted markets for fruit and vegetables.

Activity in swampland reclamation drew more attention from contemporary Californians than any other speculation of the period 1869-72;[31] and over the next two years the work was "vigorously prosecuted" in all swamp and overflowed areas of the state.[32] Then, and for years thereafter, the delta

---

[31]John Ross Browne, "Reclamation and Irrigation," Calif. State Agric. Soc., Transactions of 1872 (Sacramento: 1874), p. 406.

[32]Biennial Report of the Surveyor General of the State of California, from August 1, 1873, to August 1, 1875, p. 11.

was the focal scene for such activity. San Francisco, Oakland, Los Angeles, British, and local capital was involved. It functioned through such agencies as the Tide Land Reclamation Company, the Glasgow-California Land and Reclamation Company, and through partnerships or family developers.[33]

The droughts that ruined San Joaquin Valley wheat and barley crops enhanced delta land values and prospects.[34] Even where dry farming had been mastered the yields did not compare with those recorded on the delta's organic soils, and the dry winters which reduced yields elsewhere produced the low water levels in the delta which facilitated levee construction and breaking of the tule soil.[35] In the light of such circumstances the Alta of July 25, 1869 editorialized:[36]

> In these reclaimable lands we shall have drought-proof means of life and luxurious living for the whole population of our State, were it twice as numerous. Heretofore the certainty of occasional famine years has been a dark cloud on the horizon before the thoughtful vision. Now we see salvation. All hail! to the great minds that have conceived this enterprise. God speed their success and bring them rich reward.

---

[33]Capital was available to borrowers at 2 or 3 per cent per month. Browne, loc. cit.

[34]Report of Special Committee on Resolutions of Mr. Barker, of Nevada, Concerning Land Monopoly, p. 5.

[35]"Our Reclaimed Tule Lands," PRP, April 3, 1875, p. 1; "Cultivation of the Tule Land," SWI, Jan. 18, 1879, p. 5.

[36]Cited in Tide Land Reclamation Co., Fresh Water Tide Lands of California (1869), p. 27.

During the decade after 1868 the good fortune of various reclamation projects gradually weakened such reservations as the public and investors might have entertained about the future of tidal swamps in the delta. Land values in reclaimed tracts appreciated sharply and magnificent crops and profits were realized at comparatively low cost.

> Assuming that only two thirds of every tract sown in wheat will, for a time at least, be cultivated with care, the average result for the whole would be twenty-six and sixty-six one hundredths bushels, which, at one dollar and twenty cents per bushel, would amount to thirty-two dollars gross. The average cost of plowing, seeding, harvesting, sacking, and transportation, is about fifteen dollars to the acre, leaving, as the net result, seventeen dollars per acre, which in most cases will pay for the land and the cost of reclamation in a single year. But to this may be added, as clear profit, the hay or grain resulting from the volunteer crop after the first harvest--worth, say ten dollars an acre.[37]

Initially the entrepreneurs were overconfident. They seemed to think that reclamation procedures had been mastered. On the basis of experience gained earlier on Sherman, Twitchell, Andrus, and Bouldin islands, levee builders had come to believe that security from ordinary floods and high tides could be obtained with artificial levees raised three feet above the surface of the natural levees; another two or three feet of freeboard, and commensurate breadth of levee, were considered adequate to withstand the exceptional flood.[38]

---

[37]Browne, loc. cit., p. 400.

[38]Tide Land Reclamation Co. (1869), op. cit., p. 15, quoting "Report of Sherman Day"; "Reclamation of Swamp Land by Steam Power," MSP, March 20, 1869, p. 190.

The fallacy of these beliefs was demonstrated by the inundations that occurred annually between 1871 and 1881; the general floods of 1878 and 1881 shattered optimism that delta reclamation was practicable. In 1878 the Bulletin of San Francisco editorialized that it was of no use to try to levee against all floods. Delta residents and landowners were advised to build mounds high enough to protect houses and barns from the major floods, and to be content with levees that held off the tide and the lesser floods.[39] Deep pessimists saw reclamation as a thing of the past.[40]

Through the misfortunes there were tracts which, because of location, desperate labor, engineering skill, and luck, remained intact long enough to make the work seem worthwhile. At the same time it was realized that floods and mining debris could at any time bring to them the disasters which had destroyed other projects, and that even the wealthiest and most ingenious entrepreneurs could not continue indefinitely in the competition of building and rebuilding an island's levees higher than the defenses on neighboring islands or mainland tracts.[41] Relief was sought

---

39"The Sacramento Delta," SF Bulletin, Feb. 26, 1878, in BS, Set W 34, p. 125.

40M. M. Chipman, "Mining Debris Deposits," Report Made to the Medical Society of the State of California, at the Annual Session, Held at San Francisco, April 1881, in Report of the Committee on Medical Topography, Meteorology, Endemics, and Epidemics (San Francisco: W. M. Hinton and Co., 1881), p. 16.

41It was realized that some levees had to fail during a flood and that one might avert disaster if breaking levees elsewhere resulted in lower water levels. Report of the through judicial and political channels; delta interests were instrumental in making flood control and mining debris major political issues.

A few people recognized that there was more to delta floods than mining debris and natural phenomena; the defects of reclamation procedure were clearly recognized at least as early as 1872. There was an awareness that continued reduction of floodplain area led to high flood stages, and that building levees with a light and oxidizing material was dangerous.[42] Beavers were known to excavate chambers into the levees, thereby weakening the structure.[43] Other reasons for failure were attributed to underinvestment in levees and the promoters' ignorance of engineering and hydraulic matters.[44] Moreover, there was "a want of system"; swamp-land reclaimers were unwilling or unable to recognize that their own unco-ordinated and improperly engineered works were, along with the elements and mining debris, producing the floods.[45] In the middle 1880's reclamation was

---

Commissioner of Public Works [1894], p. 15; Robert Devlin, "Swamp Land Reclamation," (address), Commonwealth Club of Calif., Transactions, IV (Sept. 1909), p. 292.

[42]Browne, loc. cit., p. 397.

[43]Nordhoff, op. cit., p. 130.

[44]Observations of the experienced land developers E. F. Smith, James T. Stratton, and Thomas H. Williams in "Reclamation of Marsh Lands in California," PRP, May 30, 1885, p. 510.

[45]Marsden Manson, "The Swamp and Marsh Lands of California," Technical Society of the Pacific Coast, Transactions, V (Dec. 1888), p. 96.

"generally regarded as a question for the next generation to solve."[46]

The Large-Scale Reclamation Operators

The capitalists who participated in the reclamation of swamp and overflowed land were organized into companies, or they operated in partnerships or as individuals. The largest companies that operated between the late 1860's and the 1880's were the Tide Land Reclamation Company, directed by George D. Roberts, and the Glasgow-California Land and Reclamation Company, directed and largely owned by the Scotsman Morton C. Fisher. Among the individuals who were major landholders and developers were Thomas H. Williams, whose properties lay in both the Sacramento and San Joaquin deltas; Henry E. Naglee, who operated in the San Joaquin-Old River vicinity; S. C. Hastings, a central delta reclaimer; and Ross C. Sargent, an operator of the Mokelumne River vicinity. After the 1880's and 1890's the major land reclaimers were the Old River Land and Reclamation Company, the California Delta Farms Company, the Rindge Land and Navigation Company, the Bay and River Dredging Company, the Staten Island Land Company, W. H. Wolf and Sons, the Liberty Farms Company, the Holland Land Company, and the Prospect Island Farms Company. Most of their work was performed in the central delta or in the Yolo Basin.

---

[46]Statement of James T. Stratton, "Reclamation of Marsh Lands in California," PRP, May 30, 1885, p. 510.

Tide Land Reclamation Company

George D. Roberts' interest in the delta is understood to have arisen in 1869 as a result of a view which he had of the reclamation work then in progress on Sherman Island. He appears to have determined that increases in land values in consequence of reclamation might bring higher returns than were assured by investment in mining property.[47] His first direct participation as a land agent appears to have been in connection with Twitchell Island. This property had been purchased by B. F. Mauldin in 1868, after the 640-acre limitation was removed. Although Mauldin had farmed and may even have done some levee building on the island,[48] it was not until he arranged to have Roberts find some development capital that Twitchell Island became well publicized.[49]

According to Roberts he accumulated 250,000 acres of delta land by quietly buying out swampland claims for from fifty cents to $3.00 per acre, in addition to fees.[50] How much of his own money was used is unknown, but Roberts approached Oakland and San Francisco capitalists for backing to form the Tide Land Reclamation Company.[51]

---

[47]Hoag, loc. cit., p. 339.

[48]Tide Land Reclamation Co. (1869), loc. cit.

[49]"Testimony Taken by the Swamp Land Investigating Committee," Reports of the Joint Committees on Swamp and Overflowed Lands, and Land Monopoly, pp. 42, 45.

[50]Report of the Joint Special Committee to Investigate Chinese Immigration, loc. cit.

[51]Among his backers were Lloyd Tevis, A. C. Peachy, S. Heydenfeldt, Robert Watt (State Controller), Charles H.

Roberts' Tide Land Reclamation Company was capitalized at $12,000,000. To it were transferred 120,000 acres of the land that he purchased. The property was located in the Yolo Basin, the backswamps to the south of Courtland, Grand Island, Brannan, Twitchell, Andrus, Tyler, Staten, Roberts, and Union islands, and in the east central delta.[52] (For the location of company lands, see Map 17, p. 228.) Some parts of the domain were sold to individuals who established their own reclamation companies. An example of this is provided by the holdings which lay directly east of Roberts Island. These were reclaimed by S. C. Hastings and associates.[53] Some of the Tide Land Reclamation Company property was partially improved before being sold to other developers. Such property was involved in the transfer of Union and Grand islands and the Yolo Basin properties to T. H. Williams, and the transfer of Roberts Island holdings to J. P. Whitney, which occurred in 1875. It is surmised that floods in 1871 and early 1875 did enough damage to company investments that selling was expedient. Roberts suffered other reverses in the Webb Tract and Jersey Island vicinity during the early 1870's; however, this land development program

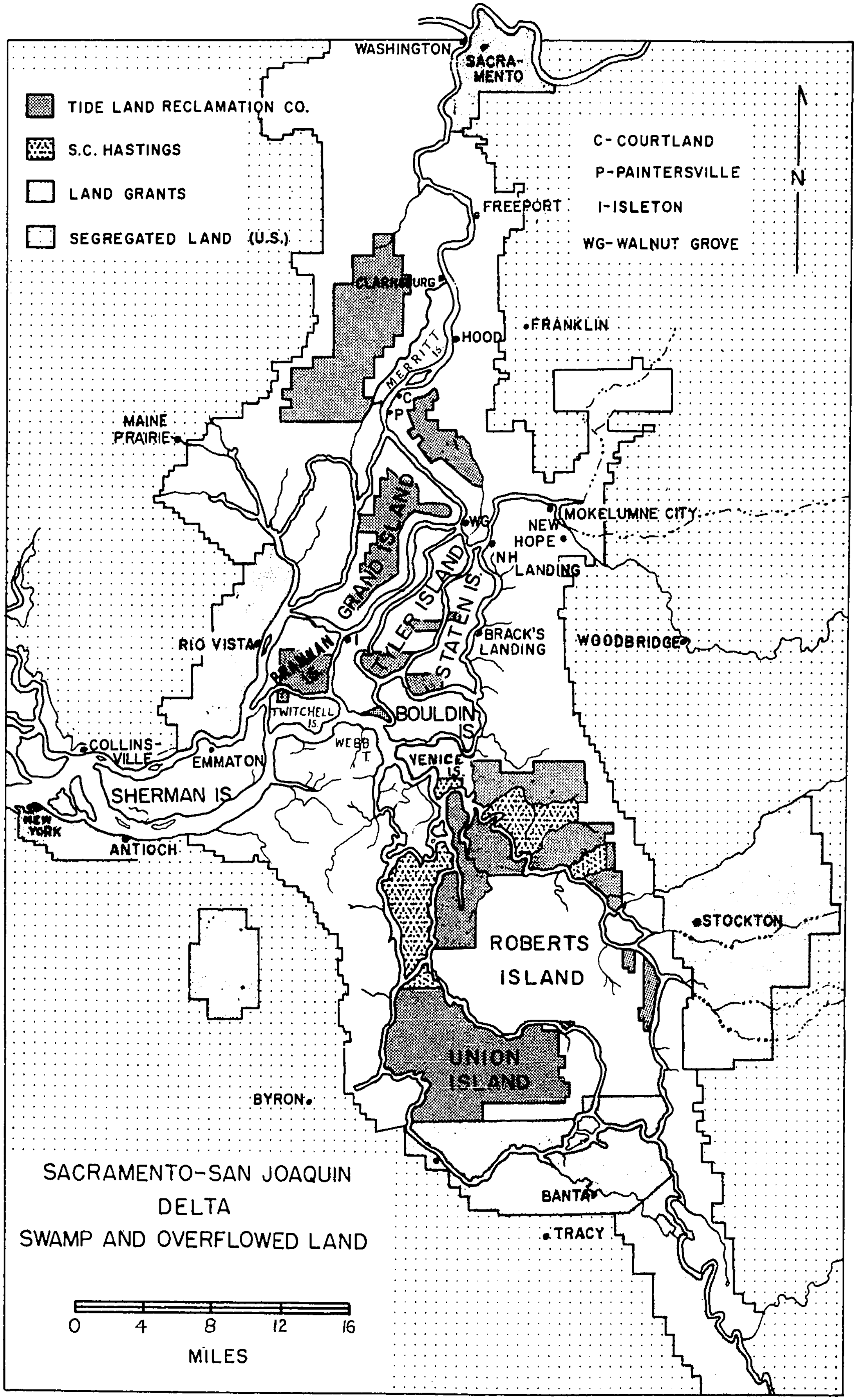
---

Burton, and William Doolan. Tide Land Reclamation Co. (1869), _op. cit._, p. 2.

[52]_Ibid._, p. 5; "Reclamation of Swamp and Overflowed Lands in California," _Report of the /U.S./ Commissioner of Agriculture for the Year 1872_ (Washington: 1874), p. 181.

[53]See "Calaveras Tracts," Appendix B.

MAP 17


WASHINGTON
SACRAMENTO
TIDE LAND RECLAMATION CO.
S.C. HASTINGS
LAND GRANTS
SEGREGATED LAND (U.S.)
C-COURTLAND
P-PAINTERSVILLE
I-ISLETON
WG-WALNUT GROVE
N
FREEPORT
CLARKSBURG
HOOD
FRANKLIN
MERRITT IS.
MAINE PRAIRIE
MOKELUMNE CITY
NEW HOPE
NH LANDING
GRAND ISLAND
TYLER ISLAND
STATEN IS.
BRACK'S LANDING
WOODBRIDGE
RIO VISTA
BRANNAN IS.
TWITCHELL IS.
BOULDIN IS.
WEBB T.
VENICE IS.
COLLINSVILLE
EMMATON
SHERMAN IS.
NEW YORK
ANTIOCH
STOCKTON
ROBERTS ISLAND
UNION ISLAND
BYRON
BANTA
TRACY
SACRAMENTO-SAN JOAQUIN DELTA
SWAMP AND OVERFLOWED LAND
0 4 8 12 16
MILES

was not attempted as a Tide Land Reclamation Company operation.[54]

The Tide Land Reclamation Company's first and greatest success was registered on Twitchell Island, where it began levee construction in 1869. Chinese laborers were contracted to build the 3.5-foot-high and 12-foot-broad (base) levees at fifteen cents per cubic yard emplaced.[55] The embankment was completed in 1870, but not in time to allow the interior of the island to "dry out" sufficiently for burning preliminary to seeding a winter crop of grain. Only 1,000 acres of wheat were planted on the drier periphery of the tract. By October of 1871 the center of this 3,680-acre island was dry enough to be burned, seeded, and tramped by sheep.[56] Reclamation costs were about $12 per acre.[57]

As soon as the levees were completed, the island was sold to Minor, Prather & Company, which paid $68,000, or about double the cost of reclamation. Roberts and other Oakland investors were among the backers of the purchasing company. The company immediately undertook to farm the island as a large-scale commercial enterprise. In the first year of operation 1,000 acres reportedly returned a 40-bushel

---

[54]See "Union Island," "Grand Island," "West Delta Districts," Appendix B.

[55]Tide Land Reclamation Co. (1869), loc. cit.

[56]Hoag, loc. cit., pp. 343-44.

[57]Browne, loc. cit., p. 401.

average wheat crop worth $67,000. The stubble was browsed by sheep which also trampled in a volunteer second wheat crop. A few thousand dollars were realized from summer truck crops as well.[58] Water damaged the wheat crop of 1871/72 but the 1872/73 season produced up to 80 bushels per acre on 1,500 to 2,000 acres.[59] Experiments were undertaken with ramie and jute in 1873 and 1874.[60] Levees were strengthened in 1871 and 1874 at an expense of $43,200;[61] unfortunately, the foresight was not rewarded. The levees collapsed in January 1875, drowning some 800 sheep and other stock.[62] The 1878 flood demoralized farming operations for at least two years.[63] It may have ruined Roberts; he does not appear to have participated in subsequent delta reclamation work. As far as is known, no further attempt to reclaim Twitchell Island occurred until after the reclamation district was reorganized in 1893.[64] The fresh generation of owners was to see the continuity of agricultural enterprise interrupted by levee breaks in July 1906, March 1907, and January 1909.

---

[58] Tide Land Reclamation Co. (1872), op. cit., p. 31.

[59] Ibid.

[60] Nordhoff, op. cit., p. 133.

[61] History of Sacramento County, p. 189.

[62] "Twitchell Island Submerged," SWI, Jan. 23, 1875, p. 7.

[63] History of Sacramento County, p. 220.

[64] McKeag, op. cit., Unit 15, pp. 2, 3.

The second tract which the Tide Land Reclamation Company reclaimed was Brannan Island. The work on the company project was begun in 1871[65] and completed in 1873, at a cost of about $6 per acre.[66] Additional outlays were made for levee work over the next five years,[67] and residents had confidence in the strength of the "very substantial" protection given by their levee of 25-foot base, 4-foot crown, and 6-foot height.[68]

Large parcels of land were leased to Sherman Island farmers, who planted wheat, barley, and some vegetables.[69] Smaller units were rented to Portuguese, Italian, and Chinese truck farmers.[70] These lands near the river rented for $20 to $25 cash per acre per annum, and the lower grain lands rented for $10 per acre.[71]

By late 1877 the reclamation company had divested itself of title to Brannan Island. The average individually

---

[65]Hoag, loc. cit., p. 341.

[66]Browne, loc. cit.

[67]Report of the Commissioner of Public Works [1894], p. 13.

[68]"On the Sacramento River," SF Call, Oct. 27, 1877, in BS, Set W 3, p. 1065.

[69]"Sherman Island," letter to ed., SF Alta, Aug. 10, 1874, in BS, Set W 18:1, p. 163.

[70]"On the Sacramento River," loc. cit., in BS, Set W 3, p. 1065; "Flooded Fields," SF Chronicle, May 15, 1878, in BS, Set W 34, p. 133.

[71]Report of the Commissioner of Public Works [1894], loc. cit.

owned farm was about 200 acres, although holdings of 3,000, 1,000, 600 (two), and 325 acres were reported. Unimproved, the land was worth $25 per acre; if improved it could be bought for $40-$60 per acre.[72] What appears to have been a rather prosperous farming area was engulfed by the 1878 flood, which pushed through the west levee and then the south levee. Levee failures in 1879 and 1881 inactivated much of the land until 1893-94, when clamshell dredges raised large defenses at a cost of about $3 per acre.[73] More expenses were incurred to dress or repair levees after the floods of 1902, 1904, 1907, and 1909.[74]

Glasgow-California Land and
Reclamation Company

The Glasgow-California Land and Reclamation Company purchased almost all of the Roberts Island backswamp area in the winter of 1876/77. Its former owner, J. P. Whitney, had made some progress with reclamation before relinquishing the property to M. C. Fisher, whose company continued the work.[75] The company also took charge of breaking the soil. Teams

---

[72]"On the Sacramento River," loc. cit., in BS, Set W 3, p. 1065; Browne, loc. cit.; History of Sacramento County, p. 220.

[73]Report of the Commissioner of Public Works [1894], loc. cit.; The Bee, Where California Fruits Grow: Sacramento County and Its Resources (Sacramento: H. S. Crocker Co., 1894), p. 52 (later citations appear as: Sacramento County and Its Resources).

[74]See Appendix A.

[75]See Appendix B.

were worked methodically from north to south in the southern part of the island, and from the alluvial ridges into the backswamp in the northern part of the island.[76] The broken land was leased to tenants on the basis of one-half share of their 12,000-acre grain crop, and one-third share of the second year's crop. The charges were higher than usual because the plains farm lands had not recovered from the drought of 1876/77, nor the rest of the delta from the flood of 1878. Later contracts usually committed farmers to pay 25 per cent of the grain crop to the company.[77] An estimated 26,000 acres of grain were under lease by the company in 1879/80, and jute, flax, and sorghum experiments were beginning.[78] Unfortunately, a levee break occurred in June 1880. A $500,000 disaster occurred in January 1886, and another bad flood in May 1893.[79] Between late 1889 and 1897 the island was organized into its present reclamation districts;[80] the Glasgow-California Land and Reclamation Company was replaced by smaller operators.

---

[76]"Tule Farming," SWI, March 3, 1877, p. 7; "Jordan's Landing," ibid., Aug. 31, 1878, p. 5; "Roberts Island Reclamation," ibid., Oct. 19, 1878, p. 7; "Agricultural Selections," SF Bulletin, Aug. 26, 1878, in BS, Set W 18:2, p. 295.

[77]"Through San Joaquin County," SF Bulletin, March 22, 1879, in BS, Set W 4, p. 1502.

[78]"Down among the Tules," SF Bulletin, Feb. 23, 1880, in BS, Set W 4, p. 1511.

[79]See Appendix A.

[80]DWR Bull. No. 37, pp. 152, 154, 157.

George Shima

Less is known about the various independent operators who pursued reclamation between the 1860's and the 1890's. (Their contributions are reviewed in Appendix B, "Reclaimed Components of the Delta.") Among their successors one, George Shima, is singled out to give an idea of methods employed in large-scale land development during the first two decades of the present century. (The discussion overlaps subsequent chapters slightly, a liberty which is taken to portray Shima's role adequately.)

George Shima was a Nagasaki-born immigrant of perceptive mind with competence in agriculture which was shaped in part by training at a Japanese agricultural school. He began work in the delta as a day laborer for a pioneer tule farmer, Arthur Thornton, of New Hope. Shima soon progressed to a 10-acre plot which he farmed on shares.[81] He became a labor contractor.[82] By 1910 Shima owned 420 acres and rented another 8,300.[83] Before the Anti-Alien Land Act of 1913 went into effect he had purchased 1,500 acres of King Island for $225,000, and spent $75,000 reclaiming the land.[84] In 1916

---

[81]"The Famous California Potato King," Special Booster Edition of the Byron Times, 1908-9, not paginated; William J. Rogers, "The Delta Story," Stockton Record, July 4, 1951, p. 15.

[82]K. K. Kawakami, The Real Japanese Question (New York: The Macmillan Co., 1921), p. 45.

[83]Yamato Ichihashi, Japanese in the United States (Stanford Univ.: Stanford Univ. Press, 1932), p. 183.

[84]Edwin E. Cox, "Farm Tenantry in California," Commonwealth Club of Calif., Transactions, XI (Dec. 1916), p. 445.

Shima leased 25,000 acres, including Bacon Island.[85] He operated on over 12,000 acres in 1922, which raised his cumulative expenditures for land leases, reclamation, and purchases to almost $8,000,000.[86]

Shima's business relations with the California Delta Farms Company, in which he held stock, were very close. The company, founded in 1907 by a syndicate of Los Angeles and local capitalists, owned Webb, Holland, Orwood, and Empire tracts, and King and Medford islands.[87] Besides reclaiming these tracts the company leveed Mandeville and Bacon islands, McDonald, Shima, Bishop, and the Cohn and Henning tracts.[88] The reclamations were supervised by Lee Phillips, with whom Shima contracted orally. The understanding was that Phillips and company obtain unreclaimed land, levee it, and turn it over to Shima to be cleared and planted to potatoes. Shima's leases cost $17 per acre in the first year, and $30 per acre per annum for the next two years. Thereafter, Shima moved onto fresh land which Phillips had leveed.[89] The term of

---

[85] Ibid.; Rogers, loc. cit., July 21, 1951, p. 15.

[86] Kawakami, op. cit., pp. 46-47; Rogers, loc. cit., July 20, 1951, p. 19.

[87] Most of the land was purchased from John Herd, once the Glasgow-California company's chief engineer and founder of the Old River Land and Reclamation Company. Rogers, loc. cit., July 18, 1951, p. 21.

[88] Ibid., July 14, 1951, p. 21; ibid., July 18, 1951, p. 21.

[89] Ibid. A contemporary account states that Shima paid $15-$20 rent in quarterly installments. Cox, loc. cit., p. 450. The relationship of Shima and Phillips has no documented parallels, but elements of the arrangement between

Shima's occupation was within the legal limits set by the Anti-Alien Land Act and it was within the three-year period before a fungus infection usually had time to become well enough established to damage potato crops.

Although Shima paid handsomely for leases to virgin land, he remained solvent most of the time on the profits which he made from the sale of the 35 or 40 per cent of the crop received from subleases to Chinese, Japanese, Hindu, and Italian farmers. An example of a cash rent arrangement in which he participated is provided by his 1916 contracts involving the Henning Tract. He leased 2,700 acres of potato and onion land from the Weyl-Zuckerman Company at $20 per acre, and subleased them at $27.50. He furnished the seed and cash needed by the small operators and, as was the custom, he employed foremen to guide and oversee the planting and cultivation. Potatoes and onions were generally raised by the groups of Chinese or Japanese farmers who combined to contract for the work.[90] The accepted man-land ratio for the potato crop was one per 75 acres until the digging period, when more labor was required.[91]

---

them appear in the agreement that existed in 1878 between the owner of 6,000 acres in the Lisbon District and tenants. Three-year contracts were awarded for the breaking of farms of 150 to 225 acres. Tenants paid the owner 4 per cent of the harvest for the privilege of breaking the tule and farming it. "A Ride through the Lisbon District," PRP, Jan. 19, 1878, p. 34.

[90]Cox, loc. cit.; Rogers, loc. cit.

[91]San Joaquin County Board of Supervisors, San Joaquin County, California, for the Farmer (n.p.: Sunset Magazine Homeseekers Bureau, /ca. 1915/, p. 51.

In order to manage the holdings, collect crop shares, and buy and sell potatoes and onions, Shima organized the Empire Navigation Company in 1919.[92] Steamboats, barges, and gasoline launches were used to pick up the company's produce and deliver it to Stockton or San Francisco.[93]

A number of other landholding companies or lessors managed subleasing much the same as did Shima. Among them were the Staten Island Land Company, I. L. Borden (Victoria Island), W. H. Wolf and Sons (Woodward Island), the Rindge Land and Navigation Company (Upper and Lower Jones tracts, Palm Tract, Rindge Tract),[94] the Liberty Farms Company, and Prospect Island Farms Company. While reclamation is no longer a function of delta operators, the tenant system continues.

Cumulative Reclamation

The periodic and cumulative gains made in reclamation are shown in Table 2.[95] Study of the data and of Map 16,

---

[92]Rogers, loc. cit., July 20, 1951, p. 19.

[93]Kawakami, op. cit., pp. 44-45.

[94]Cox, loc. cit., pp. 445, 447; "Story of Beautiful Woodward Island," "Picturesque Jersey Island," Special Booster Edition of the Byron Times; "Rindge Land and Navigation Company," Stockton Evening Mail, San Joaquin Valley Development Edition, July 22, 1911, p. 16.

[95]The agency finds that there is considerable doubt as to what may be regarded as completion dates for reclamation. "From the standpoint of its possible effect on the tidal basin, effort has been made to determine the date when each reclamation development completed its levees to a sufficient extent to permanently eliminate the area thus reclaimed from the tidal basin." In cases where tracts were flooded

page 219, reveals that reclamation was effected first on the alluvial lands of the Sacramento, San Joaquin, and Mokelumne. The central delta tracts and the Yolo and Sacramento basins were the scenes of the later reclamations. For a detailed account of reclamation progress in different parts of the delta, see Appendix B, "Reclaimed Components of the Delta."

TABLE 2

RECLAMATION GROWTH

Decade	Area Reclaimed (Acres)	Cumulative Area (Acres)
1860-1870	15,000	15,000
1870-1880	92,000	107,000
1880-1890	70,000	177,000
1890-1900	58,000	235,000
1900-1910	88,000	323,000
1910-1920	94,000	417,000
1920-1930	24,000	441,000

---

after reclamation the last date of complete reclamation has been accepted by the agency. DWR Bull. No. 27, loc. cit.

CHAPTER X

RECLAMATION METHODS

Levee Fill

The construction of levees requires large volumes of fill, a need that was met by moving material from the areas to be reclaimed or, when dredges were used, from channels. In either case, protection was not achieved except at a fairly high cost to the delta; the removal of material from inside levee lines contributed to the subsidence process, and the dredging of material from outside the levee line often resulted in levee instability. The instability occurs in peat areas where compression from accumulated fill forces underlying materials to rupture into the dredger-cut or island; the ruptures tend to weaken levees permanently.[1]

In the early days of reclamation, material for the levees was supplied by the tule sod excavated from the interior of the island or from borrow ditches dug outside of the levee. At least until the early 1870's most of the material

---

[1]Letter of William Q. Wright to Jack Williams, n.d., 1950, p. 9.

came from within the levees.[2] On the higher strips of alluvial land the construction of a levee was achieved by dumping and tamping the mineral-organic materials into a ridge, whereas on the lower tracts a more costly procedure was required. The sod was removed from the ditch with a peat spade, locally a "tule cutter" or "tule knife," and used to face one or both sides of the proposed levee. The material underlying the ditch was tamped into place between the sod block rows or on the inside of the single sod wall.[3] Sometimes the sod blocks were placed in the levees as soon as cut and at other times the blocks were permitted to dry on the ground first. In either case, they were forked into wheelbarrows and taken along planked paths to the levee, where they were fitted or tamped into a firm embankment. The firmness was transitory because the organic matter would shrink upon drying and the levee would lose one-third to one-half of the original volume. Cracks and surface irregularities developed as the material shrank.[4]

---

[2]"Reclamation of Swamp and Overflowed Lands in California," Report of the /U.S./ Commissioner of Agriculture for the Year 1872, p. 186.

[3]"Miscellaneous Report of O. P. Beasley, on the Reclamation of Swamp Lands," Annual Report of the Surveyor General for the Year 1860, pp. 54-55.

[4]"Repairing Levees," SF Bulletin, March 6, 1879, in BS, Set W 34, p. 137. A controlled study of peat alteration, made in 1907, produced a 50 per cent change in volume of the material. N. Ellery, "Report on Peat Levees, Jersey Island," Report of the State Engineer of the State of California, May 11, 1907, to November 30, 1908 (Sacramento: 1909), pp. 89-90.

It was the early practice to dig the borrow ditches immediately between the edge of the water and the outer levee toe.[5] Later on, when it was realized that levee survival was partly predicated on the flood-carrying capacity of adjacent channels, the tendency was to broaden the interval between levee toe and borrow ditch. It was also found to be helpful to leave residual berms to protect levees from deep-seated rupture and from wave attack. This practice of setting the levees back dates at least from 1875, when a reclamation project on the San Joaquin and to the north of the Calaveras mouth preserved a 35-foot berm.[6] Broader setbacks were used on Roberts Island where a shallow borrow pit of 100 to 200 feet in width was dug between the river and levee.[7] For another reason, but with the same effect, portions of the swamp varying in size from 10 to 100 acres were left on the channel side of Union Island in the process of building a straight line of levee. The parcels were sacrificed to avoid the cost and flood risks that attached to building around bends.[8]

The protective role of the berms was enhanced by the growth of willows, cottonwoods, and tules, which formed a

---

[5]Tide Land Reclamation Co. (1869), op. cit., p. 21, quoting San Francisco Daily Herald, July 10, 1869.

[6]"Reclaiming the Tide Lands," SWI, April 10, 1875, p. 5.

[7]"Roberts Island," SWI, Sept. 22, 1877, p. 7; SF Bulletin, Nov. 30, 1876, in BS, Set W 4, p. 1487.

[8]"A Ride through the Tule Country," SWI, Sept. 1, 1877, p. 5.

living defense against the persistent attack of waves.[9] The exterior borrow ditches acted as traps for alluvium transported into the delta. During the low-water period the accumulated sediment could be scraped or wheeled from the ditches onto the levees, thereby strengthening the structure and improving the channel.[10]

After dredges were adopted for levee building, deeper borrow ditches had to be dug to keep the dredges afloat at low tide. In peat areas it was a frequent occurrence to have dredges grounded by the rupture of underlying materials into the dredger-cut; the displacement of material into the ditches occurred at low tides when the weight of spoil on the levee could no longer be equalized. A second disadvantage of the early floating earth-moving equipment was that short booms required working close to the levees, thereby narrowing the berms which stabilized the levees and protected them from wave action.[11]

The use of dredges made a wider variety of fill materials accessible for levee builders. The fluid and compacted clays from channel floors or underlying the peats made good

---

[9]Nordhoff, loc. cit.; letter of H. Eugene H. to ed., PRP, Feb. 11, 1878, in BLS, No. 21, "California Counties; Sacramento," p. 273; "Repairing Levees," SF Bulletin, March 3, 1879, in BS, Set W 34, p. 137.

[10]E. D. Van Loben Sels, "How Rich Land Is Saved from California Rivers," PRP, July 1, 1905 (reprinted from California Journal of Technology, May 1905), p. 4.

[11]Wright letter to Williams, loc. cit.

levee material. Some reclaimers favored using the clays for building the entire embankment; others preferred a levee core of surface materials with a mantle of the less pervious channel bottom clays.[12]

In the early days of dredging, the sand brought up from the channels was considered treacherous material for levee building.[13] With the passage of a quarter-century this opinion was reversed. Instead of being treacherous, sand was discovered to be superior to other materials in several respects. It did not crack or leak like the clays and peats. The more cohesive clay and peat had to be reduced from the chunky state produced by plasticity and dredger jaw pressure; sand settled into a uniform mass. It did blow and wash out rapidly, although the sheer massiveness of a sand levee counteracted the tendency to erode away; oiled roads on the crown reduced wind erosion. Sand was more difficult for rodents to penetrate; gophers, squirrels, and beavers were bugbears of the peat or clay levees.[14]

Today the combination of dredged sand and clays is regarded as superior levee-making material. The majority of peat levees have been topped with the mixed material. "Most peat levees properly worked and topped . . . remain compacted

---

[12]"The Proper Material for Levees," PRP, Feb. 13, 1875, p. 104.

[13]An Illustrated History of San Joaquin County, p. 110.

[14]Van Loben Sels, loc. cit.

below tide water insuring saturation and volume maintenance. Under such conditions the peat is preserved, and remains as seepage-proof as oakum calked into a seam."[15]

Damming Sloughs

Prior to building levees on a tract it was common practice to dam the numerous sloughs by which it was drained. The dams were built on the levee line or slightly inward of it.[16] In most cases, local fill was used in the structure, though piling and stone sometimes were added to give substance.

In some parts of the delta a larger cross section of fill was amassed in the dams than in the adjacent levees. On Union Island, for instance, dams were built three feet higher and four feet wider than the levees.[17] Twelvemile Slough, in the present Wright Tract, was dammed in 1875 with a peat structure that had a crown width of 100 feet and a base width of 150 feet. The dam was given a freeboard height at high tide of 10 feet. These dimensions were considered adequate to stem the pressures of a channel 120 feet broad and 18 feet deep at high tide. Weight and shrinkage factors in peat

---

[15]Wright letter to Williams.

[16]The earliest descriptions known to this writer are the reports of O. P. Beasley and J. M. Sidwell in Annual Report of the Surveyor General for the Year 1860, pp. 54-56.

[17]Henry M. Naglee, Letter to Wm. H. Hall and Board of Engineers of the State of California upon the Subject of the Reclamation of the Overflown Lands of the San Joaquin Valley, September 20, 1879 (San Jose: McNeil Bros., 1879), p. 9.

necessitated a great deal of bulk in the initial structure.[18] How widespread this practice was elsewhere could not be determined from preserved accounts.

Dams were always furnished with sluiceways and gates; the drainage capacities of the installations were commensurate to the area served. The facilities also served as controls of irrigation water.[19] Twelvemile Slough was pierced by four timbered sluiceways, each of which had a pair of bolted double-plank tide gates.[20] Redwood was the preferred material at first, but after 1885 wood began to be replaced by more durable flanged tubes of boiler iron. Cast-iron tide gates probably came into wider use about this time. To reduce the seepage hazard along the outer line of the conduits, clay was packed in closely around them prior to placing the remainder of the fill.[21]

The Levees

Levee specifications varied according to site requirements and the resources and objectives of the builders. In

---

[18] "Reclamation of Tide Lands," SWI, Nov. 14, 1875, p. 5; "Reclaiming the Tide Lands," ibid, April 10, 1875, p. 5.

[19] "Reclamation of Swamp and Overflowed Lands in California," loc. cit.

[20] The sluiceways and gates required 24,000 feet of lumber per unit and cost $300 each. The whole dam cost $3,200 to complete. It required 24 days for a gang of 78 Chinese laborers to do the work. "Reclaiming the Tide Lands," SWI, April 10, 1875, p. 5.

[21] "Reclamation of Marsh Lands in California," PRP, May 30, 1885, p. 510.

general, the structures were highest and most massive along the Sacramento and toward the head of the San Joaquin distributaries. This was possible because the supporting natural levees were best developed there, and necessary because currents and water levels were usually most threatening in those localities. More modest levees were built in the centrally located tule islands where flood crests were lowered by dispersal through channels and over unreclaimed areas. Also, construction materials were unsubstantial on the peat islands, and the depth of underlying peat created instability. Within the limits of these conditions levees tended to be strongest where engineering skills and capital were in greatest supply.

Levee construction methods in the peat areas differed from the methods employed on alluvial natural levees. Advice on how to build in peat districts was offered by a Sherman Island resident:[22]

> Commence on the front, and cut a ditch seven feet wide and four feet deep. Place the sod in two rows on the inside of the ditch, one row within eight inches of it, and the other far enough back to give sufficient space for the bottom dirt between them. Throw in the bottom dirt and the levee is complete. Proceed in building the levee around the entire tract of land in the same way, and it is reclaimed. Always build the levee on the inside of the ditch. In extending the levee back from the river, commence at the edge of the water at low tide, run it back as deep as you can, and when in line with the front levee, put in a sluice-box. Fill in the ditch on top of the box, and that will prevent the tides from interfering much with the ditching on

---

[22]"Miscellaneous Report of O. P. Beasley, on the Reclamation of Swamp Lands," loc. cit.

> the inside of it. Continue the ditch back two feet wide and as deep as the bottom of the box, which will give drainage enough, and build the levees. When it has been extended back as far as required, commence at the other end of the front levee and extend the ditch back in the same manner. Then connect the back ends by a ditch five feet wide and four feet deep. The land is then reclaimed from water.

A variation of the peat block plan was to construct only a single wall and to strengthen it by back-plowing.[23]

In the late 1870's levees were still being built with peat blocks. Lower Roberts Island embankments were made with carefully laid peat.[24] An idea of the nature of the block walls is gained from a description of work on Union Island, where the sod blocks were fitted into a wall that rose 10 feet from a 9-foot base to a 3-foot crown. A duplicate wall was erected 8 to 12 feet inside the first one, and the space between was filled with dredged sand.[25] Another approach to leveeing with peat was tried on Bouldin and Staten islands. On the inside of the 21 miles of levee on Staten Island, 30-foot piles were driven at 6-foot intervals and then braced. On Bouldin Island the innovation consisted of an 8-foot-high redwood bulkhead erected inside the artificial levee. The boards of this levee supporter were nailed at

---

23"Miscellaneous Report of J. M. Sidwell, on the Reclamation of Swamp Lands," Annual Report of the Surveyor General for the Year 1860, p. 56.

24"Roberts Island," SWI, Sept. 22, 1877, p. 7.

25An Illustrated History of San Joaquin County, loc. cit.

4-foot intervals to braced 4 by 6 upright timbers that had been rammed 12 feet into the underlying peat.[26]

When levees were built on alluvial lands it was possible to scrape the soil into place; if organic material was used it was wheeled out of the backswamps and merely dumped onto the levee. Both materials were compacted to the degree that men or stock could tamp them. Slopes of one to five feet horizontal, to one foot vertical, were commonly developed on channel faces of the levees; inner faces were sometimes steeper. Levee tops usually were raised 7 to 17 feet above the surface of the natural levee and about 3 to 7 feet above the banks of the more central tule islands. The crowns varied from 3 to 4 feet to 20 feet in width; and levee bases from 12 to 100 feet. The toe-to-toe width of 30 to 50 feet appears to have been common.[27]

---

[26]"Staten Island Levees," SWI, Oct. 26, 1878, p. 5; "The Reclaimed Tule Lands," ibid., March 8, 1879, p. 7; "Building Levees on Peaty Land," PRP, Dec. 7, 1878, p. 356.

[27]The description of levees applies to works existing between 1868 and 1885. They are a representative cross section of levees in the delta, being based on accounts of works on Grand, Merritt, Tyler, Roberts, Union, Sherman, and Twitchell islands, and San Joaquin River east bank districts south of French Camp Slough and to the northwest of the Calaveras River. "Repairing Levees," SWI, Nov. 14, 1868, p. 7; "Reclaiming the Tide Lands," ibid., April 10, 1875, p. 5; "Land Reclamation," ibid., Jan. 20, 1877, p. 5; Tide Land Reclamation Co. (1860), op. cit., p. 43, quoting MSP of July 31, 1869; SF Bulletin, Nov. 30, 1876, in BS, Set W 4, p. 1487; "Agricultural Selections," anon., Jan. 20, 1879, in BS, Set W 18:2, p. 318; "The Flooded Regions," SF Alta, Feb. 24, 1878, in BS, Set W 34, p. 123; An Illustrated History of San Joaquin County, pp. 110-11; Stockton Board of Trade, The City of Stockton and Its Surroundings (Stockton: Daily Independent Steam Presses, 1883), p. 64; "Reclamation of Marsh Lands in California," PRP, May 30,

The difference in dimensions between the levees composed of peat and those composed of more highly mineralized fill was readily noted on Roberts Island (ca. 1876). At the upper end of the island, where natural levees were best developed, the basic structure had a height of 8 to 10 feet and a 50-foot base, 5-foot crown, slopes of three to one (3:1) on the river side, slopes of two to one (2:1) on the inside. As the proportion of organic material in the fill increased, the levees were broadened and the faces were built more nearly vertical. The crown widths reached 25 and 30 feet toward the north.[28]

On Roberts Island it was customary to excavate puddle ditches, of about six or eight feet in width by two feet in depth, under the center of the proposed peat levees. The peat removed was replaced by solidly packed material which fused with the levee, checking a tendency for seepage to take place along the contact plane of bank and levee.[29] Apparently, however, the puddle ditch was not common in delta levee building.[30] It was customary to break up the bank

---

1885, p. 510; Report of the Commissioner of Public Works /1894/, p. 16; Hoag, loc. cit., p. 344; History of Sacramento County, p. 189; Russell et al., History of Yolo County, p. 148.

[28]An Illustrated History of San Joaquin County, p. 111.

[29]"Gigantic Enterprise," SWI, Sept. 25, 1875, p. 4.

[30]This is assumed on the basis of reported levee breaks and on the absence of references to such features in the literature consulted. Wright interview disclosed that none have been dug during his 50 years of delta experience.

surfaces and to grub out woody growth so that lines of weakness would not occur at the levee base.[31]

Before dredges were used to build levees "we made nice surfaces and exact lines, being careful not to put in more material than was absolutely necessary," but when dredges were employed the fill was dumped into a pile until the rough levee had reached a suitable height. The resulting mound was two to five times as bulky as the hand-built levees, but cost about the same per linear yard to build.[32] Commonly the embankment was raised over a period of time, each coating of fill being allowed to dry out before being leveled off with scrapers. Following leveling, the levee was plowed and harrowed, sown with barley, and the resulting sward grazed by sheep. Such treatment packed the soil, even on the lower slopes where plows could not be used.[33] Today levees are compacted with bulldozers.

The Pierson District, between Courtland and Walnut Grove, was protected by a fine example of the levee structure considered most desirable in the early 1900's, and which is similar to existing works. The levee was built with a toe-to-toe width of up to 250 feet, a crown width of about 20

---

[31] P. A. Haviland and F. H. Tibbetts, Great American Levees, A Comparative Report on Flood Protection in the Mississippi and Sacramento Valleys Made for the West Sacramento Company (San Francisco: Taylor, Nash and Taylor, 1913), p. 12.

[32] Quoting T. H. Williams of Union and Grand islands. "Reclamation of Marsh Lands in California," PRP, May 30, 1885, p. 510.

[33] Van Loben Sels, loc. cit.

feet, and a height of about 20 feet above the ground level.[34] Such massive levees were impracticable on the peat foundations of the central delta. (Compare levees appearing in Plate II, p. 46, and Plate III, p. 59.)

Cross levees, built clear across an island or from the river to the high land of the delta margin, were a fairly common feature in the islands and mainland backswamp areas by the 1870's.[35] They were raised along boundaries of reclamation districts and used to compartmentalize districts. Such cross levees were insurance against flooding from neighboring land. In many cases they were as large as outer levees, although they were tapered toward the valley plains because higher ground underlay them. They continue to be important features in island flood defense. The farmed area of Sherman Island is protected on the west by a former cross levee which now functions as the main levee (see Plate I, p. 16). The northwestern remnant of Franks Tract lies to the west of a former cross levee.

Levee Maintenance

Maintenance of reclamation requires constant vigilance. At least since the large-scale corporate reclamation projects began, levee masters have been retained to patrol works and manage pump houses and ditching or other equipment

---

[34] Ibid.

[35] "Land Reclamation," SWI, Jan. 20, 1877, p. 5; Report of the Commissioner of Public Works /1894/, p. 16.

owned by a district. It is the levee master's responsibility to see that defenses against the river are effectively maintained at all times. Attention is given to such hazards as levee settling, water and wind erosion, and rodent damage.

Levee settling, it may be recalled, occurs in three ways. Surfaces lose form and elevation from the shrinkage and disintegration of organic matter within the levee or as a result of compression and displacement of underlying peat and clay beds. The settling caused by shrinkage and disintegration is virtually a continuous and universal process wherever organic materials in the levees are unsaturated. Like the settling caused by compression, the oxidation problem is most persistent in the central parts of the delta.[36]

Some of the early levees were not properly worked to insure saturation and volume maintenance. Their shrinkage was marked by the formation of fissures with transverse, longitudinal, vertical, and horizontal trends. On Sherman Island, for example, shortly after completion in 1868 of the first enclosing levee, costing $63,000, an additional $10,500 had to be expended to even up the structure.[37] Contributing to the weaknesses of imperfectly worked levees was the development of fissures along the plane between the natural bank and the overlying materials. Unless there was a good bond between levee and bank, the buoyancy of dried-out levee material was likely to cause large segments of levee to rise on

---

[36]Manson, loc. cit., p. 89.

[37]Ibid.

high tides.[38] While floating, the artificial structures would bow or break inward; sometimes they settled into place without breaking but warped because scour had removed materials from beneath.[39]

In the early 1900's, when peat island reclamation was booming, it was customary to restore shrinking levees every one to three years until a semblance of stability was obtained. At least 5 to 10 years of short-interval levee dressing were required.[40]

Compression and displacement of levee foundations appear to be largely a post-dredger problem. One authority states that every levee break that has occurred in the lower delta since 1900 was caused by deep-seated weaknesses traceable to compression and displacement. At first the ruptures occurred on the channel side as plastic clays oozed from under the levee into dredger-cuts. Ever since subsidence

---

[38]A laboratory test, made in 1907 with a cubic yard of Jersey Island peat, revealed a dry weight of 405 pounds and a wet weight of 1,470 pounds. When saturated the block had a flotation power of 190 pounds, but when dry it had a flotation power of 1,270 pounds. Ellery, loc. cit.

[39]"California Lands, A Choice Investment," Antioch Ledger, Sept. 8, 1883, in BLS, No. 44, "California Lands," p. 7; "Twitchell Island Submerged," SWI, Jan. 23, 1875, p. 7.

[40]Calif. State Agric. Soc., Transactions During the Year 1904 (Sacramento: 1907), p. 220; A. J. Wells, "Tilling the Tules of California," The American Monthly Review of Reviews, XXX (Sept. 1904), p. 313; "History of the Island Country," Special Booster Edition of the Byron Times, not paginated.

reduced the interior elevation of reclaimed tracts, the rupture of levee foundations has been inward. Subsided lands are likely to be five or more feet below low tide, and their ground water table several feet lower. Therefore, at high tide 10 to 20 feet vertical differences may exist between water tables on either side of the levee. The seepage and increased water pressure added to levee weight may result in the upswelling of hummocky surfaces and viscous clays inland of the levee and the slumping of broken levee blocks to as much as 10 feet. Attendant levee fractures or fissures may run for 100 feet or more; seepage can convert the fractures into crevasses.

Levee ruptures may be forestalled or checked by blanketing a heavy fill over the levee toe and for about 50 feet inland. The blanket of sand or clay is tapered to island level from a thickness of five feet over the levee toe.[41]

Wave attrition has been a persistent cause of levee damage, especially on faces that lie downwind from broad spans of water. Damage may be serious at any water stage, but it can be disastrous when strong winds accompany high river stages and high tides.

Some of the early land developers planted alfalfa or Bermuda grass in attempts to reduce the wave damage. Willows have been more commonly used because they survive prolonged

---

[41]Wright letter to Williams, pp. 9-10; Wright interview.

submersion better than alfalfa.[42] Some reclaimers thought that the roots of willows and other shrubs would reduce the tendency of peat levees to burst when subjected to prolonged river pressure.[43] Unfortunately, willows tend to choke out the tule, depriving levee faces of the mass of sod and stems which breaks the force of wave action.

Staked and wired brush barriers along levee fronts have been used for short periods to protect faces from wave wash.[44] A more effective method of protecting exposed slopes has been to first lay a mat of fibrous material, such as tules, brush, or straw, on the levee face, and then stake it in place with chicken wire.[45] Concrete levee facing offers permanent protection, as does the more common and less costly riprap facing. Both have been used on publicly financed waterway improvement projects, but even the $5 to $20 per running foot cost of building riprap protection is excessive for the reclamation districts.[46]

When levees are cut away by erosion, the inner faces are built up, but at the sacrifice of first-class farm land,

---

[42]"Tule Farming," SWI, March 3, 1877, p. 7; F [Flint], "Reclamation of Tule Lands," *The California Culturist*, III (Sept. 1860), p. 111.

[43]Ellery, *loc. cit.*, p. 89.

[44]*Ibid.*, p. 92.

[45]Haviland and Tibbetts, *op. cit.*, p. 22.

[46]Interview with George Raab, Stockton, Oct. 15, 1955. Wright believes that the use of riprap may date from 1900. Interview.

and, since the new levee section is on lower ground, more fill is required to bring the structure up to grade. At least as early as the first decade of the 1900's, jetties and revetments of stone and elaborate weighted brush mattresses were used to protect the outer levee face. Over a mile of flexible brush mattress was laid along the river face of levees on Brannan and Sherman islands as an emergency defense during the 1907 flood. The mattress was formed of 20-foot wire-bound brush bundles (fascines) 8 to 12 inches in diameter, laid double and with staggered joints. Quarter-inch galvanized wire cables were woven over and under fascines and attached to concrete anchor blocks placed inland. Concrete weights also were placed on the mattress.[47] Such projects were too expensive for reclamation districts. The state performed the work, assuming responsibility for half of the costs.

When floods threaten to overtop levees, sandbags are employed to add height and to absorb the impact of waves.[48] Dredges fill up sags in the levee with channel bottom material. Emergency measures employed to seal off the breaks in

---

[47] Report of the Commissioner of Public Works to the Governor of California, 1904-1906 (Sacramento: 1906), p. 9; Report of the State Engineer of the State of California, May 11, 1907, to November 30, 1908, pp. 70, 71-75.

[48] "Broken Levees," PRP, May 31, 1890, p. 554; "San Joaquin Floods," SF Call, May 17, 1878, in BS, Set W 4, p. 1495. During the flood of March 1907 the Brannan levee was overtopped about a mile north of the Rio Vista bridge when swell from a rescue steamer dislodged sandbags which had been placed five or six high on the levee. Cosby, "Notes," interview with Max Kuhn, Brannan Island, March 21, 1934.

the levees usually involve the driving of two or four rows of piles to form a rigid framework for earth-filled plank bulkheads or for walls built up of brush and sacked or bulk earth. The brush is baled tightly, wrapped in wire, and lowered between the rows of piles. Sandbags or rock placed on top of the bales hold them down.[49] Where four rows of piles have been placed the fascines are set in rows which flank a central earth-filled compartment.[50]

Rock, gravel, sand, or channel dredgings are applied directly to build up the levee around the bulkhead. Another procedure used to concentrate sand at the piling and fascine barrier involves releasing the sand into a current so that it will shoal in the crevasse. As the shoal rises, the sill of fascines is heightened. This "focal shoaling" has been used with river currents for 50 years. A post-1950 variant application of the technique used in the central delta has taken advantage of changing tides to effect shoaling. Hydraulic dredges discharge materials into the current to be carried to the crevasse; the discharge is alternately inside and outside of the levee. When the break is closed the levee

---

[49]"The Flood Waters," Sacramento Bee, Feb. 5, 1878, in Sacramento River Floods of 1878 and 1881; "Sherman Island," SF Bulletin, July 2, 1880, in BS, Set W 34, p. 142; "The Levees," PRP, Feb. 13, 1886, p. 149; "Will Cost About $24,000 to Mend Levee Break," Sacramento Union, March 6, 1904, p. 10; William Q. Wright, "Closing Breaks in Tidal Levees," Engineering News-Record, April 4, 1946, pp. 71-74 (reprint).

[50]Report of the State Engineer of the State of California, November 30, 1908, to November 30, 1910 (Sacramento: 1912), p. 118.

may be finished by direct application of dredgings, followed by dressing and compacting by bulldozers.[51]

On at least two occasions hulks loaded with sand were sunk in crevasses,[52] but the expedient did not prove to be satisfactory. One of the attempts was made on Bouldin Island in 1938, and was followed by a second experiment that was as successful as it was novel. A new levee was raised inside of the original levee line. To remove the water from the tract, three old river steamers, the J. D. Peters, Reform, and Navajo, were moored abreast and with their stern wheels adjacent to a planked low-level sluiceway that crossed the levee line. After the wheels had thrown most of the water off the island, pumps completed the work. The stranded vessels became bunkhouses.[53]

An idea of the cost of levee repairs is provided by the contract for repairing a break on the Sacramento River which occurred in 1904 just about three miles south of the city of Sacramento (the Edwards Break). A week after the crevasse opened, the district awarded a contract to close it. The contractor was to receive $24,000 if the void was filled to one foot above the flow level in 15 days. If the work was completed in a shorter time, a bonus of $300 was to be paid

---

[51]Wright, "Closing Breaks in Tidal Levees," loc. cit.; Wright interview.

[52]Cosby, "Delta History Notes," p. 18; SWI, Jan. 13, 1898, p. 3; MacMullen, Paddle Wheel Days in California, p. 113.

[53]Ibid.

for each day saved; a like amount would be forfeited by the contractor for every day or part of a day that completion was delayed beyond the deadline.[54]

Following repair of a levee break and the drainage of flooded islands, the owners are confronted with a costly job of reconstructing drainage ditches, restoring buildings, and bringing the land back into farming condition. A good deal of energy must be expended in destroying the grounded blocks of peat ("floats") which are scattered over the island. Sometimes efforts may be made to transform the depression from which the "floats" had been torn by scour and buoyancy into useful land, but modern breaks result in such deep and large depressions that they are usually left as ponds.

---

[54] "Will Cost About $24,000 to Mend Levee Break," Sacramento Union, March 6, 1904, p. 10.

CHAPTER XI

THE LABOR FORCE AND EQUIPMENT OF RECLAMATION

At first the construction of levees was done by manual effort and horsepower. Human labor was used almost exclusively in peat areas while horse-drawn equipment was restricted largely to the firm land of natural levees.

Employing Men and Horses

The bulk of the labor force engaged in levee construction was Chinese, though some Hawaiians were hired.[1] Each labor gang was recruited and directed by a Chinese foreman, under a system of agreements wherein the foreman contracted with engineers or contractors to build a given dam or section of levee[2] for a stipulated rate per cubic yard emplaced. The rate ranged between 9 and 25 cents per cubic yard.[3] Hand

---

[1]Dana, op. cit., p. 164.

[2]Nordhoff, op. cit., p. 138; Russell et al., op. cit., p. 144, interview with J. W. Hollenbeck.

[3]Presumably a certain amount of bargaining arose over rates since materials, distances to the levees, sizes of construction assignments and other variables had to be considered. The following costs per cubic yard are recorded for reference: 15¢ (Twitchell I., 1869); 20¢ (Rindge Tract, 1870); 12¢ to 17¢ (Grand I., 1871); 10¢ to 25¢ (delta, 1872); 13¢ (northwest of the Calaveras, 1874); 10¢ to 13¢ (northwest

tools were supplied by the employers, but it seems that wheelbarrows were provided either by the laborers or the employer.[4] The Oriental laborers housed themselves; their provisioning was handled through the foreman,[5] who also assigned tasks and distributed wages.[6]

The skilled labor, chiefly carpentry on the dams, was performed by Caucasians.[7] Caucasian workmen, drawn from a varied lot of drifters, also had charge of horses and the scraper and plow work. The men were fed, housed, and paid on the basis of some time-unit of work performed. For instance, the Tide Land Reclamation Company hired men for $30 to $35 per month. The turnover was high since the men, many of whom were immigrants, had come to "make money," not to work. As soon as one saved a few months' pay, he left for the

---

of the Calaveras, 1875); 9¢ (Union I., Roberts I., 1877); 10¢ or 12¢ (New Hope area, 1879); 10¢ to 20¢ (delta, pre-1885); and 17¢ (Pierson District, 1905). Tide Land Reclamation Co. (1869), op. cit., p. 42, citing MSP, July 31, 1869; "Swamp-land Matters," SWI, June 11, 1870, p. 7; "Reclamation of Tule Lands," ibid., Nov. 14, 1874, p. 5; "Reclaiming Tide Land," ibid., April 10, 1875, p. 5; "Union Island Reclamation," ibid., March 24, 1877, p. 7; "Reclamation," ibid., Sept. 1, 1877, p. 7; Hoag, loc. cit., p. 340; "Reclamation of Marsh Lands in California," PRP, May 30, 1885, p. 510; Van Loben Sels, loc. cit.; "Through San Joaquin," SF Chronicle, April 15, 1879, in BS, Set W 4, p. 1504; "Reclamation of Swamp and Overflowed Lands in California," loc. cit.

[4] "Reclamation Work," SWI, Oct. 14, 1876, p. 5; "Repairing Levees," SF Bulletin, March 6, 1879, in BS, Set W 34, p. 137.

[5] Rogers, "The Delta Story," Stockton Record, July 12, 1951, p. 19.

[6] Nordhoff, op. cit., p. 130.

[7] SF Bulletin, Nov. 30, 1877, in BS, Set W 4, p. 1487.

mines or tried to rent land on which he could put Chinese to work.[8]

Moving fill by horse-drawn plow and scraper cost about the same or more than using manual labor and wheelbarrows.[9] Scrapers were preferred, nevertheless, because the trampling worked the fill into a fairly compact mass, whereas manually placed fill too often had a compact crust but poorly consolidated core.[10]

Mules were rarely employed in the work because their hooves, smaller than those of horses, were poor supports in miry, wet peat and in cracked, dry peat.[11] Horses even bogged down. Special "tule shoes" for horses were devised to overcome the problem. The first of these was attributed to the Chinese.[12] Later 9 by 11-inch ash boards, fastened to the iron horseshoes by screws, proved more durable.[13] These

---

[8] Report of the Joint Special Committee to Investigate Chinese Immigration, p. 440.

[9] "Reclamation of Marsh Lands in California," PRP, May 30, 1885, p. 510.

[10] "Reclamation," SWI, Nov. 11, 1876, p. 7.

[11] Local tradition is supported by the discovery of but a single reference to the use of mules in the literature consulted.

[12] Rogers, loc. cit., July 16, 1951, p. 21. If the Chinese devised the first "tule shoe" it is remarkable. Their opportunities to use or to own horses were more limited than the opportunities of the Caucasians whose cultural background was closely linked with the horse.

[13] Nordhoff, op. cit., p. 131.

in turn were supplanted by oversized iron shoes,[14] consisting of an iron ring about 12 inches across which was joined to the ordinary shoe by radial metal supports. Even with such equipment, it was common to see horses bogged down to their bodies in the peat.[15]

The drag shovel or scraper was the principal horse-drawn implement used in levee building. A number of different types were experimented with. Scrapers requiring from a single horse to 14 teams were used.[16] They were worked in big gangs wherever resources and soil conditions permitted. On Union Island 82 scraper teams worked in one gang; on Roberts Island as many as 200 scrapers were used.[17] In delta periphery areas of heavy soil, scraper work was facilitated by a preliminary plowing of the land inland from the levee line.[18]

Other types of excavating and earth-moving equipment were tried in levee building, particularly on Roberts Island, where the land developers showed exceptional enterprise in

---

[14]"The Flooded Regions," SF Alta, Feb. 24, 1878, in BS, Set W 34, p. 123; San Joaquin County Board of Supervisors, San Joaquin County . . . for the Farmer, p. 51.

[15]George A. Atherton, "Reclamation and Development in the Sacramento-San Joaquin Delta," Agricultural Engineering, XII (April 1931), p. 130.

[16]"Roberts Island," SWI, Aug. 21, 1875, p. 7; "Gigantic Enterprise, ibid., Sept. 25, 1875, p. 4.

[17]Ibid.; "Reclamation," ibid., Nov. 11, 1876, p. 7; "Reclamation," ibid., Sept. 1, 1877, p. 7; "Roberts Island," ibid., Sept. 22, 1877, p. 7.

[18]"Repairing Levees," SF Bulletin, March 6, 1879, in BS, Set W 34, p. 137.

experiments to find better ways of building levees. Among the devices tried were the "Slussee" and the "Wachope" excavators. The former, operated by one man and a team, incorporated a plow, an endless conveyor, and a box which could be emptied by dropping out the bottom. Soil was carried from the moldboard to the box on the conveyor. The filled box was drawn onto the levee and dumped. The "Wachope" excavator was a complicated affair which required 10 or 12 horses and two men to manage it; it transferred plowed earth to a levee by way of a "draper" that could convey the material as far as 20 feet away at right angles from the course of the machine.[19] In principle it combined the functions of shovel and wheelbarrow or the mechanically powered dredge or ditcher. Even after the dredge became important in levee building, the scraper and wheelbarrow were used when circumstances required.[20]

In the late 1870's, manual and horse power were nearing the limit of practicable employment. Adequate defenses from the river required cheaper and faster means of moving great volumes of fill onto the levees.[21]

---

[19]"Roberts Island," SWI, Aug. 21, 1875, p. 7; "Gigantic Enterprise," ibid., Sept. 25, 1875, p. 4.

[20]A case of this, described in 1905, occurred at the Pierson District. Back levees were built in a good measure with scrapers (15¢ per cubic yard) and wheelbarrows (17¢ per cubic yard). The levee was built to dimensions of up to 100 feet at the base, 14 feet across the crown, and 18 feet in height. Van Loben Sels, loc. cit.

[21]Russell et al., reporting an interview with Captain J. W. Hollenbeck, op. cit., p. 144; Atherton, loc. cit., p. 129.

Dredging Equipment

Mechanically powered earth-moving equipment was in use for levee building as early as 1865. Dredges and ditchers were introduced around 1870, but did not come into general use until 1876.[22] Thereafter, they became increasingly common.

A prototype steam-powered mechanism, or "steam paddy," designed to scoop up earth and deposit it in a rough embankment was under construction in July 1869 by a Mr. Robertson /Roberts?/ for use in the reclamation of the greater Webb Tract.[23] The machine was expected to build a mile of levee per day, but in practice it averaged only 320 feet of 5-foot-high levee per day. Fill was removed from a 4 by 12-foot ditch. The levee had to be faced up by shovel.

About two years after the dredge was completed a steam ditcher which moved on wheels and a portable track was developed. This machine cut a 4 by 4-foot ditch and carried the fill by an endless chain elevator to the opposite side of the excavation. When larger levees were desired, a new swath was cut along the ditch, and the elevator was extended enough to allow the fill to drop onto the existing ridge.[24]

---

[22] "Reclamation," _SWI_, Nov. 11, 1876, p. 7.

[23] The greater Webb Tract included the present Webb, Franks, and Bethel tracts and Bradford and Jersey islands.

[24] Tide Land Reclamation Co. (1869), _op. cit._, p. 27; _idem_. (1872), _op. cit._, p. 31; Hoag, _loc. cit._, p. 342.

The trouble with these earlier machines was that they could not build large levees, and the levees that they did build were not as safe as was desirable because the borrow ditches were too close. The technical problem that had to be overcome was the development of a conveyor arm long enough to permit digging at a safe distance from the levee.

Improved dredges were launched at Stockton in 1875.[25] The two floating steam shovels, the Samson and Goliath, were built for leveeing the parts of Roberts Island where horse-drawn equipment could not be employed because of the soggy footing. Each machine was equipped with dippers of two and a half and three and a half cubic yards capacity. The dipper arms, rated at 40 tons capacity, could lift spoil from depths of 30 feet and carry the material over a bank at any distance under 55 feet from either side of the scow. As with most dredges, both pieces of equipment had to be towed into place. They moved fill at a cost of five cents per cubic yard.[26]

---

[25]They were built by Stephen Davis on order of J. P. Whitney, then owner of much of Roberts Island. The machinery was brought by rail from Troy, N.Y., and most of the lumber was brought from Oregon. The Samson was launched September 29, and the Goliath two weeks later. "Roberts Island," SWI, Aug. 21, 1875, p. 7; "Launched," ibid., Oct. 2, 1875, p. 7; "Launched," ibid., Oct. 16, 1875, p. 5; "Reclamation of Roberts Island," ibid., Nov. 20, 1875, p. 5.

[26]"Roberts Island," SWI, Aug. 21, 1875, p. 7; "Gigantic Enterprise," ibid., Sept. 25, 1875, p. 4; "Reclamation and Ship Canal," ibid., Sept. 25, 1875, p. 7; "Reclamation," ibid., Nov. 11, 1875, p. 7.

The *Samson*'s first job was on Duck Slough and Burns' Cut-off levees of Roberts Island,[27] but the water was so low that the equipment could not make headway unless a channel 30 by 7 feet was dug. The volume of material that had to be removed to keep the scow floating vastly exceeded the amount planned for the levee.[28] Nevertheless, the demonstration resulted in urgent requests from levee builders in the Sacramento and Mokelumne river districts for assistance from the new dredges. One of the machines was tried at Staten Island early in 1876, but its boom was so short that to dump fill where it was wanted required excavation into the natural banks of the Mokelumne.[29] In November 1876 one of these dredges was used in building a cross levee on lower Grand Island. The performance was more promising and was thought to be a successful demonstration of the utility of machinery for levee building.[30] The dredge did not, however, satisfy the requirement for a machine which would not weaken natural banks in the process of raising levees above them.

---

[27]The levee followed the right bank of the slough southwestward toward Middle River from the slough's outlet on Burns' Cut-off. The present Honker Lake Tract, the Pocket, and Roberts Island north of the Santa Fe right-of-way (including McDonald Island) would be north of the levee.

[28]"Reclamation of Roberts Island," *SWI*, Nov. 20, 1875, p. 5.

[29]"Crops on the Lowlands," *SWI*, June 24, 1876, p. 5; "A New Contrivance," *ibid.*, Nov. 18, 1876, p. 5.

[30]*Ibid.*; "Reclamation," *ibid.*, Nov. 11, 1876, p. 7; "Roberts Island," *ibid.*, Sept. 22, 1877, p. 7.

Two other dredges, designed in 1876, overcame some of the major shortcomings of the earlier equipment. One, constructed by George Roberts (of the Tide Land Reclamation Company) and General T. H. Williams, used a scow with a false deck on which fill was dumped, and from which an endless chain carrier was gravity-loaded so that the material might be taken landward. The carrier was about 100 feet long and was operated by a steam engine on the barge. The dredge had one serious shortcoming: since the carrier arm could not be shortened or lengthened, it was necessary to move the barge toward or away from the bank when dumping the fill onto a levee.[31]

Roberts and Williams also contracted with Colonel A. A. von Schmidt to construct a dredge of different design. The von Schmidt dredge, which began operating in mid-October 1876, was equipped with a suction pipe and an attached auger that loosened channel floor materials so that they could be lifted by a centrifugal pump and moved by pipe onto levees at some distance away. Like the one other contemporary suction dredge, this machine operated fairly well on sandy bottoms but was not too satisfactory in picking up indurated clay.[32]

The _Atlas_, a $50,000 experiment with another dredging technique, was built sometime in the latter 1870's for use at

---

[31]_Ibid_.; "A New Contrivance," _ibid_., Nov. 18, 1876, p. 5.

[32]_Ibid_.; "An Important Enterprise," _ibid_., Aug. 12, 1876, p. 7; "Reclamation Work," _ibid_., Oct. 14, 1876, p. 7; _An Illustrated History of San Joaquin County_, p. 111.

Grand Island. Instead of a dipper or suction pump and auger, the Atlas was equipped with a bucket-mounted rotating cylinder which chewed into the channel floor. The rotating head was mounted on a frame that projected about 35 feet beyond the bow. The excavated material fell into the wheel, then was pumped through an 18-inch diameter pipe to shore. Material was moved up to 300 feet. However, the machine lacked the power and capacity desired.[33]

In the 1880's a markedly improved dredge, the Hercules, was introduced in the delta. It was similar to the bucket-mounted endless-chain dredging machine commonly used in working auriferous gravels. The Hercules was built for General Williams, who intended to use it at Grand Island. The $40,000 rig was housed on a 100 by 80-foot scow. It was capable of moving up to 400 cubic yards per hour from maximum depths of 25 feet. The spoil passed from the buckets into a hopper and was flushed landward through a 100-foot pipe of 36-inch diameter. Ordinarily the fill did not have to be moved any farther, though it was feasible to do so by lengthening the conduit and adjusting the volume of water pumped. When the dredgings were dumped they would fall with sufficient impact to make a firm levee, which, according to General Williams, was the best and cheapest possible levee. An

---

[33]"Reclamation of Marsh Lands in California," PRP, May 30, 1885, p. 510.

improved, $100,000 version of the Hercules was built in 1885.[34]

Other dredges in service during the 1880's included two $12,000 pieces of equipment built in 1885 and 1887 by the Stockton Iron Works for John W. Ferris (Glasgow-California Land and Reclamation Company) and George F. Smith, respectively. They were carried on 60 by 36-foot hulls. Instead of a pipe conductor to carry dredged material landward, these dredges had 36-inch rubber conveyor belts that reached as far as 72 feet from the center of the hull. Depending upon the consistency of the spoil handled, from 58 to 125 cubic yards could be conveyed per hour.[35] The two machines had an earth-moving capacity somewhat below the average of the 13 dredges in service during 1888. The group's aggregate capacity, about 25,000 cubic yards per day, is said to have been exceeded only at the Suez and Panama canals.[36]

Though small, the Ferris and Smith dredges had a decided advantage over other machines. Their one unit of equipment contained the earth remover and a conveyor. It did not require water to transport the fill toward the land, and the drier fill was certain to remain where placed.

---

[34]The dredge Hercules was sold to the American Dredging Company and used in the abortive Panama Canal project of Ferdinand de Lesseps.

[35]"New Dredging Machine," MSP, March 26, 1887, p. 201.

[36]Manson, loc. cit., p. 95.

The clamshell dredge, which became the most successful type of levee-building machinery, had been used for some years in the San Francisco dock areas before introduction in the delta.[37] It was mechanically simple in design, consisting of a movable boom from which were suspended two heavy jaw-like elements, clamshells, which were drawn together after being dropped into channel bottoms. The equipment had several advantages over earlier dredges: it could work to any depth, its pay load was comparatively water-free, and the fill could be placed with a fairly high degree of precision. An early model of this type of dredge, in use near Clarksburg (Lisbon District) during 1879, had an 80-foot boom. This $12,000 dredge was powered by four 40-horsepower steam engines, two of which lifted the two- or three-cubic-yard bucket, and two of which controlled lateral movement of the boom.[38]

Booms of 60- and 70-foot length were common on clamshell dredges at first,[39] but 110- or 120-foot booms appeared before 1900. By this time the clamshell type was the principal dredging equipment in use. Models with 190-foot booms were in service by 1906, and 220-foot booms appeared in the next decade. The long-boom dredges had buckets of

---

[37]Atherton, loc. cit., p. 129; Russell et al., op. cit., p. 145.

[38]Ibid., pp. 144-45.

[39]"Merritt Island Reclamation," SF Bulletin, March 7, 1879, in BS, Set W 34, p. 139.

five-cubic-yard capacity.[40] The equipment was capable of moving fill at a cost of three cents per cubic yard,[41] one-third to one-eighth the cost of doing it by wheelbarrow or scraper and one-third the cost of dredging in 1877.[42]

The clamshell dredges numbered 10 or 15 in the 1920's. Rio Vista and Stockton were the main service and dredge-building centers. Only two of the dredges remain in use.[43]

Ditch Diggers

Two types of ditch diggers are employed in the delta. The larger one, used on drainage canals within reclamation districts, may be fitted with an interchangeable dipper arm, a trench or back-hoe, or a clamshell bucket. The smaller equipment, used to dig "spud" or irrigation ditches in the fields, usually works on the principle of a revolving drum to which are affixed bits that do the digging.

Small steam-powered dipper dredges were used to excavate the large drainage mains at least as early as the

---

[40] Russell *et al*., *op. cit*., p. 145; Atherton, *loc. cit*.; Wright interview. A representative dredge, built by the Stockton Iron Works around 1904 or 1905, consisted of a 100 by 50-foot hull and a 130-foot boom with a three-cubic-yard bucket. The dredge had a capacity of 3,000 cubic yards per full day of operation. The manufacturer had produced agricultural, steamboat, and dredging machinery for many years prior to 1889, but thereafter reclamation equipment became the particular specialty of the firm. "History of Stockton Iron Works," *Special Booster Edition of the Byron Times*, not paginated.

[41] Van Loben Sels, *loc. cit*.

[42] "Roberts Island," *SWI*, Sept. 22, 1877, p. 7.

[43] Wright interview.

1900's.[44] By 1918 a new machine, designed by the Stockton Iron Works, mounted a drag line or clamshell bucket rig onto a Holt Caterpillar tractor. The 30-horsepower ditcher could swing its 44-foot boom through 360 degrees. The bucket capacity was one-half of a cubic yard.[45] This type of equipment supplanted the floating dipper dredge because of its greater mobility and flexibility. It is an important component of most reclamation districts and all contractor equipment parks.

Irrigation ditches and minor drainage ditches were dug by hand or some form of scraper until the second decade of the twentieth century, but mechanical diggers were in a fairly advanced state of development by 1918. The early ones, run on distillate, removed a strip of soil 24 inches deep by 10 inches across at a rate of 30 to 60 lineal feet per hour. Assuming laterals spaced at 50- to 100-foot intervals, the ditcher could prepare 60 acres in 24 hours. It performed the work of 800 men.[46] Such equipment was owned by either the contractors or land owners.

Keeping ditches free of the exuberant weed and tule growth which choked them was a manual or horsepower task until the trench or back-hoe was introduced. (A back-hoe is

---

[44]Van Loben Sels, loc. cit.; Wright interview.

[45]"Stockton Iron Works," Sixth Special Booster Edition of the Byron Times, 1918, p. 121.

[46]"J. E. Funk Ditching Machine," ibid., p. 110; "J. E. Funk Ditch-Digging Machine," Fourteenth Development Edition of the Byron Times, 1932-33, pp. 190-91.

shown in Plate XI, p. 275.) Chinese laborers used to remove the growth with long knives and potato hooks until about the 1890's. These were succeeded by V-shaped cutting tools that were dragged along the ditch flanks by teams. The severed masses of floating vegetation were removed with a large hay-fork which was suspended from a boom anchored to a wagon bed.[47] Mechanical ditchers have performed the work since about 1920. (A field drainage ditch dug by back-hoe is shown in Plate XII, p. 276.)

Pumps

Whenever levees were built around a swamp tract, provision was made for sluiceways and gates through which captive water could be drained at low tide. Normally the gates were placed in the levee on or near points where it crossed captive sloughs. Drainage worked well at low tide as long as the reclaimed land remained at or near mean sea level. The efficiency of the system was impaired during flood periods, when seepage into the island was accelerated. The alluviation of river channels and subsidence of island surfaces also interfered with the proper functioning of the gravity drainage system for reclaimed land. Resulting accumulations of water on the land were costly because winter or perennial

---

[47]Weed control in ditches cost $48 per mile per year when done by hand, and $32 per mile with the later equipment. Van Loben Sels, <u>loc. cit</u>.

PLATE XI

Modern reclamation equipment

In this Roberts Island view southwest of Holt there are, from left to right, a portable pump, earth mover, wide-tracked ditcher with back-hoe attachment, and tractor with blade.

PLATE XII

Typical field drainage ditch

Ditches such as the one above are five or six feet deep. Roots and stems are the remains of hydrophytic growth that makes clearing necessary.

crops were water-logged and because spring planting had to be delayed until the ground was dry enough to work.[48]

Saturated soils were blamed for a very light grain crop on Staten Island in 1876. The loss of the 1878 crop in the Courtland vicinity was attributed to the slow rate at which water levels receded.

Pumps were added to the drainage systems of delta tracts in the late 1870's, but farmers were slow to adopt them.[49] It took a few years to learn how much pumping capacity was required to handle the rate of seepage and irrigation water accumulated on the various tracts.[50]

The first drainage pump was installed at Ryde, on Grand Island, in 1876.[51] A horse-powered pump, installed on Rough and Ready Island in 1878, was replaced by steam-powered equipment in 1879. The replacement equipment was possibly similar to two 12-inch Norton propeller pumps, powered by a fully housed 18-horsepower threshing engine,[52] which were

---

[48]"Crops on the Lowlands," SWI, June 24, 1876, p. 5; "Crop Reports," Sacramento Record-Union, May 30, 1878, in BLS, No. 21, p. 276.

[49]Sacramento County and Its Resources, p. 50.

[50]"Bouldin Island," PRP, Sept. 7, 1878, p. 149; "Reclaiming Land in California," MSP, April 30, 1887, p. 284; Atherton, loc. cit., p. 130.

[51]Sacramento County and Its Resources, pp. 50-52. The steam-powered equipment was rated at 40,000 to 50,000 gallons per minute for a 10-foot lift. It cost 11 cents to pump an acre-foot. The drainage system served by the pump consisted of a main 2.5 to 3 feet deep, 8 to 16 feet wide, and 4 miles long.

[52]"Testing the Norton Pump," PRP, March 6, 1880, p. 148; "Reclaiming Land in California," MSP, April 30, 1887, p. 284.

installed on Roberts Island in 1879-80. Because threshing engines were expensive to operate they probably were little used in delta drainage work.

Steam-powered centrifugal pumps gained favorable attention for drainage work after the reliable and economical performance of one on Rough and Ready Island was publicized. The city of Sacramento and a number of reclamation districts adopted similar equipment.[53]

A few turbine, submerged, and centrifugal pumps of less than 16-inch diameter were in operation in 1885, on Rough and Ready, Roberts, and Andrus islands, in the Pierson District, and at Walnut Grove.[54] Probably none of them was rated at more than 15,000 or 16,000 gallons per minute for local lifts. The improved 30-inch siphon centrifugal pump, rated at 38,000 gallons per minute for local lifts, was introduced in 1886 to Walnut Grove and the Pierson District.[55] It consisted of the pump, boilers, and a compound condensing engine of approximately 150 horsepower. Installed

---

[53]The pump on Rough and Ready Island was designed by John Richards of the San Francisco Tool Co. The firm became a major supplier of pumping equipment used in the delta. Its start on Rough and Ready had come about because stockholders in the reclamation project were also investors in the San Francisco company.

[54]"The efficiency of Centrifugal Pumps," MSP, April 4, 1885, p. 217; "An Improved Pumping Plant," ibid., Feb. 20, 1886, p. 124; "Reclaiming Land in California," ibid., April 30, 1887, p. 284.

[55]"An Improved Pumping Plant," MSP, Feb. 20, 1886, p. 124; "The Siphon Centrifugal Pump," ibid., June 5, 1886, p. 367.

and housed on a piling-supported foundation, it cost less than $20,000.[56]

In spite of the original expense and maintenance of pumping equipment, it was installed on a considerable number of reclaimed tracts during the decade 1885-94. Improved systems of ditches were corollary developments. Along the Sacramento in 1894 there were new 30-inch siphon centrifugal pumps at the Lisbon District, west of Freeport, and a number of 8-, 10-, 15-, and 20-inch pumps on Merritt, Randall, Grand, Andrus, and Brannan islands, on the mainland east bank of the Sacramento north of Walnut Grove, and on backswamp property that once lay to the southeast of the Montezuma Hills. Tyler, Staten, and Bouldin islands, various mainland tracts between the Mokelumne and Stockton, and Rough and Ready and Roberts islands also had pumps of 8- to 30-inch

---

[56]The large pump was added to the Pierson District because a wet winter and excessive seepage from the river had been too much for the two existing 15-inch pumps. By April 20, 1886 the 8,800-acre district had 2,000 acres with 6 to 12 inches of water on them and a 350-acre sump had up to a 5-foot and 8-inch depth of water. All water was removed by early June with the complement of pumps. The Pierson District and Walnut Grove improvements were paid for by the San Francisco Savings Union whose local representative was P. J. Van Loben Sels.

The San Francisco Tool Co. manufactured the machinery. It may be noted that the discussion of pumps based on the Mining and Scientific Press applied only to the equipment installed by the San Francisco Tool Co. The equipment is assumed to be representative; but the role of competitors and the number and place of their plants is difficult to discern since the journal only publicized the accomplishments of patentees and manufacturers who used the services of the news organ-affiliated patent attorneys. Ibid. This writer is indebted to Mr. F. Hal Higgins, Walnut Creek, California, for information concerning the journal. Interview with F. Hal Higgins, July 5, 1956.

diameters by this time.[57] Thereafter, it became common practice for owners to install pumps on tracts to be reclaimed or kept dry.[58]

Sometimes it was difficult to obtain adequate foundations for pumps and boilers on new peat levees or on flood-saturated old ones. In such circumstances barges housing pumps were tied up alongside the levees.[59] At least by 1902 one barge in service had a pumping capacity of 100,000 gallons per minute. Pumps aggregating 300,000 gallons per minute capacity were assembled at Bouldin Island after the 1904 flood in an unsuccessful attempt to drain the land before the asparagus acreage was ruined.[60] Once a tract was

---

[57]Report of the Commissioner of Public Works /1894/, pp. 13-15; "Reclaiming Land in California," MSP, April 30, 1887, p. 285; Sacramento County and Its Resources, p. 52; "To Pump In or Out," PRP, Jan. 11, 1890, p. 42; San Francisco Tool Co., Irrigation and Reclamation Machinery (San Francisco: Mysell and Rollins, 1894), p. 45.

[58]The Bethel Tract, 11 miles east of Antioch, was equipped in 1901. Woodward Island had two 20-inch centrifugal electric pumps, with a total capacity of 60,000 gallons per minute, at least by 1908. "Big Land Deal," PRP, Jan. 28, 1901, p. 55; "Story of Beautiful Woodward Island," Special Booster Edition of the Byron Times /1908-9/; A. J. Wells, The Sacramento Valley of California (San Francisco: Southern Pacific Co., 1905), p. 105.

[59]Frederick Rindge, Sr., of the Rindge Land and Navigation Co., is credited with introducing the idea of mounting pumps on barges. Rogers, loc. cit., July 24, 1951, p. 25; "History of the Island Country," Special Booster Edition of the Byron Times /1908-9/; "F. H. Rindge's Model 4,000 Acre Delta Tract," Sixth Special Booster Edition of the Byron Times /1918/, p. 108; "Great Pumping Plant," PRP, April 12, 1902, p. 251.

[60]"Asparagus Fields Not All Reclaimed," PRP, May 21, 1904, p. 327.

drained and the levees firm, permanent pumps and boilers were installed; their capacities had only to be great enough to remove the excess from seepage and irrigation. The barge-housed pumps and boilers became obsolete as soon as electricity was brought to the delta. Temporary electric pumps were more readily installed on piles and tied into existing power transmission lines.[61]

The shift from coal-burning boilers to fuel oil- and gasoline-powered motors had barely started when electric pumps appeared. By 1905/6 the electric pumps were the most widely used of all pumps; by 1920 few steam pumps remained in service.[62] The power was supplied by a network of lines that was extended everywhere in the delta; the peak periods of power line extension occurred between 1911 and 1915. There were difficulties involved in transporting and emplacing the heavy transformers and in setting and bracing power poles in peat land. Nevertheless, the convenience of the electric pump caused it to be accepted rapidly; also operation costs were low compared to those of earlier installations which required an engineer and fireman and the hauling of fuel.[63]

---

[61]Wright interview; "Venice Island," reprint of San Joaquin Valley Rancher, n.d., article appearing in Byjac News, X (Los Angeles: Byron Jackson Div., Borg-Warner, publication, Nov. 1951), pp. 12-14. This writer is grateful to Mr. William N. Beadle for calling attention to his company's publication.

[62]"History of the Island Country," Special Booster Edition of the Byron Times.

[63]Caroline M. Olney, "Orchards, Vineyards and Farms of Yolo County," Overland Monthly, XL (Aug. 1902), p. 185;

Today every drainage district has one or more large electric drainage pumps. The equipment and transformers are placed on heavy pile frameworks above the level of possible flood water. Frequently the pumps or pump houses, the reclamation district equipment park, and the levee master's residence are located together.

Reclamation Costs

The cost of reclamation, usually expressed in terms of dollars per acre reclaimed, has depended upon a number of variables. Levee dimensions reflect anticipated flood levels, foundation conditions, and the weight and binding power of materials used. The cost of constructing them was affected by labor expenses, the proportion of work done by machines, the proficiency of engineers in charge, and the rate of wave erosion on fresh fill. Finally, the area of the reclaimed tract was reflected in per acre costs; large areas usually cost less per acre to reclaim than did small areas.

Prior to the middle 1870's the cost of protecting large tracts by using common labor was between $3 and $12 per acre. Generally, mainland tracts were leveed for less

---

Rogers, loc. cit., July 25, 1951, p. 25. Interview with W. Q. Wright, July 20, 1956; letter from W. C. Fleming, Farm Advisor, San Joaquin County, to F. Hal Higgins, Walnut Creek, June 5, 1956, which quotes observations of Harold A. Walker, retired Pacific Gas and Electric dispatcher resident at Stockton; McKeag, "Delta Report," Unit 3, p. 3.

than $6, and island tracts for more than $6.[64] Expenditures mounted rapidly after the first outlay. On Sherman Island, for instance, the cost of reclamation was thought to have added up to $25 to $50 per acre in 1875.[65] On Grand Island $41 per acre was paid in levee assessments by 1880, and the cost did not cover reclamation work completed before reclamation district formation.[66]

By the middle 1880's, when dredges were used widely, the cost of constructing levees was running from $20 to $50 per acre.[67] By the early 1900's, $15 to $20 per acre was considered adequate to construct an initial levee, in consequence of the greater economy of clamshell dredges. A mile of original structure which cost $1,200 to $8,000 in the 1870's could be built on a massive scale for about $1,000 in the early 1900's.[68] Land reclaimers revised their concept of adequate levees after the floods of 1904 and 1909. Reclamation of virgin land cost between $75 and $150 in 1914.[69]

---

[64]Nordhoff, _op. cit._, p. 134; Browne, _loc. cit._, pp. 400, 401.

[65]"The Flood of Sherman Island," _SWI_, Jan. 30, 1875, p. 5.

[66]_History of Sacramento County_, p. 188.

[67]"Reclamation of Marsh Lands in California," _PRP_, May 30, 1885, p. 510.

[68]"Union Island Reclamation," _SWI_, March 24, 1877, p. 7; "Reclamation," _ibid._, Sept. 1, 1877, p. 5; Naglee, _Letter to Wm. H. Hall and Board of Engineers . . ._, p. 8; Wells, _loc. cit._; Stockton Chamber of Commerce, "San Joaquin County," Calif. State Agric. Soc., _Transactions During the Year 1904_, _loc. cit._

[69]_Report of the Reclamation Board of California_ /1914/, p. 21.

In 1916 it cost a little over $100 per acre to reclaim peat islands of 3,500 to 4,000 acres.[70]

Original levees rarely remained intact for more than a season or two, and additions had to be made to compensate for deterioration or to keep up with the ever-rising levees on adjacent tracts.[71] Even the large levees built on Union and Roberts islands at the outset of development company operations were below the ultimate needs of those tracts. Underestimation of costs was almost universal in delta reclamation.

In 1877 maintenance expenses were expected to add another $1 to $1.50 per acre per year, assuming a tract of

---

[70]"Contra Costa Reclaimed Land Rivals Richness of Delta of the Nile," Contra Costa Gazette (Contra Costa Development Number), 1916, p. 60.

[71]A case in point is supplied by Swamp Land District No. 17, which lay along the east bank of the San Joaquin from about the crossing (U.S. Highway 50) to French Camp Slough. In 1876 levees were raised and strengthened to four times their earlier dimensions. At one time proponents of further enlargement were voted down, though it was realized that across the constricted San Joaquin channel immense levees were then arising on Roberts Island. Farmers who had developed fine orchards and homesteads on the east bank were reluctant to give up the improvements so that the larger levee could be built. Interestingly enough, Middle River residents of Roberts Island had the same fears concerning neighboring Union Island that the mainland people had regarding Roberts Island. "Reclamation," SWI, Sept. 1, 1877, p. 5. The same type of opposition to enlarging levees arose on Roberts Island. This must have distressed M. C. Fisher, who had advanced money to the older property owners for building levees, and whose enclosing of the great bulk of the upper island had made it possible for the earlier settlers to farm their backlands. "Roberts Island," SWI, Sept. 22, 1877, p. 7.

2,500 to 3,000 acres. Fifty years later drainage and levee maintenance costs were about $5 per acre per year.[72]

Cumulative expenditures on reclamation projects were estimated in 1888 to have cost private investors $5,500,000, but it was recognized that the figure probably represented only half of the total costs incurred by private and public interests since reclamation began.[73] Private land reclamation in the delta had reached over $6,300,000 in 1894.[74] In 1903 the expenditures had passed an estimated $15,000,000.[75] Another estimate, made in 1906, gives $20,000,000.[76] Assuming that 275,000 acres were reclaimed by 1905, it cost approximately $60 to $65 to reclaim the average acre.[77]

In 1932 the Division of Water Resources estimated that delta levees represented a capital investment of $27,000,000,

---

[72]From paper by Sherman Day, "The Fitness of the Tule Lands for Dairy Purposes, and the Grasses Best Adapted to Those Lands," SF Bulletin, Oct. 11, 1877, in BS, Set W 19:1, p. 565; Cox, "Farm Tenantry in California," loc. cit., p. 450.

[73]The study, apparently carefully made, discovered evidence for $11 million of expenditures by private persons or reclamation and levee districts in the state as a whole. A doubling of the figure was thought to cover the unpreserved record of expenditures. Another $3.8 million covered public spending on drainage problems to 1888. Manson, loc. cit., pp. 91, 92, 93.

[74]Report of the Commissioner of Public Works [1894], p. 10.

[75]DWR Bull. No. 37, p. 135.

[76]Report of the Commissioner of Public Works . . . , 1904-1906, pp. 8, 10.

[77]The acreage figure is arrived at by assuming the area reclaimed to have been median between the 235,000 acres estimated for 1900 and the 323,600 acres estimated for 1910 by the Division of Water Resources. DWR Bull. No. 27, loc. cit.

or over $60 per acre reclaimed. Yet, a reclamation pioneer on the Sacramento, George B. Greene, stated in 1927 that in 75 years of assessment paying he had contributed a total of $530 per acre for levees, reclamation, and irrigation.[78]

---

[78] "Valley's Farm Industry Born in Sacramento County," in "Capital Family Album Section," Sacramento Union 90th Anniversary Edition, March 23, 1941, p. 5.

CHAPTER XII

BREAKING AND DISPOSING OF THE LAND

The gross area of the Sacramento-San Joaquin Delta approaches 535,000 acres, of which 45,000 acres is water surface outside of the levees. Organized reclamation and other farmed tracts, together with some swampy islets, occupy about 490,000 acres. Crop and pasture land in use averages 350,000 acres, but the area may range from 336,000 acres (1938) to 358,000 acres (1931). Virtually all of the land is irrigable. Two-thirds to three-quarters of the annual cropland is summer irrigated; even the winter cereal acreage is raised with the aid of water tables maintained at favorable levels. The difference between average cropland area and gross reclaimed area is made up by idle land, internal water surfaces and swamp, levees, and municipal or industrial land. The ratio of these four non-farming uses for the land to the whole area of non-farmed reclaimed land is approximately 3.3:2.5:2:2, respectively.[1]

---

[1]Estimates of the land and water surface areas are based on this writer's adaptations of Land Use and Crop Acreage Summary appearing in McKeag, "Delta Report." Tidal channel acreage is based on DWR Bull. No. 28, p. 18. Also consulted: Water Project Authority of the State of California, Report to the California State Legislature Pursuant to

It has not been possible to learn with any degree of exactness what proportion of the leveed area was devoted to particular land uses at any time prior to 1924, but estimates made of the status of reclamation in 1877, 1879, and in 1885 give some idea. In 1877 not less than 30,000 acres of tule land were cultivated.[2] "Several thousand acres" between the San Joaquin's western distributary and Antioch were farmed in 1879,[3] including 3,000 acres on Jersey Island and over 1,000 acres on the Bethel Tract.[4] In 1885 only one tract, the 9,000-acre Pierson District north of Walnut Grove, was completely reclaimed and farmed. Another 75,000 acres embraced all of the lands that were reclaimed in part and upon which crops were "occasionally" grown.[5] Most of the acreage was located on Grand, Andrus, Brannan, Tyler, Staten, Bouldin, Union, and Roberts islands. Another 25,000 acres of occasional crop area were located on Rough and Ready Island and on peripheral reclamations.[6]

<u>the Abshire-Kelly Salinity Control Barrier Act of 1953 . . .</u>, p. 26; DWR Bull. No. 60, p. 19.

[2]"The Tules," <u>SF Bulletin</u>, April 13, 1877, in <u>BS</u>, Set W 18:2, p. 221.

[3]"Agricultural Notes--Contra Costa," <u>PRP</u>, April 5, 1879, p. 228.

[4]"Agricultural Selections," <u>SF Bulletin</u>, March 24, 1879, in <u>BS</u>, Set W 18:2, p. 336.

[5]"Reclamation of Marsh Lands in California," <u>PRP</u>, May 30, 1885, p. 510.

[6]The accuracy of estimates is hard to establish, but the foregoing seems to agree roughly with an 1883 estimate that there were 86,000 acres of reclaimed land in San Joaquin

By 1910 there were 323,000 acres of reclaimed land in the delta. About 70 per cent of the acreage lay in San Joaquin County, 16 per cent in Contra Costa County, and 14 per cent in the north delta counties. Slightly over 60 per cent of the acreage was irrigated, and the rest was capable of raising winter grain or pasture.[7]

Over the years, some reclamation was performed as a means of developing improved pastures, but the ultimate goal for most investors and farmers was the creation of remunerative cropland. Once the land was drained, preparation for cultivation involved the troublesome and costly breaking of virgin organic or mineral-organic soils. Fire was the cheapest method and was used at least as early as the middle 1860's.[8] Experiments with horse-drawn equipment that was intended to be more effective than the plow, and which did not destroy the body of the soil as did fire, also began early. Mechanically powered equipment did not become significant in land preparation until the traction engine and tractor were developed, although steam plows may have been used.

County. The land in this case was termed "effectually" reclaimed. Stockton Board of Trade, The City of Stockton and Its Surroundings, p. 66.

[7]Report of the Conservation Commission of the State of California, January 1, 1913 (Sacramento: 1913), p. 222.

[8]"Miscellaneous Report of O. P. Beasley, on the Reclamation of Swamp Lands," Annual Report of the Surveyor General for the Year 1860, p. 54.

Removing the Tules

Burning was the accepted method of removing stands of tules. It was done in the fall, after the tops had died and when the sod was driest. Sometimes the standing tules were rolled or mowed before burning to insure more thorough destruction of the vegetation. At other times the standing cover was burned subsequent to the burning of the sod. Whatever the timing, the object was to remove an enormous bulk of matted material which hindered other steps in land preparation such as ditching or plowing.[9]

Breaking the Soil with Fire

Burning was also the cheapest and quickest method of reducing the fibrous organic soil to a workable condition. From the earliest times there was an awareness that the organic material lost about half of its original volume with burning, and that the surface of the land was lowered accordingly. Deeper burning was to be avoided.[10] The depth of

---

[9]A representative roller, used on the Lisbon District, consisted of double cylinders mounted in a frame similar to that of a reaper. The diameter of the cylinders was about six feet. The equipment was mounted in front of the horses. "A Ride through Lisbon District," PRP, Jan. 19, 1878, p. 34. Rollers of ten feet diameter, pushed by four horses and steered into the tules by means of a rudder wheel are described also. Illustrations of Contra Costa Co., . . . , p. 8; Tide Land Reclamation Co. (1869), op. cit., p. 39, citing SF Times, June 22, 1869; Munro-Fraser, History of Contra Costa County, . . . , p. 54; Hoag, loc. cit., p. 341; "Our Reclaimed Tule Lands," PRP, April 3, 1875, p. 1; "A New Shipping Point," SWI, Aug. 24, 1878, p. 2; Nordhoff, op. cit., p. 130.

[10]Tide Land Reclamation Co. (1869), op. cit., p. 39.

fire penetration was controllable a little by using the tide gates to manage water levels in the tract or by postponing the burning until dessication had taken place to a desired depth. There is no direct evidence that the water levels were controlled for this purpose in the early reclamation days. Rather, the depth of burn was controlled by the timing; early burns resulted in shallow penetration because dampness retarded the fire.[11] It seemed to be customary to let the turf dry enough to be burned 6 to 18 inches deep.[12] The thoroughness and penetration of fire was greatest in the peat areas, and it diminished as the mineral content of sod increased. On the upper portion of Roberts Island, for instance, some of the burning would reach into only the top six or seven inches of peaty material.[13]

The general practice was to ignite the sod in many places.[14] One procedure was to have a Chinese laborer dig holes into the turf, followed by a second man who dropped wisps of straw into the holes and started the fires.[15] A second method, devised by a farmer on Upper Roberts Island when he could not start fires otherwise, was to ignite

---

[11]"Reclamation of Swamp and Overflowed Lands in California," Report of the /U.S./ Commissioner of Agriculture for the Year 1872, p. 185.

[12]Tide Land Reclamation Co. (1869), loc. cit.; Browne, loc. cit., p. 397.

[13]"Burning Tules," PRP, Nov. 16, 1878, p. 309.

[14]Tide Land Reclamation Co. (1869), loc. cit.

[15]Nordhoff, op. cit., pp. 130-31.

kerosene that had been poured into numerous depressions kicked into the turf.[16] Willows and other undesirable woody growth were cut out of the ground after the fires.[17]

Ashes and the scorched alluvium that remained after the fire usually would not support horses or oxen.[18] Even though walking on peat ash surfaces was disagreeable, sowing was done by hand, commonly with a coffee-mill sower.[19] The broadcast seed was brushed in by dragging branches over the ashes,[20] or it was trampled in by slowly and systematically driving compact bands of sheep over the surface. Bands of 200, 300, and 500 sheep did thorough work. In districts where the mineral soil particles formed a large proportion of the volume of a soil, or where the peat was well dried out, plowing and harrowing preceded seeding and harrowing.[21]

While to burn and "sheep-in" land must have involved variable costs, records of the expenses entailed are sketchy. The following data may or may not have been representative. A tract of 1,500 acres was burned in 1871 or 1872 for $100.[22]

---

[16]"Burning Tules," PRP, Nov. 16, 1878, p. 309.

[17]San Joaquin County Board of Supervisors, San Joaquin County, California, for the Farmer, p. 51.

[18]Hoag, loc. cit., p. 343.

[19]Nordhoff, op. cit., p. 131. Seeding was done at a rate of 20 to 40 pounds per acre. "Our Reclaimed Tule Lands," PRP, April 3, 1875, p. 221.

[20]Ibid.; Tide Land Reclamation Co. (1869), loc. cit.

[21]Hoag, loc. cit., p. 341; "Cultivation of the Tule Land," SWI, Jan. 18, 1879, p. 5.

[22]Nordhoff, loc. cit.

To "sheep-in" cost from 35 cents to $1.25 per acre.[23] A band of 500 sheep could cover about 10 to 16 acres per day, allowing time for feeding on the levees or on volunteer cover.[24] In later years, rolling, burning, and grubbing cost $3.75 per acre, plowing $5.00, and harrowing $1.25.[25]

The first grain crops averaged up to 40 and 60 bushels per acre, though not consistently. Harvesting with headers was accompanied by rather large grain losses. Sometimes sheep were permitted to glean and to tramp in seed for a volunteer second crop. At other times the second crop was encouraged by plowing with a two-share gang plow drawn by four horses wearing tule shoes.[26] By this time dessication and oxidation had proceeded far enough that the organic soil would support the teams.

Economy was not the only reason that made the burning of tule turf attractive to farmers. It produced fairly good seedbeds. Also, it was believed that the fires prevented "disastrous miasma," and in so doing made the islands more habitable.[27] More important, the system often resulted in

---

[23]Tide Land Reclamation Co. (1869), loc. cit.; "Reclamation of Swamp and Overflowed Lands in California," loc. cit.

[24]Ibid.; Nordhoff, loc. cit.

[25]San Joaquin County Board of Supervisors, loc. cit.

[26]Nordhoff, loc. cit.; Hoag, loc. cit., p. 343.

[27]"A Ride through the Tule Country," SWI, Sept. 1, 1877, p. 5; "Burning Tules," PRP, Nov. 16, 1878, p. 309.

spectacular yields which "contributed to keep up the delusion that such was a proper treatment of these lands."[28]

The practice of burning peat had serious shortcomings. The fires were likely to penetrate irregularly, burning deep holes here and there; or to progress irregularly, leaving hummocks of unaltered living and dead organic material among the ashes.[29] The uneven surfaces that resulted hindered efficient operation of teams and equipment.[30] Lowered surfaces were harder and more expensive to keep drained.[31] Soils were depleted, and mineral salts became concentrated in a narrower zone. The occasional escape of fire into peat levees threatened immediate disaster. The dense smoke and ashes that blew eastward caused discomfort in communities to leeward.[32]

Breaking the Soil with the Plow

Virgin peat was difficult to plow before mechanically powered equipment came into use. When it was wet it was too

---

[28] "Burning Tule Lands," ed. of SF Bulletin, Jan. 17, 1879, in BS, Set W 18:2, p. 317.

[29] Nordhoff, op. cit., p. 130.

[30] Browne, loc. cit.

[31] "Burning the Tule Lands," SF Bulletin, March 24, 1879, in BS, Set W 18:2, p. 317.

[32] An interesting case of a fire escaping into the levee of Lower Roberts Island occurred in November of 1878. The fire was restricted to a 450-foot section by cutting trenches into the levee; it was put out by pouring on water for a day and a half. The water was pumped by a fire engine which had to be barged some 60 miles from Stockton to reach the fire. "The Roberts' Island Fire," SWI, Nov. 2, 1878, p. 7.

soft and when dry too tough to be worked satisfactorily with team-drawn implements.[33] The team plowing cost about $4 to $6 per acre; harrowing another $6. Four to six horses were required to pull a plow that turned a four-inch furrow.

Since much of the freshly turned sod was too soft to permit horses to walk in furrows without miring down, a remedy was developed in the form of a cutting tool which consisted of a triangular frame into which 20 steel knives were set four inches apart. These penetrated seven or eight inches into the turf. This "tule cutter" was drawn over the ground as in cross-plowing. It left in its wake a blocky surface which was either seeded and harrowed or turned with a plow.[34]

The firmer sedimentary floors of backswamp ponds and the lower parts of levee backslopes were easier to work with teams than was the peat. The upturned materials were allowed to dry out for a week or two before the first of several harrowings required to reduce the chunky consistency.[35] On occasion the mineral-organic soils of levee backslopes were turned and the exposed roots burned before planting.[36]

---

[33] Ibid.

[34] "A Tule Cutter," SWI, March 10, 1877, p. 7; Tide Land Reclamation Co. (1872), op. cit., p. 32.

[35] "Tule Farming," SWI, March 3, 1877, p. 7.

[36] An Illustrated History of San Joaquin County, p. 108; Illustrations of Contra Costa Co., . . . , loc. cit.; Munro-Fraser, loc. cit.

On Roberts Island a disc harrow was devised for use on the more mineral soils. Eight horses were required to draw this heavily weighted sod slicer.[37] Embodying similar ideas was a "tule cutter" that consisted of fin-like blades set at four-inch intervals which wound around a three-foot cylinder.[38]

Both mechanical and chemical breaking of the delta soils were practiced extensively. Probably burning was the more popular method because of its economy and the fine ash seedbed that was produced. In any case, the soil decomposed enough in a season or two that further working was simple.[39]

Traction Engines and Tractors

When mechanically powered farm implements were introduced to the delta, sod breaking became less difficult. Traction engines and tractors bogged down from time to time but operated satisfactorily wherever surfaces were dry and firm enough to support them.

The sequence of developments which produced the powerful "Caterpillar" type tractor was foreshadowed by the construction of large combine harvesters during the late 1880's.[40] These harvesters, capable of cutting 24- to 32-foot

---

37"Reclamation," SWI, Sept. 1, 1877, p. 5.

38*An Illustrated History of San Joaquin County*, *loc. cit*.

39"A Tule Cutter," SWI, March 10, 1877, p. 7.

40"A Glowing Past--A Promising Future," *Tideways*, I (April 1952), p. 11.

swaths, were too cumbersome for teams to handle satisfactorily. Yet extensive grain farming in the Central Valley and in the delta required large-scale equipment. Steam traction engines were devised as prime movers. By 1900, the coal burner was being converted to oil, a change hastened by anticipation that operating costs would decline and that reduced fire hazards would result in a drop of the 4 to 6 per cent rates for fire insurance covering grain crops.[41]

The traction engine was the principal powered unit in delta farming between 1900 and 1920. It was suited to operation in peat soils which were dangerous or even impassable to horses when moist or when dry and cracked. By 1903 a 20-ton engine with dust-proof cabin was designed for use on the organic soils. The machine was not seriously hampered by the clouds of smothering dust which enveloped men and teams while working the soil. An idea of its size may be had from the dimensions of drive and steering wheels. The smaller steering cylinder was 64 inches in diameter and 50 inches wide. The drive wheels had an 8-foot diameter and a 5-foot face.[42] Between 1916 and 1918, near the peak of the traction engine's usefulness, as many as 50 were in use at one time on a single tract when the Holland Land Company was reclaiming its vast Yolo Basin holdings.[43]

---

[41] "Oil Burning Traction Engines," PRP, June 16, 1900, p. 375; "Peat Land Grain Insured," PRP, July 2, 1904, p. 7.

[42] "Large Traction Engine," PRP, March 7, 1903, p. 150.

[43] "Holland Land Company," Sixth Special Booster Edition of the Byron Times, p. 116.

In 1904, the first moderately successful steam-driven "Caterpillar" type tractor was developed at Stockton. An internal combustion engine was substituted for steam power between 1906 and 1908.[44] By the end of another decade, it was in general use as a farm machine by wealthy operators such as F. H. Rindge whose Rindge Land and Navigation Company used 16 "Caterpillars" in 1918 to do company and contract work on about 50,000 acres.[45] Thereafter the track type tractor became a more common possession of delta operators. No other machine has operated as well or as effectively in working reclaimed, unreclaimed, and levee land.

Land-Breaking Costs and Value Increment

Virgin tule land was generally bought for between $1.25 and $5 per acre, though as little as 75 cents and up to $25 was paid.[46] Costs of peat land reclamation ranged from $3 to $12 per acre in the early 1870's, and up to $150 per acre in the succeeding decades. Preparing the tule soil for its first crop cost from 50 cents to about $15 per acre,

---

[44]Rogers, loc. cit., July 13, 1951, p. 19.

[45]"F. H. Rindge's Model 4,000 Acre Delta Tract," Sixth Special Booster Edition of the Byron Times, p. 108; Wright interview.

[46]Report of the Joint Special Committee to Investigate Chinese Immigration, loc. cit.; "Reclamation of Marsh Lands in California," PRP, May 30, 1885, p. 510; "Large Purchase of Peat Lands," PRP, Jan. 30, 1904, p. 70; "Reclaiming Land in California," MSP, April 30, 1887, p. 284; "Our Great Reclamation Problem," Commonwealth Club of Calif., Transactions, I (March 1904), p. 26.

depending upon the original condition and the methods used. When improved, this land sold for $40 to $150 per acre during the 1880's, 1890's, and early 1900's. The average price was about $200 per acre by 1910, and $250 in 1914. It has since gone up to about $400 per acre in cases of transactions involving large areas. The prices varied in accordance with proximity to navigable channels when they provided the only avenues over which products could be moved to market.[47]

Land prices also reflected the condition of levees. The most desirable property was that which was enclosed by strong levees.[48] Peat soils and the smaller acreages were more costly per unit area.[49]

---

[47] "Reclamation of Swamp and Overflowed Lands in California," loc. cit., p. 187; Nordhoff, op. cit., p. 134; Report of the Joint Special Committee to Investigate Chinese Immigration, loc. cit.; "Reclamation of Marsh Lands in California," PRP, May 30, 1885, p. 510; "Reclaiming Land in California," MSP, April 30, 1887, p. 284; An Illustrated History of San Joaquin County, p. 109; Sacramento County and Its Resources, p. 52; "Our Great Reclamation Problem," loc. cit.; San Joaquin County Board of Supervisors, op. cit., p. 52; "San Joaquin County," Calif. State Agric. Soc., Transactions /1904/, p. 222; Wells, loc. cit., p. 316; Reports of the Control of Floods in the River Systems of the Sacramento Valley and the Adjacent San Joaquin Valley, Cal., U.S. 62d Cong., 1st Sess., H. Doc. 81 (Washington: 1911), Appendix A, p. 7; Report of the Reclamation Board of California /1914/, loc. cit.

[48] M. L. Requa and H. T. Cory, "The California Irrigated Farm Problem" (Washington, March 1, 1879), p. 71. (Mimeographed.)

[49] Among the transactions of 1901 and 1902 these occurred: 70 acres for $70 per acre; 1,100 acres for $50 per acre; 3,000 acres for $58 per acre; and 6,300 acres for $39 per acre. The first two transactions were on sedimentary Middle Division of Roberts Island; the second two were on peat soil Bouldin Island and the Upper Jones Tract, respectively. Cosby, "Delta History Notes," pp. 71, 72, 82, 84;

A clearer idea of the comparative costs incurred and of the values added by reclamation may be obtained from specific cases. In the interval between May 1868 and May 1869 the value of the land on Sherman Island appreciated from about $1.40 per acre to $14 to $25 per acre. Sales were numerous as reclamation proceeded because owners needed money to pay the assessments against their remaining property; bank loans were unavailable generally until after the land was reclaimed.[50] By the time that the land was in cultivation (1871), it brought from $50 to $75 per acre.[51] By 1885 unreclaimed swamp was valued at $5 to $25 per acre. It was reclaimable for an average cost of $30 to $50 per acre and was subsequently sold for $75 to $125 per acre,[52] if it was sold at all.

Tenantry

There never has been any widespread interest on the part of landowners in subdividing and selling.[53] "It is a

---

SDI, Oct. 23, 1901 (6,300 acres); ibid., Dec. 18, 1901 (3,000 acres); ibid., Sept. 21, 1902 (70 acres); ibid., Dec. 3, 1902 (1,100 acres).

[50]Tide Land Reclamation Co. (1869), op. cit., p. 38, citing a letter to San Francisco Times, May 14, 1869; "Sherman Island Improvements," MSP, May 22, 1869, p. 330.

[51]Hoag, loc. cit., p. 345.

[52]"Reclamation of Marsh Lands in California," PRP, May 30, 1885, p. 510.

[53]"History of the Island Country," Special Booster Edition of the Byron Times; An Illustrated History of San Joaquin County, loc. cit.; Cox, loc. cit., p. 444; personal observation.

notable fact that little of the thoroughly reclaimed lands is offered for sale as the owners are fully satisfied with the returns and believe that the investment is a profitable one."[54] Owners have chosen to rent, lease on shares, or assign the land to managers. Such sales as are made usually are in large tracts. There seems to be a sentiment against small operators. In the past they lacked the resources or inclination to support reclamation district decisions and assessments.

Whenever possible, owners of large holdings avoided subdivision to the point where control of a reclamation district was lost. Experience had shown that "a centralized and arbitrary control is sometimes of vital importance in the reclaimed land." This control was exercised by the party or group which held the majority of acreage in a district. When ownership was diffused there was a multiplication of areas where disagreement could arise on district reclamation policy and management.[55] Friction also developed over water distribution where subdividing resulted in the separation of land from the river, and the attendant riparian water rights. The landlocked irrigator became dependent upon return flow from riverside property; sometimes such an arrangement produced complications when the irrigation cycle of crops on the

---

[54]Stockton Board of Trade, loc. cit.

[55]"The Netherlands of America," Stockton Evening Mail, San Joaquin Valley Development Edition, July 22, 1911, p. 20.

higher land differed from the requirements of the lower land.[56]

It has been difficult for tenants to enter the landowner class. Just before World War I no tract of less than 100 acres could be bought for less than $250 per acre; prevailing values of valley plains land up to 10 miles east of the delta were $75 to $150 per acre. Sales contracts required one fifth in cash, and the balance in four equal annual payments. Interest was 6 per cent. A small farmer required a good deal of capital to cover the purchase price, operating costs, and levee and drainage assessments.[57]

Landowner attitudes and the cost and insecurity attendant upon ownership in the delta have fostered a pattern of tenantry. Almost since the start of reclamation most of the farm land has been tenant cultivated. Commonly, the white landowners leased their property to whites, or to Chinese or Japanese entrepreneurs. Some of the lessees employed white or Oriental labor to work the farms, but the usual arrangement until about World War I was to sublease to Orientals on a share basis.[58] Thereafter, Orientals became

---

[56] Ibid.; Brown interview.

[57] Cox, loc. cit., p. 449.

[58] Report of the Joint Special Committee to Investigate Chinese Immigration, pp. 439-40; "Dire Disaster," SF Chronicle, Feb. 24, 1878, in BS, Set W 34, p. 121; "Lee Yuen," SWI, Feb. 13, 1882, p. 3; "Enterprising Chinese Farmer," Special Booster Edition of the Byron Times, not paginated.

paid field hands; anti-alien land leasing enactments forced change.[59]

Cash renters usually have paid $10 to $50 per acre, in advance, for row crop land.[60] When the tenant subleases, he does so for a 25 to 66 per cent share of the crop. Owners also lease on shares. Share agreements have varied with crop types and with the responsibilities assumed by the contracting parties, but the general terms have remained about the same over the past 80 years.

Agreements usually are oral. In the 1870's or 1880's an owner received 35 to 50 per cent of the crop if he supplied seed, feed, teams, and implements.[61] His share was greater for the crops which required least hand labor; barley,

---

[59]DWR Bull. No. 23, p. 364.

[60]"Reclamation of Swamp and Overflowed Lands in California," loc. cit., p. 179; "Dire Disaster," SF Chronicle, Feb. 24, 1878, in BS, Set W 34, p. 122; "The Flood," SF Chronicle, Feb. 26, 1878, in BS, Set W 34, pp. 126-27; San Joaquin County, Its Products and Resources (Stockton: Ruggles and Robinson, 1888), p. 5; Sacramento County and Its Resources, p. 44; Colvin B. Brown, "Millions in Potatoes," Sunset, IX (March 1902), p. 15; "Sacramento County," Calif. State Agric. Soc., Transactions /1904/, p. 174; "San Joaquin County," ibid., p. 222; "History of the Island Country," Special Booster Edition of the Byron Times; A. J. Wells, "San Joaquin County, California," Sunset, XXVI (June 1911), p. 694; "Borden's Magnificent Victoria Island," Sixth Special Booster Edition of the Byron Times; San Joaquin County Board of Supervisors, op. cit., pp. 24, 25, 43, 51; Cox, loc. cit., pp. 445, 447, 450; Requa and Cory, op. cit., p. 91.

[61]Tide Land Reclamation Co. (1869), loc. cit., citing SF Times, May 10, 1869; and p. 36, citing SF Call, July 28, 1869; "Reclamation of Swamp and Overflowed Lands in California," loc. cit.; "Roberts Island," SWI, Oct. 19, 1878, p. 9; "Through San Joaquin County," SF Bulletin, March 22, 1879, in BS, Set W 4, pp. 1502-3; San Joaquin County Board of Supervisors, op. cit., p. 43.

for instance, returned a 50 per cent share to the owner who furnished teams and equipment with his land. Tenants supplied half or more of the sacks and paid labor and board expenses.[62] In the 1930's the owner ordinarily received 25 per cent of a potato crop, 30 to 40 per cent of a corn or other grain crop, and either 33 or 66 per cent of an asparagus harvest. The 33 per cent share of asparagus production was received when the tenant was given a 10-year contract to plant and harvest. The owner secured 66 per cent when furnishing bearing acreage on an annual lease.[63]

Today, sugar beets and tomatoes, the hand labor crops, give landowners a 20 to 25 per cent share of the harvest. Corn and milo generally yield a third of the crop for the owner.[64]

In 1916, by which time the roles of the owner and tenant were well established, the owner was responsible for the maintenance of levees, the digging and maintenance of main canals, the excavation of seepage ditches near the levees, and the cost of moving water into or out of the island. As a rule, owners also furnished barns and bunkhouses. Tenants maintained the seepage and drainage ditches

---

[62]Cox, loc. cit., pp. 445, 450.

[63]Cosby, "Delta Field Notes," p. 39, interview with George E. Cox, July 21, 1934.

[64]Interview with Charles Upham, Sherman Island, August 28, 1955.

and put in irrigation laterals.[65] In the days before tractors the average tenant farm was a 200-acre unit.[66] The crops to be grown were specified in the leases, which were made for terms of one to five years. The agreements were terminable on January 1, provided four months' written notice was given in advance. Otherwise, rent was paid on or before that date. When not forthcoming, the owner assumed a crop mortgage. Commission houses were informed of the situation, and all payments to the operator by the houses were in checks made out to the mortgage owner. When presented with the check, the landowner usually made out a second check to the tenant at half of the value of the commission agent's payment. The arrangement continued until such time as the grower could forward a statement from the mortgage holder that the debt had been liquidated. Other liens might be placed on the crop for advances made by the commission houses to the farmer.[67]

Because potatoes were exceptionally profitable on virgin soil, they remained for a long time a keystone crop in the tenant farming picture of the delta. Fungus infestations became so widespread after three years of potato crops on one tract that they could not be raised again without giving the

---

[65]Cox, loc. cit., pp. 448-49; San Joaquin County Board of Supervisors, op. cit., p. 51; "Borden's Magnificent Victoria Island," Sixth Special Booster Edition of the Byron Times, p. 104.

[66]"The Drexler Tract," Stockton Evening Mail, San Joaquin Valley Development Edition, p. 27.

[67]Cox, loc. cit., p. 447.

land a rest. The situation was reflected in the premium prices which were paid for virgin land and in the gradation of rents on old land in accordance with the time lapse between the preceding potato crop and the one planned.[68] It was reflected also in the manner of crop and tenant rotation that developed. On older land, it became customary to rotate the potatoes with beans and barley. An example of the rotation procedure is afforded in the Elmwood Tract, north of Stockton. The 1915 potato crop was followed by beans in 1916 and again in 1917, and by barley in 1918 to "rest" the soil before renewing the cycle.[69] Few tenants were sufficiently versatile or well enough equipped to farm all three crops, necessitating yearly contracts with particular operators to raise particular crops. A new crop usually brought a new tenant or tenant group onto the land. Because the operators changed as the fields were rotated, they tended to remain town residents who resorted to camp life in the field when the season and crop required. White American farmers were reluctant to participate in this transient form of cropping.[70] Hence, the areas devoted to intensive field crop farming were occupied by Chinese, Japanese,[71] Italians, and Portuguese.

---

[68]Ibid.; "The Tule Lands of the San Joaquin," SF Bulletin, March 24, 1879, in BS, Set W 18:2, p. 336; San Joaquin County Board of Supervisors, op. cit., pp. 50-51.

[69]"Splendid Elmwood Tract," Sixth Special Booster Edition of the Byron Times, p. 114.

[70]"The Netherlands of America," Stockton Evening Mail, San Joaquin Valley Development Edition, July 22, 1911, p. 20.

[71]Cox, loc. cit.

CHAPTER XIII

LAND USE IN THE DELTA

The Sacramento-San Joaquin Delta is a remarkably fertile agricultural region. For almost a century visitors and residents have extolled its productivity, but the supreme tribute is the modern assertion that yields are so heavy that the crops are causing the land to subside. A comparison of delta and upland crop yields, made in 1954, lends weight to the assertion (see Table 3, p. 308).

Delta farmers are fortunate in having the most equable climate of the Central Valley floor. Marine influences, while they modify extremes of temperature, are not so great that the delta is deprived of the sunny and warm growing season common to the rest of the valley. The crops are not dependent on precipitation, the entire reclaimed area being irrigable from the delta channels.

The land is flat or nearly so. It is easy to plane, ditch, or irrigate; and work with mechanized implements is unimpeded by claypan, gravels, or rock. The friable soil is generally permeable and rich in nitrogen, but the intensive use which the land receives makes supplemental fertilization with the other elements essential.

TABLE 3

COMPARISON OF AVERAGE YIELDS PER ACRE, PEAT AND UPLAND SOIL, SAN JOAQUIN COUNTY[a]

Crop	Upland Soils (Per Acre)	Peat Soils (Per Acre)
Asparagus	2,000 lbs.	2,500 lbs.
Barley	15 sacks	25 sacks
Carrots	20 tons	22 tons
Celery	800 crates	350 crates
Corn	2,000 lbs.	3,000 lbs.
Onions	600 sacks	650 sacks
Potatoes	225 sacks	350 sacks
Sugar beets	15 tons	18 tons
Sunflowers	900 lbs.	1,200 lbs.
Tomatoes	17 tons	17 tons

[a]Compiled by San Joaquin County Agricultural Extension Service, 1954, but applicable to the delta as a whole.

Growth of Agriculture, 1849-1900

Agriculture as a sustained activity in the delta began with the subsistence gardening of the Gold Rush. People of various nationalities cleared the higher levee land for gardens and pastured stock in the tules. Location on the main thoroughfare between San Francisco and the mines and access to San Francisco, Sacramento, and Stockton were factors which fostered the early development of commercial farming. The first phase was one of concentration on potatoes, onions, beans, and a wide variety of more perishable produce. The swamps were used as summer range for beef cattle raised by farmers of the valley plains-delta margin. Orchards, dairying, and grain farming do not appear to have received much attention until after the 1870's.

The lines of development are not well defined, but particular phases of husbandry came to be associated with different ethnic groups. By the 1870's Chinese, Italian, and Portuguese tenant farmers were identified with garden or truck farming. The Chinese also became specialists in row crops such as potatoes. American-born settlers tended to engage in grain, orchard, and livestock husbandry. These ethnic specializations had jelled by the end of the nineteenth century. From time to time new crops were introduced, particularly after land developers entered the business of reclamation and speculation. Some of the introductions did well but others, among them ramie, jute, and rice, never were successfully grown and marketed.

By the 1870's farming was flourishing. The delta's early vegetables earned premium prices in central California cities, while the staple potatoes and beans comprised a large share of the state's produce.[1] Livestock, dairy products, and hay were shipped to San Francisco Bay cities, as were also deciduous fruits, chiefly peaches and pears. Moreover, the premium fruit found ready markets in the East once transcontinental rail shipments were feasible. Wheat, California's second golden harvest, was produced in the delta for export.

Some irrigating had been done earlier, but the practice does not appear to have become a common part of delta farming until the 1870's. Flood irrigation had been tried on small grain by 1871, but was given up because of the excessive weed growth that resulted.[2] For other crops land soaking before planting or flood irrigation were practices in use during the 1870's. Subirrigation prior to plowing and planting dates from the same decade; it was originally used for beans and potatoes or to encourage the growth of a volunteer hay crop.[3] Since then subirrigation has been used on all growing crops.

---

[1]In 1875 nearly all of the delta produce trade was with San Francisco. "Down the River," Sacramento Bee, Nov. 5, 1875, in BS, Set W 5, "California Counties; Santa Cruz to Yuba," p. 1870.

[2]"Sherman Island Improvements," MSP, May 22, 1869, p. 330.

[3]"Crops on Sherman Island," correspondence to SF Bulletin, May 21, 1871, in BS, Set W 18:1, p. 147; "The Tule

Irrigation water was delivered to the backswamp land through tidal gates and drainage ditches in the 1870's. Filled mains backed water into field ditches of two- to four-foot depth; from these the water spread along the six-inch- to two-foot-deep laterals ("spud ditches") which were spaced at intervals of 65 to 85 feet. Seepage occurred in the peat soils. Water levels were controlled with dams across the ditches.[4]

Water delivery systems independent of drainage ditches were in use by the latter 1870's.[5] These systems were maintained by the farmer, only the drainage system being the responsibility of the reclamation districts. Water wheels, windmills, and low-head pumps were used on the higher alluvial banks[6] where furrow and check irrigation were the rule. Gravity flow and siphons after the 1900's were used on the lower tracts.[7] Nevertheless, it appears that much of the

---

Lands of the San Joaquin," SF Bulletin, March 24, 1879, in BS, Set W 18:2, p. 336; "Reclamation of Swamp and Overflowed Lands in California," Report of the /U.S./ Commissioner of Agriculture for the Year 1872, p. 186; "Agricultural Notes--Contra Costa," PRP, April 5, 1879, p. 228.

[4]Letter of H. Eugene H. to ed., /PRP/, Feb. 11, 1878, in BLS, No. 21, p. 274; Report of the Conservation Commission of the State of California, January 1, 1913, p. 222.

[5]"Tule Farming," SWI, March 31, 1877, p. 7.

[6]McKeag, "Delta Report," Unit 3.

[7]"How Rich Land Is Saved from California Rivers," PRP, July 1, 1905, p. 5; Wells, "Tilling the 'Tules' of California," loc. cit., p. 314; idem., "San Joaquin County, California," loc. cit., p. 695.

land was without irrigation as late as 1898, when, to save grain crops, the Moss Tract levee was breached to admit water, and a steamer was used to pump water onto Rough and Ready Island.[8]

Agriculture, 1900-1924

Although it began earlier, the transformation of delta farming of perishable crops from garden to field agriculture is essentially a twentieth century development. Asparagus, celery, and tomatoes were handled thereafter on a scale previously associated only with such hardy staples as potatoes, beans, and onions. Sugar beets developed into an important cash crop. The scale of all operations expanded rapidly. Barley replaced wheat as the major winter grain crop. Dairying grew apace in the San Joaquin delta. To the north, along the natural levees of the Sacramento, Bartlett pear orchards reached their prime. Alfalfa hay was cut for the city livery trade or, along with crop waste and other feed, was moved to market in the form of beef and mutton.

Marketing methods altered around 1900. Canneries and wholesale produce houses began to handle delta crops directly; trade names and product standards were adopted; and buyers went into the field to contract for crops. Earlier the

---

[8]Cosby, "Delta History Notes," pp. 18-19; SWI, March 25, 1898; *ibid*., April 9, 1898. In 1909 less than half of the reclaimed land was irrigable. *Report of the Conservation Commission of the State of California, January 1, 1913*, pp. 165, 222-23.

customary method of selling field crops was by consignment to wholesale markets or shippers.[9] The change favored producers, although it was another two or three decades before the radio and telephone gave the farmers as good an access to market news as the dealers possessed.[10]

Although crop acreage and value figures are unavailable for the decade 1900-10, barley occupied the most extensive area,[11] while potatoes were the most valuable crop. After potatoes, beans and asparagus were the most valuable row crops. Onions, field corn, celery, sugar beets, sweet potatoes, flax and flaxseed, wheat, alfalfa, and rye were among the secondary crops of the decade.[12]

The relative standing of the intensively farmed field crops remained about the same in 1913[13] and 1916. In 1916

---

[9]"Marketing the Crops," Special Booster Edition of the Times, not paginated.

[10]Capt. H. J. Corcoran, "River Navigation in Early Days," Commonwealth Club of Calif., Transactions, VIII (Nov. 1913), p. 585; Sacramento River Basin, Calif. Dept. of Public Works, Div. of Water Resources, Bull. No. 26 (Sacramento: 1933), p. 157.

[11]DWR Bull. No. 23, p. 365.

[12]An impression of the relative importance of the row crops is provided with data from San Joaquin County. The 1905 potato crop was worth $1,000,000; bean production was valued at $300,000; and the asparagus crop was worth $160,000. "San Joaquin County," Calif. State Agric. Soc., Report for the Year 1906 (Sacramento: 1909), pp. 168-69; Wells, "Tilling the 'Tules' of California," loc. cit., p. 315; Report of the Conservation Commission . . . , p. 222.

[13]Reconnaissance Soil Survey of the Sacramento Valley, California, by L. C. Holmes and J. W. Nelson, USDA, Bur. of Soils (Washington: 1916), p. 2426.

barley was probably still the leading crop in acreage, with 120,000 acres alone in the part of the delta which lies east of the San Joaquin Old River and Mokelumne North Fork (San Joaquin County). Beans and potatoes occupied 40,000 and 30,000 acres, respectively. Among the lesser crops were 4,000 acres of onions, 3,000 acres of sugar beets, 3,500 acres of field corn, and 1,000 acres of celery.[14] The importance of these crops in the delta west of Old River (Contra Costa County) and along the Sacramento (Solano, Sacramento, and Yolo counties) has not been documented from available evidence; but there is no reason to believe that the relative importance of each varied much from the pattern in San Joaquin County. Inclusion of a possible 30,000 acres of asparagus and of a possible 20,000 acres of orchard may be made for the reclaimed districts along the Sacramento River.

A change from the earlier farming methods occurred after World War I. The "Oriental influence" gave way to the "new industrial farming."[15] Mechanization, contract day labor rather than sharecropping gangs, the use of fertilizer, the weakening of the traditional potato-barley-beans rotation, and the development of new crops were involved. Barley and potato acreage in the San Joaquin River districts declined as new plantings were made of field corn, sugar

---

[14] Cox, loc. cit., pp. 445, 447.

[15] DWR Bull. No. 23, p. 365.

beets, celery, and onions.[16] In the Sacramento River districts asparagus and sugar beets were part of the new agriculture.

Agriculture, 1924-57

From 1924 to the present, winter grain and asparagus have ranked first and second among delta crops in terms of acreage. (Acreage figures are shown in Table 4, pp. 316-17.) Grain, chiefly barley, usually occupies 25 to 35 per cent of the cropland; and asparagus, 17 to 21 per cent. Field corn and alfalfa have ranked third and fourth in acreage fairly consistently, with corn accounting for 9 to 15 per cent of tilled land (until 1950), and the alfalfa acreage varying from 6 to 10 per cent of the crop area. Since 1950 corn has been replaced by milo as the chief summer grain crop. The milo acreage is larger than the area devoted to sugar beets (1952), which generally occupies about 8 per cent of the area. Beans, the deciduous fruits, onions, potatoes, canning or table vegetables, pasture, and seed crops have varied in importance over the past 25-30 years. Animal husbandry has been a secondary activity since 1924.

Since the 1920's increasing mechanization, improved seeds and cultivation techniques, and more intensive use of fertilizer have occurred. Portable sprinkling systems, using

---

[16] W. C. Fleming, "California's San Joaquin River Delta Has Great Production Potential," San Joaquin County Agricultural Extension Service MS, Stockton, Aug. 31, 1955, p. 1.

TABLE 4

CROP ACREAGE IN THE SACRAMENTO-SAN JOAQUIN DELTA, 1924-52[a]

Crop	1924[b]	1931[b]	1938[b]	1945[b]	1952[c]
Alfalfa	28,700	22,100	28,900	24,600	35,400
Asparagus	52,600	69,500	66,600	62,300	75,800
Beans	36,400	23,400	7,500	8,300	2,300
Corn	23,100	53,100	39,300	36,500	17,800
Milo	......	......	......	......	32,200
Celery	4,100	6,300	7,100	5,600	3,400
Onions	3,900	3,500	1,800	2,100	1,900
Pasture	800[d]	12,700	13,900	15,800	22,200
Potatoes	26,800	18,000	10,600	8,000	6,400
Seeds	900	8,700	3,000	8,400	100
Safflower	......	......	......	......	5,000
Sunflower	......	......	......	......	2,900

TABLE 4--Continued

Small grains	29,700[d]	91,100	114,700	117,400	90,500
Sugar beets	21,700	32,600	30,600	22,400	28,400
Tree crops	16,500	10,400	5,800	4,900	4,900
Truck crops	3,900	6,600	12,000	33,700	1,600
Tomatoes	......	......	......	......	26,400
Totals	249,100	358,000	341,800	350,000	357,200

[a]Figures are rounded off to nearest 100.

[b]Data collected by Sacramento-San Joaquin Water Supervisor, Division of Water Resources, but adjusted by McKeag in tables accompanying "Delta Report," from which they are taken.

[c]Data collected by McKeag. Tabulations appear in "Delta Report" tables as preliminary figures.

[d]Pasture and small grain acreage tabulations for 1924 are for irrigated land. Non-irrigated pasture and small grain acreage, possibly amounting to 90,000 acres, was not recorded.

aluminum pipe and truck-mounted "Smitty" pumps, have become commonplace since World War II for irrigating such crops as sugar beets, alfalfa hay, and milo (see Plate XIII, p. 319). Selective weed-killing sprays, also relatively new introductions, are of inestimable value to delta farming; weed control has been a serious problem in the moist soils. Bulk handling of grain is largely a development of the 1940's and 1950's.

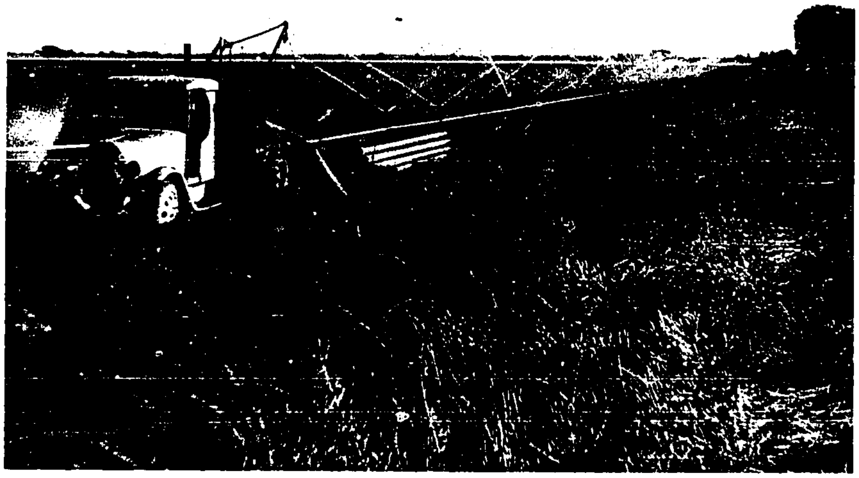
The market orientation of delta crops in the 1950's is similar to what it was before 1924, but the various commodities move in different volumes than prevailed 30 to 50 years ago. Increased tonnages of asparagus and tomatoes dominate the cannery trade, while pears have declined in importance. Beans, onions, and potatoes are shipped in shrinking annual tonnages. On the other hand, the higher value feed crops have grown in importance. Sugar beet tonnages are larger also. Most of the feed is consumed in central California, and sugar beets are processed in or near the delta. The produce and fruit move to state and national marketing centers.

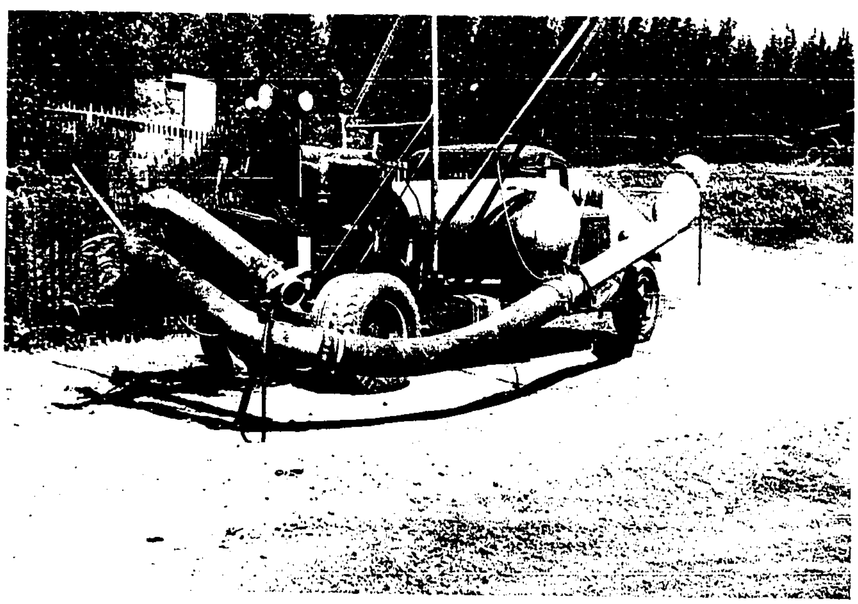
Food and Industrial Crops

Subsistence and Commercial Gardening

Subsistence gardening evolved into commercial agriculture during the 1850's and 1860's as white settlers and their Chinese employees or tenants cleared and grubbed the natural levees. By 1857 the clearing had resulted in the development

PLATE XIII





Typical portable irrigation pumps

Upper photograph shows a portable sprinkler system operating in Reclamation District 999. The truck is mounted with a pump and intake line. Lower photograph shows a pump rig. The suspended intake line is similar to the one which leads into ditch of upper photograph.

of a continuous line of farms on the east bank of the Sacramento from the capital city to opposite Rio Vista;[17] downstream the farms were discontinuously distributed. On the west bank from Clarksburg headward levee land was generally occupied;[18] Merritt, Sutter, and Grand island natural levees were filling up along the Sacramento and near the head of offshoot sloughs. The more flood-prone lower levees were less improved.[19] Agricultural developments were slower to occur along the Mokelumne, Calaveras, and San Joaquin banks, but levee land which in 1850 had little attraction was occupied and fenced "in an inconceivably short time" after the autumn of 1851. By November 1852 these banks of the Mokelumne, Calaveras, San Joaquin, and Stanislaus had been entirely occupied.[20]

The Sacramento River natural levee soils were planted to grain, deciduous fruit trees, table vines, and to a wide variety of table crops. Common and sweet potatoes, maize, beans, melons, squash, peanuts, and celery were planted.[21]

---

[17]<u>History of Sacramento County</u>, p. 190.

[18]"Report of Yolo County Surveyor," <u>Annual Report of the Surveyor General of the State of California for 1856</u> (Sacramento: 1857), p. 257.

[19]"Field Notes of the Subdivision Lines and Meanders of Township 5 North, Range 4 East, Mt. Diablo Meridian, California," U.S. Dept. of the Interior, General Land Office, Field Notes 66, Folio 11 (at Bureau of Land Management, Survey Records Office, Sacramento). (Handwritten.)

[20]<u>SF Alta</u>, Nov. 15, 1852, in <u>BS</u>, Set W 18:1, p. 28.

[21]"Miscellaneous Report of O. P. Beasley, on the Reclamation of Swamp Lands," <u>Annual Report of the Surveyor</u>

Double cropping was practiced; sweet potatoes or onions might follow a small grain or pea crop, and beans might follow the winter crop of potatoes or cabbage.[22] Every inch of the soil was highly valued. On Tyler Island, for instance, an 80-acre farm, half of which was yet in tules, sold for $6,000 in 1861. The improved land here and along the Sacramento did not amount to much more than 660 feet across from river to backswamp.[23]

White farmers tended to be owner-operators, who were particularly interested in grain, fruit, and stock. Some Italian and Portuguese immigrants and numerous Chinese were cash or share tenants and hired market-garden or row-crop farmers.[24]

It is assumed that most of the natural levee farms of the Mokelumne and Calaveras rivers grew vegetables and grain in excess of subsistence needs during the 1850's and 1860's. The trade in such crops was so lucrative that it warranted a considerable outlay to reclaim Rough and Ready Island, just

---

General for the Year 1860, pp. 54, 55; Russell et al., History of Yolo County, . . . , p. 171; "Visit to a California Ranch," SF Alta, Aug. /?/, 1860, in BS, Set W 3, p. 1009.

[22]Ibid.; "Report of the Solano County Assessor," Calif. State Agric. Soc., Transactions During the Years 1864 and 1865 (Sacramento: 1866), p. 234.

[23]First Annual Report of the Swamp Land Commissioners, December 15, 1861, pp. 15-16.

[24]Russell et al., op. cit., pp. 170-71; Leale, Recollections of a Tule Sailor, pp. 48, 50.

west of Stockton, and supported truck gardens along the San Joaquin.[25]

An idea of the nature of small-scale farming in the 1870's is afforded by glimpses of activity at Rough and Ready, Roberts, and Sherman islands. On Rough and Ready Island a handful of Italian share tenants and hired hands worked several properties, raising tomatoes, peppers, egg-plants, a little asparagus, and other truck crops. Some 12 acres of deciduous orchard and vine and a few acres of alfalfa were farmed at the eastern end of the island. At times the orchard owner and largest operator was able to ship $1,000 worth of produce per week to San Francisco and Stockton.[26] By early 1879 the island was shared with cultivators who raised field crops of barley, potatoes, corn, and beans on the lower backslopes and in the reclaimed back-swamps. The relationship of truck gardens to island peripheries and of field agriculture to the lower land was established early.[27]

The conversion of natural levees into farm land on Roberts Island may be credited to Chinese lessees who, at

---

[25]"San Joaquin News," SF Alta, June 10 and 13, 1852, in BS, Set W 4, p. 1397; "San Joaquin News," SF Alta, Sept. 26, 1852, in BS, Set W 4, p. 1406; Report of the Commissioner of Public Works /1894/, p. 14.

[26]"Tule Farming," SWI, March 3, 1877, p. 7.

[27]"Agricultural Notes--San Joaquin County," PRP, April 26, 1879, p. 277; "Down Among the Tules," SF Bulletin, Feb. 23, 1880, in BS, Set W 4, pp. 1510-11.

least by 1869, were establishing truck and fruit gardens on the San Joaquin River side of Roberts Island.[28] South of Rough and Ready Island the cleared land had become an almost continuous series of 6- to 50-acre cultivated plots by 1875. The farmed strip stretched into the island 200 to 500 feet. Another 60-acre strip of cultivated levee was located on the west side of the island to the north of the Pescadero Grant line. Here and there along the levee were the homes and barns of a dozen white families, chiefly grain and bean farmers and stock owners.[29] Scattered clusters of Chinese gardeners occupied the Grant land. Like the renters to the north, the Chinese raised onions, beans, and blackberries.[30]

Once the land development companies began to reclaim the backswamps in the 1870's, the land use pattern changed. Extensive grain fields appeared over the interior of Roberts Island.[31] The white lessees were mainland residents as well as island settlers. Most of the latter lived within a mile of the river; their houses occupied slight alluvial prominences amidst the grain fields. Some of their farm structures had been built by the land developers as base camps for

---

[28]"Notes of a Trip Up the San Joaquin River," letter to ed., SWI, June 19, 1869, p. 5.

[29]One farm, described in 1877, consisted of 170 acres, of which 60 were wheat, 10 barley, and 10 beans. The rest was tule, useful for pasture. "A Tule Land Farm," SWI, March 24, 1877, p. 7.

[30]"Among the Tules," SWI, Oct. 7, 1876, p. 5.

[31]"Down among the Tules," SF Bulletin, Feb. 23, 1880, in BS, Set W 4, p. 1511; "Agricultural Selections," SF Bulletin, Aug. 26, 1878, in BS, Set W 18:2, p. 295.

the reclamation and land clearing crews.[32] In addition to the expansion of grain fields over the interior of the island, an enlargement of bean and potato acreage occurred near the river, where the thrifty Chinese and Italians even planted on the artificial levee.[33] A few small deciduous orchards were scattered around the higher periphery too.[34]

Sherman Island developed an agricultural landscape similar to the one at Roberts Island. In the years when the island remained dry, wheat and barley acreage was extensive; there were about 4,150 acres of small grain in 1871,[35] 7,000 acres in 1873/74,[36] and 10,000 acres in 1874/75 (flooded).[37] As a rule, the wheat and barley were planted on high-water-table virgin or young soil while the rented produce land was located near the river. Chinese farmers raised potatoes,

---

[32]"Gigantic Enterprise," SWI, Sept. 25, 1875, p. 4; "A Ride through the Tule Country," ibid., Sept. 1, 1877, p. 5.

[33]"Through San Joaquin County," SF Bulletin, March 22, 1879, in BS, Set W 4, p. 1502.

[34]"Supplemental Report on the Condition of Various Fruit Districts," Third Biennial Report of the State Board of Horticulture of the State of California for the Thirty-eighth and Thirty-ninth Fiscal Years (Sacramento: 1888), p. 261.

[35]This writer's estimate is based on a reported 100,000-sack crop for the 1870/71 season. "A Tour through the Interior," SF Alta, Sept. 23, 1872, in BS, Set W 18:1, pp. 154-55.

[36]"Sherman Island," letter to ed., SF Alta, Aug. 10, 1874, in BS, Set W 18:1, p. 162; Nordhoff, op. cit., p. 132; address of J. A. Hosmer, San Joaquin Valley District Agricultural Society, "Transactions," in Calif. State Agric. Soc., Transactions During the Year 1874, p. 620.

[37]"The Flood at Sherman Island," SWI, Jan. 30, 1875, p. 5.

onions, and various other vegetable and fruit crops on land for which they paid rent of $15 to $20 per acre per annum.[38]

During the late 1800's there were apparently three areas where truck farming remained the predominant activity. The Freeport-Clarksburg to Sacramento area, the vicinity of Stockton to the San Joaquin bridges, and the delta margin to the east of Antioch.

The natural levees to the north of Freeport-Clarksburg remained occupied by truck gardens, small grain and alfalfa fields, a few hop yards, modest orchards, and improved pastures during the late 1800's. Operation of the small farms was in the hands of people of Italian, Portuguese, French, German, Chinese, and American origin. Native-born Americans were numerous at first but soon the South Europeans predominated. The commercial orientation of the farms was toward Sacramento primarily, although produce was shipped to San Francisco.[39]

The natural levee north of Clarksburg and on the west side of the river was considered the choice garden land in Yolo County. A lower and narrowing continuation of the natural levee situated to the south was partly devoted to gardens, partly overrun with wild blackberry bushes, and largely

---

[38]"Tule Farming," SWI, March 31, 1877, p. 7; Tide Land Reclamation Co. (1869), op. cit., p. 34, citing Daily Examiner, July 24, 1869; "Letter to Editors," Press /?/, dated Feb. 11, 1878, in BLS, No. 21, pp. 273-74.

[39]Sprague and Atwell, The Western Shore Gazetteer and Commercial Directory . . . , p. 57.

devoted to pasture. The emphasis on stock and gardens and the relative unimportance of the winter grains resulted from the tendency of Yolo Basin water to "set back" over most of the land during the wet season. There was more certainty of raising a summer vegetable crop. Less capital and equipment were required to manage gardens than grain farms. The same was true east of the river where Italian and Portuguese gardeners supported families on a half dozen or so irrigated acres of truck and berry crops.

In the 1880's the Portuguese predominated among west bank residents, particularly opposite Freeport, in what was known as the Lisbon District. American-born settlers owned and operated the larger farms, some of them with dairy herds of 40 to 80 Durhams, and one or two with hop yards.[40]

Farming on a small and intensive scale characterized the area in the early 1900's. Tomatoes, field beans, melons, yellow onions, small grain, and alfalfa were the chief crops. Bartlett pears and early peach varieties were planted near the river. The tomatoes had become important for cannery and the fresh midseason trade. Usually Chinese or Japanese share tenants raised the crops on contract to the canneries of Sacramento.[41]

---

[40] *Ibid.*, pp. 49, 54, 55, 57, 91, 94; *Sacramento County and Its Resources*, pp. 106-7.

[41] Olney, "Orchards, Vineyards and Farms of Yolo County," *loc. cit.*, p. 185; "Tomatoes This Season," *PRP*, Sept. 9, 1911, p. 201.

In the late 1870's market gardens near Stockton were developing into formidable competitors for the San Francisco produce trade then dominated by farmers of the Santa Clara Valley and of the bay margins to the south of Oakland. Delta producers had good soils that were easier to irrigate than those of competing localities. Delta crops ripened early,[42] and water transportation was cheap. By 1883 large tonnages of garden vegetables were moving to San Francisco.[43] A day's harvest was picked up by steamers in time to be landed at San Francisco the following morning.[44]

Chinese and Italian gardeners leased land to the east of Antioch and along Old River for $10 to $20 per acre per year in the 1870's and 1880's.[45] Their produce was shipped to San Francisco or consumed in the short-lived Mount Diablo Range coal-mining communities of Nortonville, Sommersville, and Judsonville.[46] This type of farming persisted into the early 1900's, when large-scale land development companies improved old reclamations and added new acreage for the

---

[42]"Gardening in the Tules," SWI, June 9, 1877, p. 7.

[43]Stockton Board of Trade, op. cit., p. 38.

[44]"The Netherlands of America," Stockton Evening Mail, San Joaquin Valley Development Edition, p. 21.

[45]"Agricultural Notes--Contra Costa," PRP, April 5, 1879, p. 228; Contra Costa County Board of Trade, Contra Costa County, . . . (San Francisco: W. B. Bancroft and Co., 1887), pp. 8-9.

[46]Bancroft, History of California, VI, 527-28.

production of potatoes, onions, beets, alfalfa, beans, and grain.[47]

The garden crops harvested in January and February were asparagus, cabbage, carrots, cauliflower, celery, lettuce, green onions, radishes, spinach, turnips, and table beets. In March and April, green peas, string beans, summer squash, cucumbers, new potatoes, and new onions reached maturity. After May and June, tomatoes, green corn, and other common summer vegetables were harvested.[48]

The post-1923 truck crop dot maps (see Map Plate A, pocket) do not give an adequate picture of the activity distribution because the category is a catchall used by the census taker for irrigated vegetable crops which move into cannery or produce channels. (Tomatoes, carrots, cucumbers, radishes, lettuce, and table beets are among the vegetables so grouped.) It is probable that most of the acreage shown for 1924, 1931, 1938, and 1945 contained tomatoes. A comparison of the 1945 truck map bears this out. Except for the southernmost San Joaquin River districts, which were not reported before 1952, the 1945 and 1952 maps show similar distribution patterns.

Tomatoes for canning have been raised in the delta over the past 40 or more years.[49] Canneries located at

---

[47]"The Busy Little Town of Knightsen," Special Booster Edition of the Byron Times, not paginated.

[48]Sacramento County and Its Resources, p. 36.

[49]San Joaquin County Board of Supervisors, op. cit., p. 55.

Sacramento, Stockton, Tracy, and Manteca, and near San Jose and Oakland contract for the crop. All of the northern delta harvest and nearly all south delta production goes to the canneries. The distribution of the tomato acreage, however, is less a reflection of proximity to canneries than a reflection of the available area of suitable soil.

Cultivation techniques are being refined constantly. Since 1948 the practice of seeding the canning tomato crop directly into the field has been followed. By 1954 about three-fifths of the crop in Sacramento County was seeded.[50] Drilling is done in late March to late April. The procedure shortens the time between seeding and harvest by two months.[51] Another practice which has virtually ended the usefulness of cold or hot frames for raising seedlings has been the transplanting of young tomato plants rushed to the delta from the Imperial Valley by air express.[52]

Tomatoes are planted on mineral soil rather than on peat (see Map Plate A, pocket). Peat soils produce an adequate yield, about 17 tons per acre, but the crop matures about two weeks later than those crops planted on mineral

---

[50]Torrey Lyons, "Field Seeding of Tomatoes in Sacramento County" (rev. ed.), University of California, College of Agriculture, Extension Service, Sacramento County, Feb. 1954, p. 1. (Mimeographed.)

[51]P. S. Minges _et al._, _Tomato Propagation_, University of California, College of Agriculture, Extension Service, Circular 160 (Jan. 1950), p. 25.

[52]Interview with Alex. Johnson, Walnut Grove, July 15, 1955.

soil. The higher nitrogen content of peat soil is a major delaying factor. It is a common occurrence for the organic soil crops to reach their prime after the canneries are shut down. Sometimes the late crop is partially marketed in the East. This happens when frosts end production in the East before the early Florida crop is mature.[53]

Potatoes

Potatoes, a major cash crop from the 1870's until the 1930's, have been particularly successful in virgin or burned organic soils. Much of the reclamation which occurred in the first and second decades of the twentieth century was performed to provide new land for the profitable crop. Potatoes were well suited to planting on virgin soil because weed control was easier to maintain with them than with most other crops. Potatoes also were considered to be a good replacement crop on land where floods had destroyed winter grain.[54] Since inclusion of soil burning in the rotation cycle is considered by some operators to have fungus, weed control, and fertilizing benefits, it has been common to burn after several years of grain and beans and before replanting potatoes.[55]

---

[53]Interview with John P. Underhill, Farm Advisor--Vegetables, Agricultural Extension Service, San Joaquin County, Stockton, February 25, 1957.

[54]Cosby, "Delta History Notes," pp. 48-49; SDI, March 29, 1901, p. 2.

[55]The pedologist Weir maintains that the "liberation of available potash may be a more important reason for

It is uncertain when potatoes were transformed from a garden crop to a field crop specialty, but the change is believed to have started in the late 1860's or early 1870's, when large-scale reclamations were begun. In the 1870's Grand Island was already noted for its production of quality potatoes. Plantings were fairly extensive on other Sacramento River tracts. Some 2,000 acres were raised on Bouldin Island in 1878, and Andrus and Staten islands had large acreages.[56] Although Chinese market gardeners were common among the producers prior to 1878, they became numerous over the next two years when they came to the delta to raise this particular crop. Their harvest was so great that the San Francisco market was "overwhelmed." In 1880 prices dropped to as little as 15 cents per sack before the glut was overcome.[57]

Plantings were extensive, in some cases entire islands being devoted to the one crop. About two-thirds of Tyler Island was planted to potatoes in 1900, and 7,000 of Victoria Island's gross 7,500 acres during 1900 and 1901.[58]

---

burning than is generally admitted." "Peat Lands of the Delta," California Agriculture, III (July 1949), p. 6.

[56]"Down the River," Bee, Nov. 5, 1875, in BS, Set W 5, p. 1870; "Boulden Island," PRP, Sept. 7, 1878, p. 149; "Potatoes from Andros Island," SWI, Dec. 23, 1876, p. 7; Leale, op. cit., p. 65.

[57]"The Crop Outlook," SF Call, March 28, 1880, in BS, Set W 18:2, p. 408.

[58]"Island Crops Advanced," PRP, March 17, 1900, p. 167; "A Potato Patch of 7,000 Acres," PRP, May 18, 1901, p. 311.

In the 1900/1 season the pastures of the Sargent-Barnhart Tract were planted in potatoes. Other districts with substantial potato acreages included Andrus, Twitchell, Bradford, and Staten islands (north-central delta); Union and Roberts islands and Reclamation District 17 (in the southern delta); and the Brack, Sargent, Smith, and Boggs tracts of the Mokelumne to Calaveras river vicinity.[59] Nevertheless, the estimated area of the following season's crop was no more than 18,000 acres. That year's harvest of some 2,000,000 sacks, each worth $1 or more delivered at the levee, was highly profitable[60] (see Plate XIV, p. 333). Net returns of $60 or more per acre created several fortunes of $75,000 and $100,000 almost overnight;[61] this started a rush to raise potatoes. Emphasis was placed on developing the highly productive virgin land which remained in the San Joaquin delta. In 1902 about 28,000 acres of potatoes were planted in San Joaquin County.[62] The older potato districts of the Sacramento declined in relative importance. The soils were diseased;[63] and a mid-planting season flood occurred on Brannan

---

[59]Cosby, loc. cit., pp. 49-50; SDI, March 29, 1901, p. 2.

[60]"A Great Bean Field," PRP, Dec. 14, 1901, p. 374; "Heavy Transactions in Potatoes," PRP, Jan. 11, 1902, p. 27; Brown, "Millions in Potatoes," loc. cit., p. 14.

[61]"Heavy Transactions in Potatoes," PRP, Jan. 11, 1902, p. 27.

[62]"Vegetables Bring Good Prices," PRP, Sept. 19, 1903, p. 183.

[63]Interview with Mr. J. S. Brown, Walnut Grove, July 14, 1955.

PLATE XIV

A loading scene representative of the period before trucks and roads had supplanted water carriers. Photograph, taken on Victoria Island in the early 1930's, is of a scene then fast disappearing. (Cosby photography) and Andrus islands. But the long-run cause of the diminishing emphasis on potatoes was asparagus, which was being planted intensively in the Sacramento districts.

In 1902 and 1903 profits per acre remained at the 1901 level.[64] By 1908/9 and 1910/11 there were about 35,000 or 40,000 acres of potatoes in the delta.[65] Some 40,000 to 50,000 acres were planted in 1915,[66] but between 1916 and 1919 the spread had reverted to the more nearly normal 30,000 to 40,000 acres.[67]

An early crop was planted in December, but the main crop was planted between March and June. The early crop was harvested in May, and digging continued until the end of the year. As a rule the crop was sold before harvesting. Prices ranged from 30 cents to $3 per sack; $1 was about the average. The sacked potatoes moved to landings where barges or freighters picked them up for the wholesale buyers (see

---

[64] "Potato Growers on Velvet," PRP, Sept. 5, 1903, p. 151; "Potatoes Yielding Heavily," PRP, June 28, 1902, p. 433.

[65] Calif. State Agric. Soc., Report for the Year 1909 (Sacramento: 1910), pp. 55, 147, 173, 199; idem., Report for the Year 1910 (Sacramento: 1911), pp. 77, 143, 158, 203; Report of the California State Board of Agriculture for the Year 1911 (Sacramento: 1912), pp. 286, 349, 361.

[66] "Reconnaissance Soil Survey of the Lower San Joaquin Valley, California," by J. W. Nelson et al., in Field Operations of the Bureau of Soils, 1915 (Seventeenth Report), USDA, Bur. of Soils (Washington: 1919), p. 2596.

[67] Cox, loc. cit., p. 445; "Good Potato Prices," Sixth Special Booster Edition of the Byron Times (1918), p. 113.

Plate XIV, p. 333). Deliveries were made to Stockton, San Francisco, and Sacramento wharves.[68]

Among the potato wholesalers George Shima was noted as an innovator of merchandising improvements. He was the first local grower and shipper to adopt a trademark, a red bag. He is said to have been the first to wash and grade potatoes before sacking them for market. This attention to improved appearance and product standards is one of the reasons why Shima was interested in developing virgin peats; the soil produced a light-skinned potato in addition to yielding well.[69] Shima developed a remarkable facility for gauging profitable marketing situations; the faculty gained him the nickname "Potato King" in 1906 or 1907 when he cornered much of the local crop.[70]

The potato acreage has declined steadily from World War I to the present decade, chiefly the result of competition from Idaho and early Kern County potatoes.[71] From about 7 per cent of the crop area in 1924, potatoes dropped to 5 per cent in 1931, to 3 per cent in 1938, to 2 per cent in 1945, and to 1.8 per cent in 1952, with little change since (see Table 4, pp. 316-17).

---

[68]Brown, loc. cit., pp. 15, 17.

[69]Rogers, loc. cit., July 4, 1951, p. 15.

[70]"The Famous California Potato King," Special Booster Edition of the Byron Times, not paginated.

[71]Underhill interview.

The potato area of the delta is now confined to Bacon and McDonald islands and several tracts to the north and east (see Map Plate B, pocket), which have contained the core of potato acreage over the past 50 years. The nearly complete devotion of one island to the crop, a common practice in the early 1900's, had become unusual by the early 1930's when the maximum concentration in any tract rarely exceeded 50 to 55 per cent. By 1952, 31 per cent represented a heavy acreage for one island and, as earlier, few tracts had such a large proportion of the land planted to potatoes.

Retention of the crop on the limited basis of the present reflects the preference of operators and owners as much as it does the suitability of the peat soil to its culture. The operators, some of whom are owners, tend to be wholesale packers and shippers who produce and market potatoes, celery, and onions, which mature at different times, thereby extending the operating season of the packing shed and keeping permanent employees occupied. A few operators in the area raise the same crops on a smaller scale. The customary rotation of operators with the different crops brought onto the land has virtually ceased since World War II. Tenants and owner-operators in the potato areas tend to be diversified.[72]

The Early Rose and American Wonder varieties were favorites among potato varieties raised until sometime before

---

[72]Interview with Ronald S. Baskett, Farm Advisor--Field Crops, Agricultural Extension Service, San Joaquin County, Stockton, February 25, 1957.

1894 when the Burbank replaced the Early Rose.[73] Today the Burbank and White Rose varieties are most common.[74]

Production, which averages 350 sacks per acre, is maintained with commercial fertilizers. The potatoes-barley-beans rotation of 50 years ago has been replaced with a rotation which begins with potatoes, follows with field corn to obtain full utilization of the fertilizers applied to the preceding crop, and ends with barley. The cycle is renewed with potatoes.[75]

Beans

Comparatively few data exist for estimating the delta's acreage of dry edible beans. This cash crop was one of the staples in pioneer farming as well as in the diet. The suitability of delta soils, especially the newly developed peats, is suggested by the presence on Grand Island in 1894 of 2,000 of the 7,000-acre Sacramento County bean crop.[76] Much of the remaining acreage probably was distributed on adjacent islands, which had the same soils and transportation assets possessed by Grand Island. For the remainder of the delta, the acreage is unknown. The whole area raised about

[73] San Joaquin County Board of Supervisors, loc. cit., pp. 51-52; Sacramento County and Its Resources, p. 23.

[74] Potato Growing in Western United States, by W. C. Edmundson, C. A. Schaal, and B. J. Landis, USDA, Farmers' Bull. No. 2034 (Washington: 1951), p. 22.

[75] Interview with R. S. Baskett.

[76] Sacramento County and Its Resources, pp. 36, 44.

13,000 acres in 1899; 18,375 acres in 1900; and 24,720 acres in 1901.[77] Before 1915 the bean area was about 20,000 acres annually, but the acreage doubled in 1916.[78] Beans fitted in well with the potato rotation and were in active demand during the pre-World War I period. In the 1920's and early 1930's, when potato acreage declined, beans also lost ground, partly because of the reduced need of beans in rotation, but principally as the result of a shift in consumer preferences.

An aspect to the situation which discourages bean growing today is the tendency of some soils to become alkaline with subirrigation, and a high incidence of bean root rot.[79] A few decades ago asparagus began replacing bean acreage; recently tomatoes, sugar beets, field corn, milo, and alfalfa have been taking over on the soils where beans were planted.

In modern delta farming beans occupy a minor place. The areal decline of plantings is outlined in the data appearing in Table 4. About 36,400 acres were set out in 1924; 23,400 in 1931; and 7,500 acres in 1938. The increase to the 8,300 acres recorded in 1945 appears to reflect a wartime phenomenon, since the acreage has declined sharply since then. In 1952 there were about 2,300 acres of beans in the

---

[77] "A Great Bean Field," PRP, Dec. 14, 1901, p. 374.

[78] Nelson et al., loc. cit.

[79] Interviews with R. S. Baskett and John Spurlock, County Director, Agricultural Extension Service, Sacramento County, Sacramento, July 12, 1955.

delta, representing about 0.5 per cent of the crop area, compared with 6 per cent twenty years earlier.

The 1924 distribution map reveals large concentrations of beans in the Yolo Basin, the central islands, Union Island, and the Fabian Tract (see Map Plate C, pocket). The Yolo Basin soils frequently remain wet until fairly late in the summer, causing quick-growing beans to be preferred. In recent years corn and milo have replaced beans there, as is shown by comparing the 1952 bean and milo maps (see Map Plate L, pocket).

The variety of beans raised in the delta has diminished since 50 years ago. Around 1900, lima, white, pink, bayo, red kidney, and blackeye peas were grown.[80] The pinks, whites, and bayos were popular before World War I.[81] In recent years only the red kidney beans have been common. Production averages about 1,000 to 1,200 pounds per acre.[82]

Asparagus

The introduction of commercial asparagus to the Sacramento Valley is attributed to a settler who farmed 40 acres of riverside land just to the south of Sacramento in the early 1850's.[83] Within a quarter of a century many carloads

---

[80] Sacramento County and Its Resources, p. 36; Olney, loc. cit.

[81] Nelson et al., loc. cit.

[82] Interview with R. S. Baskett.

[83] Sacramento County and Its Resources, p. 172.

of the asparagus were being shipped from farms on the lower American River.[84] By 1880 enough of the crop was produced near Stockton to start consignments to San Francisco produce houses;[85] but important developments were taking place near Sacramento where farmers were making a net $100 to $175 per acre by 1894. Since it was the most profitable fresh vegetable raised, acreage expanded rapidly.[86] The Capitol Packing Company in Sacramento began canning asparagus in 1882,[87] but not until the process was improved (after 1890) did the demand spur a significant acreage expansion.[88]

Robert Hickmott, who had gained experience with asparagus at the Sacramento cannery, planted the crop on Bouldin Island where he built a cannery in 1892.[89] Within four years his asparagus fields were extensive enough that the early crop was being shipped in carload lots.[90] His canned product was well enough received to justify erection of a second

---

[84]"On the Sacramento," SF Bulletin, Dec. 23, 1876, in BS, Set W 3, p. 1062.

[85]"San Joaquin Asparagus for the Bay," PRP, April 17, 1880, p. 249.

[86]Sacramento County and Its Resources, p. 36.

[87]"Asparagus Growing for Canneries," PRP, July 19, 1902, p. 36.

[88]Cosby, Soil Survey of the Sacramento-San Joaquin Delta Area, p. 10.

[89]"Asparagus Growing for Canneries," PRP, July 19, 1902, p. 36.

[90]Cosby, "Delta History Notes," p. 5; SDI, April 15, 1896.

cannery before 1900.[91] At the turn of the century there were 3,000 acres of asparagus on 6,000-acre Bouldin Island.[92] In the following year the canneries operated from March 15 to June 15, canning about 20 tons of asparagus a day.[93] (See Map Plate D, pocket, for asparagus distribution in 1902.)

Several other canneries were opened in the delta before 1904. As a rule, the companies owned much of the asparagus acreage. Hickmott owned half of Bouldin Island,[94] while another 1,500 acres were owned by W. H. Metson and Associates who operated the Golden State Asparagus Canning Company. Golden State owned bearing acreage on Grand and Andrus islands, and operated canneries at both places. The California Fruit Canners Association, operators of canneries at Sacramento and at Trask's Landing (Vorden), were supplied from the Pierson District primarily. The California Asparagus Company operated on Jersey Island.[95]

From the point of view of the independent growers, the erection of asparagus canneries was a boon. In 1902 the canneries paid up to $60 per ton for the crop which had grossed

---

91"San Joaquin County," Calif. State Agric. Soc., <u>Transactions During the Year 1901</u> (Sacramento: 1903), p. 378.

92Cosby, <u>loc. cit</u>., p. 33, <u>SDI</u>, March 25, 1900, p. 7.

93<u>Ibid</u>., pp. 61-62, <u>SDI</u>, June 12, 1901, p. 3.

94"Asparagus Growing for Canneries," <u>PRP</u>, July 19, 1902, p. 36.

95"Asparagus on Bouldin Island," <u>PRP</u>, March 1, 1902, p. 155; "Canning Asparagus," <u>PRP</u>, April 7, 1906, p. 215; Winfield J. Davis, "Sacramento County," Calif. State Agric. Soc., <u>Transactions During the Year 1901</u>, p. 329.

as little as $20 per ton a few years earlier when commission agents marketed it for the fresh market.[96]

In the south delta, where potatoes were doing very well, hundreds of acres of asparagus were planted in various districts;[97] but no canneries were built until the Empire Asparagus Company selected Middle River, a west-side Jones Tract landing, for a site in 1905. The expectation of success for this enterprise, and for a number of other producers, was brightened by the 1904 flooding of 6,000 acres of asparagus on Bouldin Island. With the major producing area out of operation, other growers could profit handsomely. Although the Sacramento districts did prosper, the asparagus yields along Middle River were too low to be profitable to the producers.[98] It was not until 1909-15 that the islands west of Stockton were supporting profitable canneries at Middle River, Holt, Orwood, Stockton, and Antioch.[99]

96"Asparagus Brings Stiff Prices," PRP, April 12, 1902, p. 251.

97"San Joaquin County," Calif. State Agric. Soc., Transactions During the Year 1901, loc. cit.

98California Promotion Committee, California Today (San Francisco: California Promotion Committee, 1903), p. 80; "Grows Asparagus," PRP, Sept. 9, 1905, p. 167; "New Asparagus Cannery," PRP, Sept. 23, 1905. Why the crop was a poor producer has not been learned from available sources. Perhaps the planted stock was of inferior quality; possibly the peat had not decomposed into friable structure in which asparagus does well.

99"The Netherlands of America," Stockton Evening Mail, San Joaquin Valley Development Edition, p. 21; San Joaquin County Board of Supervisors, op. cit., p. 21; "The City of Antioch, Gateway to the Delta," Antioch Ledger--The Golden Link, June 1924, not paginated.

Asparagus

Asparagus production was well over 24,500,000 pounds in 1905-6 and 27,750,000 pounds in 1909-10. The average for the five-year period exceeded 21,600,000 pounds, which suggests an area of 13,500 to 21,000 producing acres.[100] Most of the crop area remained in districts lying in the Sacramento River delta. The planted area had expanded to about 52,600 acres in 1924 (see Map Plate D, pocket). By this time such pioneer areas in raising the crop as the Pierson District, Grand, Twitchell, Andrus, Bouldin, and Jersey islands were past their prime producing years.

In the 1920's the possibility of expanding the asparagus acreage within the older districts was restricted by the limited availability of relatively expensive orchard land.[101] Cheaper land was obtained in the Yolo Basin districts, on Tyler Island, and in the tracts to the east of the Mokelumne South Fork. In 1931 plantings reached 69,500 acres. In 1938, there were 66,600 acres of asparagus; but Ryer Island and the Egbert District were past their prime development. Other Yolo Basin lands retained important acreages until

---

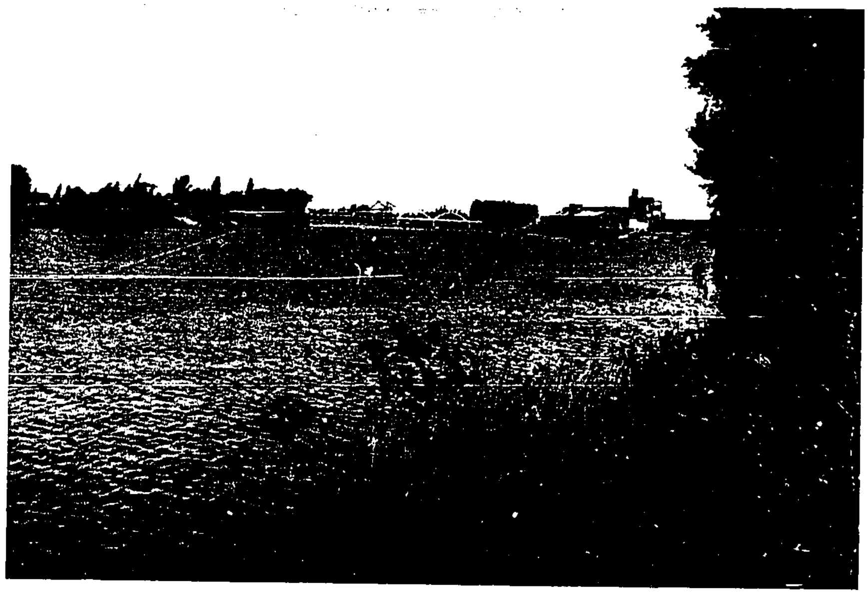
[100] Calif. State Agric. Soc., _Report for the Year 1906_, pp. 72, 150, 168, 193, 227; _idem._, _Report for the Year 1907_ (Sacramento: 1908), pp. 70, 142, 160, 184, 211; _idem._, _Report for the Year 1908_ (Sacramento: 1909), pp. 63, 141, 159, 215; _idem._, _Report for the Year 1909_, pp. 55, 147, 199; _idem._, _Report for the Year 1910_, pp. 143, 158, 203.

[101] Millard A. Klein, "Asparagus Industry," _The Eden of California--1925 Biennial Deluxe Edition, River News_ (Rio Vista), p. 37. For an account of the modern industry see Marcia McClain, "The Distribution of Asparagus Production in the Sacramento-San Joaquin Delta" (unpublished Master's thesis, Dept. of Geography, University of California, 1954).

World War II. Through the 1930's crop expansion was rapid on Union, Coney, and Lower Roberts islands and on other older reclaimed organic soil areas in the San Joaquin part of the delta.

By 1945, when there were 62,300 acres of asparagus in the tule land, the older organic soil districts of the San Joaquin delta had become the major producing area. Union, Victoria, and Lower Roberts islands and the Fabian, Clifton Court, Byron, Wright, and Shima tracts had concentrations of acreage. By the 1940's the older producing areas along the Sacramento were giving up asparagus, and in 1952 the crop had all but disappeared. Reflecting the trend was the reduction of operating canneries near Walnut Grove, Isleton, and Rio Vista from 10 in 1929 to 3 in 1950, and none in 1955 (see Plate XV, p. 345). Jersey and Bradford islands and the Webb Tract no longer raised the crop in 1952. Bouldin and Staten islands and adjacent mainland tracts preserved some acreage, as did the disease-free, altered organic and organic-mineral soils of the new and older districts in the San Joaquin delta. Plantings were also carried onto mineral soils on Roberts and Union islands. Over 75,800 acres were growing in 1952, 95 per cent in districts facing the distributary system of the San Joaquin (see Plate XVI, p. 346). The situation contrasts with 1938, when 41 per cent of the crop was there, and with 1924, when 16 per cent of the asparagus acreage lay in the San Joaquin delta.

PLATE XV



Sacramento River view to the
north of Isleton

The grain elevator (tall structure at right), built in 1940, reflects an emphasis in agriculture that developed locally after the asparagus boom waned. Structure overlying water is an old asparagus loading shed. Cupola marks location of an elevator which moved freight from riverboat decks to the warehouse floor. Grand Island is on the left and Andrus Island on the right.

PLATE XVI

A San Joaquin Delta asparagus farm

The crop is permitted to go to fern after the spring harvest season. This Lower Jones Tract land is less than minus five feet in elevation. To the right, on outer edge of the levee, is a willow and blackberry thicket. Windmill draws domestic water from a well.

The delta's asparagus acreage has occupied from around 15 to 22 per cent of the total cropland since 1924. When at its prime on given tracts, asparagus commonly occupies between 60 and 90 per cent of the total tract area. (See Maps 18 and 19, pp. 348 and 349, for crop distribution patterns showing asparagus acreage beginning [1932] and at its prime [1952] on the San Joaquin Delta Roberts Island and Jones Tracts.)

The asparagus crop, chiefly the Palmetto and Colossal varieties, is harvested from mid-February until the end of June or July. It becomes profitable in the third year after transplanting from hotbeds to the fields. Six to 10 years of heavy yield are normal on most tracts, which may expect a commercial life of 12 years.[102] Fusarium wilt makes replanting impracticable, although for the past four or five years some replanting following costly fumigation has been tried. The results are inconclusive.[103]

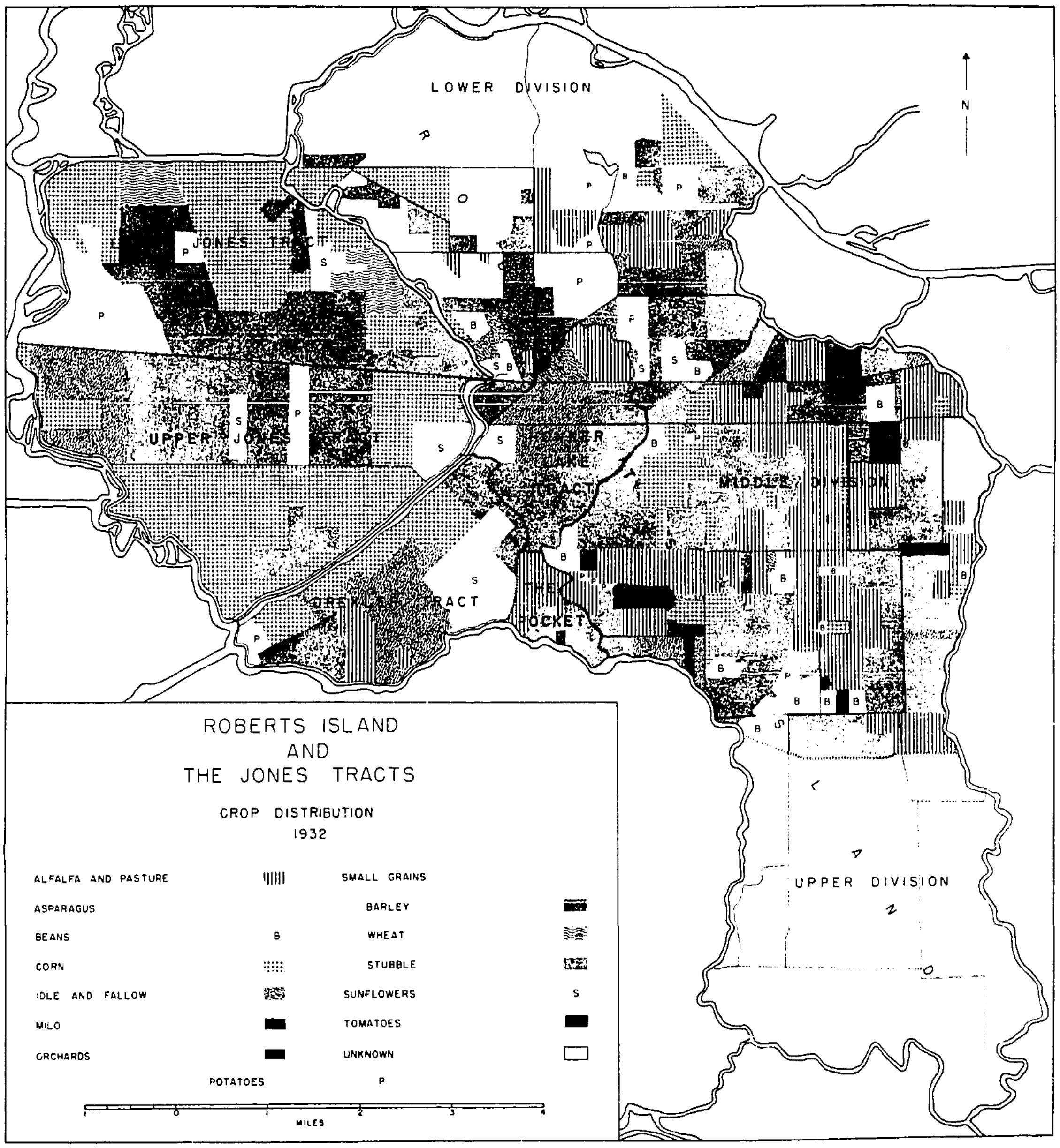
Asparagus has high labor requirements. Continuous cultivation is necessary for production of the white asparagus in demand for canning. Manpower requirements at harvest time are approximately one per acre. The laborers, usually Japanese, Chinese, and Hindus before World War I, went over

---

[102]"The Netherlands of America," Stockton Evening Mail, San Joaquin Valley Development Edition, p. 22; "The Amazing Story of California's Fabulous 'Prima Donna' Crop--Asparagus," Tideways, III (April 1954), p. 10.

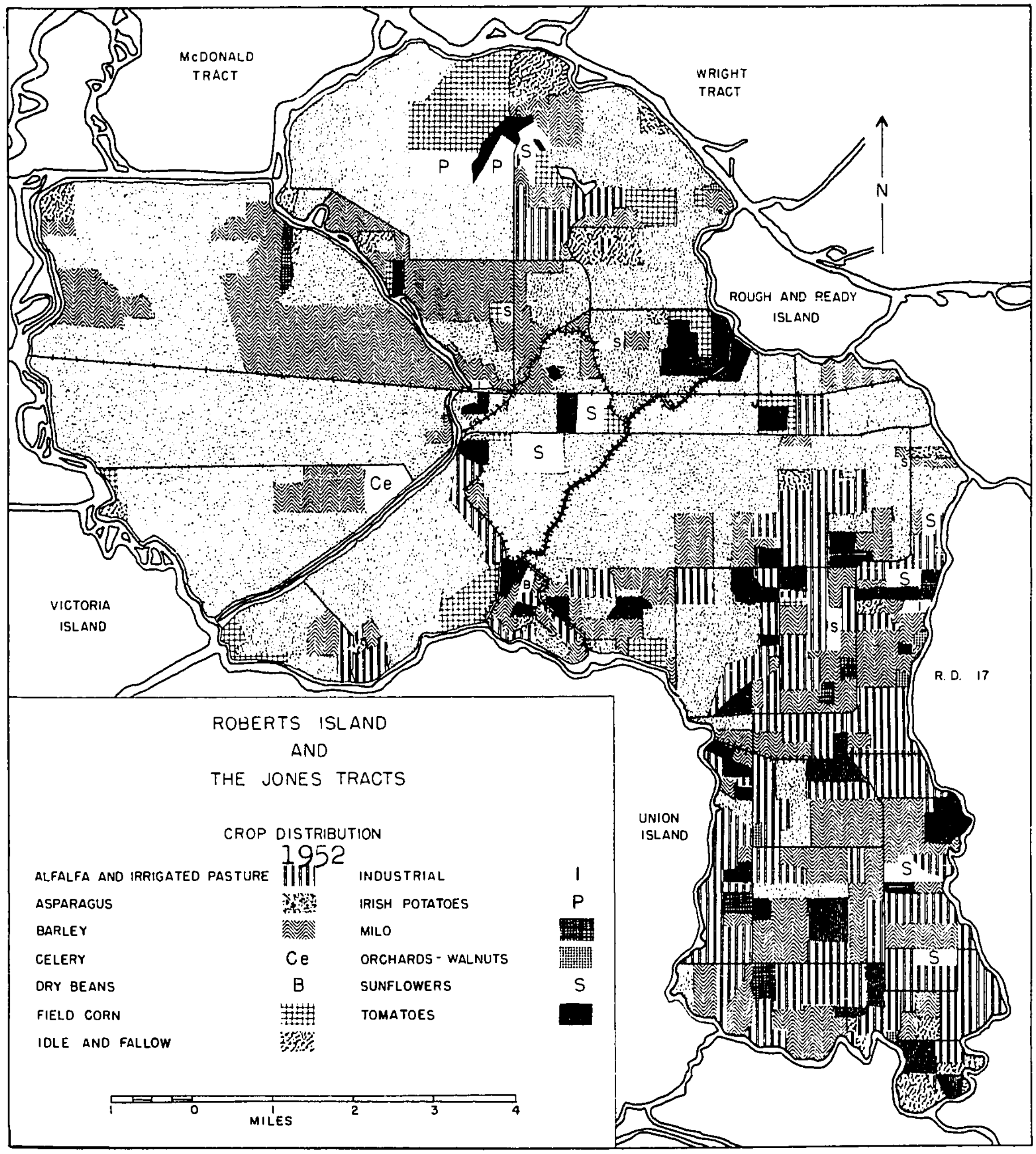
[103]Underhill interview.

Map 18



Source: County Agricultural Commissioner's Reports

Map 19



Source: County Agricultural Commissioner's Reports

each field daily.[104] Since the war Filipino labor has dominated in the asparagus fields, although Mexican nationals are numerous.

Early season shipments of asparagus move to eastern markets by air express, but the bulk of the green crop moves by rail. Shipments are made within 8 to 12 hours of cutting the crop, usually on consignment from local packers. After mid-April, when the eastern production becomes competitive, the local harvest moves to the large and diversified city canneries,[105] the delta plants having shut down through the 1940's and early 1950's. Trucks haul the crop from field margins to packing houses and canneries. Forty or more years ago the harvest moved by barge or river freighter from landings on the river to packing houses and railheads, canning centers, and transfer points where San Francisco Bay freighters could pick it up.[106]

The delta crop, worth around $11,000,000, represents about half of the national production. About 60 per cent of the value of the local product is sold in cans and the rest is crated for the fresh market. It appears likely that further expansion will take place on mineral soils. Consumer

---

[104] Personal interview with Bob Gardiner, Gardiner Improvement Co., Isleton, California, July 21, 1955. "Asparagus Growing for Canneries," PRP, July 19, 1902, p. 36; "The Netherlands of America," Stockton Evening Mail, San Joaquin Valley Development Edition, p. 21; Carpenter and Cosby, Soil Survey of the Suisun Area, p. 12; "The Amazing Story of . . . Asparagus," loc. cit.

[105] Ibid.

[106] W. I. Fechtmen, "Discussion," DWR Bull No. 3, p. 102; "Home of Asparagus," PRP, April 27, 1901, p. 263.

tastes are turning away from the white canning asparagus which was grown to advantage on the easily ridged peat soil. Ridging or heaping soil over growing asparagus to keep the shoots white is no longer a cultural requirement to obtain premium prices; moreover, mineral soils yield 3,000 to 4,000 pounds per acre, which is comparable to peat soil production.[107]

Celery

The planting of 500 acres of celery in 1901 marked the start of large-scale cropping of this product. Earlier it had been grown on a truck-garden scale.[108] After 1901 individual plantings of from 25 to several hundred acres were common, particularly on Jersey and Woodward islands and the Upper Jones Tract.[109] Nevertheless, celery has always been a minor crop in the delta and total acreage has remained small, usually occupying 1 to 2 per cent of the cropland. As a rule, culture has been restricted to peat areas, where blanching was facilitated by the nature of the soil. Since 1948 consumer preference for blanched celery has waned, and the peats are losing their advantage over mineral soils.

---

[107]Underhill interview.

[108]"San Joaquin County," Calif. State Agric. Soc., Transactions During the Year 1901, loc. cit.

[109]"Celery Experiments," PRP, Nov. 20, 1902, p. 343; "Will Grow Celery," PRP, July 11, 1903, p. 22; "Celery," PRP, April 2, 1904, p. 215; "The Netherlands of America," Stockton Evening Mail, San Joaquin Valley Development Edition, p. 25; Cosby, "Delta History Notes," p. 84, SDI, Nov. 20, 1902, p. 5.

Because of the change in preference, soil no longer has to be ridged around plants, with the result that the characteristic 42- to 46-inch row spacing for blanched celery is disappearing. For economic reasons, the rows must be brought closer together; otherwise, the delta average yield of 400 to 500 crates per acre will prove unremunerative in the face of competition from the 1,000- to 1,200-crate per acre production of the Salinas Valley.[110]

The areal distribution of celery acreage is more or less the same as for potatoes and onions (see Map Plate E, pocket). Crops are raised by the same operators so that packing sheds and employees will have a longer season of activity.[111] Thus, during the mapped years, the Terminous Tract and Bouldin Island have contained 36 to 56 per cent of delta celery acreage. At different times Grand, Andrus, Venice, and Staten islands, and the Rindge Tract each have had 475 acres or more planted to celery. The crop has been raised sporadically and on a limited scale in numerous other districts where peat and altered peat soils exist.

Sugar Beets

First attempts to raise sugar beets in the delta centered about Isleton where, in 1876, a beet sugar refinery was erected.[112] Poor management and the 1878 flood ruined the

---

[110]Underhill interview.

[111]Ibid.

[112]History of Sacramento County, p. 221. At first the intention was to manufacture sugar from melons, a practice

enterprise. In 1880 new operators contracted with farmers to raise about 500 acres of sugar beets, but that enterprise failed also.[113]

In 1897 there was a considerable amount of enthusiasm for the crop. The owners of the Carquinez Strait sugar mill at Crockett contracted for several hundred acres of test planting in the New Hope and Moss tracts (east delta); another 2,600 acres were contracted for in 1899 on the Naglee-Burke property (south delta); and, 2,000 acres were planted at New Hope in 1900. The New Hope tests are known to have been disappointing, but the Naglee-Burke land had 7,000 acres planted in 1902.[114] Experimental plantings were made on the Pierson Tract, north of Walnut Grove, in 1897; and there was talk of planting a large acreage on Lower Roberts and Union islands to supply a mill that was going to be erected near Stockton.[115] Interest subsided, presumably because of the poor results on the New Hope Tract.

---

which the mill owner had been familiar with in the Midwest. The plan did not prove feasible. "Sugar from Melons," SWI, July 1, 1876, p. 7.

[113]"Beet Sugar in California," PRP, June 14, 1879, p. 386; "Revival of Isleton Sugarie," PRP, Feb. 7, 1880, p. 85; "Beet Sugar at Isleton," PRP, Feb. 14, 1880, p. 104.

[114]Cosby, "Delta History Notes," p. 21, SDI, June 30, 1897, p. 3; ibid., p. 30, SDI, Oct. 12, 1899, p. 2; "Beet Sugar Assurance," PRP, May 26, 1900, p. 327; "Harvesting Sugar Beets," PRP, Sept. 22, 1900, p. 183; "No Beets Next Year," PRP, Nov. 24, 1900, p. 327; "Sugar Beets and Beans," PRP, Nov. 22, 1902, p. 327.

[115]Cosby, loc. cit., pp. 16-17, SDI, Oct. 29, 1897, p. 6; ibid., pp. 13-14, SDI, June 13, 1897, p. 3; loc. cit., SDI, July 9, 1897, p. 2; loc. cit., SDI, Aug. 22, 1897, p. 8.

Renewed interest in sugar beets occurred about the time of World War I. The crop became particularly attractive to farmers who had access to rail transportation. Refiners, anticipating continued expansion, installed automatic loading platforms at existing rail sidings.[116] The Spreckels Company plant at Manteca was the first modern refinery to be situated near the delta.[117] In 1917 the Pacific Sugar Company erected a refinery on a newly dredged access channel north of Tracy. The factory, now owned by the Holly Sugar Company, was accessible to all districts situated on navigable water. Sugar mill operators chartered barges and launches to haul beets from the contract producers. By 1918 the radius of operation for the Tracy plant included the Bethel Tract (400 acres), Byron Tract (520 acres), Fabian Tract (1,500 acres), and Naglee-Burke Tract (650 acres). Another 4,000 or 5,000 acres of beets were contracted for on valley plains soils within the recently developed irrigation districts near Tracy, Bethany, Byron, and Brentwood.[118]

A north delta counterpart to the Manteca and Tracy sugar mills was established by the American Crystal Sugar Company at Clarksburg around 1920. It encouraged development of sugar beets on the mineral soils along the Sacramento and

---

[116]Cox, loc. cit., pp. 445-46.

[117]"Manteca--the Home-Seeker's Paradise," Sixth Special Booster Edition of the Byron Times, p. 80.

[118]"Farming the Knightsen Section," ibid., p. 35; "Grunauer-Kroner Lands," ibid., p. 65; "Famous Byron Tract," ibid., p. 19; "Tracy's Million Dollar Sugar Factory," ibid., p. 76.

in the Yolo Basin. Farmers who were looking for a replacement crop for beans considered this crop to be good for rotation and to be the most profitable one available.[119] Successes registered on the Sacramento and Columbia soils prompted plantings on organic soils. The results on many of the peat tracts were unsatisfactory.[120] Liming and burning the soil improved yields to some extent,[121] but the sugar content of the beets remained low, with the result that plantings decreased in the organic soils.[122]

The dot maps (Map Plate F, pocket) show the extension of sugar beet plantings onto peat lands that occurred during the late 1920's and in the early 1930's. The central delta islands and districts raised 2 per cent of the crop in 1924, 20 per cent in 1931, 38 per cent in 1938, and 43 per cent in 1945. As a rule, the acreage of sugar beets did not exceed 30 or 35 per cent of the gross area of any district. Bacon and McDonald islands and Empire and King tracts have been the most consistent sugar beet producing areas. Since 1950 government acreage limitations, a nematode problem, and the low

---

[119] "Sugar Beets," The Eden of California . . . , River News, p. 45.

[120] Cosby, Soil Survey of the Sacramento-San Joaquin Delta Area, p. 11.

[121] Ray A. Pendleton and W. W. Robbins, Fertilizers for Sugar Beets on Some California Soils, Univ. of Calif., College of Agriculture, Agricultural Experiment Station, Bull. 694 (Berkeley, Nov. 1945), pp. 19, 24.

[122] W. C. Fleming, "California's San Joaquin River Delta Has Great Production Potential," p. 2.

sugar content of beets raised on peat have resulted in the retirement of the crop from the central delta and other areas of organic soil. In 1952 the central islands accounted for only 2 per cent of the sugar acreage.

For over 30 years sugar beets have been a steady crop on the mineral soils of Sacramento River and Yolo Basin districts. They have been less important on the mineral soils of the San Joaquin delta because of farmer interest in such competitive crops as canning tomatoes and alfalfa,[123] and because the refining companies prefer to contract with operators who are steady raisers of sugar beets. These annual contracts have been for between 20,000 and about 33,000 acres since 1924. Usually the crop occupies around 8 per cent of the total delta crop area.

The harvest is shipped by barge to Tracy and Clarksburg, by rail to Tracy and Manteca, and by truck to all of the refineries. The harvest season of this February-to-April-planted crop runs from August until December, or until the rains make the fields too wet in which to work. A small percentage of the crop is harvested in March and April before the seed stalk is developed, thereby increasing the tonnage per acre and extending the operating period for the mills. However, the sugar content declines and the roots become

---

[123]Interview with W. C. Fleming, County Director, Agricultural Extension Service, San Joaquin County, Stockton, February 25, 1957.

woody and harder to process if the harvest is delayed for long.[124]

Onions

Onions, like beans and potatoes, are one of the products which delta farmers have raised continuously as garden and field crops since the 1850's and 1860's. They were areally less important than potato and bean acreage, but no certain information is available about the extent of plantings until 1901, when over 2,000 acres were cultivated in the delta.[125] In the period before World War I, from 2,000 to 4,000 acres were planted annually, usually on better-drained mineral and mineral-organic soils;[126] late crops were the rule.[127] In the 1920's and 1930's onions occupied between 3,000 and 4,000 acres. Since then around 2,000 acres has been the normal planting. Less than 1 per cent of the total cropped area is planted in onions.

Since 1924 onion farming has been localized in the Yolo Basin and on the reclamations between Terminous and Orwood tracts (see Map Plate G, pocket). The friable,

---

[124]Interview with D. D. Dickensen, Plant Breeder and Pathologist, Holly Sugar Company, Tracy, Feb. 25, 1957.

[125]"A Great Bean Field," PRP, Dec. 14, 1901, p. 374.

[126]Cox, loc. cit., p. 445; Nelson et al., loc. cit., p. 2597.

[127]San Joaquin County Board of Supervisors, op. cit., pp. 42-43.

humus-rich peats and loams are well suited to the development of the shallow-rooted bulb although, as with most of the delta crops, there must be fertilization with phosphates and potash.[128]

Onions are a speculative crop raised by the packer-operators and a truck crop raised for the local produce trade. The scale of operation varies accordingly. Roughly two-thirds of the onions are harvested as an early crop, but the season can be a failure for the large operators if competing Texas producers market their crop at the same time.[129]

Tree Crops

Modest plantings of fruit trees occurred wherever pioneer settlers located. In some areas, chiefly along the Sacramento River, the orchards proved to be so remunerative that a number of settlers shifted from general farming to fruit ranching. Orchards became numerous in the 1860's. They contained a variety of trees, chiefly peach, apple, pear, nectarine, and plum. Occasional descriptions of farm operations and of the composition of shipments to market create the impression that peaches were the leading tree crop, with apples and pears of lesser importance.[130]

---

[128]Glen N. Davis, Onion Production in California, Univ. of Calif., College of Agriculture, Agricultural Experiment Station, Circular 357 (Berkeley, Sept. 1943), pp. 3, 5, 6-7.

[129]Baskett interview.

[130]One ranch, about opposite Clarksburg, was described as having nearly 1,000 peach trees and "as many more of

The corridors of natural levee that lie between Freeport-Clarksburg and Isleton on the Sacramento have been covered by a more or less continuous strip of deciduous orchards since the late 1860's. The heart of the fruit district was the six miles of bank land extending north and south from the head of Grand Island. Walnut Grove and Hood approximate the limits of the district which in the 1870's was described to be "without exception the best for peaches in California."[131] Plums and pears comprised another important segment of the orchard acreage. There were smaller plantings of apricots, cherries, figs, nectarines, quince, table grapes, and apples in the some 2,000 acres of orchard that comprised the fruit belt.[132]

During the late 1870's and in the 1880's growers were finding that the quality and quantity of stone fruit yields were declining. The trouble was attributed to the rise of the seepage-fed water table which resulted when alluviation elevated the bed of the Sacramento River.[133] Flowing and

---

apples and pears" in 1860. The pears were identified as Baldwins and russets. "Visit to a California Ranch," SF Alta, Aug. /?/, 1860, in BS, Set W 3, p. 1009.

[131]Hoag, loc. cit., pp. 339-40.

[132]Ibid.; "A Fruit Shipping Center," anon., April 14, 1877, in BS, Set W 19:1, p. 504; "The Forthcoming Harvest," SF Bulletin, May 9, 1878, in BS, Set W 18:2, p. 271; History of Sacramento County, p. 219; Sprague and Atwell, op. cit., p. 59.

[133]"A Whole Fruit District Nearly Ruined," PRP, July 31, 1880, p. 68.

standing flood waters were contributing factors.[134] Although the early varieties remained profitable for a long time,[135] the composition of riverside orchards changed because operators avoided replacement planting with stone fruit.

Pears, particularly the Bartlett variety, began to assume greater relative importance among the tree crops as the stone-fruit trees were replaced. The pear tree was better adapted to existing edaphic conditions than other deciduous fruit trees. Besides, a national market developed strong demand for this premium fruit. Pears along with cherries, peaches, apricots, and plums also found good markets within the state.[136]

The ascendancy of pears as a commercial tree crop in the delta is associated with the remarkable transformation that came about in California fruit-raising districts after the first transcontinental railroad was completed. To that time the pioneer fruit ranchers were concerned about the

---

[134] "The Forthcoming Harvest," SF Bulletin, May 9, 1878, in BS, Set W 18:2, p. 271; "Harvest Propsects," SF Bulletin, March 20, 1879, in BS, Set W 18:2, p. 334.

[135] The main varieties of fruit raised in the district (1888) were: Red Astrachan, Bellflower, and Twenty-Ounce Pippin apples; Alexander, Early Hale, Early and Late Crawford, Susquehanna, Orange Cling, and Salway peaches; the Royal apricot; Black Tartarian, Early Purple Guigne, and Royal Ann cherries; the Bartlett, Beurre Clairgeau, Hardy, and Seckel pears; and Purple Duane, Bradshaw, Columbia, Washington, and Coe's Golden Drop plums. "Report of A. T. J. Reynolds," Official Report of the Tenth Fruit Grower's Convention of the State of California (Sacramento: 1889), p. 232.

[136] "Miles of Orchards," PRP, April 10, 1886, p. 348; Report of the Examining Commission on Rivers and Harbors, p. 145; Wells, The Sacramento Valley of California, p. 105.

possibility of glutting California with fruit. Drying some of the crop for sale in the East was tried, but high labor and freight costs priced the product out of the eastern market. Shortly after the railroad was completed, shipments of fresh fruit moved east, but the first shipments were failures because of high freight rates and delays in transit. By 1870, however, the Pacific Railroad carried 70 carloads of fruit out of California. In the next year 115 carloads, mostly pears and grapes, moved toward the East on fast trains, and with little delay. Rates remained fairly high, but the fruit arrived in sufficiently good condition to pay the costs.

Bartlett, Winter Nelis, and Seckel pears were very popular and, even before 1876, Chicago and New York commission houses had agents in California to buy the crop from such areas as the delta. The pears shipped well on the transcontinental trip. After refrigerated car service began in 1875, many other less hardy California fruit varieties also entered the flow of shipments to the East.[137]

Bartlett pear raisers on the Sacramento had a premium early fruit which was in such demand that buyers were willing to pick, pack, and transport it at their own expense. In such circumstances a good orchard in a good year netted $200

---

[137] "Fruit Preserving," SF Bulletin, Dec. 15, 1876, in BS, Set W 19:1, p. 501; "The Fruit Trade of San Francisco," anon. (1871), in BS, Set W 19:1, pp. 443-44; "Fruit Culture," Paper read by C. W. Reed before Sacramento Farmers' Club, Jan. 27, 1872, in BS, Set W 19:1, pp. 442-43.

or more per acre in the 1890's.[138] Several instances of $200 to $350 per acre returns are reported for 1906 in the vicinity between Courtland and Walnut Grove; in the 1920's per acre profits of $500 to $1,000 are described.[139] From the outset of fruit raising, the natural levee lands were desirable. These properties with the lowest water table in the delta were retained by the pioneer families which valued their holdings so highly that it was "impossible to buy an acre."[140]

Individual orchards of the 1870's did not exceed 60 or 80 acres; the average breadth of the tree strips extended up to about 250 feet away from the river.[141] Within the next two decades orchards of 100 or more acres became common.

---

[138]Sacramento County and Its Resources, p. 34.

[139]"Big Returns from Bartletts," PRP, Dec. 8, 1906, p. 364; "Delta of Sacramento and San Joaquin," The Eden of California . . . , River News, p. 57.

[140]Sacramento County and Its Resources, p. 42. Several instances of $1,000 per acre offers being refused by owners for orchard land are noted in one 1878 source. "Dire Disaster," SF Chronicle, Feb. 24, 1878, in BS, Set W 34, p. 121.

[141]"Up the Sacramento," SF Call, Oct. 16, 1877, in BS, Set W 3, p. 1064. As an example of the place that the orchard held in a farm operation during the 1870's, one 640-acre property near Courtland had 60 acres in fruit along the river which yielded a gross of $5,000 to $10,000 per annum. In contrast, the rest of the farm grossed $3,000 on the sale of butter, cattle, and alfalfa seed. Forty cows were maintained, and a dozen or so cattle were sold for beef each year. In the orchard there were 7 acres of pears, 15 of Muscat and Black Hamburg grapes, and 38 of apples, apricots, cherries, plums, peaches, and figs. The remainder of the farm included 380 acres of pasture and hay land and 200 acres of backswamp. Labor was performed by 6 to 10 full-time Chinese who earned $28 to $30 per month without board. The hands were doubled during the fruit harvest. Cone, Two Years in California, pp. 138-40.

While the trees usually occupied less than 15 per cent of the area of larger farm units in the earlier period, as much as 60 per cent of a large property might be devoted to orchards in the 1890's.[142]

At least as far as the large operators were concerned, the combination of fruit and commercial livestock was common. Cattle (chiefly Devons and Durhams), horses, and probably swine were kept by all ranchers to meet domestic requirements and provide some income. (Plate XVII, p. 364, shows representative farm scenes.) Large and small farm units also devoted land to such crops as wheat, barley, buckwheat, alfalfa, potatoes, sweet potatoes, beans, and squash.[143]

The provision that was made for farm labor in the 1870's and thereafter is uncertain, but it is likely that the orchards and the stock on large places were cared for by permanent employees. Some orchards were managed on shares.[144]

In 1885 the orchard area along the Sacramento comprised about 6,000 acres. There were 2,000 acres of fruit trees between Walnut Grove and the head of Randall Island, 3,000 on Grand Island, 600 on Andrus Island, and 300 acres

---

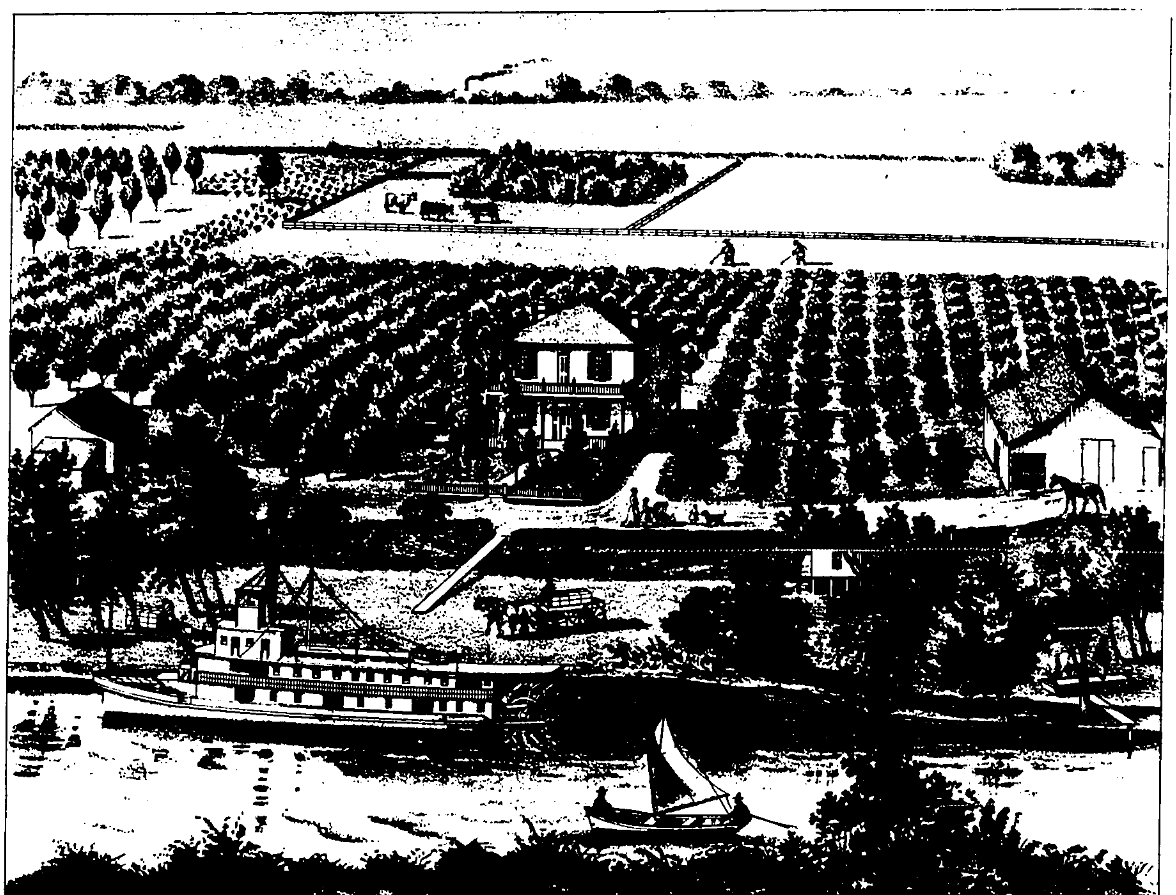
[142] History of Sacramento County, pp. 258, 260, 262; Sacramento County and Its Resources, pp. 42-44, 184, 186, 192.

[143] Ibid., pp. 42-44, 46, 181, 186, 192; "Down the River," Bee, Nov. 5, 1875, in BS, Set W 5, p. 1870; "Miles of Orchard," PRP, April 10, 1886, p. 348.

[144] SF Call, n.d., in BLS, No. 21, p. 276.

PLATE XVII

A VIEW ON THE FRUIT & VEGETABLE RANCH OF **FREDERICK DAVIS**, 35 ACRES, SETTLED BY HIM IN 1868, GRAND ISLAND, STEAMBOAT SLOUGH, SACRAMENTO C°, CAL.



Typical farm and river scenes along the Sacramento in the 1880's (from History of Sacramento County . . .).

on Tyler Island.[145] Lesser acreages were planted on the other islands and mainland districts in the vicinity.

Each orchard had a frame shed near the river landing where grading and packing were done. River freighters picked up the fruit daily during the harvest season, moving the crop to Sacramento, whence it was shipped East by refrigerated car, or to San Francisco, where the fruit was marketed through retail outlets.[146]

Orchards were scattered along the periphery of Roberts Island and Reclamation District 17 in the 1870's, and 10,000 fruit and nut trees were planted on Union Island in 1879;[147] but the San Joaquin River orchards did not prosper. A comparatively high water table in spring and early summer probably had a good deal to do with it, although poor management practices are ascribed to the "citizens of foreign birth" who farmed much of the orchard land. They "almost invariably" raised cabbages, potatoes, onions, strawberries, and other crops between the trees. The frequent irrigation required by the steady succession of crops harmed both the trees and their fruit. The susceptibility of the San Joaquin orchards to attack by tree borers was attributed to high pruning done

---

[145]"Reclamation of Marsh Lands in California," PRP, May 30, 1885, p. 510.

[146]"Fruit Notes," PRP, July 11, 1885, p. 25; Sacramento and Its Resources, pp. 43, 185-86; "Report of A. T. J. Reynolds," loc. cit.

[147]"Through San Joaquin County," SF Bulletin, March 29, 1879, in BS, Set W 4, p. 1503.

to facilitate row crop farming.[148] In 1900 and 1901, while a blight was virtually wiping out San Joaquin Valley pear orchards, island fruit producers protested against the foreign growers, many of whom were Italian, who refused to spray because of the expense.[149] By 1913 only small remnants of deciduous orchards survived in the San Joaquin delta.[150]

Pear blight also damaged Sacramento River orchards in the decade before World War I. New plantings were established on resistant Japanese stock but were not satisfactory. The matured crops developed "black end," a discoloration of the fruit, attributed to the high water table. Many of the orchards containing Japanese rootstock were cut down during the 1920's and 1930's; old orchards of all fruit varieties grown locally were also taken out with no compensating increase in new plantings. As a rule, old orchards were not replaced with the same fruit varieties, because the new generation lacked vigor.[151] Also there was little fresh land

---

[148] W. H. Robinson, "Report of the San Joaquin County Horticultural Commission," Third Biennial Report of the State Board of Horticulture . . . , p. 272.

[149] Cosby, "Delta History Notes," p. 40, SDI, Nov. 7, 1901; S. W. Shear, Economic Aspects of the Pear Industry, Univ. of Calif., College of Agriculture, Agricultural Experiment Station, Bull. 452 (Berkeley, 1928), p. 29.

[150] San Joaquin County Board of Supervisors, op. cit., p. 47.

[151] Pear Growing in the Pacific Coast States, by C. F. Kinman and J. R. Magness, USDA, Farmers' Bull. No. 1739 (rev. ed.; Washington: 1949), p. 21; interview with John F. Wilcox, Brannan Island, Aug. 28, 1955.

available for planting, and that was acquired by asparagus growers. The depression, competition from younger California pear areas, and the passing of the early generations of orchard owners probably hastened the drift away from pears. The younger generations tended to be absentee owners.

The orchard area diminished from 16,500 acres in 1924 to 10,400 acres in 1931, to 5,800 acres in 1938, and to 4,900 acres in 1945, when the trend was arrested (see Map Plate H, pocket). In 1952 there were 4,900 acres of fruit trees in the delta; new plantings on a modest scale are being made in the Sacramento River districts (see Plate XVIII, p. 368).

Although there are some apple, cherry, peach, and plum trees in the northern part of the Sacramento fruit district, the Bartlett pear completely dominates the orchard industry. Other fruits do not compete well with the profitable pear nor with the products of other deciduous fruit areas.[152] Well over nine-tenths of the fruit area produces the famed dessert and canning pear. (Delta pears usually are the first to ripen in California.) The six-week eastern shipping season normally begins in late June or early July. Following the dessert-pear shipping season, most of the fruit is trucked to cold-storage plants and canneries in Sacramento, Stockton, and the San Francisco Bay Area.

The average orchard today is an owner-operated unit of 50 acres, although some are sharecropped for a 40 or 50 per

---

[152]John Spurlock interview, July 12, 1955, and letter to this writer, April 30, 1957.

PLATE XVIII

View to the northwest through a young riverside orchard on upper Andrus Island. Alfalfa occupies much of lower land. The Sacramento River levee is visible in the distance.

cent payment, and some are managed by salaried personnel. There are a number of 20- to 30-acre operations, several 90 to 100 acres, and two or three of 200 acres. In most cases the orchard is part of a property that also includes field crop land. (Map 20, p. 370, shows a representative distribution of orchard and other crops in 1952.) A representative orchard-field crop operation includes 45 acres of pears, 28 acres of barley, 38 acres of corn, and 60 acres of tomatoes.

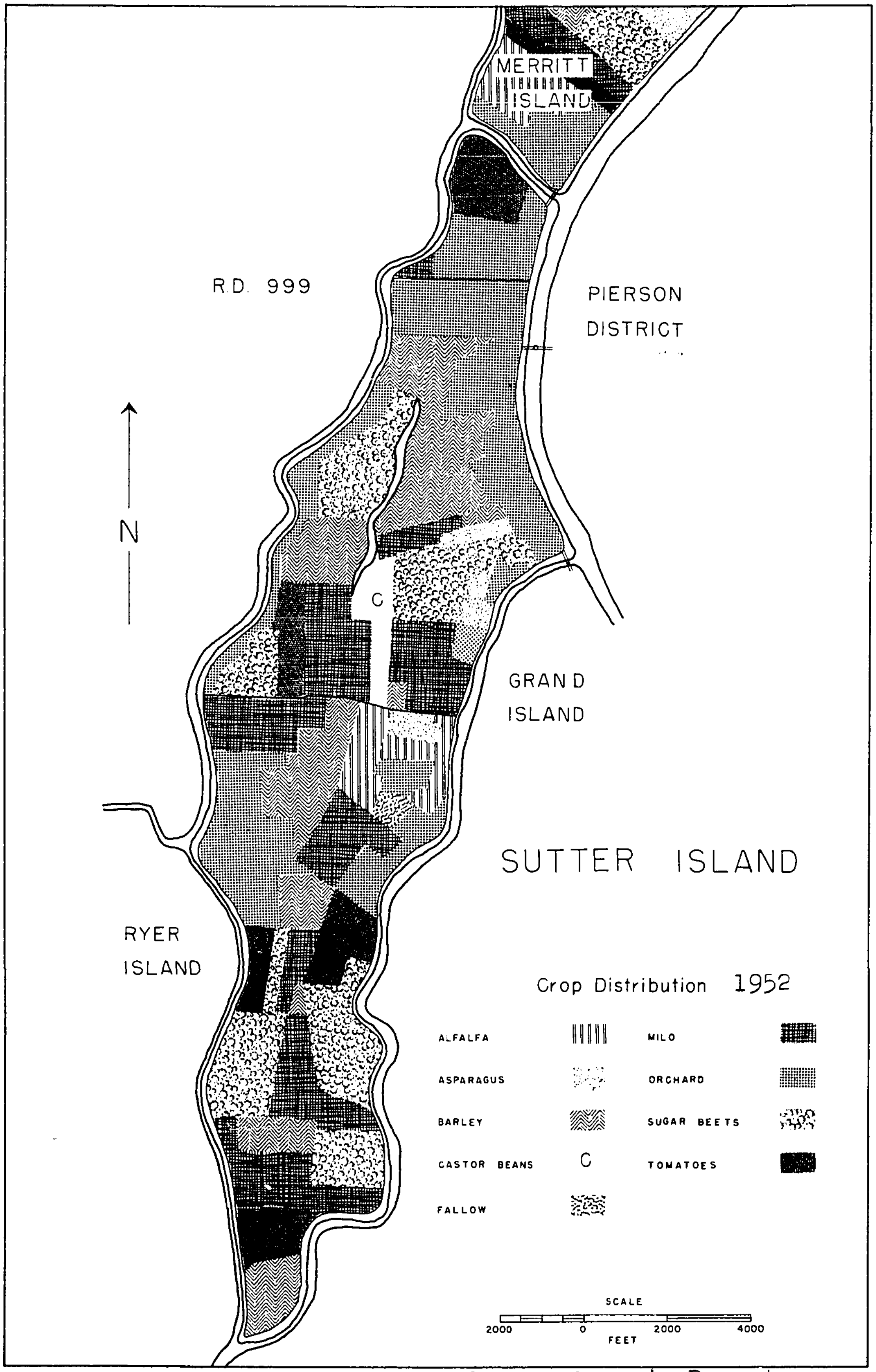
Before World War II the fruit was harvested by Chinese, Japanese, and some Filipino laborers; the latter became less numerous as the asparagus industry, their chief interest, moved into the San Joaquin delta. Mexican nationals have been added to the labor force in recent years. The Mexicans are housed in local camps; otherwise the pre-World War II custom of housing native-born labor in ranch camps has been given up by all but the largest operators.[153] As a result, farm labor has little or no direct contact with the landowners. The labor contractor is the intermediary who recruits his hands in Sacramento, Stockton, and in the Chinese community of San Francisco.

Relations of tenants or managers and owners are cordial and stable. In some cases the relationship involves second and third generation associations; resident owners are more apt to take a direct interest in the tenant's performance.

---

[153]Wilcox and Spurlock interviews.

Map 20



Source: County Agricultural Commissioner's Reports

Orchards are irrigated two to four times per season. Check irrigation is common, but sprinkling is gaining popularity because of savings in labor and the improvements in water management. Sprinkling does not raise the water table, nor does it foster salt accumulation, as check irrigation and subirrigation do.[154]

Chicory

Of the minor crops that received sustained attention in the delta in the early years, chicory was the most highly localized. A small acreage was raised downstream from Sacramento and Washington (West Sacramento) between 1860 and 1880.[155] Between 1872 and World War I a larger acreage was raised on mineral soils in Reclamation District 17 and on Roberts Island. The southern crop area was located entirely within a few miles of a mill located on the right bank of the San Joaquin about eight miles southwest of Stockton.[156]

In the 1870's, when all of the production was to the east of the river, between 200 and 500 acres were harvested.[157] In the early 1900's up to 1,200 acres were

---

[154]Salt injury to trees is noticeable in the late summer yellowing of leaves. The Isleton area is most affected.

[155]Sprague and Atwell, op. cit., pp. 152-53.

[156]An Illustrated History of San Joaquin County, pp. 433-34; San Joaquin County Board of Supervisors, op. cit., p. 69; "The Chicory Industry," PRP, Dec. 14, 1878, p. 373; "Chicory Crop," PRP, Sept. 7, 1895, p. 146.

[157]"The Chicory Industry," PRP, Dec. 14, 1878, p. 373.

planted of this coffee additive. Cultivation had virtually ceased before World War I, the result of a disappearing market among the San Francisco coffee roasters, foreign competition, and the 1911 flood.[158] Vegetables and alfalfa have replaced it.

Seed Crops

Seed crops likewise have been of little importance, although alfalfa, onion, and table vegetable seeds have been propagated for sale as planting material. Weed control and other costs are too high to justify cultivation of crops to produce seeds for planting except when highly favorable prices prevail as during and right after World War II. In the last few years sunflowers and safflowers have been raised for feed or for industrial markets.

Sunflower seeds of the varieties used for cage bird feed have been raised on contract with commercial seed companies[159] to the southeast of the delta, in the Manteca vicinity, at least since 1913.[160] The distribution pattern for 1952 appears to reflect a diffusion of contract operations into the southern delta from the Manteca area (see Map

---

[158]"San Joaquin County," Calif. State Agric. Soc., Report for the Year 1906, p. 169; San Joaquin County Board of Supervisors, op. cit., p. 28.

[159]P. F. Knowles, Shall I Grow Sunflowers?, Univ. of Calif., College of Agriculture, Agricultural Extension Service [c. 1950], p. 3.

[160]San Joaquin County Board of Supervisors, op. cit., p. 53.

Plate J, pocket). Because acreages tend to be small and because the contracts are made with the same operators year after year, there is not much dispersion to the pattern. The plants do particularly well on alkali-free soils of light texture. The cultural requirements of this summer crop are similar to those of field corn.[161] Like corn, sunflowers are fair weed competitors. They are about as profitable to raise as the corn.[162]

Safflower was introduced to California as a cash crop in 1948-49. By 1952, 5,000 acres were planted in the delta (see Map Plate J, pocket). This winter- or spring-seeded annual is a poor weed competitor in the early stage of growth, and for that reason it is not planted in the peat soils. Weed control is easier in the mineral soils. The plant matures a month or six weeks after barley. It is not included in a double-cropping system; but it may be substituted for wheat or barley in rotation.

Oil seed processors are interested in safflower because it yields an oil that is colorless and does not yellow with age. The paint and varnish industries are the principal safflower oil consumers.[163]

---

[161]P. F. Knowles and L. L. Davis, Sunflowers As a Field Crop, Univ. of Calif., College of Agriculture, Agricultural Extension Service /c. 1954/, p. 5.

[162]Baskett interview.

[163]P. F. Knowles and L. L. Davis, Safflower, a New Oil Crop, Univ. of Calif., College of Agriculture, Agricultural Extension Service (1951), pp. 3, 4, 6, 7.

Miscellaneous Crops

A variety of other crops introduced by speculators and farmers into the delta have not succeeded commercially. At one time or another, ramie, jute, hemp, cotton, sugar cane, rice, cranberries, broom corn, mulberry trees, peppermint, and spearmint have been planted.[164] In the case of sugar cane the federal government operated experimental plots on Union Island in 1894. Some sugar cane was planted in the Terminous vicinity in the following year. Hemp was raised on up to 400 acres of Ryer Island in 1900/1 and 1903; it was allowed to ret in the fields.[165]

Feed Crops

The Small Grains

Wheat was the principal grain raised in the Central Valley until about the first decade of the present century.

---

[164]Tide Land Reclamation Co. (1869), op. cit., p. 7; "Report of the State Board of Agriculture for 1868 and 1869," Calif. State Agric. Soc., Transactions During the Years 1868 and 1869 (Sacramento: 1870), p. 16; Henry G. Langley (ed.), The Pacific Coast Almanac and Year Book of Facts for 1868 (2d ed.; San Francisco: Towne and Bacon, Printers, 1868), p. 58; Stockton Board of Trade, op. cit., p. 71; An Illustrated History of San Joaquin County, p. 108; Calif. State Agric. Soc., Report for the Year 1905 (Sacramento: 1906), p. 226; San Joaquin County Board of Supervisors, op. cit., p. 36; Illustrations of Contra Costa County, . . . , p. 8; Cosby, "Delta Field Notes" (1934), p. 37.

[165]"Sugar Cane," PRP, March 23, 1895, p. 178; "Report from the Second District Agricultural Association, Composed of the County of San Joaquin, for the Year 1894," Calif. State Agric. Soc., Transactions During the Year 1894 (Sacramento: 1895), p. 239; "Hemp Grown Down the River," PRP, May 25, 1901, p. 327; "Large Field of Hemp," PRP, Sept. 5, 1903, p. 151.

Its cultivation was begun in the delta vicinity on land owned by Sutter, Weber, March, and Bidwell. Cultivation was interrupted briefly by the first rush to the gold placers but as soon as the new settlers came to the delta and delta margin the cereal crop was planted again.

By the 1870's and 1880's wheat was a major commercial crop. In the 1870's a ratio of five or six to one is suggested as the relationship of wheat to barley. The estimate is based on three pieces of evidence: in 1874, 11,000 acres of wheat and 2,000 acres of barley were planted on Grand and Sherman islands. A Roberts Island farm had 60 acres of wheat to 10 of barley in 1877; also in 1877, a farm in the Reclamation District 17 had 250 acres of wheat and 50 acres of barley.[166] About 50,000 acres of wheat and barley were farmed during the 1880's in reclaimed districts south of the Mokelumne and east of Old River. Perhaps another 25,000 acres were planted in other parts of the delta.[167]

Barley was raised extensively in the 1890's; after the decade 1900-10, the acreage superseded that of wheat.[168] By

---

[166] Address of J. A. Hosmer, loc. cit.; "A Tule Land Farm," SWI, March 24, 1877, p. 7; "A Ride through the Tule Country," SWI, Sept. 1, 1877, p. 5.

[167] The first estimate is based on production and acreage data reported in the sources listed below. The second estimate is based on assumptions of area reclaimed and crop interests. "Down Among the Tules," SF Bulletin, Feb. 23, 1880, in BS, Set W 4, p. 1511; "Harvesting on Roberts Island," PRP, Aug. 14, 1880, p. 101; "Reclamation of Marsh Lands in California," PRP, May 30, 1885, p. 510; An Illustrated History of San Joaquin County, p. 553.

[168] Union Island, prominent among wheat-raising districts in the 1870's and 1880's, was largely planted in

1911 barley was the main winter grain crop.[169] The 1916 crop occupied about 120,000 acres,[170] and in 1919, 97,000 acres were raised.[171] The acreages approximate the extent of plantings that have prevailed since 1931. Barley now occupies 90 per cent or more of the peat land planted to winter grain.[172] For the delta as a whole, perhaps 75 per cent of the winter grain land is drilled to barley. A minor acreage of the small grains is harvested for hay when the crop is excessively weedy. In 1931 there were 91,000 acres of barley and wheat (see Table 4, pp. 316-17). In selected subsequent years the winter crops occupied 115,000 (1938), 117,000 (1945), and 90,500 (1952) acres. The acreages represent 25 to 35 per cent of the delta crop land (see Map Plate K, pocket).

As a rule, wheat and barley have been planted in December and January and harvested in June and July. Planting immediately after a potato or sugar beet harvest has been common practice. Oats, never of any real importance, may be planted in January or February on land suitable for the other

---

barley by the 1902/3 crop season. Cosby, "Delta History Notes," p. 91, <u>SDI</u>, July 3, 1903, p. 3.

169"The Netherlands of America," <u>Stockton Evening Mail, San Joaquin Valley Development Edition</u>, pp. 20-21.

170Cox, <u>loc. cit</u>.

171George S. Nickerson, "Discussion," DWR Bull No. 3, p. 99.

172Interview with Alan Carlton, Coordinator, University of California Peat Soil Conservation and Dust Abatement, Feb. 25, 1957.

small grains. Another minor crop, buckwheat, was planted in the seventies as a late season crop after flooding. It was sown as late as August. Barley also functioned as a late season crop if started before August.[173]

The nature of small grain farming has altered considerably since 1870. The change has been toward reducing the number of times the crop is handled, shortening the harvest season, and increasing the ratio of land to hands employed. In the 1870's, when 100 acres was the optimum area that two men and two good horses could harvest, the reaped grain was bound and stacked in piles which, by August, were dispersed all over a given island. Threshing of barley, the earlier crop, progressed as wheat was harvested. Wheat stacks were still being threshed as late as October, a situation which sometimes resulted in crop injury or loss as a result of early rains.[174] Thirty years later the stacks had almost disappeared because combine harvesters, powered by horse or traction engines, enabled ranchers to cut, thresh, and sack the grain in one operation.

---

[173] "Late Crops for the Overflowed Lands," Bee, March 27, 1878, in Sacramento River Floods of 1878 and 1881, not paginated; "Crops on Sherman Island," SF Bulletin, May 21, 1871, in BS, Set W 18:1, p. 147; SF Call, n.d., in BLS, No. 21, p. 276; "The Flooded Regions," SF Alta, Feb. 24, 1878, in BS, Set W 34, p. 123; "The Netherlands of America," Stockton Evening Mail, San Joaquin Valley Development Edition, p. 20; Spurlock interview.

[174] Browne, "Reclamation and Irrigation," loc. cit., p. 400; "Sherman Island," SF Alta, Aug. 10, 1874, in BS, Set W 18:1, p. 162; "Harvesting on Roberts Island," PRP, Aug. 14, 1880, p. 101; Cosby, "Notes," SDI, Oct. 10, 1882.

In the early 1900's the smaller horse-drawn grain combines were apt to be owner-operated on small holdings. On larger ranches owner-operated or contractor-owned traction engines were the rule.[175] The acreage covered per day varied with the land and the equipment; however, in about two days a crew was capable of handling the work which 30 years earlier two men had required all season to accomplish. Today an operator, on his own self-propelled, internal combustion combine, harvests and threshes grain from about as much land per day as the crew could do 50 years ago. He usually completes the harvest before mid-July. Contract harvesting is now of little or no significance. In either case, the grain leaves the field in bulk. Sacks have not been used since the 1940's.[176]

Barley and wheat yields in the delta average a third or two-thirds higher than on dry-farmed soils of the sandier valley plains.[177] The delta record is about three tons of barley and two tons of wheat per acre;[178] normally one-half

---

[175]Traveling harvester groups included an engineer, a crew of eight, a cook, and a messenger. Besides the harvester, the rolling stock consisted of a horse-drawn water tender and coal cart, a straw wagon, and a commissariat. The harvesting team was paid at the rate of 14 to 17 cents per 100- to 125-pound sack of grain harvested. N. A. Cobb, The California Wheat Industry, New South Wales, Dept. of Agriculture, Misc. Pub. No. 519 (Sydney: 1901), pp. 16, 19-21.

[176]Statement regarding sacking of grain based on Brown interview.

[177]Stockton Board of Trade, op. cit., p. 72; Cone, op. cit., pp. 112-13; Carlton interview.

[178]Spurlock interview.

to two-thirds of these tonnages is the yield. Production records run about 1,200 pounds per acre above what they were 40 or more years ago; the normal crops are around 600 pounds heavier per acre.[179]

Little variation in production occurs from year to year or from one soil to another. Such as does occur usually reflects the available supply of fertilizer in the soil, either freshly applied or left over after the preceding crop's requirements have been met. For example, grains are raised on the fertilizer residue left after sugar beets or potatoes. Unlike the valley plains, there is no significant relationship between yield and precipitation. In the delta, barley and wheat are not irrigated; but it is customary to maintain the water table to within two and a half or three feet of the soil surface until the first of June. The water table is lowered for about two weeks prior to harvesting.[180]

In spite of good yields, there are some shortcomings to raising winter grain in the delta. Wheat and barley develop such rank-growing stems that lodging must be expected. The former practice of grazing sheep on the sprouting crop to retard heavy growth is unusual today. Now the tendency is to delay planting until February or March, particularly on peat. In addition to curtailing

---

[179]"Crops on Sherman Island," SF Bulletin, May 21, 1871, in BS, Set W 18:1, p. 147; Address of J. A. Hosmer, loc. cit.; Sacramento County and Its Resources, p. 48; Stockton Board of Trade, loc. cit.

[180]Baskett and Spurlock interviews.

straw growth, the delay reduces the incidence of leaf diseases.[181] The wheat has tended to be darker than the grain produced on the uplands, and both the wheat and barley harvests are often fouled with weeds.[182] When weed development is excessive the crops are cut for hay. Now that selective chemical sprays may be used to kill broadleaf weeds the problem is not as acute as it was 10 years ago. Still, in years of late spring rains the more weed-prone barley may have to be windrowed before threshing to reduce the weed fouling.[183]

Small grains are planted throughout the delta. The accompanying maps for 1931, 1938, 1945, and 1952 reveal the distribution[184] (Map Plate K, pocket). They show an increasing density in the Sacramento River districts and a decreasing density of plantings in the San Joaquin part of the delta. Respectively, the developments are paralleled by the reduction or expansion of asparagus acreage. The heavier than average concentration which appears along the lower Sacramento River in 1945 and 1952 also reflects the suitability of small grain on high water table, slightly alkaline land (see Map 21, p. 381). The thinning out of the pattern that has occurred in the northern end of the delta is

---

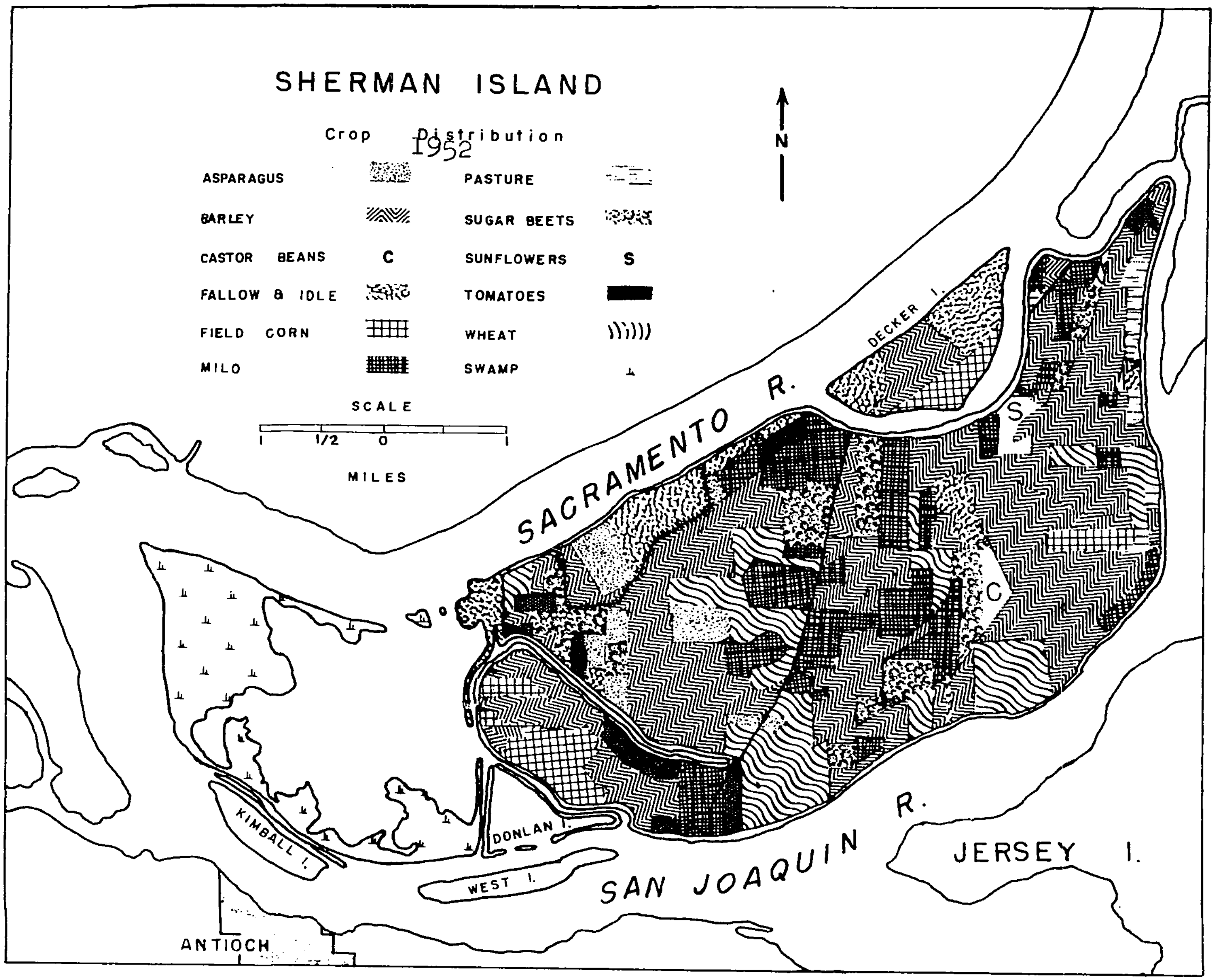
[181]"Contra Costa County," PRP, Jan. 2, 1875, p. 12; "Island Crops Advanced," PRP, March 17, 1900, p. 167; Baskett interview.

[182]*Ibid*.; Johnson interview.

[183]Baskett interview.

[184]The 1924 data have been discarded because they are not complete enough to be useful.

Map 21



Source: County Agricultural Commissioner's Reports

partially attributable to growth of the Sacramento suburbs. In a given district the small grain may cover 55 or 60 per cent of the gross area. Government acreage restrictions on wheat, the stage of rotation on a given tract, and the selection of a crop which the operator expects to see have a profitable year are conditioning factors.

Most of the grain is sold on consignment to Central Valley and San Francisco Bay Area feed mills. Some is barged from small private elevators located on Ryer, Andrus, and Staten islands, but most of it is custom-trucked out of the delta. The crops are handled in bulk, a method which, like the elevators, dates from around 1940.[185]

Field Corn and Milo

As a commercial industry the raising of field corn began sometime after 1908. The high yields and the relatively low labor requirements of the crop induced farmers to increase plantings so that the area of about 3,500 acres in 1916 and 1917 increased six or eight times in 1918.[186] The appearance of long lines of corn cribs on the levees accompanied this expansion.

By 1924 the corn acreage had returned to the 1916 and 1917 level, but over 53,000 acres were raised in 1930 (see

---

[185]Brown, Baskett, Johnson interviews and personal observation of writer.

[186]"Indian Corn Is Paying California Growers," PRP, Jan. 4, 1919, p. 4; Cox, loc. cit., p. 444.

Table 4, pp. 316-17). In 1938 the crop had declined to 39,300 acres, as much of the former corn area in the central delta had been planted in asparagus. The next significant reduction occurred between 1945 (36,500 acres) and 1952 (17,800 acres), as milo was transformed from the minor crop of pre-1950 into a bright prospect.

In 1952 over 32,000 acres were planted to milo. The Cache Slough and Sacramento River districts were favored areas, although some was grown in the south delta (see Map Plate L, pocket). In general, peat areas are not planted to milo; field corn copes better with the weed situation that arises on such soils.[187]

Field corn is well adapted to peat soils. It finds ample nitrogen in the organic soils and is comparatively inexpensive to irrigate. Midwestern hybrid seed is drilled before mid-June, the date of planting varying according to the desired harvest period. Average yields are 4,000 pounds per acre, but 5,000 to 7,000 pounds per acre may be expected. The yield is 3,000 pounds greater than farmers could expect before the introduction of hybrid corn in the early 1940's. On the other hand, per acre production and harvest costs are three to four times higher today.[188]

---

[187]Baskett and Carlton interviews.

[188]"Indian Corn Is Paying California Growers," PRP, Jan. 4, 1919, p. 4; Dale G. Smeltzer and R. S. Baskett, "Hybrid Corn Varieties, Eleven Years' Tests," Univ. of Calif., Agricultural Extension Service, San Joaquin County (1954), pp. 1, 6 (mimeographed); Torrey Lyons and A. D. Reed, "Growing Field Corn in Sacramento County on Peat

Milo is raised on altered peat soils for the most part. While it is a catch crop in some parts of California, it is a planned crop in the delta. Of particular interest to farmers here is the early maturing variety, Ryer 15. This milo was selected from a field of Double Dwarf 38 Milo on Ryer Island in 1944, and the rancher built up seeding stock over a period of years. The variety is largely responsible for the recent acreage expansion of milo in the delta. The 90-day Ryer Island milo is suitable for lands which, because of dampness, must be planted late. It may be planted as late as July 15, a decided improvement over most milos, which should be planted in April to early June. It is popular for double-cropping after a winter grain or after peas. It fits into a rotation in much the fashion that corn has been used: after alfalfa, tomatoes, or sugar beets.

The Ryer 15 milo produces a bright red grain which is in great demand among feed grain buyers. Yields of 5,500 pounds per acre are normal.[189]

Alfalfa Hay and Pasture

When settlers first established themselves in the delta, they usually farmed the natural levee, using backswamp

---

Soil," Univ. of Calif., Agricultural Extension Service, Sacramento County (1955), pp. 1-3 (mimeographed); Fleming correspondence.

189 Spurlock interview; interview with John Golden, Solano County Agricultural Commissioners Office, Rio Vista, Aug. 2, 1955; John Lindt, Torrey Lyons, and Doyle Reed, "Milo in the Sacramento Valley," Univ. of Calif., Agricultural Extension Service, Sacramento County (1955), pp. 1-13 (mimeographed).

areas for pasture (see Plate XVII, p. 364). Because of the drier edaphic condition and the trampling of stock the swamp plants died out. Selective feeding by stock may have altered the composition of the cover somewhat, although it was not until leveeing and draining of the tules happened that much change occurred in the vegetation pattern. Clover was particularly successful in becoming established on levees or wherever the land had dried.[190]

Hay was cut on the tule lands of the lower Calaveras and east of Antioch at least as early as 1852 or 1853.[191] In the disastrously dry year of 1864, at which time cattle were feeding on swampy Bouldin Island,[192] stockmen secured not less than 50,000 tons of "very fair quality" hay from the delta swamps. Another 50,000 tons were left uncut; yet large numbers of cattle and sheep starved on the adjacent valley plains. The charge for pasturing privileges apparently excluded much of the stock from the tule; and cutting and hauling delta hay to the parched range involved more cost than the surviving stock could have sold for.[193]

---

[190] Annual Report of the Surveyor General of California, for the Year 1862 (Sacramento: 1863), p. 12; "Visit to a California Ranch," SF Alta, Aug. [?], 1860, in BS, Set W 3, p. 1009.

[191] "San Joaquin News," SF Alta, Dec. 12, 1852, in BS, Set W 4, p. 1412; "San Joaquin News," SF Alta, July 24, 1853, in BS, Set W 4, p. 1431; Munro-Fraser, History of Contra Costa County, pp. 484-85.

[192] An Illustrated History of San Joaquin County, p. 552.

[193] "Annual Report of the Board," Calif. State Agric. Soc., Transactions During the Years 1864 and 1865, p. 35.

Planted pastures and irrigated grain or alfalfa hay land were developments of the early 1870's.[194] In four cuttings an average annual crop of four to six tons of alfalfa per acre was expected, and up to eight tons per acre were cut in select areas. The crop was raised for hay and pasture in fields and on the levees. After the last mowing of the fall the crop was pastured for about six months. By the 1890's alfalfa hay was baled in quantities and loaded onto schooners destined for San Francisco, for sale to the livery trade.[195] Other legumes and grasses raised as feed crops and in the rotation system were clover, timothy, redtop, and rye grass.[196]

The alkali-tolerant alfalfa grows well on the better-drained alluvial and alluvial-organic soils. It occupies somewhat over 8 per cent of the delta crop area, with an annual crop of 22,000 to 35,000 acres. While acreage is found in the east and west delta districts, where soils are transitional between valley plains and the floodplain, alfalfa is planted more extensively on the Columbia and Sacramento soils of the north and south delta (see Map Plate M,

---

[194] "Crops on Sherman Island," SF Bulletin, May 21, 1871, in BS, Set W 18:1, p. 147; "The Tule Lands of the San Joaquin," SF Bulletin, March 24, 1879, in BS, Set W 18:2, p. 336; "Reclamation of Swamp and Overflowed Lands in California," Report of the /U.S./ Commissioner of Agriculture for the Year 1872, p. 186.

[195] Sacramento County and Its Resources, p. 46; W. E. Davis, "Sacramento County," Calif. State Agric. Soc., Transactions (1901), p. 323.

[196] Nelson et al., loc. cit., p. 2594.

pocket). Individual districts may have up to 75 per cent of the field area planted to the crop.

A concentration of alfalfa acreage that occurred in 1924 on Roberts Island reflects the prevailing interest in dairying. The reduced intensity of plantings that took place in 1931 came about as dairies went out of business and as asparagus was put onto the land. Later intensification of the pattern may be associated with a beef feeding program which some south delta operators have adopted. Acreages scattered through the peripheral districts represent production for local beef feeding and dairy interests as well as production for sale. Alfalfa acreage in the Sacramento districts is produced chiefly for sale, the harvest being trucked to local, Central Valley, and north of San Francisco Bay dairy or beef feeding operations.[197]

Alfalfa seedings last only three or four seasons because of the high water table condition in the delta.[198] Yields of nine tons per acre are cut in five to six mowings.[199]

Livestock

The role of livestock in the delta is relatively minor compared with the place which the stock has in the economic

---

[197] Wilcox interview.

[198] Cole et al., Soil Survey of the Tracy Area, p. 67.

[199] Spurlock interview.

activity of immediately adjacent valley plains areas. The traveler is struck by the differences that exist in cattle and sheep concentrations. Sheep ranches flank the delta land on the northwest. Beef, dairy, or sheep operations have an almost continuous distribution from Sacramento to Stockton. Between Antioch and Byron, on the west side of the delta, dairies are numerous; to the south of Byron, or southwest of the delta, a broad interval of grain fields and unimproved land is found where beef cattle and sheep are grazed; south of the delta, between Old River and Tracy there are several dairy and beef operations. A number of the small farms lying to the south of Stockton also maintain beef cattle. In most of the peripheral belt heavy-textured and poorly drained soils prevent field agriculture from being competitive with the livestock activity; the situation is quite different from that of the delta where deep and friable soils are prevalent.

Early Stock Movement

Prior to the Gold Rush, creole cattle ranged at will on the dry-land valley plains and into the delta margins. The progeny of cattle brought into California from the East were noticeable among the herds in the 1850's and 1860's. Some of the cattle were transient, having been driven to the delta to rest and gain weight before being taken to the mines. Other range cattle were raised for the same market by settlers.[200]

[200] W. C. Fleming, "History of Beef Cattle in San Joaquin," Holt's San Joaquin County Gazette, VI (April 1952),

Cattle movement became more restricted as farmers settled upon the plains and delta land. Pre-emptions on the plains east of the delta date from the early 1850's.[201] In the late 1860's the open range began to disappear to the west and south of the San Joaquin delta; pre-empters and railroad land buyers were moving in to raise grain.[202] There is some evidence that the range in the vicinity of the south delta was deteriorating at the time. Grass, wild clover, alfilaria, and wild oats were "being grazed out" and encroached upon by noxious weeds.[203] The Montezuma Hills, the channel ridge plain to the north, and their fringing swamps were range country too.[204] By the 1870's the hills were transformed with wheat fields, but grazing remained the predominant activity on the alkaline plains and in the Yolo Basin.[205]

---

p. 1; An Illustrated History of San Joaquin County, p. 522; Rogers, "The Delta Story," Stockton Record, July 3, 1951, p. 9.

[201]"San Joaquin News," SF Alta, Feb. 17, 1853, in BS, Set W 4, p. 1420; "San Joaquin News," SF Alta, July 15, 1853, in BS, Set W 4, p. 1429.

[202]Contra Costa Gazette, Nov. 16, 1867, in BS, Set W 1, "California Counties; Alameda to Los Angeles," p. 168; Cronise, The Natural Wealth of California, p. 160; "Reclamation of Tule Lands," SWI, Dec. 18, 1869, p. 5; Leale, Recollections of a Tule Sailor, pp. 54, 56.

[203]Anon., April 27, 1868, in BS, Set W 4, p. 1464.

[204]"Report of the Solano County Assessor," Calif. State Agric. Soc., Transactions During the Years 1864 and 1865, p. 234.

[205]Gregory et al., History of Solano and Napa Counties, . . . , p. 49.

Periodically San Joaquin Valley droughts were so serious that cattle and sheep raisers brought their stock to the cover and water which the delta afforded.[206] Otherwise, the delta was a finishing ground for range cattle. Some 25,000 sheep and 11,000 head of Miller and Lux cattle being finished for the San Francisco butchers were in the west central islands in 1871.[207] About 19,000 sheep were ferried from Antioch to Sherman Island in the fall of 1875.[208] In the spring of 1877 some 15,000 Miller and Lux cattle were brought from the central and southern San Joaquin Valley to Stockton where they were embarked on barges and delivered to various of the islands for feeding. Sheep were delivered by rail to Banta and taken into the adjacent swamps in early 1877.[209] Drought in that year produced an exceptional movement of livestock. Sheep and cattle, some from as far away as Santa Barbara County, passed through the delta on route to green ranges in the northern coastal counties. The Antioch ferry delivered them to Collinsville, as did an occasional inbound coastal vessel. Some stock was landed at Cache Slough.[210]

---

[206]"Resources of San Joaquin County," SWI, Aug. 22, 1868, p. 6.

[207]Hoag, loc. cit., p. 343.

[208]"Sheep on Sherman Island," SWI, Oct. 9, 1875, p. 7.

[209]"Taking Cattle to the Tules," SWI, March 31, 1877, p. 5; "Condition of the Crops," Sacramento Record-Union, April 12, 1877, in BS, Set W 18:2, p. 220.

[210]"Moving Live Stock," SWI, June 23, 1877, p. 7.

By the end of the year even the delta tracts were unable to support their stock. Losses in extreme cases were high. One grazier in the Marsh Land Grant area lost about 5,000 of 6,000 sheep; on Winter's Island, south of Collinsville one band of cattle was reduced from 700 or 800 to 200 head.[211] Cattle movement from the south to the delta feeding area appears to have been less important in the 1890's and early 1900's, although several thousand head arrived by rail for island distribution in 1904.[212]

Sheep

A more common form of stock movement was the seasonal migration of many sheep, but very few cattle, between the delta and the Coast Ranges and Sierra Nevada. In December 1905, for instance, there were 40,000 sheep on Roberts Island and at least 20,000 in the Terminous vicinity awaiting movement to plains and foothill range.[213]

Commonly Basque and Portuguese sheepherders drove their flocks into the delta pastures and harvested fields in late summer and in the fall. Sheep were brought in to improve the condition of the ewes before lambing time.

---

[211] "Contra Costa," PRP, Jan. 19, 1878, p. 36.

[212] Cosby, "Delta History Notes," SDI, Aug. 18, 1904, p. 2.

[213] "Contra Costa County," Calif. State Agric. Soc., Transactions During the Years 1868 and 1869, p. 59; Fleming, "History of Beef Cattle in San Joaquin," loc. cit., p. 6; "Sheep Need Green Feed," PRP, Dec. 30, 1905, p. 422; Cosby, "Delta History Notes," p. 44, SDI, Jan. 12, 1901.

Bands, mostly Shropshire-Merino crosses, were brought from Coast Range and Sierra Nevada foothill areas to clean up stubble fields, root out ungathered potatoes, feed on bean straw, or to graze on sprouting barley and wheat.[214] The land-use fee was 75 cents to $1 per acre per season.[215]

By the 1930's the sheep which were brought into the delta included Rambouillet and Hampshire or Shropshire cross-breeds. For the most party, they were stubble-fed, but some browsing on levees and swamp vegetation occurred.[216] Today a few sheep may be trucked to the central islands; more are driven to peripheral feeding areas (see Plate XIX, p. 393). The numbers involved probably do not exceed 35,000. Stubble fields are leased for one to one and a half cents per head per day; harvested sugar beet fields are leased for one half to a cent more per day.[217] Corn fields, too, may be gleaned over a 45- to 60-day period in the fall and early winter.[218]

---

[214]"Contra Costa County," PRP, Jan. 2, 1875, p. 12; "Island Crops Advanced," PRP, March 17, 1900, p. 167. Cattle were turned onto the grain also. "A Happy Island," PRP, April 17, 1880, p. 249.

[215]"Heavy Loss by Fire," PRP, Aug. 11, 1900, p. 87; San Joaquin County Board of Supervisors, *op. cit.*, pp. 52, 68.

[216]Carpenter and Cosby, *Soil Survey of the Suisun Area*, p. 11.

[217]Brown interview. Estimate of stock by this writer.

[218]Information obtained in correspondence with Fleming and Spurlock.

PLATE XIX

Livestock scenes

Upper scene shows beef cattle in an irrigated pasture on Roberts Island. Ditch and banks in foreground are chocked with weeds. Lower scene shows the sheep range and dry-farmed grain land of the Yolo Basin valley-plains margin.

Dairying

For many years dairy cattle were the most profitable farm animals kept in the delta. Along the Sacramento, milk cows were rather numerous from the 1870's until the early 1940's. Many Caucasian tenants and landowners had at least a cow or two; some had herds of 40 or 60. The expectation in the 1870's was that perennial pastures and access to fast riverboat transportation would make dairying a prosperous industry in the delta. Residents of the Sacramento fruit district, Sherman, Venice, and Rough and Ready islands, and near Antioch were particularly active in establishing herds.[219] The Sherman and Venice island herds were kept up briefly until the flood hazards were recognized. Operators at Rough and Ready Island and in the Antioch vicinity were more successful, as were the dairy farmers in the Isleton vicinity and northward. Skimming stations were in operation at Walnut Grove and Clarksburg, and a creamery at Isleton by the 1900's,[220] by which time dairymen were again predicting

---

[219]Sprague and Atwell, op. cit., pp. 58, 74-77; Cone, op. cit., pp. 138-39; "Dairying in the Tule," SWI, Sept. 2, 1876, p. 5; "On the Sacramento River," SF Call, Oct. 27, 1877, in BS, Set W 3, p. 1065; letter of H. Eugene H. to ed., Press /PRP?/, Feb. 11, 1878, in BLS, No. 21, pp. 273-74; Wells, The Sacramento Valley of California, p. 105; "Thriving Creamery," PRP, May 2, 1903, p. 279; Sacramento County and Its Resources, p. 107.

[220]Wells, "Tilling the 'Tules' of California," loc. cit., p. 315; "Dairying in the Islands," Special Booster Edition of the Byron Times, not paginated; "Union Island the Largest in the Delta," Stockton Evening Mail, San Joaquin Valley Development Edition, p. 25; San Joaquin County Board of Supervisors, op. cit., pp. 60, 63.

that the year-round pasture land would be a major milk-producing area of California.[221] There was reason to expect such a future: Bouldin Island had a new herd of 1,000 cattle; 1,300 acres of the Terminous Tract had just been leased to a San Francisco Peninsula dairy for feeding another herd of 1,000; Staten Island landowners had begun to emphasize the stock in preference to cropping;[222] a 150-head dairy was established on 1,300 acres of Lower Roberts Island, and there were other herds between there and Banta or Tracy.[223]

A number of Sacramento River dairy farmers gave up after the 1907 flood, and the industry never recovered.[224] The competition of row crops eased many of the San Joaquin dairies out of operation by the mid-1920's. Considering the mineral element deficiencies (molybdenum toxicity) of peat, the soil's susceptibility to parasite infestation, and the flood hazard, it is surprising that some of the dairies lasted as long as they did.[225] Apparently dairies established

---

[221]Cosby, "Delta History Notes," p. 37, SDI, Sept. 22, 1900, p. 5.

[222]Ibid., p. 35, SDI, Aug. 24, 1900, p. 3; ibid., p. 37, SDI, Sept. 22, 1900, p. 5; ibid., p. 87, Stockton Daily Record, March 4, 1903; "Island Farmers Become Stockmen," PRP, Sept. 28, 1901, p. 199; "Staten Island Crops All Right," PRP, June 21, 1902, p. 411.

[223]Pastures of Australian rye grass, alsike, white and red clover, and orchard or blue grass were suitable for summer haying and fall and winter or year-round dairy pasture. With full-time use three acres of the pasture supported four cows for eight months and one cow for the four winter months. "San Joaquin County," Calif. State Agric. Soc., Transactions During the Year 1904, p. 220.

[224]Gardiner interview. [225]Fleming interview.

in the Contra Costa County periphery of the delta were flourishing at the time that the peat area dairies were declining. Between 1914 and 1929 there were 30 dairies established in the west delta vicinity; they shipped fresh milk and butterfat to San Francisco Bay cities.[226]

Dairying today is reduced to about 100 Holstein-Frisian cows in the Sacramento River districts, a few herds in the Banta vicinity of the south delta, and a number of valley-plains dairies in Contra Costa County which overlap former swamp and overflowed land of the west delta. The smaller dairies to the north appear to be the least vigorous enterprises. They are the remnants of a Sacramento delta activity which supported 1,000 head in the early 1940's, and which furnished fresh milk to Sacramento. The more southerly groups include herds of 50 or more dairy cattle; possibly 1,200 cows are present.

Beef Cattle

For the delta as a whole the fattening of market cattle by local operators has been an adjunct to farming, but owners of the mainland swamp and overflowed land between Freeport and the Calaveras have raised cattle as a major activity for the better part of the past century.[227] The use

---

[226]"Alfalfa One of Leaders in Profitable Farming," Fourteenth Development Edition of the Byron Times (1932-33), p. 9.

[227]"General Report of Chas. D. Gibbs," SDI, April 17, 1875, p. 7; "Extensive Reclamation Work," SDI, Oct. 26,

of improved pastures has been common for most of the period, but intensive beef finishing programs which include supplementary trough-fed concentrates are recent developments, seen chiefly on Roberts Island and to the northwest of Stockton (see Plate XIX, p. 393). Stall feeding operations are located on Ryer and Merritt islands and near Tracy. There may be 18,000 head of beef cattle in the delta.[228] At least since the 1920's the number of cattle handled in beef operations has been on the increase. The growth has paralleled the increased local emphasis on high-energy feed crops. Even some orchard operators now include feeder cattle in their operations.[229]

At least as far as Agricultural Extension agents and some landowners are concerned, the delta has considerable potential for expansion of beef feeding activities. The organic soils are particularly well regarded for pasture development. Molybdenum and parasite problems are controllable. Peat pastures stand up well under use; alluvial soils tend to mire. Either soil type has a high livestock carrying capacity per unit area. The pastures can produce 500 to 600 pounds of beef per acre per season.[230] Barley and alfalfa,

---

1878, p. 5; An Illustrated History of San Joaquin County, p. 553; A. J. Wells, The San Joaquin Valley of California (San Francisco: Southern Pacific Co., 1905), p. 28.

[228]This writer's estimate is based on interviews and correspondence with Fleming, Spurlock, and Golden.

[229]Spurlock correspondence.

[230]Baskett interview.

and the more expensive corn, milo, and sugar beet crops are immediately accessible as grain or fodder sources. The danger of floods can be reduced materially by constructing mounds where feed may be stored and the stock penned. In the eyes of some operators, floods are a secondary problem. They usually come in winter and spring; these people are thinking in terms of summer and fall feeding only.[231] The transformation of clean-tilled peat fields into sod-supporting land is regarded as a partial solution to the wind erosion and subsidence problems. The cover will hold the soil. Also pastures require a higher water table than row crops, and a higher water table retards the rate of peat oxidation.[232]

Swine

There may be 1,500 swine in the delta today, most of them in the south delta, raised by a handful of operators. No particular enthusiasm is shown by others.[233] As with other livestock, the swine population is much reduced from the situation of 80 years ago.

Tule swamps offered premium foraging areas for swine; the pigs ranged freely. They were numerous by the mid-1850's, but were so wild that many farmers had no idea how

---

231 Spurlock, Fleming, and Carlton interviews.

232 Carlton interview.

233 Brown, Spurlock, and Golden interviews.

many they owned.[234] Droves of feral swine were to be found throughout the unreclaimed tule swamps in the 1870's. They were hunted and trapped. Trapped mature stock were killed, but the young were domesticated.[235] Large numbers of the domesticated swine are known to have been raised on timothy, stubble, and on the volunteer growth of draining back-swamps.[236] It is surmised that the swine were Suffolks, Berkshires, and Chinese breeds or crosses.[237] Jersey and Staten Islands are identified as hog producing districts,[238] but it is probable that all settled areas were well stocked. The assumption is made because pork was a staple among Caucasians and Orientals, because the waste from dairy, orchard, and row crop operations made suitable feed for swine, and because they foraged so well in the tules. Continuing with assumptions, it is likely that the domesticated swine population declined as the Chinese disappeared and as dairying was given up. The future of feral swine was sealed as crop land was extended into the tules. Among the suspected, but undocumented, circumstances that reduced local interest in

---

[234]"Report of San Joaquin County Assessor," Annual Report of the Surveyor General of the State of California for 1855, p. 298.

[235]"Wild Hogs," SWI, March 31, 1877, p. 5; "Wild Boar Hunting in the Tules," SF Bulletin, Feb. 3, 1879, in BS, Set W 73, p. 40.

[236]"The Tules," SF Bulletin, April 13, 1877, in BS, Set W 18:2, p. 221.

[237]Sprague and Atwell, op. cit., p. 59.

[238]Leale, op. cit., p. 72.

swine were the floods. Frequently recurring inundations must have made fence maintenance costly. Fences that were not swept away soon dislodged and floated off.[239]

Horses

Horses were almost exclusively the draft animals used in delta farming. The traction engine drove them out of grain farming fairly early, but they were employed in numbers for row crop farming until the early 1930's, when they were replaced by the row crop tractor. The horses were slow; feed requirements subtracted land from cash crop production; and barn maintenance was costly.[240] A few barns survive; the very few horses seen now are maintained for recreation purposes.

An impression of the distribution pattern to livestock activities is given on the maps that show pasture land (see Map Plate N, pocket). Most of the areas so used lie in districts that are peripheral. Edaphic conditions in these areas are unfavorable to the culture of the more remunerative cash crops. Alkali, claypan, or dune soils are the disadvantages. Existing pastures, commonly of ladino clover and rye grass, may be irrigated; most of the peripheral salt grass acreage has not been so improved.

---

[239]By 1880 tule land fencing had been given up for the most part. "Fences for Tule Lands," PRP, April 17, 1880, pp. 248-49.

[240]Wilcox and Brown interviews.

Hunting

Wildfowl and game have been hunted or trapped on an intensive scale since the Rocky Mountain Men and Hudson's Bay Company brigades entered the delta. Sports and subsistence hunting was pursued by the Argonauts. The beginnings of commercial wildfowl hunting are obscure, although by the 1870's there were men who found their support in this occupation. The hunters shot prodigious numbers of birds,[241] the delta take moving chiefly to San Francisco. In late 1876 the birds were so plentiful that San Francisco Bay Area commercial hunters were sending 50 to 150 dozen birds to market per day. Mallards, canvasbacks, snipe, and geese were sold to the retailers for around $3 per dozen.[242]

The delta's western apex was considered the "cream" of shooting areas by sportsmen, although they also did well along the San Joaquin Old River. Sportsmen would take the train to Pittsburg, Antioch, or the San Joaquin bridge for a weekend outing; or they took steamboat passage to Rio

---

[241]One individual hunting in the swamps north of Stockton shot 613 mallards and 12 other fowl in a four-day hunt during December 1875. "Extensive Shooting," SWI, Jan. 8, 1876, p. 7. The shooting of 208 birds before ten in the morning on one day, and the killing of an average of over 100 for several days by one individual are reported for the Courtland vicinity in November 1878. "Rod and Gun," SF Chronicle, Nov. 10, 1878, in BS, Set W 73, p. 35. Another case is recorded where three men bagged 200 mallards and teals in two days at Union Island. "Good Hunting," SWI, Dec. 14, 1878, p. 5.

[242]"Duck Shooting," [newspaper unknown], Dec. 21, 1876, in BS, Set W 73, pp. 8-9.

Vista and landings farther north, where guides and boats were secured. Flatboat inns anchored in the tules afforded lodging.[243]

In the early 1900's the delta was drawing hunters by the hundreds.[244] It still does, but access to waterfowl shooting areas is hampered by the existence of posted private property. Realistic landowners have agreed with the California Department of Fish and Game to permit the seasonal establishment of cooperative pheasant hunting areas on Twitchell, Staten, and Ryer islands. Other owners control access to their islands without the aid of the state. State wardens and the shrinkage of flocks prevent hunters from obtaining the unlimited bags of 40 or more years ago.

---

[243] Ibid.; "Rod and Gun," SF Chronicle, Nov. 24, 1878, in BS, Set W 73, pp. 36-37.

[244] Oliver H. Fary, "Fields and Factories," Sunset, XXIV (May 1910), p. 590.

CHAPTER XIV

TRANSPORTATION AND TOWN DEVELOPMENT

Accessibility to markets is a factor which, along with the circumstance of good soil, plenty of water, and a favorable climate, contributed to the vigor of agricultural development in the delta. Farming advanced rapidly as markets became available for the high value crops which the delta produced.

Water Transportation

The crop emphasis and the nature of the market changed in the 70 years after 1850 but the rivers remained the chief transportation corridors until the delta had been linked with its principal markets by good hardtop roads and organized trucking services. Water carrier service was available to every farm. It was fast, cheap, and fairly reliable at all seasons; perishables and bulky cargoes were handled with convenience and success.

At first the transient river and land traffic brought much of the market to the delta or its vicinity, but by the latter 1850's enterprising farmers on the Sacramento were using their own schooners to freight produce to urban markets.[1]

By 1864 the fruit and vegetable trade from the Sacramento River districts was important enough to employ two sailing vessels on regularly scheduled freight runs to San Francisco. Each ship made two round-trips from the city each week, normally departing in the early afternoon and arriving at Hood after eight or nine hours. From this terminal the ships "beat down" the main stream to about the latitude of Rio Vista, discharging empty cases and baskets and loading cargoes at landings on both banks. The return to San Francisco was a steady "beat" for two nights and a day.[2]

In 1867 the prospering fruit farmers of the Sacramento delta engaged a steamboat, the _Reform_, to carry their produce. The 181-ton stern-wheeler eventually became the nucleus of the farmer-owned California Transportation Company, formed in 1875.[3] The steamboat offered two-day round-trip service, usually leaving San Francisco early in the morning. As paying cargo it carried passengers, most of whom were Chinese, rice, oil, tools and lumber, other supplies, and packing containers. The freighter loaded coal at Black Diamond Landing (near Pittsburg), as did most of the river

---

[1]Dana, _op. cit_., p. 162.

[2]Leale, _op. cit_., p. 36.

[3]_Ibid_., p. 65. Among the early investors the names of Runyon, Hollister, Barry, Kercheval, and Meyers are recalled by Leale.

boats of that day, and proceeded to Rio Vista and the Old River branch of the Sacramento. Passengers and cargo were deposited as the vessel zigzagged upstream from bank to bank to about Clarksburg. The downstream trip involved as many as 65 riverside calls before the uninterrupted leg to San Francisco could begin. At the landings the crew would load as many as 1,000 splint baskets of peaches. Usually lesser quantities of fruit, boxed tomatoes, sacked potatoes, and kegs of preserved melons were taken aboard. Fresh melons were thrown from man to man and stacked on the vessel, not without disaster. The loading of sheep was expedited by the trained lamb owned by a crew member.[4]

A number of independent and fleet-operated vessels also competed for the delta trade. They were unspectacular small stern-wheelers, barges, schooners, and launches, a drab lot in comparison to fast and well-appointed river monarchs which linked Sacramento and Stockton to San Francisco. (See Plate XVII, p. 364, which shows representative vessels of the late 1800's.) The packets called only at one or two landings in the delta; they provided first-class passenger and freight service to and from the major cities.[5]

The independent steamboat operators disappeared by the 1890's when the California Navigation and Improvement

---

[4]Ibid., pp. 46-48, 51; "The Fruit Trade of San Francisco," /source unknown/, in BS, Set W 19:1, p. 443.

[5]MacMullen's Paddle Wheel Days in California describes the through river traffic.

Company of the San Joaquin and the Southern Pacific Railway and California Transportation Company of the Sacramento came to dominate river traffic.[6] These carriers served hundreds of landings. Some of the larger facilities, elaborate timbered and roofed wharves, were regular calling places located at villages or in front of particularly large ranches. More rudimentary landings, made of brush dumped onto the riverbank, were flag stops. A white flag or lantern signaled Southern Pacific freighters to call and a red flag or lantern stopped the California Transportation Company steamers.[7]

After 1900 independent and small fleet operators gained a fresh start by introducing gasoline-powered motorscrew towboats and launches.[8] Their success as carriers was made possible by the increased agricultural activity and accelerated reclamation of the post-1900 period. Diesel-powered vessels were employed in the late 1920's,[9] only to share the decline of water freighting. The diesels are still in service, doing contract barge towing for the delta's sugar

---

[6]Vivian, The Commercial, Industrial, Agricultural, Transportation, and Other Interests of California, p. 222; Leale, op. cit., pp. 46-48; "Central California's Important Transportation Interests," Special Booster Edition of the Byron Times, not paginated; Russell et al., op. cit., p. 187; "Water Terminal and Transfer Facilities, Third San Francisco, Calif., District," Water Terminal and Transfer Facilities, U.S. 66th Cong., 2d Sess., H. Doc. 652 (1921), p. 2065.

[7]Macmullen, op. cit., pp. 90-91.

[8]A. E. Anderson, quoted in Control of Floods on the Mississippi and Sacramento Rivers, p. 165.

[9]"Island Transportation Company of Stockton," Sixth Special Booster Edition of the Byron Times, p. 125.

beet refineries, local grain elevators, and for the levee improvement projects of the Corps of Engineers (see Plate XX, p. 408). The towboats also move through the delta when taking barges of petroleum, rock, and grain to up-river points.

Generally, the charges for river carrier service in the delta have been reasonable. In 1877, Sacramento River fruit was carried to San Francisco for 8 to 15 cents per package; sacked grain was shipped for $1 per ton; sacked beans, onions, and potatoes cost $1.50 per ton; and watermelons were taken aboard for $2 per hundred melons. A minimum charge of $1.25 per call was common for many years, although in the 1920's the minimum calling charge was set at $2.50 for all but about two dozen major landings on the Sacramento. The state designated the latter as free landings.[10]

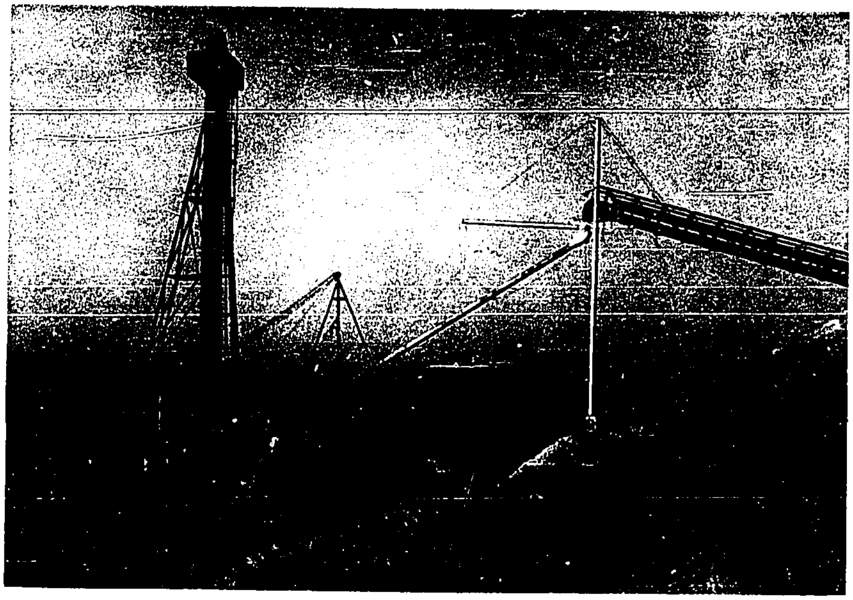
Between 1900 and the 1930's the motor-screw towboats and freighters competed favorably with the steam stern-wheelers in contract and scheduled freighting. Some large-scale farm operations owned their own barges and towboats, among them 47-foot towboats and 200-foot stern-wheelers. Barges ranged in capacity from 25 to 800 tons. None of the carriers drew more than 8 feet of water, loaded, and most could operate in 4 to 5.5 feet of water, light draft.[11]

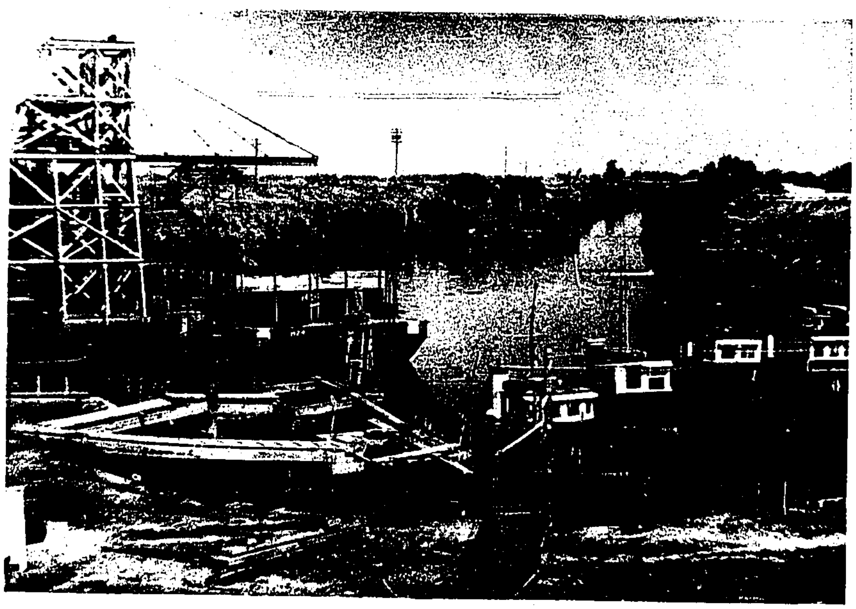
---

[10]"On the Sacramento River," <u>SF Call</u>, Oct. 27, 1877, in <u>BS</u>, Set W 3, p. 1065; Rand, <u>loc. cit.</u>; Macmullen, <u>op. cit.</u>, p. 92.

[11]Corcoran, "River Navigation in the Early Days," Commonwealth Club of Calif., <u>Transactions</u>, VII (Nov. 1913),

PLATE XX





Delta shipping

Towboats and barges still move some of the delta crops. Upper view shows grain barge being loaded at Staten Island. Lower view shows towboats and barges at sugar refinery dock north of Tracy.

A "mosquito fleet" of fast gasoline launches operated to the disadvantage of the larger steam carriers in both passenger and freight service. The commercial launches, particularly active in the San Joaquin Delta, were based at Stockton for the most part.[12] Other power boats were operated by crop buyers and farm families.[13]

Although powered vessels had dominated the delta traffic for years, freight schooners continued to operate until about the mid-1920's,[14] in the hay and grain traffic. Originally these vessels were sharp of bow and keel, but after the 1870's the shoaling nature of delta waterways induced builders to construct flat-bottomed square-ended scows[15] (see Plate XV, p. 345).

---

p. 585; "Victoria Island, a Gem of the Delta," Stockton Evening Mail, San Joaquin Valley Development Edition, p. 23; "Island Transportation Company, Stockton," loc. cit.; DWR Bull. No. 22, pp. 144, 322-24; Partial Report from the Chief of Engineers on Sacramento, San Joaquin, and Kern Rivers, . . ., U.S. 71st Cong., 3d Sess., H. Doc. 791 (1931), p. 54; Wright interview.

[12]The Colberg Motor Boat Service, Woodward Transportation Service, Island Transportation Company, and the Delta Transportation Company operated out of Stockton. "Colberg Motor Boats," "Woodward Transportation Company," "Island Transportation Company, Stockton," Sixth Special Booster Edition of the Byron Times, pp. 125-27.

[13]"Exhibits," Control of Floods on the Mississippi and Sacramento Rivers, p. 167; Heuer, "What the Government Has Done for California's Waterways," in "Internal Waterways," Commonwealth Club of Calif., Transactions, VIII (Nov. 1913), p. 556.

[14]DWR Bull No. 22, pp. 322-23.

[15]Tinkham, op. cit., p. 325; Leale, op. cit., pp. 33, 35; Corcoran, loc. cit.

A few floating general stores plied the river, stopping at the various landings to exchange merchandise for cash and produce. The floating traders returned to Sacramento or San Francisco to sell the produce, replenish inventories, and to pick up customer orders. As with all of the local traffic, the merchant boats functioned as errand and gossip carriers too.[16]

Water Transportation and the Railroads

The water carriers engaged in delta traffic were not as vulnerable to railroad competition as were the carriers that plied the rivers headward of the delta. The tidewater railroad competition with non-delta river traffic was first felt in the early 1870's as the lines were completed and as mining debris was fouling navigable channels.[17] The more reliable rail service drew the Central Valley's grain trade with San Francisco away from the riverboats. Nevertheless, in 1899 about one quarter of California's wheat crop still reached tidewater through the delta.[18] In the 1900's the direct water service between Stockton or Sacramento and San Francisco had survived despite keen rail competition.[19]

---

[16] Macmullen, _op. cit._, p. 88; Russell _et al._, _op. cit._, p. 191.

[17] DWR Bull. No. 26, p. 155.

[18] _Report of the Examining Commission on Rivers and Harbors . . ._, p. 147.

[19] _Reports on Preliminary Examination and Survey of San Joaquin River, . . ._, U.S. 65th Cong., 1st Sess., H. Doc. 332 (1917), p. 15.

Delta water carriers encountered no direct rail competition within the region before 1899, when the Atchison, Topeka and Santa Fe began to operate a main line west from Stockton;[20] even after 1900 the railroad operation was not injurious although carloading points were developed at Holt, Middle River, Orwood, Knightsen, and Antioch.

The railroad was a boon rather than a bane to the delta freight operators. The state and national markets which they opened up kept the delta freighters busy. Riverboats delivered produce from farm landings to carloading centers at Sacramento, Stockton, Antioch, Holt, and Middle River. When the asparagus trade developed during the first three decades of this century several railroad companies extended feeder lines into the delta.[21] In 1929 the Oakland, Antioch and Eastern Railway (Sacramento Northern) laid track from West Sacramento to Reclamation District 999 in the Yolo Basin; the spur was not accessible to riverboats. The Sacramento Southern Railway (Southern Pacific) extended a track southward from Sacramento to river landings at Freeport, Hood, Locke, Walnut Grove, Isleton, and Bouldin Island. The Western Pacific reached tidewater in the delta at Terminous by extending a line west from its mainline connection between Sacramento and Stockton.

---

[20]Hulaniski, _The History of Contra Costa County_, pp. 287, 290.

[21]_Control of Floods on the Mississippi and Sacramento Rivers_, p. 133; "Western Pacific Developments," _Twelfth Development Edition of the Byron Times_ (1930-31), p. 192; Gardiner interview.

All of the railroad feeder lines, except the Southern Pacific track between Isleton and Bouldin Island, remain in service. Most of the loadings are pears, early vegetables, and sugar beets.

Decline of Water Transportation

The mid-1920's were critical years for river carriers because oiled and paved roads, improved ferries and bridges, automobiles and trucks, and radio and telephone service were becoming general through the delta. Motor vehicles and improved roads reduced farmer and crop buyer dependence upon boats. Telephone and radio communications also reduced water carrier use; business information and transactions could be obtained directly from a ranch house or office. The employment of trucks for shipping crops from field to railhead or wholesale assembly point eliminated the cargo handling formerly required between field, levee, and shipboard. The trucks were quicker and more flexible cargo carriers.

Among the specific developments that transformed the delta into a road-conscious rather than river-conscious community was the oiling of roads, begun in the Isleton to Sacramento area in 1901;[22] the introduction of the Model "T" truck, particularly important after 1910;[23] the paving of a road westward from Stockton to Holt in 1915, and its

---

22"Asparagus Festival Will Lure 50,000 to Isleton," Sacramento Union, May 16, 1937, in BLS, No. 21, p. 17.

23Wright interview.

extension across the delta in 1924;[24] the construction of a concrete highway from Sacramento to Rio Vista in 1925;[25] and the installation of an automobile ferry, in 1920, and a bridge, in 1925, across the lower San Joaquin River just east of Antioch.[26] The linking of the Sacramento islands with the mainland to the west and south and the spanning of the San Joaquin delta by a road had important results. The period 1920 to 1926 is recalled as a time of rapid change-over to truck transportation from river freighting.[27]

With the exception of Decker Island, which lies in the Sacramento channel to the north of Sherman Island, all productive parts of the delta are accessible to motor vehicles. The islands are reached over numerous drawbridges (see Plate XXI, p. 414), a pontoon bridge, or by one of 17 small cable-guided ferries that may be county, state, or privately operated. The gasoline-powered ferries are propelled from bank to bank by an engine, housed on the scow, which draws the cable around a rotating wheel (see Plate XXI, p. 414).

The roads vary from first-class state and county asphalt highways to rutted county and private washboard lanes. Most roads, good and bad, are on the crown of the artificial levees. Although they are narrow, and have little

---

[24] San Joaquin County Board of Supervisors, loc. cit.

[25] "Rio Vista," The Eden of California--1925 Biennial Deluxe Edition, River News (Rio Vista), p. 29.

[26] "A Ferry Brings a Bridge," The Golden Link, not paginated.

[27] Brown, Wright, and Johnson interviews.

PLATE XXI

Draw bridges and ferries link the islands and mainland tracts

Upper scene is at Walnut Grove, on the Sacramento. Main streets front on the levee road at right and left. Lower scene shows ferry which serves Ryer (foreground) and Grand islands.

shoulder, they afford good views of the flanking crop land and channels. Wherever the levee is left for a cross-island road a sharp grade is encountered. While the levee roads tend to be fairly uniform in elevation, there are noticeable swells in many of the cross-island roads. Even the well-engineered State Highway 12 from Rio Vista to Lodi reveals undulations produced by differing rates of oxidation in underlying peat materials.

Occasionally the highway from Rio Vista to Lodi, the Borden Highway from Stockton westward (State Route 4), and the picturesque river road from Antioch to Sacramento (State Route 24) are heavily traveled. Usually, however, delta roads do not have much traffic. Time-conscious drivers prefer to take the straighter and wider federal highways which skirt the delta, following the route of roads created when the delta was a swamp.

Towns and Other Communities

Hamlets or towns rose at a number of landings in the delta vicinity to serve non-delta farming areas and delta settlers. Mokelumne City, at the head of practical navigation on the Mokelumne River; Maine Prairie, at the head of navigation on Cache Slough; Freeport, where the Sacramento nears the elevated valley plains; Brack's Landing, terminus on the South Fork of the Mokelumne for the short-lived San Joaquin and Sierra Nevada Railway; and French Camp primarily serve non-delta farmers. Stockton, Antioch, and Rio Vista also performed freight transfer and trading functions for non-delta hinterlands, although they catered to delta residents as well. The essentially delta-oriented trading and shipping centers include Walnut Grove, Courtland, Isleton, Clarksburg; the less important Holt, west of Stockton, Ryde, Locke, and Vorden, in the vicinity of Walnut Grove; and a host of other places such as Emmaton on Sherman Island, Venice on Venice Island, and Hagginsville on Staten Island, which no longer exist.

Since almost any spot along the delta waterways was a potential landing place, the landing that prospered and grew had to perform other functions beside serving as a delivery point for produce. Stores, small craftsmen's shops, a lumber yard, warehouses, a meeting hall, a tavern, and express and post offices were the types of establishments that attracted the farm community. Frequently the improvements were built by wealthier landowners who were offering service to both settlers and tenants.

Subsidized or free-growing, the hamlets usually had an improved landing or wharf. The buildings faced it and the river across an artificial levee which served as the main street. The edifices were customarily raised on piles or mounds. Usually they were of frame construction, although a few brick buildings appeared in the more substantial towns.

Repeated floods and competition from better located sites ended the existence of a number of hamlets. Some of the shipping points that served non-delta areas succumbed to the railroad. All of the communities were hampered by the river-oriented settlement pattern. Farmers and land developers were within comparatively easy sailing reach of the larger cities of Central California, and there were numerous riverboats which performed such town functions as freight, passenger, and news collection and distribution.

Mokelumne City

Mokelumne City, Brazos del Rio (Rio Vista), and Emmaton are the best-known towns which succumbed to floods. The first place, situated on the Mokelumne left bank just upstream from the Cosumnes mouth, was founded in 1856. By 1862 the lumber and shipyard nucleus had attracted three stores, two hotels, a saloon, blacksmith shop, and several residences. The whole town was washed away that year.[28] Woodbridge and Lockeford, founded in 1859 and 1862, respectively, were towns farther upstream on the Mokelumne which replaced Mokelumne City. Lockeford enthusiasts, desirous of strengthening their town's economic position, subscribed a $40,000 Mokelumne River improvement project in 1868. A company was incorporated to clear the river of snags and other impediments to making Lockeford head of navigation. The project failed.[29]

---

[28]Bancroft, History of California, VI, 513; An Illustrated History of San Joaquin County, pp. 221-22; Cosby, "Notes," p. 15, SDI, Jan. 17, 1862, p. 3.

[29]Tinkham, op. cit., p. 17.

New Hope

New Hope was founded immediately to the southwest of the Mokelumne City site. This town, now Thornton, was linked by road to New Hope Landing, situated opposite the head of Staten Island. The landing had sporadic steamboat connections with the Stockton-San Francisco packets which were met at a landing on the Webb Tract.[30] A more reliable service was available at Walnut Grove, a mile or two northwest of New Hope Landing. New Hope also lay on the "lower road"[31] between Stockton and Sacramento. This crossroads location creates the main function of the present village of Thornton. There are one or two stores and garages among the cluster of houses. Today New Hope Landing is a camping ground for sports fishermen and transient farm labor.

Rio Vista

Brazos del Rio was surveyed in 1857 about one mile south of the mouth of Cache Slough. This first Rio Vista, also known as Brazoria, contained a cluster of residential and commercial buildings, a wharf, and a post office. The latter was a major asset to the village as not another office lay within 20 miles.[32] In 1858 the town gained the additional

---

[30]Correspondence of SF Chronicle, June 15, 1879, and "Fertile Fields," SF Post, June 16, 1879, in BS, Set W 18:2, p. 348; "Running on the Mokelumne," SWI, Nov. 9, 1878, p. 7; "Up the Mokelumne," SWI, Nov. 30, 1878, p. 7.

[31]As opposed to the present U.S. Highway 50-99, the "higher road."

[32]SF Bulletin, Dec. 20, 1878, in BS, Set W 5, p. 1876.

advantage of daily steamer service with San Francisco and Sacramento.[33] For years it was the only port of call in the delta regularly visited by the river packets. Local merchants and residents benefited from the transient trade which had to funnel through the landing to and from lower river points. The bustling town, renamed Rio Vista in 1860, was swept away by high water and waves during the mid-winter of 1861/62.[34]

The second Rio Vista was platted in early 1862 at its present location on high ground that lies slightly downstream from the first site. In 1868 it had a population of 200 and in 1878 some 1,500 people lived within a 10-mile radius. It was the only town of importance in the delta. There were a post and telegraph office and a variety of retail and tradesman shops. The mainstay of its trade was the local tule farmers and grain and stock ranchers of the Montezuma Hills and valley plains. Residents of the delta islands either traded with the riverboats in their neighborhood or would "go down the bay" to San Francisco. Fares were low and the service good; two or three Sacramento River packets sailed regular daily schedules in either direction.[35]

Rio Vista's role as a delta emporium was enhanced in 1904 when a locally financed $60,000 cannery was opened to

---

[33]Russell _et al._, _op. cit._, p. 190.

[34]"A Trip to Sacramento and Back," _SF Bulletin_, Jan. [?], 1862, in _BS_, Set W 3, p. 1010.

[35]Cronise, _op. cit._, p. 308; _SF Bulletin_, Dec. 30, 1878, in _BS_, Set W 5, p. 1960.

pack pears, peaches, tomatoes, and beans.[36] By this time ferry service was available to Grand and Brannan islands. The town was reached by bridge from Brannan Island after 1918.[37] Since then it has maintained its position as a trading center for residents of the lower delta. It is a growing town of 2,500 people, most of whom are supported directly or indirectly by agriculture. The town has a farm equipment manufacturing plant, a packing house, and is a dredge depot. Its growth is partially supported by activity in the adjacent 20-year-old natural gas field, by a bustling sports fishermen trade, and, to a lesser degree, by the operation of a "mothball" ship storage depot.[38]

In plan and location Rio Vista is not a true delta town. It spreads unrestrained over an area of rolling land that, in large part, overlooks the river. The business district is similar to those of many other small California towns in that the buildings are likely to be roomy stucco or brick edifices fronting on wide, straight, well-paved streets. The new residential tracts west and north of town are spacious.

Emmaton

Emmaton, like the first Rio Vista and Mokelumne City, was all but destroyed by flood. The site is located on the

---

[36]"New Cannery," PRP, July 9, 1904, p. 23.

[37]Interview, Frank Viera, Ida Island, July 23, 1955.

[38]Personal observation and communication of John R. Aye, Rio Vista, May 20, 1957.

Sacramento about six miles south of Rio Vista and nearly two and a half miles downstream from the northern end of Sherman Island.

The town was founded in 1871, by J. M. Upham, a land proprietor. Upham constructed a wharf, hotel, store, lumber yard, and two grain and hay warehouses. Daily riverboat service, an express and post office, a saloon, and a blacksmith shop were the conveniences which the town offered,[39] until destroyed in the winter of 1878. Efforts at recovery did not succeed; nevertheless, the site has been occupied by farmhouses, labor camps, or packing sheds since.

Onisbo, Hagginsville, and Venice

Among the landings which have disappeared as focal points for trading because of inadequate population or competition of better situated places are Onisbo, Hagginsville, and Venice. Onisbo, situated opposite the head of Steamboat Slough, had a post office in 1853 and a school and Masonic Hall in 1860. But the rise of nearby Courtland and Walnut Grove overshadowed Onisbo, whose position was further weakened in 1867 when the post office was transferred to Courtland.[40] Hagginsville, a Staten Island hamlet on the North Fork of the Mokelumne, consisted of store, hotel, and post

---

[39]"Crops on Sherman Island," SF Bulletin, May 21, 1871, in BS, Set W 18:1, p. 147; Hoag, loc. cit., p. 344; letter to ed., PRP, Feb. 11, 1878, in BLS, No. 21, p. 273.

[40]History of Sacramento County, p. 220.

office in 1879.[41] With Walnut Grove only about five miles away, and very sparsely populated immediate environs, the place could not survive.

Venice was a speculation, the "merits" of which few people appreciated when it was launched in the late 1860's. Some enterprising individuals anticipated that the silt-plagued Stockton harbor would eventually be sealed as the outlet for San Joaquin Valley wheat. They attempted to promote establishment of a deep-water port on the San Joaquin side of Venice Island and extension of a railroad spur from the mainland but with no success. By 1871 only a house stood at Venice landing.[42]

Maine Prairie, Moore's
Landing, and Banta

Competition from the railroads sapped the trade of several villages that were dependent upon valley plains trade. One of the oldest and most vigorous of these places was Maine Prairie, founded in 1859 at the head of navigation on Cache Slough. For a decade large tonnages of wheat were hauled to the landing from adjacent farming areas of Solano and Yolo counties. The traffic reportedly rivaled that of Stockton. After 1868, Dixon and Elmira, towns on the

---

41"Hagginsville and Staten Island," SF Bulletin, Nov. 28, 1879, in BS, Set W 4, p. 1510.

42"Communication with the San Joaquin Valley--the City of Venice, etc.," letter to ed., SF Alta, Aug. 27, 1866, in BS, Set W 4, p. 1452; Tide Land Reclamation Co. (1872), op. cit., p. 30.

Sacramento to Benicia railroad, outgrew Maine Prairie. Over the following 10 years homesteaders gradually left the Maine Prairie area, and the vicinity became the sheep range that it is today. Maine Prairie was almost a "ghost town" by 1879.[43] A similar cycle of development characterized Moore's Landing, a San Joaquin Old River shipping point which was flourishing in 1868. Grain trade from the Livermore Valley supported a hotel, smithy, lumber yard, store, and saloon for a year or so before the neighboring railroad siding at Bethany came into existence.[44] About 10 miles east of Moore's Landing was the older but smaller hamlet of Banta which retained its name after being literally moved to a railroad siding.[45]

Freeport and Brack's Landing

Freeport and Brack's Landing were unique in that both were founded and briefly operated as tidewater railroad terminals. Freeport, base for the Freeport Railroad Company, was surveyed in 1863. Some 300 to 400 people resided in the town. It was hoped that free docking facilities, deep water, and the railroad would divert Folsom and Virginia City traffic from Sacramento to Freeport, but the scheme was a clear failure in 1864. The town declined to a ferry point which in the 1890's had one combination store, post and express

---

[43]Cosby, Soil Survey of the Sacramento-San Joaquin Delta Area, p. 7; SF Bulletin, May 23, 1879, in BS, Set 18:1, p. 197.

[44]Leale, op. cit., pp. 54, 56.

[45]An Illustrated History of San Joaquin County, p. 220.

office.[46] The ferry has been supplanted by a bridge but the town has not been much altered. One or two stores, perhaps two dozen residences, a sports fishermen dock, and a railroad beet-loading dump are strung along its single street. Nevertheless, it is not the forgotten place that Brack's Landing is. There the wharf and other facilities of the narrow-gauge San Joaquin and Sierra Nevada Railway were abandoned almost as soon as they were completed in 1884-85.[47]

Antioch and Stockton

The surviving delta fringe communities which are both delta- and non-delta-oriented economically are Antioch and Stockton. Antioch was a quiet farming village until the late 1860's when the pace of growth was hastened by an influx of grain farmers and by the discovery of coal in the Diablo Range. Although New York Landing (Pittsburg) became the main coal-loading port for river steamers, Antioch grew as a trading center for delta hay cutters and gardeners and for the grain farmers who obtained government and railroad land to the south and east.[48] Salmon canning and asparagus and

---

[46]"Letter from Sacramento," anon., Oct. 2, 1863, in BS, Set W 3, p. 1024; "The Freeport Failure," ed., Sacramento Record-Union, Sept. 26, 1864, in BS, Set W 3, p. 1035; Sprague and Atwell, op. cit., p. 47; History of Sacramento County, p. 219; Sacramento County and Its Resources, pp. 48, 190.

[47]"San Joaquin and Sierra Nevada Railway," SWI, Feb. 28, 1885, in BS, Set 18:1, p. 199.

[48]Munro-Fraser, op. cit., pp. 484-85; "Editorial Note," Oakland Evening Transcript, June 19, 1869, in BS, Set W 18:1, p. 124; anon., Oct. 1, 1868, in BS, Set W 4, pp. 1466-67.

celery packing and shipping were the activities of this town which drew upon the delta for raw materials. The development of fish canning, now defunct, was post-1880; and produce packing and shipping were largely a post-1900 development.

Stockton's first commercial importance was as a mine supply center. The mining industry and the expansion of agriculture in the vicinity and in the San Joaquin Valley nourished commerce and manufacturing. The valley became particularly important to Stockton after the wheat boom began in the late 1860's. The port was an export loading point for the grain brought in from the south by railroads and river barges. Wagon-making, shipbuilding, milling, and tanning were important manufacturing activities by the 1850's. The manufacture of steam engines, foundry products, farm implements, and dredges developed as the San Joaquin Valley and delta agriculture expanded.[49] In the early 1900's tracked tractors were developed at Stockton. They, the dredges, and boats were designed primarily for delta use. The packing industry, that keeps Stockton among the foremost vegetable processing centers of California, developed about 50 years ago. Then, as now, farm operators and laborers engaged in delta work resided in Stockton; the proportion of delta workers who live in the city has increased since the 1920's, when improved roads and motor vehicles became common. A shift to day labor employment from sharecropping by Oriental tenants was involved as well.

---

[49]Tinkham, op. cit., pp. 311, 322, 323, 182-83; Cronise, op. cit., p. 318.

Walnut Grove

The true delta towns are Walnut Grove, Courtland, Isleton, and Clarksburg. They lie within the delta and it is delta economic activity which supports them.

The community of Walnut Grove began to take form in 1857.[50] It possessed an exceptionally advantageous location on existing communication routes. Here Tyler and Georgianna sloughs made junction with the Old River channel of the Sacramento. The sloughs afforded direct access to the Mokelumne and the most direct waterway to the San Joaquin from Sacramento. The heads and drier parts of Staten, Tyler, and Andrus islands were grouped opposite the townsite; Grand Island lay across the river. Like the levees which extended north between Walnut Grove and Courtland, the natural and artificial levees which enclosed these islands supported trails. These and the water courses met at Walnut Grove.

At first Walnut Grove's location with reference to lines of communication was important primarily for local travel. The through steamboat traffic did not follow Old River until the 1870's, and the Stockton to Sacramento traffic by way of Georgianna Slough may not have amounted to more than the thrice weekly round trip of a small steamer that operated in 1858.[51] For these reasons, Walnut Grove grew slowly in its first decade or two.

---

[50] History of Sacramento County, p. 221.

[51] An Illustrated History of San Joaquin County, p. 117.

In the late 1870's the hamlet developed some vigor. It boasted such permanent improvements as a hotel, schoolhouse, meeting hall, and covered wharf and warehouses. It functioned as a shipping point for the immediate parts of Tyler and Andrus islands and, probably, for the less frequently served New Hope landing district at the forks of the Mokelumne. For a while plans were afoot to improve Walnut Grove's crossroad function by clearing Georgianna Slough so that it might serve as a regular river route to Antioch and the San Joaquin Delta. Also, the slough clearing was expected to facilitate the rafting of logs from the Mokelumne to a mill and fruit box factory which operated at the town between 1876 and 1878.[52] These plans and expectations failed to materialize.

A stage service between Walnut Grove and Sacramento was in operation as early as the winter of 1877/78.[53] Ferry service to Grand and Andrus islands became well established by the 1890's.[54] Another ferry linked Tyler and Staten islands; and by 1901 bridges were installed over Georgianna Slough at Walnut Grove and over the Mokelumne to the north of New Hope. These bridges and ferries funneled stage and wagon traffic through the town. Some movement to Sacramento

---

[52]"Up the Sacramento," SF Call, Oct. 10, 1877, in BS, Set W 3, p. 1064; History of Sacramento County, loc. cit.

[53]"Crop Reports," SF Call, April 11, 1878, in BS, Set W 18:2, p. 264.

[54]Sacramento County and Its Resources, p. 50.

occurred on the levee road from Walnut Grove but the preferred route was by way of Tyler and Staten islands and the "lower Sacramento road" that led northward from New Hope (Thornton).[55] The crossroads function has outlasted the river landing role of the town.

Although the original town was strung along the levee to the east of the river, the modern Walnut Grove lies on both sides of the Sacramento. A bridge joins the halves. Over the past 25 years an attractive residential section, the more pretentious part of it being called "asparagus row," has been built to the west of the river. Commercial houses face the bridge and levee-top road. The residences lie behind and below this levee road. A more extensive development of business houses, a hotel, bank, and theatre front upon the levee-top main street on the east side of the river. Behind and below these structures lie a cramped "Chinatown," various commercial houses, warehouses, packing sheds, and a railroad siding.

Courtland

Courtland, located at the lower end of Randall Island, owed its early prestige to the existence of a post office which opened in 1867. The office was moved thither from Onisbo, the hamlet situated opposite the head of Steamboat Slough. Wharves, a hotel, and stores formed the commercial nucleus of the town which in its northeastern sector included

---

[55]W. F. Davis, loc. cit., p. 338.

a large shanty area. Fire swept away this "Chinatown" in December 1879 and again in 1930. After the second disaster landowner refusal to grant leases discouraged the Orientals from returning to Courtland;[56] Locke, Walnut Grove, and Isleton gained many of the displaced.

Courtland's later wealth was based upon the prosperous fruit raising industry and general farming of the Pierson District, Grand, Sutter, and Randall islands. After 1900 the asparagus boom added to the town's growth. Most of the growth has been residential; Courtland has a modest business and no industrial development. The locality's modern packing houses for fruit or asparagus were erected at Hood, on Randall Island, or at Vorden, and Locke. Courtland property owners have been successful in preserving a residential community.

Isleton

Isleton was founded in 1874 on the bank of the Sacramento where Brannan and Andrus islands meet. A wharf, built in the following year, afforded the most convenient access to regular water carrier service that was available to farmers on the interior of the two islands. By 1880, the hinterland supported two stores, a hotel, and stable, although expectations of greater growth had been held in 1876 when the

---

[56]History of Sacramento County, p. 220; "Courtland Once Scene of Vast Chinatown Razed by 1879 Fire," Sacramento Union, March 14, 1937, in BLS, No. 21, pp. 5-6.

locally financed California Sugar Manufacturing Company was formed; its life was brief, however.[57] Fifteen years later Isleton was little larger.[58]

The town's brightest growth period began around 1900 when asparagus canneries were established on Bouldin, Andrus, and Grand islands. Three large canneries also operated within the town in the 1920's and 1930's. The packing house and agricultural labor supported a three-block-long business section which lay along and just inside the Sacramento levee. The older, southern part of town retains the residences and modest trading areas that catered to the white community. To the north was a "Chinatown." Its two-story box-like frame buildings have been developing a "Mexican" aspect since the 1940's. The surviving, but inoperative canneries lie adjacent to "Chinatown" and along the river. Numerous small company-owned cabins occupy the cannery grounds. The cabins, canneries, and edifices of "Chinatown"'s streets and alleys have deteriorated; but the more spacious white residential area to the south and west of the main street reveals better care and recent growth. About a mile and a half north of Isleton, flanking a road that bisects Andrus Island, is a new residential district of modest bungalows. As in other delta towns, the white housing areas are occupied by ranch operators, ranch employees, packing plant or trucking firm

---

[57] History of Sacramento County, p. 221.

[58] Sacramento County and Its Resources, pp. 50, 192.

salaried personnel, the merchant class, and the occasional individual who chooses to live near good fishing.

Clarksburg

Clarksburg was a river landing which did not become a community of any consequence until after 1916, when the Holland Land Company took over the development of Reclamation District 999, the Holland District. The company sold or rented farms in pieces of 20 acres or more. By 1920 some 80 units, aggregating 15,000 acres, were sold for a total of over $4,250,000. Purchasers were screened for agricultural capabilities and civic interest before being sold any land. They were to have a model town, Clarksburg, in which to live, trade, and center their social life. Crops were shipped by water from the town landing or from the banks of dredger cuts made in the process of constructing Yolo Basin levees. A ferry, later a bridge, to Freeport made it possible to haul or drive to Sacramento. The Oakland, Antioch and Eastern Railway, which approached the northern end of the district, afforded rail service for crop shipping. In the early 1920's the American Crystal Sugar Company constructed a beet sugar refinery to the north of town.[59] Its operation contributes to the prosperous and stable appearance which marks this residential community.

---

[59]Russell _et al._, _op. cit._, pp. 152, 217; "Holland Land Company's 20,000 Acre Garden Spot," _Sacramento Union, 1920 California State Fair Annual_, p. 42 (advertisement); "Holland Land Company," _Sixth Special Booster Edition of the Byron Times_, p. 116.

Ranch Communities

Viewed for several decades after 1870 the average riverside scene along the Sacramento and on the San Joaquin north to about the latitude of Stockton included a thinly wooded, often farmed, natural levee face. Surmounting the natural levee was an artificial embankment that served as roadbed and flood defense; behind it, on mounds or piling, stood houses and barns. Fruit or vegetable sheds and brush landings or small wharves also marked the homesteads. Squalid waterside "Chinatowns" were scattered along some levees every hundred yards or so; and there was the occasional village with commercial houses and wharf, and a few isolated school or church buildings.

Farm buildings varied from modest thatched sheds to striking frame mansions. The more elaborate homes were surrounded by cluttered gardens of shrubs, palms, magnolias, citrus, and pepper trees. Eucalyptus, sycamore, and walnuts were common about the houses too. The Sacramento in particular offered an interesting trip for the riverboat passenger. Houses, shanty towns, fields, and pastures were easily seen from the steamboats.[60]

The alluvial lands along the Sacramento, in the New Hope District, Reclamation District 17, and on Roberts and

---

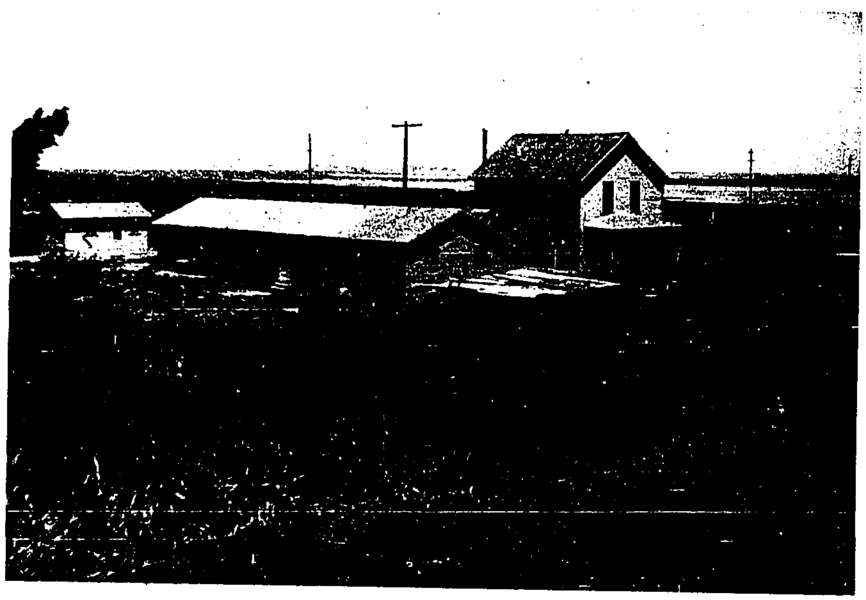
[60]Hutchings, Scenes of Wonder and Curiosity in California, p. 281; Browne, loc. cit., p. 402; Cone, op. cit., p. 136; SF Call, n.d., in BLS, No. 21, p. 276; Sacramento County and Its Resources, p. 43; Nordhoff, op. cit., p. 130; "Miles of Orchard," PRP, April 19, 1886, p. 348.

Union islands, are the principal areas where ranch homesteads of the smaller owner-operators are seen today. The cluster of buildings usually includes a residence, garage and sheds, and sometimes a barn. Some of the older mansions and rectangular two-story houses and gardens remain. The bungalow is the more characteristic modern residence. Barnyard fowl and stock are absent; gardens and small home orchards are fairly common. A few farms have small-boat landings; usually, however, delta agriculturalists are not particularly devoted to fishing or boating. Earlier generations lived with the river by choice; the water and traffic were always in view. Today's farm homes lie so far below the levees that the river is not part of the view; and outer levee faces are so steep and high that it is not easy to reach the water.

Larger private farms or corporate properties may have bunkhouses, labor camps for single men, or family-cottage camps (see Plate XXII, p. 434). The bunkhouses and camps were an essential adjunct of delta farming at least as early as the 1870's. The basic unit consisted of a two-story frame bunkhouse for 15 to 30 men, and sheds, stables, or a barn. For intensively farmed crops the ratio of basic camp unit to land was about one to 250 or 300 acres, in the case of potatoes, and one for 100 to 200 acres of asparagus.[61] Headquarters camps generally included a smithy shop, later garage and machine shop, and storage buildings; sometimes

[61] Upham, Gardiner, and Brown interviews.

PLATE XXII



Modern labor camps

Upper photo shows bunkhouses just inside of Egbert Tract levee. Lower photo shows a Sherman Island camp which, from left to right, consists of wash room, bunkhouse, cook house, poultry shed. Contrast weed control in the two photographs.

there was a grain and bean cleaner, barley mill, and, in one case (Jersey Island), a hotel.[62] For at least 20 years a small company town has existed on Liberty Island. Many vacant camps are seen today; the current practice appears to be to have several full-time employees in residence, or to subdivide tracts into tenant farms.

Resort Communities

A phenomenon that has developed over the past quarter century is the cabin or cottage settlement of fishermen and boating enthusiasts, retired or working. The most elaborate of these communities rings the southern half of Bethel Tract, in the west central part of the delta. The cabins are perched on or inside the artificial levee. Gardens may occupy the interior portion of the small lots; a small boat dock lies on the riverside of the levee (see Map 22, p. 436). The southern end of Andrus Island has a similar but smaller and less commercialized strip of houses just inside the levee. Ida Island, a large, unleveed, wooded bar about two miles west of Isleton, has a cluster of long-term leased cottages and a campground for transient fishermen. A similar appendage to Ryer Island in Steamboat Slough is used in the same way. There are similar communities across Old River from the southwest corner of Union Island (see Plate XXIII, p. 437) and in the wooded San Joaquin bottomland a mile or

---

62"Picturesque Jersey Island," Sixth Special Booster Edition of the Byron Times, p. 117.

Map 22

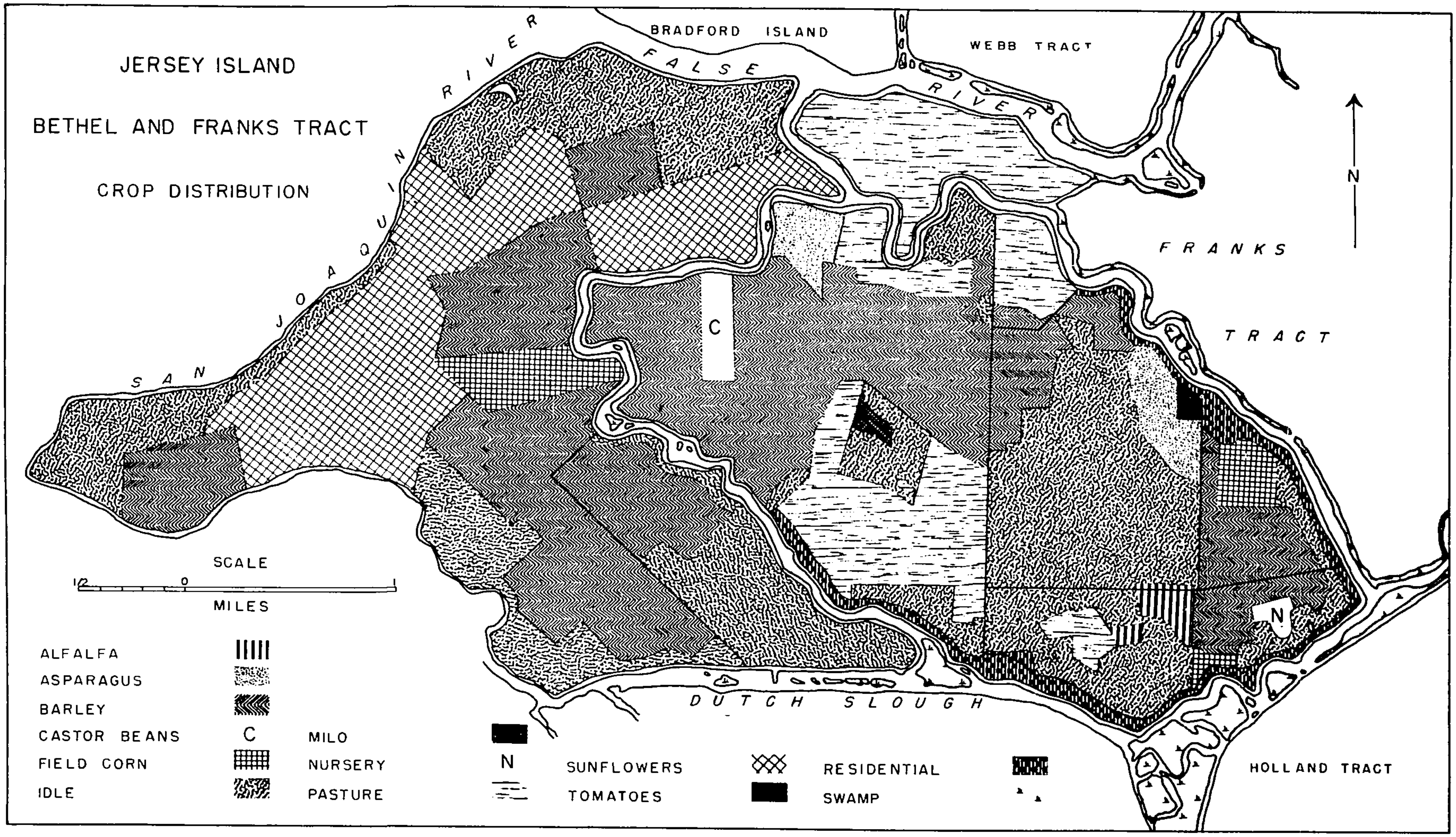

JERSEY ISLAND
BETHEL AND FRANKS TRACT
CROP DISTRIBUTION
SAN JOAQUIN RIVER
FALSE RIVER
BRADFORD ISLAND
WEBB TRACT
FRANKS TRACT
DUTCH SLOUGH
HOLLAND TRACT
N
C
N
SCALE
1/2
0
1
MILES
ALFALFA
ASPARAGUS
BARLEY
CASTOR BEANS
C
FIELD CORN
IDLE
MILO
NURSERY
N
PASTURE
SUNFLOWERS
TOMATOES
RESIDENTIAL
SWAMP

PLATE XXIII

Resort communities

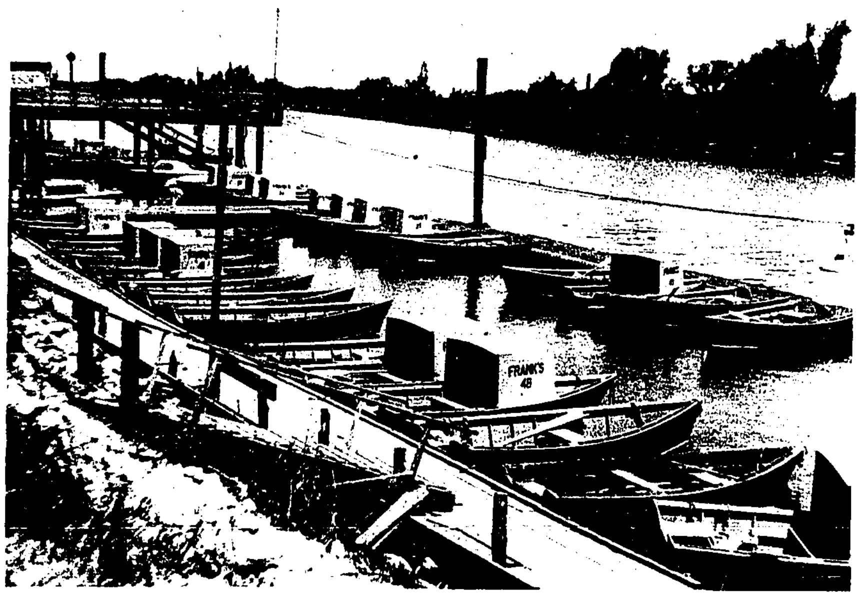
A representative sportsman community, on the mainland southwest of Union Island, appears in upper view. Lower view is of house boats on Whiskey Slough, Roberts Island.

more to the south of Highway 50. Related to these assemblages of cottages and cabins in function is a small group of houseboats which occupies the head of Whiskey Slough, between Roberts Island and the Lower Jones Tract (see Plate XXIII, p. 437). The upper part of Steamboat Slough and the Sacramento bank of Sutter Island afford shaded deep-water anchorages for pleasure cabin craft, some of which appear to be permanent summertime fixtures.

There are several camps along the Sacramento for sports fishermen, vacationers, or transient laborers. About 70 boat liveries scattered through the delta rent boats or outboard motors to fishermen but offer no camping or residential facilities. These boat livery establishments usually consist of a frame structure or two, floating docks, a gasoline pump, and a fleet of rowboats. Some of them also lease mooring space to pleasure-boat owners (see Plate XXIV, p. 439). In this respect they compete with the yacht clubs at Stockton, Antioch, and on the north side of the Bethel Tract.

With the exception of Rio Vista and Stockton, none of the towns closely affiliated with the delta has done much to publicize or foster the recreation possibilities of the region. There are a handful of motels within the region, and they barely offer the norm of convenience and comfort which a large segment of California vacationers is accustomed to. State property along the Sacramento dredge spoil areas and river berms has been used by campers for years but none of

PLATE XXIV



Boat liveries

Upper photo shows boat liveries at Terminous, southeast of Staten Island. Lower photo is adjacent the submerged Franks Tract (right). The rowboat hoods are designed for wind protection primarily.

the made land has been improved for recreational purposes (see Plate XXV, p. 441).

PLATE XXV

Unimproved campsite

In 1907 the Brannan Island levee was overtopped and breached at this point, opposite Cache Slough mouth. The campground occupies area where original levee lay. Rio Vista is in the distance (southwest).

CONCLUSIONS

The Sacramento-San Joaquin Delta is a region in which complex continuing processes of change have transformed a floodplain tidal swamp into an intensively developed agricultural landscape. The elements of the physical environment such as elevation, land forms, hydrography, underground drainage, soils, vegetal cover, and fauna have been altered to such an extent by human activity that care must be exercised in attempting to visualize the pre-reclamation landscape from what is seen in the field today. Natural processes of landscape alteration may be recognized as alluviation, wind and water erosion, soil weathering, and subsidence, but the expression of these processes in the delta is largely as a by-product of cultural activity. The chief cultural activities that have shaped the present landscape were the production of mine tailings, alteration of channels, land drainage and clearing, land burning, land planing and cultivation, levee construction and maintenance, and flood control and irrigation measures.

Through the past century of change the delta has been identified by an agricultural landscape that is quite distinct from that of surrounding segments of the Central Valley. The differences were not so strongly pronounced when stock raising and wheat farming were the dominant land uses as they were to be after the delta's intensive row crop and orchard activities were transformed from garden-scale to field-scale operations. Delta land use is intensive; most of the peripheral areas support stock and winter grain operations. It seems reasonable to assume that the contrasts in land use will continue to be obvious for some years to come.

Preservation of the delta is part of state and federal land and water development programs for California.. For the immediate future it appears that the delta will continue in its present agricultural and recreational functions. Urban industrial and residential growth is expanding rapidly in central California, but a number of factors suggest to this writer that the growth will not spill into the delta for some years. The advisability of permitting such growth in the delta may be questioned.

Industrial construction in the delta may seem attractive because of flat land, water supply, and access to water and rail communications; improved highways can be built. However, it would seem that the existing tidewater sites on firm land to the west of the delta offer more suitable areas for industrial growth; highway and rail developments south of Suisun Bay are superior to delta facilities and can be extended with fewer technical problems than are presented by peat and numerous channels. North of the bay the communications network is relatively undeveloped; but road and rail construction would be on firm land; and the lack of fresh water may be overcome by the contemplated north bay aqueduct. These firm lands west of the delta have no flood problem; the construction of shipping facilities would involve less difficulty on a tidal bay than on a narrow and stoutly leveed floodway-navigation channel.

For the present, delta landowners appear to be opposed to industrial and residential subdivision development. Residential subdividing seems less suitable than on the valley plains. Besides floods, high water tables, and subsidence, the extension of urbanization into the delta is prejudiced by the communications problem, the peat fire hazard, and the existence of miles of exposed water surfaces to tempt children. Flood disasters are less costly on farm land and recovery quicker.

It is appropriate that cheaply irrigated, superior farming land such as the delta boasts should be kept in such use, and urban developments be restricted to the marginally productive land of the delta periphery. Moreover, the retention of recreational facilities in close proximity to the rapidly growing San Francisco Bay Area is essential. The delta channels offer a recreation resource for future development. Owners of farm land could benefit by leasing property for recreational development along the crown, backslope, and inner toes of artificial levees. On many tracts these areas support little more than a road and weeds, yet they could be broadened to assure long-term protection for the farmer, plus surfaces whereon controlled construction of summer residences could take place. Small boat landings may be placed on the outer levee face. The resulting loss of farm land to residential use would be relatively small. The income from property so leased could materially ease the burden of levee and drainage maintenance which the crop land must now support; and land leasing would not upset landowner control of the reclamation districts.

In the last hundred years, the delta--a tidal swampland with natural levees--has been transformed through modern methods of reclamation into an intensively cultivated agricultural landscape. The most recent indication of this change is the 1940 total of 249,100 crop acres which increased to a 1952 total of 357,000 crop acres. When the land development companies began reclamation of backswamps in the 1870's, the size of farms converted from garden plots to entire islands with farms of tens of thousands of acres.

To meet the challenge of the delta, revolutionary machinery was developed for ditching and handling great quantities of peat. Here the Holt Caterpillar was born; here Robert G. Le Tourneau, manufacturer of half of the world's earth-moving equipment, began his career. Such unique machinery and modern methods brought about the settlement and agricultural productivity which set this delta apart from all other deltas of the world.

APPENDIX A

FLOODS IN THE DELTA

The floods of the Sacramento-San Joaquin Delta have varied from widespread disasters to inundations of single islands or reclaimed districts. A review of the phenomena discussed below permitted the general observations made in Chapter I, "The Delta, Its Hydrography and Land Forms," and in Chapter VII, "Hydrographic Problems and Solutions in the Delta."

Floods, 1850 to 1861

First of the notable floods to strike the delta occurred during May and June, 1850, when the whole of the land from the present Walnut Grove to above Freeport was reported as overflowed. At least two feet of water overlay the natural levees at the head of Steamboat Slough; only Indian mounds remained dry. Presumably most of the remainder of the delta was submerged.[1]

A three-month siege of high water along the Sacramento began in March 1852. In December, waters rose at least three

[1]Testimony of William B. Foster and John G. Cleal, Evidence taken Before the Swamp Land Committee, p. 2.

feet above the levees of the Steamboat Slough vicinity. The wet condition was prolonged through February, and recurred in April, lasting into June. During the early part of the flood and in April almost every piece of land was awash except for scattered Indian mounds. Crops were lost wherever artificial levees failed to hold the water.[2]

Barely had the deluge receded from the Sacramento lands when the San Joaquin overwhelmed adjacent bottomland.[3] This flood resulted in pressure for a state reclamation program.

The Flood of 1861/62

Although swamp areas were overflowed in alternate years beginning in 1853, the next flood of disaster dimensions occurred in 1861/62.[4] The first heavy flow of water was reported at Stockton on December 26, 1861. Runoff from the Sierra foothills began to submerge the town and by mid-January all of the streets were covered by a foot or more of water. No entire acre of land was visible between the town and the Coast Range to the west. The area had barely begun to drain when the flow of the Sacramento basin surged past

---

[2] Ibid., and testimony of Josiah B. Greene, p. 8; Gregory et al., History of Solano and Napa Counties, . . . , p. 67.

[3] "San Joaquin News," SF Alta, June 6, 1852, in BS, Set W 4, p. 1397.

[4] Testimony of J. B. Greene, Evidence Taken Before the Swamp Land Committee, p. 8; Russell et al., op. cit., p. 146.

Stockton, raising water levels in town and at the head of Roberts Island to 12 feet above the low tide marks experienced during other winters.[5] A more remarkable water level was recorded about 10 miles northwest of Rio Vista; the water at the head of Lindsey Slough was not less than 18.56 feet above low tide level.[6] This Yolo Basin water surged across the Sacramento channel, checking the river's current as far upstream as Sacramento.[7] There was no current at Stockton either, although for several days the water moved up the San Joaquin to about the latitude of French Camp before turning with the San Joaquin flow to the northwest.[8] The Sacramento water entered the San Joaquin delta over Brannan, Andrus, and Twitchell islands.

A yellow blanket of water covered a zone estimated to have been 250 to 300 miles long and to have averaged at least 20 miles in width.[9] No earlier inundation, and possibly none since, is thought to have surpassed it in extent.[10] At the

---

[5]"Report of the San Joaquin County Surveyor," Annual Report of the Surveyor General [1862], p. 94; John S. Hittell, The Resources of California (San Francisco: A. Roman and Co., 1863), p. 405; Cosby, "Notes," p. 15, SDI, Jan. 16, 1862, p. 3; "Reclamation of Swamp Lands by Steam Power," MSP, March 20, 1869, p. 190.

[6]Report of the Commissioner of Public Works [1894], p. 31.

[7]Hoag, "Farmers' Gardens," loc. cit., p. 346.

[8]"Report of the San Joaquin County Surveyor," loc. cit.

[9]Francis P. Farquhar (ed.), Up and Down California in 1860-1864; The Journal of William H. Brewer, . . . (New Haven: Yale University Press, 1931), p. 242.

[10]DWR Bull. No. 22, p. 126.

flood's peak there were no significant barriers to navigation anywhere in the delta.[11] The only buildings that were not carried off or smashed by waves were the ones that rested on Indian mounds, on settler-built mounds, or that stood in quiet water. Much stock drowned or starved before steamers and scows could effect transfers to high ground.[12]

Rio Vista was swept away. Its residents sought refuge on higher ground to the south in hastily erected oxhide shelters. Meanwhile, some 15 miles to the northeast, Mokelumne City was shattered by the waves. Like the original Rio Vista, it did not recover.[13]

A lasting memento of the flood is to be seen in the general distribution of Bermuda grass, which appears to have been spread from test plantings that had been made in the vicinity of Sacramento.[14]

Floods, 1862 to 1877

Lesser inundations occurred between 1862 and 1876, among them one in the Yolo Basin which flooded Maine Prairie

---

[11] Elliot Evans, "Some Letters of William S. Jewett, California Artist," Calif. Hist. Soc., Quarterly, XXIII (Sept. 1944), p. 233; DWR Bull. No. 22, p. 53.

[12] Hoag, loc. cit.; Farquhar, op. cit., p. 244; Evans, loc. cit.; Cosby, "Notes," p. 5, SDI, Jan. 8, 1862, p. 3; ibid., p. 16, SDI, Jan. 18, 1862, p. 2.

[13] An Illustrated History of San Joaquin County, p. 222.

[14] "Bermuda Grass," SF Bulletin, April 3, 1877, in BS, Set W 18:2, p. 219.

during midwinter 1867/68.[15] In the autumn of 1871 high water damaged Grand and Twitchell islands, and in the following spring the lands adjacent the Calaveras were flooded.[16] Jersey Island was flooded in 1873, and Bouldin Island and the Bethel Tract in 1874, apparently because of high tides and inadequate levees.[17] Sherman Island had breaks from the same causes in 1875 and 1876;[18] and the Twitchell Island levee was shifted into the island by hydrostatic pressure in early 1875.[19]

Levees were topped or broken by the San Joaquin River at Rough and Ready Island, Reclamation District 17, and the present Byron Tract in the winter of 1875. The flood damage was partially the by-product of reclamation works. Upper Roberts Island and the east bank, opposite, were leveed. Old River, choked by a mass of driftwood and sand near its head, was constricted too. A resulting rise in the water plane caused a large flow to follow the sharper gradient of a westerly distributary, Paradise Cut, to an outfall which lay

---

15"Solano County Items," Vallejo Record, Jan. 4, 1868, in BS, Set W5, p. 1830.

16Report of the Commissioner of Public Works /1894/, p. 14; Nordhoff, Northern California, Oregon, and the Sandwich Islands, p. 129; Tinkham, A History of Stockton, p. 371.

17McKeag, "Delta Report," Unit 15.

18"Contra Costa County," PRP, Jan. 2, 1875, p. 12; "The Flood at Sherman Island," SWI, Jan. 30, 1875, p. 7; "High Water," ibid., Feb. 19, 1876, p. 5.

19"Twitchell Island Submerged," ibid., Jan. 23, 1875, p. 7.

below the barrier on Old River. An estimated half of the San Joaquin's flow was funneled toward the northwest, where it damaged the Byron Tract; the pressures along the San Joaquin broke the right-bank levees.[20]

Another localized flood occurred in early 1876. Marsh Creek spilled across the unleveed landward side of reclamations situated to the south of Jersey Island.[21]

Floods of 1878

There were two flood periods during 1878. The first, which occurred in February, was one of the most disastrous in the state's history. It devastated the Sacramento River districts and the islands between the Sacramento and San Joaquin. The second flood, occurring in May, was destructive along the San Joaquin. The timing of each was representative for the two river systems.

Trouble with high water in the Sacramento River districts began on February 3 when a left-bank levee burst a short distance south of Freeport.[22] Two days later a

---

[20]"Levee Broken," ibid., Nov. 27, 1875, p. 5; "Overflow," ibid., Nov. 27, 1875, p. 7; "Overflowed Lands about Stockton," ibid., Nov. 4, 1876, p. 3; McKeag, op. cit., Unit 17.

[21]"High Water," SWI, Feb. 19, 1876, p. 60.

[22]The section on the February 1878 flood is based on (1) a collection of Sacramento Bee clippings, Sacramento River Floods of 1878 and 1881: "The Rain, River and Levees," Feb. 4; "The Flood Waters," Feb. 5; "More of the Waters," Feb. 11; "Effects of the Storm," Feb. 19; "Terrible Disaster," Feb. 22; "Resumed Hostilities," Feb. 26; (2) BS, Set W 34: p. 115, "The Storm," SF Post, Feb. 19; p. 120, "The

gopher-riddled levee just south of Sacramento "gave way with a bound." Water from each of the breaks accumulated in two separate sections of the Sacramento Basin. Because the embankment of the short-lived Freeport to Brighton railroad spanned the basin with solid fill, water from the northern crevasse could not escape. As a result of this, the whole of the basin between Sacramento's "R" Street levee and Freeport was under water within a week.

Meanwhile, the Sacramento had been spilling into the Yolo Basin. By February 5 a great flow was surging through the mouth of Cache Slough. The torrent raised the Sacramento to levels which threatened the security of Grand, Andrus, Brannan, and Sherman islands. Further breaks did not occur, however, until February 19.

After several days of rainfall the soaked and weakened levee parted on the outside of a Sacramento River bend about six and a half miles below the capital city. The flow churned through the crevasse into Yolo Basin "with a roar." Soon thereafter the newly completed back levee of the Lisbon

---

Great Flood," SF Bulletin, Feb. 23; pp. 121-22, "Dire Disaster," SF Chronicle, Feb. 24; p. 123, "The Flooded Regions," SF Alta, Feb. 23; p. 123, "The Flood," SF Chronicle, Feb. 26; p. 124, "The Flood," SF Bulletin, Feb. 25; p. 124, "The Great Washout," SF Chronicle, Feb. 25; p. 125, "The Flood," SF Post, Feb. 26; p. 124, "The Scene of the Flood," SF Call, March 4; (3) BS, Set W 4: p. 1495, "San Joaquin Floods," SF Call, May 17; (4) Petition of Henry M. Naglee (Sacramento: 1878), pp. 1-4; and (5) "Chief Engineer's Report," Report of the Board of Commissioners of the Sacramento River Drainage District to the Governor of California (Sacramento: 1878), p. 20.

District, opposite Freeport, broke; and on February 22, back levees at Clarksburg and on adjacent Merritt Island gave way. Apparently they had collapsed under the pounding of the same gale-blown waves which melted rear levees at Freeport and on the Pierson District (south of Courtland), and which broke down the "R" Street levee at Sacramento.

The escape of Yolo Basin water into the Sacramento built up water levels and currents to the point that soaked levees could no longer withstand the pressures. The Sherman Island levee gave way at Horseshoe Bend on February 19, the same day as the Lisbon District levee. All but narrow strips of the artificial levee were soon lost to view. Emmaton, a hamlet on the Sacramento bank of Sherman Island, was submerged; residents remained in the upper floors of houses which they had secured to the levee with lines. On February 21, Andrus and Brannan islands were flooded by a single break which occurred about a mile north of Isleton. At the time no cross-levee separated the two islands. The town survived until February 23.

Disaster came to Grand Island on February 21 when the 10-foot levee on Steamboat Slough was overtopped about one mile north of the island's lower end. Within two days a quarter of a mile current was devouring the levee as it poured water into the otherwise enclosed island. The build-up of water became such a threat to the security of the remaining levees and other improvements on the upper island that the levee was intentionally breached at four places along the Sacramento. The diversion of water across the island overcame Isleton's levees.

By February 24, no reclaimed district along the Sacramento remained intact except Randall Island, north of Courtland. An inland sea covered the Yolo and Sacramento basins, extending southward across the delta. Venice, Jersey, Bacon, most of Union Island, and all of the leveed mainland from Jersey Island to the Byron Tract were submerged. These tracts along the San Joaquin's Old River appear to have been swept over by waters which had poured northwestward along the line of Paradise Cut. The Cut became the main distributary for the San Joaquin when a dam at its upper end gave way. Roberts and Rough and Ready islands survived, probably because of the diversion made away from the main channel at Paradise Cut. Miraculously, Bouldin Island survived, but in a very soggy condition.

In addition to the intact islands there were some relatively dry strips of artificial levee. Farm families, their tenants, and numbers of livestock congregated upon them awaiting rescue by the steamers and barges which moved freely over the delta.

Estimated losses for the delta as a whole approached \$10,000,000; for Andrus and Brannan islands, \$400,000; and for Grand Island the estimates ranged from \$500,000 to \$2,000,000. Twelve hundred sheep were lost on Sherman Island; otherwise stock losses were not large. Damage to crops and improvements was considerable. The villages of

Freeport, Clarksburg, Isleton, Emmaton, and Walker Landing were awash.

Later, in mid-May 1878, Sierra Nevada runoff raised both the Sacramento and San Joaquin rivers bank-full. No notable damage resulted along the northern river, but serious difficulties arose in the San Joaquin River portion of the delta. A sheet of water covered everything but slight knolls on the lower plains to the north and east of Tracy. Union Island and the mainland to the south went under water for the second time in three months. Roberts Island and District No. 17, to the east of the main channel, remained intact. Where damage was done to levees and buildings the responsible agency was wave attack. At least 2,500 acres of grain and a minimum of 1,000 head of stock were lost.[23]

Floods, 1879 to 1903

The Sacramento inundated Sutter, Grand, Brannan, and Sherman islands again in early 1879.[24] Seepage from the Mokelumne River ruined crops on reclaimed mainland districts in April 1880;[25] and the San Joaquin broke levees on Upper Roberts Island and to the east of Byron in June.[26]

---

[23]"Wayside Notes," SF Bulletin, May 18, 1878, in BS, Set W 18:2, pp. 273-74; "San Joaquin Floods," SF Call, May 17, 1878, in BS, Set W 4, p. 1495.

[24]"Harvest Prospects," SF Bulletin, March 29, 1879, in BS, Set W 18:2, p. 334.

[25]"Around Lodi," PRP, May 1, 1880, p. 246.

[26]"Crops Flooded," PRP, June 26, 1880, p. 424; "Inundated Wheat," ibid., July 10, 1880, p. 20.

The Sacramento islands were visited by a high water stage in January-February 1881.[27] Yolo Basin was full to within five miles of Davis, having received a large ingress of water over the Sacramento levees and by way of crevasses. A break about one-half mile south of Washington occurred on January 31. Left-bank levees which had been weakened by gophers also gave way about five miles below Sacramento. The break renewed the by-pass function of the Sacramento Basin just as earlier flows had coursed through the Yolo Basin.

Outflow from Cache Slough overcame Brannan, Sherman, Andrus, then Grand Island. A succession of levee breaks between Freeport and Walnut Grove flooded all Sacramento bank lands but Randall Island by February 4. The Randall Island levee finally broke on that day. Staten Island, surrounded by the Mokelumne, was also flooded. Tyler Island, though soaked by seepage, remained intact. As for the San Joaquin portion of the delta, all sections except Roberts Island and District 17 were submerged from levee breaks or seepage by February 10. Damage, while extensive, seems not to have been staggering as in the 1878 flood.

The San Joaquin resumed its destructiveness on January 24, 1886, when it burst into the Middle Division of Roberts Island. The adjacent Moss Tract, parts of Stockton,

---

[27] The paragraphs about the 1881 flood are based on a collection of Sacramento Bee clippings, Sacramento River Floods of 1878 and 1881: "Thor's Thunderbolts," Jan. 31; "The Waste of Waters," Feb. 2; "On the Yolo Side," Feb. 4; "The Islands," Feb. 4; "Over in Yolo," Feb. 5; "On the San Joaquin," Feb. 10; "Down the River," Feb. 26.

and the Mokelumne mainland reclamations near New Hope were flooded too. Within a week the flooded area was extended into Lower Roberts Island because the cross levee broke. For Roberts Island the damage was estimated at $500,000; about $60,000 loss to crops and improvements occurred on the Moss Tract.[28]

The Mokelumne River burst its left-bank levees in late March 1899. Several thousand acres were flooded in the New Hope and Terminous tracts.[29]

Snow-melt water kept the San Joaquin River at consistently high levels from March until mid-July of 1890.[30] A number of levee failures occurred during May. South of the San Joaquin Old River some 3,000 acres were flooded. The north levee of the Grant Line Canal was overtopped also, resulting in the inundation of about 8,000 acres on Union Island. The outflow from the island entered Middle River opposite the Roberts Island "Pocket," which was submerged in spite of elaborate sandbagging. About a week later, on May 30, the Union Island levee on Middle River was breached, submerging the easternmost 8,000 acres of the island. Losses

---

[28]The account of this flood is based on the following PRP articles: "Roberts Island," Feb. 6, p. 124; "San Joaquin Notes," Feb. 6, p. 125; "San Joaquin County Notes," Feb. 13, p. 148; "The Levees," Feb. 13, p. 149; "Stockton Notes," Feb. 20, p. 172; "Fortifying the Dikes," Oct. 23, p. 341.

[29]Cosby, "Delta History Notes," pp. 26-27, SDI, March 28, 1899, p. 5; ibid., SDI, March 29, 1899, p. 4.

[30]Report of the Examining Commission on Rivers and Harbors . . ., p. 89.

in crops and improvements to the owners and tenants on Union Island were estimated at $600,000.[31]

In 1893 a considerable portion of Roberts Island was submerged, but recovery was made by the fall of 1894.[32]

The Mokelumne waters overwhelmed 15,000 to 20,000 acres of cultivated land in the New Hope vicinity during March of 1899.[33] In the following January some of the land was again subjected to excess water.[34] At this later time Jersey Island was returned to the watery state that had existed just two years earlier.[35]

During February and May of 1901 the San Joaquin River repeated the familiar pattern. A poorly maintained levee on Reclamation District 17 gave way on February 21. Within a day 4,500 acres were under one to 10 feet of water. Breaks also inundated the lands to the south of Roberts Island, mainland properties near Banta and Tracy, the Fabian and Bell and Clifton Court tracts, and Victoria Island. A repeat flooding of the Fabian and Bell Tract and of some of the land fronting on Paradise Cut occurred in May.[36]

---

[31]"Broken Levees," PRP, May 31, 1890, p. 554; "Union Island Flooded," ibid., June 7, 1890, p. 578.

[32]"Waterways in the San Joaquin," ibid., Sept. 15, 1894, p. 161.

[33]Cosby, "Delta History Notes," pp. 26-27, SDI, March 28, 1899, p. 3, and March 29, 1899, p. 4.

[34]Ibid., p. 33, SDI, Jan. 10, 1900, p. 7.

[35]Ibid., p. 32, SDI, Jan. 5, 1900, p. 5.

[36]Ibid., pp. 45-47, 59-60, SDI, Feb. 21, 1901, p. 3; Feb. 22, 1901, p. 5; Feb. 26, 1901, p. 8; March 1, 1901,

A build-up of Yolo Basin waters registered a level at Rio Vista of 14 feet above low tide on March 2, 1902. While the gradient downstream then existing was a foot to the mile, the waters virtually stood still upstream to Walnut Grove.[37] Andrus and Brannan islands were flooded.[38]

Floods, 1904 to 1911

A disaster similar to the floods of 1878 and 1881 visited the lower Sacramento in February and March 1904.[39] The left bank was breached on February 28 (the Edward's Break) at a point about three miles below Sacramento, pouring a broad torrent into the Sacramento Basin. It soon covered that part of the basin which lay between Sacramento's "Y" Street levee and the ridge at Freeport. By March 2, various small reclamation districts below Freeport were flooded, largely by backwater.

---

p. 5; March 10, 1901, p. 5; March 28, 1901, p. 5; May 21, 1901, p. 2.

[37]"Report of the Committee of Twenty-Four . . . ," Report of the Commissioner of Public Works and Engineers /1901-2/, p. 23.

[38]"Great Pumping Plant," PRP, April 12, 1902, p. 251.

[39]Description of the 1904 flood is based on: "Crevasse in River Levee below This City Widening," "The Situation Explained," Sacramento Union, Feb. 28, p. 9; "Two Breaks at Walnut Grove," ibid., Feb. 29, p. 5; "Review of the River," "Bouldin Island Imperiled," ibid., March 3, p. 10; "Rivers Flooding the Lowlands," SF Chronicle, March 1, p. 3; "Thousands of Acres Flooded," ibid., March 2, p. 5; Cosby, "Delta History Notes," pp. 107, 116-17, 120, SDI, March 3, p. 5; March 4, p. 5; March 31, p. 5; April 1, p. 5.

The Mokelumne River system contributed to the backswamp inundations on February 29 as it poured over Staten and Tyler islands, the Arkansas District to the east of Walnut Grove, and the New Hope vicinity. The Brack Tract flooded on March 1; the Sargent Tract was engulfed on March 2; Bishop and Cohen tracts and Venice and Bouldin islands were awash on the third.

Sherman Island defenses were topped on February 28 by the flow which issued from the inland sea of Yolo Basin. Brannan, Ryer, and Jersey islands were flooded in another two days. Slack water above Rio Vista failed to break into Grand and Andrus islands, though the east levees were trouble spots for the latter island. Upstream, the Pierson and Lisbon districts and Merritt Island remained intact.

Total damages were estimated at $5,000,000 or more.[40] They might have been higher had the swampland residents not had several days of warning.[41]

During the first week of July 1906, there were levee breaks on Sherman, Venice, Twitchell, and lower Roberts islands, the Upper Jones Tract, Union Island, and the Fabian and Bell Tract. Unlike the inundations already described,

---

[40]Robert Devlin (address), in "Swamp Land Reclamation," Commonwealth Club of Calif., Transactions, IV (Sept. 1909), p. 292.

[41]"Families Camp on Levees," SF Chronicle, March 3, 1904, p. 5.

these are attributed to the action of exceptionally high tides.[42]

In March 1907 another great general flood visited the Central Valley. Several days of heavy downpours saturated the land, raised streams to flood stages, and filled the flood basins. The mean daily runoff into the Sacramento Valley was about 532,000 cubic feet per second between March 18 and 21, a moderately long period of record runoff. Another 227,000 cubic feet per second of water entered the San Joaquin Valley at the time.[43]

Several breaks occurred in Sacramento east-bank levees between Clarksburg and Courtland on the night of February 21. The flow intensified the high backwater stages which had existed in the Sacramento Basin as a result of Mokelumne runoff. Meanwhile, the Yolo Basin was receiving the larger share of Feather, American, and Sacramento flows through breaks at various points north of Sacramento. The accumulation of water on February 24 that the high tide had abetted exceeded the previous high at Rio Vista by three feet. Levees failed in the Lisbon District and on Ryer, Brannan,

---

[42]Memo of interview with George Atherton by Elvin Moorehead (Aug. 11, 1934), as recorded in Cosby, "Delta History Notes," p. 157; Rogers, "The Delta Story," Stockton Record, July 16, 1951, p. 15; "Rising Waters Take Rich Land," SF Chronicle, July 10, 1906, p. 5.

[43]W. B. Clapp, E. C. Murphy, and W. F. Martin, "The Flood of March, 1907, in the Sacramento and San Joaquin River Basins, California," American Society of Civil Engineers, Transactions, LXI (Dec. 1908), pp. 281-83, 319.

Andrus, Twitchell, and Bouldin islands, and on lower Sherman Island. Staten, Tyler, and Venice islands and the New Hope, Sargent-Barnhart, and Terminous tracts also were submerged.[44]

Along Old River, in the southern delta, levee failures were registered at the Clifton Court Tract, Coney and Victoria islands, and Byron and Palm tracts. Lower Jones, Franks, and Bethel tracts, and Jersey Island were inundated; likewise most of the reclaimed land between Stockton and the Rindge Tract, inclusive. Most of Stockton was under water for a week.[45]

In January 1908, Jersey Island suffered a levee break along its San Joaquin River side, possibly at points where floodgates had been inadequately maintained. The danger had been anticipated.[46]

Heavy rainfall during early January 1909 produced flood crests on the lower Calaveras and American rivers by the thirteenth and fifteenth, respectively. The former river overflowed into Stockton and the surrounding countryside; the American River flow contributed to the Yolo backwater flooding

---

[44] *Ibid.*, pp. 318, 319; *The Rivers and Floods of the Sacramento and San Joaquin Watersheds*, by Nathaniel R. Taylor, USDA, Weather Bureau, Bulletin 43 (Washington: 1913), pp. 69-70.

[45] *Ibid.*, p. 91; Clapp *et al.*, *loc. cit.*, p. 326; Rogers, *loc. cit.*, July 17, 1951, p. 17; Wright interview.

[46] *Report of the State Engineer of the State of California, November 30, 1908, to November 30, 1910* (Sacramento: 1911), p. 122; "Report on Peat Levees, Jersey Island," by N. Ellery, *Report of the State Engineer . . . , May 11, 1907, to November 30, 1908*, p. 91.

of Broderick to the west of Sacramento, and precipitated the inundation of Andrus, Brannan, Twitchell, Bouldin, Venice, Sherman, and Jersey islands, and the Bethel Tract.[47]

On January 30, 1911, heavy warm rains began to fall upon the headwater areas of the San Joaquin River. On February 1, the rising crests were felt at the head of the delta. They spread over a large area between Roberts Island and the valley plains to the east; Reclamation District 17 and leveed areas to the south of it were overcome. The Calaveras and Mokelumne rivers also brought considerable damage to bottomland of the delta margin.[48]

Later in 1911 Bethel Tract was flooded through carelessness. To combat a peat fire a trench was dug through the levee, and a pipe laid. Seepage along the pipe transformed the filled ditch into a crevasse overnight.[49]

Later Floods

The Mokelumne River broke its left-bank levees near Woodbridge in early 1928. Water spilled westward into Beaver Slough and across the southeastern corner of the New Hope Tract. A north-south levee connecting Beaver and Hog sloughs

---

[47]N. R. Taylor, op. cit., pp. 70, 80, 81, 91; Report of the State Engineer . . . , November 30, 1908, to November 30, 1910, pp. 117-18.

[48]Ibid., p. 82; "Favors West Side Canal," Stockton Record, Feb. 10, 1911, in A. de Wint Foote, "Scrapbook of Clippings on Flood Control and Reclamation," Bancroft Library, University of California, not paginated.

[49]Rogers, loc. cit., July 17, 1951, p. 17.

saved the valuable crop land to the west. The impounded water was drained off through pipes installed for the purpose.[50]

In mid-February of 1936 Franks Tract and Quimby Island were inundated. Repairs were made by October,[51] but in February 1938 a combination of excessive runoff and high wind-abetted tides flooded most of Franks Tract again. On February 11, several hundred feet of the north levee was pushed into the island by lateral pressure. A small area in the northwestern part of the island was saved by a cross levee. On the next day levees were topped near the confluence of the Stanislaus and San Joaquin. On February 13, Mandeville and Rhode Island levees gave way before the persistent pressure of water, as did also those of Liberty and Prospect islands. The Quimby Island levee burst at a point weakened by a beaver den, the only such case known. Brack Tract was barely saved with sandbags. A dredge was rushed to save Venice Island's sloughing levees but the settling continued. The levee broke on February 15, and the torrent of inflowing water almost capsized the dredge.[52]

---

[50]Stearns, loc. cit.

[51]Rogers, loc. cit., July 25, 1951, p. 19.

[52]"Flood Threat Averted by Cold Weather and Falling Streams," Stockton Record, Feb. 12, 1938, p. 1; "19,000 Acres Rich Farm Lands Flooded As Levees Crash; Many Flee Homes," ibid., Feb. 14, 1938, p. 1; "Rich Venice Island, 3,150 Acres, Flooded As Levee Breaks," ibid., Feb. 16, 1938, p. 1; Rogers, loc. cit., p. 31; William Q. Wright letter to Jack Williams. Wright is the authority for the statement about Quimby Island. Wright interview.

Frequent rains over the Sacramento watershed kept streams and the by-passes at high levels during January and February of 1940. Although the Little Holland Tract flooded on January 12, it was not until February 25-29 that general flooding of the Yolo Basin seemed imminent. Excessive precipitation and runoff during the period necessitated opening the Sacramento weirs on February 27.[53] By the afternoon of the next day Liberty and Prospect islands, by-pass tracts, were under water. The Upper Hastings and Egbert tracts were submerged on March 1.[54]

The Webb Tract was swamped on June 2, 1950, when a high tide produced a rupture at a known place of deep-seated levee weakness.[55] A 100-yard section of the barrier broke initially.[56] The following December 11, Venice Island was flooded, causing $250,000 damage.[57] The accident occurred on a shrinkage-weakened cross levee which was inadvertently exposed to water when a normally dry basin between it and the

---

53E. H. Fletcher, "Floods in the Sacramento Valley, February 27-March 6, 1940," Monthly Weather Review, LXVIII (March 1940), p. 71.

54Report of Director of Public Works on Emergency Flood Conditions, by Frank W. Clark, Calif. Dept. of Public Works, Div. of Water Rights (Sacramento: 1940), pp. 15, 30.

55Wright letter to Williams, p. 10.

56Rogers, loc. cit.

57W. B. Hogan, "Report in Regard: Request for Flood Control and Water Conservation of San Joaquin River and Tributaries Presented to Sub-Committee of the Appropriations Committee of Civil Functions of the War Department of the United States Senate," June 1951 (in files of San Joaquin County Agricultural Extension Service, Stockton), p. 12.

outer levee was filled with seepage from the river. The levee breach began as a leak along the line of a siphon.[58]

During late December of 1955 heavy rains fell upon the deep Sierra Nevada snow pack at all elevations up to about 10,000 feet. The usual winter flows in the Feather, Yuba, and other watersheds became torrents as the runoff poured through their tributaries. Though the destruction at Yuba City was the most widely publicized aspect of the flood, the soggy Central Valley was flooded over a wide area. The great flows of the Sacramento Valley were conducted toward the sea through the Yolo By-Pass and between the levees of the river. The Mokelumne and Calaveras rivers also carried exceptional flows.

Some levees were damaged in the delta but were reinforced with sandbags. At Rio Vista the water stood 10 feet above sea level; it reached almost 9.5 feet along Andrus Island.

The small reclaimed areas which were submerged first were Dead Horse Island; the McCormack Williamson Tract in the Sacramento Basin; and unleveed Ida Island, about two miles to the west of Isleton. The Empire Tract and Quimby and Bradford islands were flooded on December 26. Venice Island, which expected to flood, was evacuated at the time. Lower Andrus Island was evacuated and Isleton residents prepared to

---

[58]Louis W. Ware and H. R. Cedergren, "Report of Inspection of Venice Island Levees," Jan. 5, 1950 (in files of San Joaquin County and Stockton Public Library), p. 2 (typewritten); Wright, loc. cit.

leave because a long stretch of levee near the confluence of the Mokelumne with the San Joaquin was expected to go. The state highway across Bouldin Island was closed in anticipation that leaking levees would burst. Tyler, Twitchell, Brannan, Bradford, and Jersey islands had soggy levees and disappearing freeboards. Radio-equipped motorized levee patrols were maintained. Local residents pooled their labor and farm equipment to fill sandbags or to build up levees. In some cases the sandbag dikes added enough height to withstand water which rose 18 inches higher than the levees. In at least one instance (Brannan Island) a leak was sealed along the line of an irrigation siphon. On the Empire Tract the levee disintegrated while crews were working. One worker had a spectacular two-mile ride across the island holding onto a log.

It was fortunate that winds remained moderate during the flood because the saturated levees on several tracts could not have withstood the pounding of waves. In recognition of their weakened state the traffic on the Stockton Ship Canal was halted.[59]

---

[59]The material for the flood of December 1955 was gathered from The Sacramento Union. "No Big Flood Seen in Area of Sacramento," "Soggy Isleton Levees Holding," Dec. 27, 1955, pp. 1-2; "New Crises for Isleton from Tide," Dec. 28, 1955, pp. 1, 14; "How Yuba City Flood Was Born," Dec. 28, 1955, pp. 1, 4; "Bolstered Levees Win Battle Against Flood in This County," Jan. 1, 1956, pp. 1, 2.

APPENDIX B

RECLAIMED COMPONENTS OF THE DELTA

Discussion of the progress of land reclamation in the delta may follow a chronological order or it may be approached through the designation of areas where sequences of change were closely related in time and form. Because the chronological order is difficult to follow, there being so many islands and tracts, the material is presented below by the areally and historically related components: Sacramento and Mokelumne Islands (1860-90), Southern San Joaquin Islands and Mainland (1870-90), Mokelumne and Calaveras Mainland (1880-90), West Delta (1890-1910), North Delta Margin (1890-1920), Central Delta (1900-20), Sacramento Basin (1910-20), Yolo Basin (1910-30) (see Map 16, p. 219). Each component possesses a pedologic identity that tends to reflect the location and time factors referred to above.

Unrestrained Reclamation

The transfer to reclamation supervision to the county boards of supervisors and the removal of acreage restrictions on swamp and overflowed ownership occurred in the late 1860's. A colorful forty years of independent reclamation followed during which 300,000 to 325,000 acres were more or less permanently reclaimed.[1] Concerning the reclaimed area, it seems reasonable to state that, with the exception of Randall Island, recurring levee breaks or seepage problems have required three or more post-reclamation drainings for each tract.

Sacramento and Mokelumne Districts

The alluvial rims of backswamp tracts south of Freeport and Clarksburg attracted early settlement because of their accessibility and the agricultural promise of the wooded natural levees. The rims were occupied in the 1850's; leveeing began on them in the same decade. During the 1860's these areas were organized into reclamation districts which, following the transfer of reclamation administration to the counties, were reorganized to suit the requirements of owners, and the present districts evolved from the reorganizations. Among them are the east-bank lands between Freeport and Walnut Grove: Reclamation Districts 744, 745, 746, and 813, Randall Island (R.D. 755), the Pierson District (R.D. 551), Locke (R.D. 369), and Walnut Grove (R.D. 554). The reclamation experiences of these lands parallel those on the larger islands to the west and south, all of which were effectively reclaimed prior to 1900. The island group includes Sutter (R.D. 349), Merritt (R.D. 150), Ryer (R.D. 501), Grand (R.D. 3), Andrus (R.D. 317, 407, 556), Tyler

[1] DWR Bull. No. 27, 158.

(R.D. 136, 364, 532, 563, 807), and Staten islands. Nearer the center of the delta are Bouldin (R.D. 756), Sherman (R.D. 341), Brannan (R.D. 2067), and Twitchell (R.D. 1601) islands. Particular reclamation experiences which have been traced down include:

Sutter Island

Sutter Island residents formed Reclamation District 349 in February 1880, although levee work had been performed earlier. Full protection against the numerous floodings was attained in 1896, when the levees were enlarged by dredges. Thereafter the tules of the alluviated backswamp were broken and farmed regularly. Ownership remains in relatively small parcels on this 2,600-acre island. All but 210 acres are agricultural.[2]

Merritt Island

Merritt Island is a 4,900-acre tract composed of Columbia soils around the periphery and of stratified sedimentary and organic soils in the former backswamp. Land ownership has been in the hands of numerous individuals since the island was purchased as swamp and overflowed land. The first reclamation district was organized in 1862 and reformed in 1868 and 1874.[3] Levees were completed in 1876.[4] Several

---

[2]McKeag, "Delta Report," Unit 7. [3]*Ibid*.

[4]Letter of R. F. Hester to ed., *Woodland Democrat*, Feb. 18, 1876, in *BS*, Set W 5, p. 2084.

floods topped the defenses before 1893 but the island has not been submerged since. About 95 per cent of its surface is agricultural.[5]

Ryer Island

Reclamation began on Ryer Island in 1865, but stopped.[6] The island came into the possession of a land agent, B. F. Mauldin,[7] who appears to have sold it to several San Francisco capitalists who provided the money to build levees along Cache and Steamboat sloughs.[8] Work began anew in 1872, but floods so discouraged the investors that the project was abandoned in 1887. Reorganization and levee reconstruction during 1888 and 1889 did not prevent floods in 1896, 1902, 1904, and 1907 from covering the island. It was not until 1907 that massive dredged levees gave Ryer Island permanent protection.[9]

In recent years the 12,000-acre tract has been devoted to crop land almost entirely. About 400 acres are devoted to levee, 115 acres are water, and 10 acres are occupied by a small grain elevator and residences.[10]

---

[5]McKeag, loc. cit.

[6]Report of the Swamp Land Commissioners for the Years 1864 and 1865, p. 13.

[7]Testimony Taken by the Swamp Land Investigating Committee, p. 45.

[8]Browne, "Reclamation and Irrigation," loc. cit., p. 402.

[9]McKeag, op. cit., Unit 11; Cosby, "Delta History Notes," p. 1, SDI, Jan. 23, 1896, p. 1.

[10]McKeag, loc. cit.

Grand Island

By the early 1870's Grand Island was divided among numerous small and a few large proprietors. The small well-tended holdings aggregated about 7,600 acres, chiefly in the upper island and along the natural levee of Old River. About 2,000 acres, some of them bank land, were owned by William Gwynn and Henry Miller. Another 8,000 acres, mostly back-swamp, were owned by George D. Roberts of the Tide Land Reclamation Company.[11]

The task of clearing the backswamp areas for farming neared completion in 1875; Roberts had 4,000 acres in cultivation that year; another 4,000 acres were to be ready for planting in 1876. However, flooding occurred.[12] Excellent crops were produced in 1877[13] but the situation was unusual, to judge from one backswamp farmer's comment that high water had permitted him to raise only one of four crops planted after 1873.[14] In any case, the land was cleared.

General Thomas H. Williams succeeded George Roberts as owner of much of the Grand Island backswamp, although the two remained business associates. In addition to the 11,000

---

[11]Hoag, "Farmers' Gardens," loc. cit., pp. 339-40. The operations of the company receive fuller coverage in Chapter IX, "Reclamation Sequence."

[12]Ibid.; McKeag, op. cit., Unit 12.

[13]Report of the Commissioner of Public Works [1894], p. 14.

[14]History of Sacramento County, p. 262.

acres which he acquired on Grand Island, Williams purchased 20,000 acres of Yolo Basin land from Roberts. This swamp area lay west of Clarksburg and Merritt Island. The General, who was regarded as a "land hog" by his contemporaries, did not lease or share his land; he hired men to work it. He was accused of hiring Chinese instead of Caucasians, a choice which the General attributed to the shortage of other people who could work.[15] Perhaps the malcontents wished to lease his land so that they might have it farmed on shares by the Chinese.

If Williams was poorly disposed toward the smaller landholders it was partly because they had opposed being assessed for the reclamation of his land. Small proprietors of bank land were not badly damaged by floods. Their farms, which in 1878 numbered 27 and varied from 35 to 640 acres, had prospered without having the island completely leveed and reclaimed.[16] Some of the lesser owners formed eight separate reclamation districts between 1880 and 1883 in order to escape the island reclamation assessments.[17]

Reclamation was a critical necessity to Williams. He had suffered a major reverse from the 1878 flood, and recovery was delayed by the floods of 1879 and 1881. To have the

---

[15]"The Flooded Regions," SF Alta, Feb. 24, 1878, in BS, Set W 34, p. 123; "The Flood," SF Chronicle, Feb. 26, 1878, in BS, Set W 34, p. 127; Dana, The Sacramento: River of Gold, p. 163; History of Sacramento County, p. 220.

[16]Ibid., p. 188; "The Great Washout," SF Chronicle, Feb. 25, 1878, in BS, Set W 34, p. 124.

[17]McKeag, loc. cit.

levees repaired and the land drained he eventually exchanged 4,500 acres with an engineer, John W. Ferris, who had been active in the reclamation of Roberts Island.[18] The final dredge leveeing of Grand Island was made sometime around 1894.[19] Since then the lands have been spared flooding.

In its present state Grand Island has a gross area of 16,870 acres. Agricultural land occupies 16,000 acres, and about 680 acres are occupied by levees, berm, water surfaces, and municipal development. The remaining 200 acres are covered by a mass of dredge spoil which was removed by the Minor Project deepening of the Sacramento. The waste area is a refuse disposal area for neighboring communities.

Pierson District

The Pierson District[20] lands were organized for protection in 1872 and 1874. Levees eight feet high were built along Snodgrass Slough but in 1876 and 1878 the tract was flooded. Improved levees that cost an initial $180,000, and which were dressed from time to time later, withstood all floods until 1907. Since then the district has been secure. Randall Island operated as a part of the district until 1904

---

[18]Rogers, loc. cit., July 6, 1951, p. 19.

[19]Cosby, "Delta History Notes," p. 155, from memo of Atherton interview by Moorehead; McKeag, loc. cit.

[20]The district is referred to as the Pearson District in the early literature. Sometimes it is called the Runyon District.

although it was separated by a cross levee from the larger tract since before the 1878 flood.

Pierson District land is protected by 360 acres of levee. There are about 50 acres of residential and business area and about 15 acres of water surface within the levees. The remainder of the 8,990-acre tract is agricultural. Approximately 25 acres of Randall Island's 420-acre area is devoted to non-agricultural purposes, chiefly levees.[21]

Andrus Island

Modest levees were built on Andrus Island prior to the 1870's, but the complete enclosure of the tract with relatively strong levees did not occur until 1872-73.[22] Because four or five landowners who lived near the center of the island could not agree to the program for reclaiming the whole unit, they built their own system of cross levees.[23]

The levees were enlarged in 1874 and 1876 but the 1878 flood breached them. During the 1880's and 1890's the repaired levees and cross levees were further strengthened.[24] More reconstruction was needed after the 1902, 1907, and 1909 floods. Since then the flood defenses have been dressed

---

[21]McKeag, op. cit., Unit 8.

[22]"Dire Disaster," SF Chronicle, Feb. 24, 1878, in BS, Set W 34, p. 122; Report of the Commissioner of Public Works /1894/, p. 13.

[23]Hoag, loc. cit., p. 341.

[24]McKeag, op. cit., Unit 13.

occasionally; disaster has been averted by narrow margins at least twice.

Within the 460 acres of levee lie approximately 195 acres of municipal or business land, and a little over 8,000 acres of crop land, most of it held in small units.[25]

Tyler Island

About one-quarter of Tyler Island was reclaimed and in cultivable condition by October 1877. The largest block of improved land was at the upper end of the island. It was connected directly to the mainland on the north by an earth dam which sealed off Tyler Slough.[26]

In 1878 the northern quarter of the island was flooded. Recovery was made in 1879 and the seven-foot-high levees restored.[27] The levees, largest in the state upon their completion,[28] held during the 1881 flood. The lower island was added to the reclaimed area in 1894.[29] All was flooded in 1904, reclaimed, flooded in 1907, and again reclaimed.

Tyler Island contains 8,960 acres. About 360 acres are occupied by river levees and cross levees; another 140 acres are devoted to non-agricultural uses.[30]

---

[25] Ibid.

[26] "Up the Sacramento," SF Call, Oct. 16, 1877, in BS, Set W 3, p. 1064.

[27] "Agricultural Selections," SF Bulletin, Jan 20, 1879, in BS, Set W 18:2, p. 318.

[28] "Harvest Prospects," SF Bulletin, March 20, 1879, in BS, Set W 18:2, p. 318.

[29] McKeag, loc. cit.

[30] Ibid.

Staten Island

In the winter and spring of 1872-73 Staten Island was ringed with a five-foot-high levee.[31] The structure was enlarged in 1876. It had a common shortcoming of the levees of that period: so much water seeped through that wheat and barley stands either failed or were light.[32] The crops were lost completely in the 1878 flood.[33] Again, levees were strengthened; over $100,000 was spent in the process during the fall and winter of 1878-79.[34] Another flooding of the island occurred in February 1881, and in early 1886 a levee break flooded the lower half of the island.[35] Recovery work, completed by the winter of 1887-88,[36] increased the total reclamation expenditure to $607,500.[37] So far as is known, the levees held until 1904. That year and again in 1907, high drainage costs added to the existing burden.[38]

Of Staten Island's 9,250-acre total area, 8,710 acres are farmed. The levees cover a little over 510 acres, and an

---

[31] *Ibid.*, Unit 18; Browne, *loc. cit.*, p. 401.

[32] "Crops on the Lowlands," *SWI*, June 24, 1876, p. 5.

[33] "Up the Mokelumne," *SWI*, Nov. 30, 1878, p. 7.

[34] "Staten Island Levees," *SWI*, Oct. 26, 1878, p. 5; "The Reclaimed Tule Lands," *ibid.*, March 8, 1879, p. 7.

[35] "The Levees," *PRP*, Feb. 13, 1886, p. 149.

[36] Cosby, *loc. cit.*

[37] McKeag, *loc. cit.*

[38] *Ibid.*; "Asparagus Fields Not All Ruined," *PRP*, May 21, 1904, p. 327.

elevator and packing sheds occupy 15 acres. Water surfaces within the tract cover 10 acres.[39]

Bouldin Island

Between 1871 and 1874, $9,675 was spent to build levees on Bouldin Island. Another $57,000 was expended to reclaim the soil and to construct farm buildings. Persistent deterioration of the peat levees and their collapse after a year's standing resulted in the abandonment of this effort in 1874. In 1877, $43,000 was invested in levee repairs and in surfacing the old levee with two feet of sediment. Desperate labor saved the island during the 1878 flood, but so much seepage penetrated the levees that planting had to be delayed. Later in the year the four-foot levees were raised and broadened again.[40] Piling-anchored plank bulkheads were used to add strength to the works.

Bouldin Island appears to have survived all floods between 1876 and 1904. It is possible that the delta's first asparagus cannery was built here in 1892 because, in addition to affording suitable soil, the island had a good flood survival record. A second cannery was built in 1902. In March of 1904 the island was flooded. Recovery was made by July 1905,[41] but the island was awash again in March 1907 and

---

[39]McKeag, loc. cit.

[40]Report of the Commissioner of Public Works [1894], p. 15; "Bouldin Island," PRP, Sept. 7, 1878, p. 149.

[41]"Bouldin Island," PRP, July 29, 1905, p. 71.

January 1908. It remained a tidal lagoon until 1918 because owners could not agree on how to restore it. Restoration to an arable condition was made by the California Delta Farms, a land-developing and large-scale farming company.[42]

The levees occupy a little over 6 per cent of the island's 6,016 acres. About 170 acres of water surface and 70 acres of fishermen's camps and other residences cover the non-arable portions of the island.[43]

Sherman Island

Prior to the spring of 1868 Sherman Island was virtually tule covered except for a few small riverside plots which were partially reclaimed.[44] The owners organized reclamation districts and proposed to levee the land for $5 per acre.[45] The three- to five-foot levee was finished in April 1869, making Sherman the first of the peat islands to be leveed completely. The cost was $80,000.[46]

---

[42] Fourth Biennial Report of the Reclamation Board of California, p. 31.

[43] McKeag, loc. cit.

[44] Tide Land Reclamation Co. (1869), op. cit., p. 21, citing Daily Herald, July 10, 1869.

[45] The reclamation districts were No. 50, to the west of Mayberry Slough, and No. 54 to the east. Among the landowners of the period were Bigelow, Boggs, Clark (R.D. 50), and Upham, Little, and McCall (R.D. 54). Ibid., p. 38, citing letter to SF Times, May 14, 1869.

[46] Ibid., p. 21, Daily Herald, July 10, 1869.

During the winters of 1871/72[47] and 1874/75 the Sherman Island levees failed. The 1874/75 experience was disheartening. A levee failure in late 1874 was repaired before much water damage resulted. Hardly was the project completed before several crevasses were pushed through the north and south levees west of Mayberry Slough. Those on the south side were repaired quickly but the two breaches on the Sacramento River defied easy correctives. Water covered all but 100 acres of crop land in the western part of the island.[48] In February 1876 the western part was flooded again.[49] Landowners had not recovered from these costly disasters before the flood of February 1878 devastated the entire island,[50] wiping out virtually all improvements. The landowners were faced with the problem of restoring their private operations as well as underwriting some $54,000 in assessments (1878) to repair levees that had melted away during the flood.[51] Slow progress was made in reconstruction. Fresh levee breaks in 1879 made it impossible to farm more than a small area.[52] By July 1880 most of the eastern part of the island was again

---

[47]Ibid., p. 38, SF Times, May 14, 1868; "Sherman Improvements," MSP, May 22, 1869, p. 330.

[48]"Contra Costa County," PRP, Jan. 2, 1875, p. 12; "The Flood at Sherman Island," SWI, Jan. 30, 1875, p. 5.

[49]"High Water," SWI, Feb. 19, 1876, p. 5.

[50]"The Scene of the Flood," SF Call, March 4, 1878, in BS, Set W 34, p. 179.

[51]History of Sacramento County, p. 189.

[52]"Harvest Prospects," SF Bulletin, March 20, 1879, in BS, Set W 18:2, p. 334.

plowed and planted, but the crop season ended when the levees collapsed from the pressure of high water.[53] An assessment of $13,141[54] was made to pay for levee repairs but most of the land remained under water at least until 1894, when reclamation was renewed.[55] Levees were breached in February 1904, July 1906, March 1907 (western part), and in 1909. The record of losses incurred and the cost of repairing levees is incomplete. It is known that in August of 1909 nearly $30,000 had been spent to close two levee breaks that had converted the island into a tidal lagoon earlier in the year.[56]

Around 1912 the state acquired the western part of Sherman Island to be used as a spoil area for the Minor Project flood channel improvement of the lower Sacramento. Sporadic farming continued on the uncovered parts of the 1,800-acre tract until about 1925, when water was admitted onto the island to extinguish a peat fire.[57] The remainder of the island has been water-free to date.

The abandoned part of Sherman Island contains about 3,325 acres of swamp and shallow water. The remaining 10,450

---

[53]"Sherman Island," letter to ed., SF Bulletin, Aug. 16, 1880, in BS, Set W 34, p. 143.

[54]History of Sacramento County, loc. cit.

[55]Report of the Commissioner of Public Works /1894/, p. 12.

[56]Report of the State Engineer . . . , November 30, 1908, to November 30, 1910, pp. 117-18.

[57]McKeag, op. cit., Unit 14.

acres of the island are covered with 475 acres of levee, 135 acres of water surface, and crop land.[58]

Brannan and Twitchell Islands

Brannan and Twitchell Islands were the sites for the first Tide Land Reclamation Company reclamation projects. The early developments are described under reclamation procedure.

Rectangular Brannan Island is protected by 177 acres of levee and berm, about 2.3 per cent of its area. The smaller and elongated Twitchell Island has 5.9 per cent of its area in such land use, or 218 acres. Virtually all of the remainder of both tracts is productive agricultural land.[59]

Southern San Joaquin Islands and Mainland

Today the levees and drainage systems of predominantly alluvial lands in the southern portion of the San Joaquin delta are maintained by various reclamation districts, two protection districts, and independent owners. This delta segment includes Reclamation District 17 which, like Grand Island (R.D. 3), has maintained its organizational and areal identity since the 1860's. The other districts have been reorganized several times. Included are Rough and Ready

---

[58] *Ibid*.

[59] McKeag, *op. cit*., Unit 15.

Island (R.D. 403), the Roberts Island Upper Division (R.D. 554), Middle Division (R.D. 524), Lower Division (R.D. 684), and the Honker Lake, Drexler, and Pocket tracts; Union Island (Protection Districts 1 and 2); the Fabian Tract (R.D. 773); R.D. 2062, which includes the Farmers Developed Land Company, the Moreing Ranch, and the Fink and Winler Ranch; the Pescadero lands (R.D. 2058); and properties served by the Fremont Irrigation Association, Independent Mutual Water Company, and Holly Sugar Corporation water distribution systems. All of these pieces of land were reclaimed in the decades 1870 to 1890.

Reclamation District 17

Reclamation District 17 occupies a narrow corridor of natural levee and former backswamp east of the San Joaquin from the delta head to French Camp Slough. It is 10 miles long by 1.75 miles wide. The strip was well leveed along the river and to the higher land by early 1864.[60] Repairs were needed in the winter of 1868[61] and in 1875.[62] The levees were enlarged in 1877, by which time the whole tract was thoroughly reclaimed for agriculture.[63] The levees

---

[60] Report of the Board of Swamp Land Commissioners for the Years 1864 and 1865, pp. 9-10.

[61] "Repairing Levee," SWI, Nov. 14, 1868, p. 7.

[62] "Levee Broken," SWI, Nov. 27, 1875, p. 5; "Overflow," ibid., p. 7.

[63] "Land Reclamation," SWI, Jan. 20, 1877, p. 5.

withstood the floods of February and May 1878. Later breaks are documented for 1901 and 1911.[64]

The reclamation district's 6,540 acres include 293 acres of levee and berm. Another 17 acres comprise the total of water surfaces and other non-crop uses.[65]

Rough and Ready Island

Small-scale reclamation of Rough and Ready Island began in 1853 when James Crozier and W. L. Wright engaged laborers to cart fill to the natural levee at the eastern end of the island where the two men had a market garden. The fill was used to elevate about 18 acres of the levee three and a half to four feet above the water. It is said to have cost about $1,200 per acre to raise the first five acres; later reclamation was done at an average cost of about $600 per acre. Ditches from which the fill material had been removed were expected to refill with sediments carried onto the island by floods.[66] Another settler, following the Crozier example, filled about five acres of adjacent bank land by 1872.[67] Between 1853 and 1872 the lower-lying

---

[64]See Appendix A, "Floods in the Delta."

[65]McKeag, _op. cit._, Unit 26.

[66]_Report of the Commissioner of Public Works_ [1894], p. 16; "Tule Farming," _SWI_, March 3, 1877, p. 7.

[67]_Report of the Commissioner of Public Works_ [1894], _loc. cit._

acreage received no attention; the bulk of the island remained a refuge for wild waterfowl.[68]

In 1872 a reclamation company was formed to retrieve the remainder of the swampy island.[69] A small levee was completed at a cost of $16,280,[70] and the land was divided among the investors of the company.[71] The levees admitted so much seepage in 1873 that the crops were destroyed.[72] Thereafter every high-water stage covered what became essentially a pasture. In some years, as 1875-76, the island did not drain until August, leaving little prospect for summer crops. In December 1876, levees two to three feet high, and of corresponding breadth, were completed.[73] Except for the February 1881 break, Rough and Ready Island remained free of floodwater until 1892. This levee break was repaired, and all levees were strengthened by a clamshell dredge which had been built for the purpose.[74] No flooding has occurred since.

---

[68] SF Bulletin, Nov. 30, 1876, in BS, Set W 4, p. 1487.

[69] W. K. Rowell, T. B. Bigelow, and other Oakland capitalists were involved. Bigelow appears to have been the major shareholder. "Agricultural Notes--San Joaquin," PRP, April 26, 1879, p. 277; "Down among the Tules," SF Bulletin, Feb. 23, 1880, in BS, Set W 4, pp. 1510-11.

[70] Report of the Commissioner of Public Works [1894], loc. cit.

[71] "Down among the Tules," SF Bulletin, Feb. 23, 1880, in BS, Set W 4, pp. 1510-11.

[72] Report of the Commissioner of Public Works [1894], loc. cit.

[73] "Swamp Land Reclamation in San Joaquin County," SWI, Dec. 2, 1876, p. 5.

[74] Report of the Commissioner of Public Works [1894], pp. 16-17.

The island was subdivided into 300- and 400-acre tracts by low levees during 1878 to localize the source of vexing seepage.[75] The ditches from which the earth was removed produced the solution to the wet ground problem. These drainage lines fell to one part of the island where pumps were installed to remove the water. Horsepower pumps were used at first but soon were replaced by pumps powered with steam produced from Mount Diablo coal. Thereafter fuel-powered equipment was employed.[76]

Rough and Ready Island contains 1,467 acres, of which 79 are levee.[77] Since early in World War II it has been developed as a United States Navy supply installation.

Roberts Island

At one time the Tide Land Reclamation Company owned a substantial part of Roberts Island. B. S. Alexander, formerly Surveyor General of California, reported that reclamation of the island was practicable. The General, who had been retained by George Roberts, anticipated favorable levee

---

[75]"Rough and Ready," SWI, Aug. 31, 1878, p. 7.

[76]"Agricultural Notes--San Joaquin," PRP, April 26, 1879, p. 277; "Down among the Tules," SF Bulletin, Feb. 23, 1880, in BS, Set W 4, pp. 1510-11. In 1881 a 10-inch centrifugal pump was placed to drain the island. Later a 15-inch pump was added. The second pump included a horizontal boiler and single-acting engine for power. The new pumps were manufactured by the San Francisco Tool Co., then initiating a long history of specializing in reclamation and irrigation equipment. "Reclaiming Land in California," MSP, April 30, 1887, p. 284.

[77]McKeag, loc. cit.

building conditions toward the south because of the presence of mineral soils. Economies in reclamation were foreseen if Middle and Old rivers were sealed so that Union Island and Roberts Island could be reclaimed as a unit.[78] Nothing came of the plan, and the company's work on Roberts Island was stalled in 1871.[79]

Following purchase of the Tide Land Reclamation Company properties by J. P. Whitney, the tract was again surveyed. Plans for draining it permanently were submitted in April of 1875.[80] Several reclamation districts were reorganized to facilitate the work.[81]

Systematic leveeing of the southern half of the island was carried out from several work camps scattered around the periphery of the present Middle Division.[82] The work was completed in the fall of 1876.[83] Thereupon the protected land was leased in parcels of 100 to 1,000 acres.[84] It was

---

78Tide Land Reclamation Co. (1872), op. cit., citing "Tide Land Report" of B. S. Alexander to George D. Roberts, p. 27.

79McKeag, op. cit., Unit 24.

80"General Report of Charles D. Gibbs, Civil Engineer, on the Examination of Roberts Island, San Joaquin County, for the Purpose of Reclamation," SWI, April 17, 1875, p. 7.

81McKeag, loc. cit.

82"Gigantic Enterprise," SWI, Sept. 25, 1875, p. 4; "Roberts Island," ibid., Aug. 21, 1875, p. 7.

83Ibid.

84"Gigantic Enterprise," SWI, Sept. 25, 1875, p. 4; "Swamp Land Reclamation in San Joaquin County," ibid., Dec. 2, 1876, p. 5; SF Bulletin, Nov. 30, 1876, in BS, Set W 4, p. 1487.

planned to strengthen the levees and to reclaim the northern part of the island in 1877. Toward the end of 1876, Whitney sold his interest in the island to Morton C. Fisher, director and major stockholder in the Glasgow Land and Reclamation Company.[85] Contract labor completed the levees and automatic tide gates in time to permit breaking the tule sod of the Lower Division in mid-1878.[86] Three million cubic yards of fill were used to construct the new levees and straighten the old ones to the south; the cost to the company was approximately $360,000.[87]

Roberts Island reclamation work was interrupted or renewed several times as the result of floods. In 1875/76 high water interrupted the reclamation of the Middle Division, but the great flood of 1878 failed to penetrate any of the three divisions of Roberts Island. The area was noteworthy as the only large tract to survive the disaster, but in early 1880 Middle and Upper divisions were flooded. Six years later Middle and Lower divisions went under water. The independently owned Pockett, adjoining Middle Division on the west, was flooded in 1890, and in 1893 virtually all of the

---

[85]The date of transfer has not been learned; it is arrived at approximately by deduction. SF Bulletin, Sept. 12, 1876, in BS, Set W 18:1, p. 193; "Swamp Land Reclamation in San Joaquin County," SWI, Dec. 2, 1876, p. 5; "Tule Farming," ibid., March 3, 1877, p. 7; An Illustrated History of San Joaquin County, p. 111.

[86]"Jordan's Landing," SWI, Aug. 31, 1878, p. 5.

[87]An Illustrated History of San Joaquin County, loc. cit.; Report of the Commissioner of Public Works /1894/, p. 16.

island was awash.[88] Apparently Middle and Upper divisions and the Pocket recovered quickly but Lower Division's restoration dates from 1897, after the Old River Land and Reclamation Company acquired holdings from the financially weakened Glasgow Land and Reclamation Company. The new organization employed six dredges on the operation.[89] The independently owned Drexler Tract was reclaimed in 1897,[90] and the Honker Lake Tract in 1900.[91] With the exception of Lower Division, which flooded in mid-1906,[92] the Roberts Island lands have remained disaster-free.

The levees of the Roberts Island districts occupy 10 per cent of the Pocket's 540 acres, 5 per cent of Honker Lake's 2,180 acres, 4 per cent of the 3,140 acres in the Drexler Tract, 3.7 per cent of the exposed Upper Division's 7,646 acres, 2.3 per cent of the 10,600-acre Lower Division, and 1.6 per cent of Middle Division's 11,900 acres. Up to 2.5 per cent of the various districts is used for non-farm purposes.[93]

---

[88]Except for documentation cited below, the paragraph is based on Appendix A, "Floods in the Delta."

[89]Cosby, op. cit., p. 17, SDI, Oct. 17, 1897, p. 6.

[90]Cosby, op. cit., p. 154, from memo of Atherton interview by Moorehead.

[91]Cosby, op. cit., p. 34, SDI, April 10, 1900, p. 5.

[92]See Appendix A, "Floods in the Delta."

[93]McKeag, op. cit., Units 23 and 24.

Union Island

Originally Union Island comprised the present Union Island, the Fabian Tract, Victoria Island, and the upper half of Woodward Island. It was another area where the Tide Land Reclamation Company owned a great deal of land. The first levee enclosure of any size was made in 1872, but was washed out in the spring of 1876.[94] Under the supervision of Captain W. C. Walker, partner and general superintendent in the company, 45 miles of levee were under construction in the fall and winter of 1876. A number of white engineers, foremen, and carpenters, and up to 1,000 Chinese laborers were employed. Later on the project was directed by General T. H. Williams of Grand Island.[95]

The levee built on Union Island was unique for its time. Instead of an initial small structure, to which fill was added over a period of years as necessity dictated, a large structure was built at the outset. The base averaged 50 feet from toe to toe; the crown was 5 feet across when made of alluvium and 20 feet across when made of peat; it was 8 to 10 feet high. The levee was set back 200 feet from the river. A borrow pit 120 to 160 feet wide and 3 to 4 feet deep was excavated in front of the levee. Parcels of land

---

[94]McKeag, op. cit., Unit 25.

[95]Illustrations of Contra Costa Co., . . . , p. 8; "Reclamation of Union Island," SWI, July 1, 1876, p. 7.

were cut off to preserve a fairly straight levee line. The structure was completed in 1877.[96]

In the fall and early winter of 1878 General Williams began to build an eastern and southern cross levee to protect his northwestern two-thirds of Union Island from recurrence of floods of February 1878 proportions. The water had come onto his land as a result of a levee break that occurred on the neighboring Pescadero land grant part of the island. Williams built the cross levee after failing to induce the grant owner, General H. E. Naglee, to construct larger levees along Old River.[97] The Williams property was fully enclosed by 1880. Four years later the eastern third of the present Union Island was reclaimed, but both it and the main Williams holding were flooded in 1890. Within a year the eastern property had recovered. The main portion of Union Island was re-leveed between 1894 and 1897, on a larger scale than any earlier work, Williams having secured the aid of the Old River Land and Reclamation Company to dredge the Grant Line and North canals as well as to strengthen other levees. In consideration of its contributions, the company received a 10-year lease to western Union Island and title to Victoria Island, freshly severed from Union Island by North and

---

[96]"Swamp Land Reclamation in San Joaquin County," SWI, Dec. 2, 1876, p. 5; "A Ride through the Tule Country," ibid., Sept. 1, 1877, p. 5.

[97]"Union Island Levees," SWI, Sept. 21, 1878, p. 5; "Union Island," ibid., Dec. 7, 1878, p. 7; An Illustrated History of San Joaquin County, p. 190; "Through San Joaquin County," SF Bulletin, March 29, 1879, in BS, Set W 4, p. 1503.

Victoria canals. Victoria was sold after reclamation to Oregon capitalist-farmers.[98]

Union Island remains unique among the delta tracts in the administrative organization handling its reclamation needs. Two protection districts, formed in February 1903, operate on behalf of the landowners. The organizations have boards of trustees which call for assessments based on county valuations, and which are collected on county tax rolls.[99] Elsewhere reclamation assessments are made on an acreage basis.

The Union Island levees and berms cover about 860 acres. Crop land occupies 23,760 acres, and water surfaces occupy 170 acres.[100]

Pescadero Properties

Reclamation of the land grant property at the southern end of the delta followed the construction of a 750-foot dam across the head of Paradise Cut, the second distributary into which the San Joaquin River divides as it enters the delta. Some 400 men constructed the seven-foot-high earth barrier and prepared 2,000 acres for cultivation near Old River

---

[98]Cosby, _op. cit._, p. 154, from memo of Atherton interview by Moorehead; _ibid_., pp. 12-13, _SDI_, May 8, 1897; _ibid_., p. 22, _SDI_, Sept. 16, 1897, p. 5; _ibid_., pp. 20-21, _SDI_, June 19, 1898, p. 3.

[99]McKeag, _loc. cit_.

[100]_Ibid_.

during the spring of 1877. Other crews completed the levees on the Pescadero part of Union Island.[101]

Floods in February and May 1878, July 1890, February and May 1901, and in July 1906 interrupted improvement work on the lands.[102] The Fabian and Bell levees were strengthened in 1898 by dredges,[103] and after the 1906 inundation. The properties along Paradise Cut were being thoroughly reclaimed in the latter 1890's.[104]

The Fabian and Bell Tract and Reclamation Districts 2058 and 2062 have about 8 per cent of their areas devoted to levees and berms, water surfaces, and non-agricultural land. Respectively, 6, 4.4, and 5.4 per cent of the tracts are devoted to levees. These are more exposed to floods than the higher land between Old River and Tracy served by irrigation districts. On the higher areas, the 3,196-acre Naglee-Burke Irrigation District, 724-acre Fremont Irrigation District, and the 2,288 acres of the Independent Mutual Water Company and Holly Sugar, less than 3 per cent of the land is in levees. The proportion is unusually low for the delta's smaller districts.[105]

---

[101] "Reclamation," SWI, March 3, 1877, p. 5; Cosby, "Notes," p. 38, SDI, Feb. 27, 1877, p. 3.

[102] See Appendix A, "Floods in the Delta."

[103] Cosby, "Delta History Notes," pp. 20-21, SDI, June 19, 1898, p. 3.

[104] Cosby, "Delta History Notes," p. 29, SDI, Sept. 13, 1899, p. 2.

[105] McKeag, op. cit., Units 25 and 27.

The Mokelumne and Calaveras Mainland

Formerly a zone of backswamp existed between the eastern plains and the delta islands, and between the Mokelumne and Calaveras rivers. For many years the land was used for pasture. Beginning in the dry years of the 1860's a little farming was attempted. Then and in the next decade reclamation was pushed with vigor in several districts facing the Mokelumne and north of the Calaveras. Reclamation of the northern group of districts, those on the Mokelumne, was essentially completed between 1880 and 1890. Included in this group were the lands of the present New Hope Tract (R.D. 348), the Canal Ranch Tract, Brack Tract (R.D. 2033), and Terminous Tract (R.D. 584). Reclamation of the districts near the Calaveras and to the north of it was accomplished a decade or two later. This area includes the Smith Tract (R.D. 1608), the Sargent-Barnhart Tract (R.D. 2074), Fox Ranch, State Farm, and March Garden and Brookside lands. The second Smith Tract (R.D. 1616), which is to the south of the Calaveras, was reclaimed after 1900.

Between the Mokelumne and Calaveras segments are a number of districts which, because their reclamation was post-1900, are grouped for discussion with the similar components of the Central Delta. The intermediate lands are the Elmwood, Wright, Rindge (R.D. 2037), Shima, and Atlas tracts.

Mokelumne Tracts

Reclamation in the area between the Mokelumne River and the Terminous Tract was furthered by a pioneer rancher who settled on the margins of the delta about eight miles west of Lodi. This stockman of the Gold Rush, Ross C. Sargent, was unique among delta land developers; he intended to reclaim land so that it could be sold to individual settlers. At their maximum, his delta holdings included the home ranch, roughly the Terminous and Shin Kee tracts, the New Hope Tract, and all but 640 acres of the Canal Ranch and Brack Tract.[106]

The New Hope and Terminous tracts were partially improved during the 1860's in pursuance with Board of Reclamation plans. The home ranch was leveed in 1872;[107] it and the New Hope Tract were further improved in 1876.

Before he had sold much of the New Hope Tract, Sargent purchased, at from $5 to $15 per acre, almost all the land between it and the home ranch. His reason for doing so was to eliminate small landowners who did not wish to build the large levees which he considered essential to the protection of the entire area.[108]

---

[106] An Illustrated History of San Joaquin County, pp. 552-53.

[107] Browne, loc. cit., p. 402.

[108] "Fertile Fields," SF Post, June 16, 1879, in BS, Set W 18:2, p. 349.

In 1878 levees were built simultaneously from the high land down the Mokelumne and the sloughs which flank the Terminous Tract, and along the South Fork of the Mokelumne. Lateral sloughs crossed in the course of construction were fitted with dams and tide gates.[109]

The Sargent lands were desirable and reasonably priced. They were more attractive than islands in the delta because they provided immediate access to high land, an advantage when stock had to be evacuated because of floods. There were sales of about 1,200 acres in 1877, and 3,500 acres in the fall of 1878. The sales were made on easy five-year terms which yielded Sargent about $20 per acre. Leases also were available.[110]

The New Hope Tract was reclaimed between 1880 and 1884, and the Brack and Terminous tracts were reclaimed in 1886.[111] There were over 13,000 acres of cultivated land in the various districts in 1889.[112] Major known interruptions to crop-land expansion occurred during the floods of 1880, 1886, 1899, 1900, 1904, and 1907.[113]

---

[109] "Extensive Reclamation Work," SWI, Oct. 26, 1878, p. 5.

[110] "Agricultural Selections," SF Bulletin, Dec. 7, 1877, in BS, Set W 18:2, p. 250; "Fertile Fields," SF Post, June 16, 1879, in BS, Set W 18:2, p. 349; SWI, Nov. 2, 1878, p. 5.

[111] Cosby, "Delta History Notes," p. 153, from memo of Atherton interview by Moorehead.

[112] An Illustrated History of San Joaquin County, p. 553.

[113] See Appendix A, "Floods in the Delta."

Modern levees occupy 2.5 per cent of New Hope's 9,860 acres, 3.3 per cent of the Brack Tract's 4,855 acres, and 5 per cent of the 3,314-acre Canal Ranch. The New Hope Tract contains about 250 acres of non-agricultural land, while the other two districts are almost devoid of non-producing area.[114]

Calaveras Tracts

Serious reclamation work was begun to the north of the Calaveras River in the spring of 1875. A number of capitalists, among whom S. C. Hastings, G. F. Smith, and H. Barnhart were most important, owned all of the swamp and overflowed land between the river, the San Joaquin, and Twentyone Mile Slough. Apparently the bulk of the 10,600 acres involved was purchased from Hastings and the Tide Land Reclamation Company.[115]

The whole tract was leveed in 1876. The two- to five-foot-high embankments were raised to an average height of six or seven feet in 1877. Levees were 40 to 50 feet wide from toe to toe.[116] Following the 1878 flood, the area seems to have been neglected for at least a decade. The Sargent-Barnhart Tract levees were built by suction dredge in 1888;[117]

[114]McKeag, op. cit., Unit 19.

[115]"Reclaiming the Tide Lands," SWI, April 10, 1875, p. 5; "More Reclamation," ibid., April 7, 1877, p. 7.

[116]Ibid.

[117]McKeag, op. cit., Unit 21.

further levee work resulted in strong protection after 1896. The Smith Tract was reclaimed in 1897,[118] and the remaining Calaveras properties were well leveed by 1900.[119]

Levees occupy between 5.2 and 6.9 per cent of the area of the various tracts that front on waterways in the Calaveras River vicinity. The parcels of land vary in area from the 188-acre Fox Ranch to the 2,085-acre Stockton Acres area,[120] now broken up into a residential subdivision.

West Delta Districts

Most of the land which slopes toward Old River from the west and toward the San Joaquin from the Antioch-Brentwood vicinity was claimed by settlers before 1870. The alluvial plains were then undergoing a transformation from open range into fields of dry-farmed grain.[121] The backswamp and island areas were in an early stage of reclamation. Protected land was sold and then customarily leased to Chinese and Italian gardeners who paid $10 to $20 per acre annually.[122]

---

[118] Cosby, "Delta History Notes," p. 154, SDI, April 15, 1896, p. 3.

[119] DWR Bull. No. 27, Plate XXXIV.

[120] McKeag, *op. cit.*, Unit 21.

[121] *Illustrations of Contra Costa Co., . . .*, pp. 29-31; "Sherman Island," PRP, Feb. 20, 1875, p. 124.

[122] Contra Costa County Board of Trade, *Contra Costa County, . . .*, pp. 8-9.

The most grandiose reclamation plan in this area was initiated by George D. Roberts, in partnership with other men, but independent of the Tide Land Reclamation Company. The swamp area to be improved adjoined dry land to the south of Jersey Island and comprised the present Webb (R.D. 2026), Franks, and Bethel (R.D. 1619) tracts, and Bradford (R.D. 2059) and Jersey (R.D. 830) islands.[123]

This area was considered to possess the same advantage over the island parts of the delta that the Calaveras-Mokelumne lands had. It was contiguous with firm land, enabling stock raisers to drive their animals to high land when floodwaters rose. From the standpoint of reclamation, it was thought that costs would be lower because the landward side of the tract did not have to be leveed.[124] The levee was built between 1870 and 1872 at a cost of about $4 per acre enclosed. Its completion transformed swampland valued at less than $2 per acre into land worth $40 to $50 per acre.[125]

It appears that Bradford Island and Bethel Tract (then Sand Mound Ranch) were sold to other developers in 1872. Levees were raised and strengthened on each property, in spite of which floods in 1873-74 washed onto the pastureland and small areas of field crops. Jersey Island (and probably all of the other tracts) went under in 1878. It

---

[123] Hoag, <u>loc. cit</u>., p. 342.

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

[125] Browne, <u>loc. cit</u>., p. 402.

was restored in 1879.[126] Several other floodings are understood to have occurred. Among those which are certain were inundations of Jersey Island in 1898, 1900, 1907, 1908, and 1909; and of Bethel Tract in 1907, 1908, and 1911. Franks Tract, reclaimed by modern methods between 1902 and 1906, was flooded in 1907.[127] Presumably, the floods washed over adjoining tracts on the west side; the Holland Tract was not permanently reclaimed until 1910 and the Webb Tract in 1912.[128] Levees are most difficult to maintain in this area; Franks Tract was finally abandoned after levee breaks in 1936 and in 1938.[129] The Webb Tract was inundated in 1950, and restored in 1952. Bradford Island levees broke in 1955.

Initial reclamation of the Byron Tract (R.D. 800) began in 1870 with a four-and-a-half-foot levee along Old River, and was completed in 1874. A flooding in 1875 was followed by the 1877 to 1879 enlargement of levees to the south.[130] Breaks undoubtedly occurred subsequently because the land was not fully reclaimed until about 1900.[131] The Clifton Court Tract (R.D. 802), to the south, was reclaimed

---

126"The Tule Lands of the San Joaquin," <u>SF Bulletin</u>, March 24, 1879, in <u>BS</u>, Set W 18:2, p. 336.

127See Appendix A, "Floods in the Delta."

128Cosby, "Delta History Notes," p. 154, from memo of Atherton interview by Moorehead.

129See Appendix A, "Floods in the Delta."

130McKeag, <u>op. cit</u>., Unit 17.

131Cosby, <u>loc. cit</u>.

in 1898 or 1899.[132] Coney Island (R.D. 802), east of Clifton Court, was reclaimed sometime between 1893 and 1897. All of them were flooded in 1907.[133]

The land between the Byron and Holland tracts was leveed after 1900. Veale Tract, the highest and more northerly part of this area, was diked in 1900 and farmed two years later.[134] Palm (R.D. 2036) and Orwood (R.D. 2024) tracts, along Old River, were reclaimed around 1902-6. The former was under water in 1907.[135]

Today's levees on the west side occupy from 2.7 per cent of tract areas, in the case of the high Hotchkiss Tract, to 10 per cent, in the case of Coney Island. The island is small (1,000 acres) and exposed. Levees occupy an average of 4.8 per cent of the area of the other tracts. With the exception of much-subdivided Bethel Tract, where about 6 per cent of the land is non-agricultural, these districts are almost entirely devoted to farming or pastoral activities.[136]

---

[132] Cosby, "Delta History Notes," p. 21, SDI, June 19, 1898, p. 3.

[133] Cosby, "Delta History Notes," p. 46, SDI, Feb. 26, 1901, p. 8; "Marvelous Coney Island," Sixth Special Booster Edition of the Byron Times, p. 20; see Appendix A, "Floods in the Delta."

[134] Cosby, "Delta History Notes," p. 83, SDI, Oct. 4, 1902, p. 3.

[135] Cosby, "Delta History Notes," p. 154, from memo of Atherton interview by Moorehead; McKeag, loc. cit.; see Appendix A, "Floods in the Delta."

[136] McKeag, op. cit., Units 15, 16, 17, and 25.

North Delta Margin

The delta tracts to the north of Freeport include Reclamation Districts 673, 535, 824, 900, 765, and 307. The first three are east of the Sacramento River and north of Freeport. District 673 is also known as the Pocket District. District 824 is the Freeport District. The second three tracts are west of the river. District 307 is also known as the Lisbon District; District 765 is Glide.

Settlers occupied the banks of the river and began to build levees in the 1850's. The flood defenses were enlarged in the 1870's to withstand the pressures of flood in the debris-choked Sacramento, but reclamation came later: in 1891-95 for the Pocket and District 535; in 1911-14 for the others.[137]

The modern levees occupy an average of 5.4 per cent of the area of the districts east of the river, and 3.7 per cent of the larger districts to the west. While the area devoted to levees is normal for the delta, the eastern districts have an unusually large 5 per cent or more of their areas devoted to non-agricultural activity. The 11,266-acre west-bank district west of Sacramento (R.D. 400) has one third of its area in industrial and municipal improvements and water surfaces. Its suburban and port developments, its location far north of the delta distributaries, and elevation and soil factors place this district out of the delta as conceived in this

---

[137] McKeag, op. cit., Units 2 and 3.

paper; however, the unit is discussed because public agency delta studies include it.[138]

Central Delta

In the central part of the delta are a number of great islands and mainland segments which are predominantly peat and where natural levees were comparatively little developed. Attempts to reclaim these tracts in the late 1860's and 1870's were unsuccessful. Completion of the projects required a lot of capital and stronger incentives than existed so long as nearby areas could be reclaimed more easily and less expensively. Even these would not have been adequate before efficient pumps and the clamshell dredge were perfected toward the end of the century.

Woodward Island (R.D. 2072) was reclaimed in 1902. Upper Jones (R.D. 2039) and Lower Jones (R.D. 2038) tracts were reclaimed in 1900-2 and 1905-6, respectively;[139] they were flooded in 1906-7, but remained dry thereafter. Venice Island (R.D. 2023) was reclaimed in 1906, but floods in 1906, 1907, 1909, 1938, and 1950 have made it a costly investment.[140] The Rindge Tract (R.D. 2037), leveed during

---

[138] DWR Bull. No. 27; McKeag, op. cit., Unit 2.

[139] "Story of Beautiful Woodward Island," Special Booster Edition of the Byron Times, not paginated; Cosby, loc. cit.; Rogers, loc. cit., July 12, 1951, p. 19.

[140] Cosby, loc. cit.; see Appendix A, "Floods in the Delta."

1905-07,[141] and Victoria Island (R.D. 2040), leveed in 1905,[142] were flooded in 1907. Empire Tract (R.D. 2029) was leveed in 1909; King Island (R.D. 2044), Bishop Tract (R.D. 2042), Shima Tract, McDonald Island (R.D. 2030), and Quimby Island were reclaimed in 1913-14.[143] Elmwood Tract was reclaimed sometime between 1910 and 1915.[144] Bacon Island (R.D. 2028) and Medford Island were ready for farming in 1916, and Mandeville (R.D. 2027) in 1918.[145] Mildred Island was partially leveed by 1913, completely protected in 1918-20, and farmed in 1921.[146] With the exception of Mandeville and Quimby islands and the Empire Tract, these reclaimed districts have not had the continuity of productive use broken by floods. Mandeville was inundated in 1938, Quimby in 1938 and 1955, and the Empire Tract in 1955.[147]

The small islands of the central delta, Mildred, Medford, and Woodward, and the larger islands with irregular levee lines, Venice and Bouldin, have more than 5 per cent of their area in levees. The more compact larger units like

---

[141]McKeag, _op. cit._, Unit 21.

[142]Cosby, _loc. cit._; see Appendix A, "Floods in the Delta."

[143]_Ibid._; "Picturesque Jersey Island," _Sixth Special Booster Edition of the Byron Times_, p. 117; Rogers, _loc. cit._, July 18, 1951, p. 21; McKeag, _op. cit._, Unit 22.

[144]_San Joaquin County, California, for the Farmer_, p. 7.

[145]Cosby, _loc. cit._,; McKeag, _loc. cit._

[146]_Ibid._

[147]See Appendix A, "Floods in the Delta."

McDonald and Victoria islands and the Jones tracts have 2.3 to 3.5 per cent of their areas in protective works. On these large land units, and on Venice and Mandeville islands, 5 or 6 per cent of the enclosed area may be water surface. Channels and swamp areas within the other districts are more restricted.[148]

Sacramento Basin Districts

The Sacramento Basin was a backswamp area until 35 to 45 years ago. In its lowest parts were aligned, from north to south, the Sacramento Drainage Canal, two small lakes, and Snodgrass Slough. Organic and fine alluvial soils became available as reclamation confined the flood-basin to smaller areas.

Reclamation began along the river in the 1850's. The higher districts were not effectively reclaimed until between 1890 and 1910,[149] and the basin land until the decade 1910-20.

Deadhorse Island, between Walnut Grove and Staten Island, was leveed in 1900 but remains a flood-prone 220 acres. The adjacent 1,688-acre McCormack-Williamson Tract was reclaimed around 1919, about six or seven years after the more northerly Reclamation District 1002 and the Ehrhardt

---

[148] McKeag, op. cit., Units 18, 21, 22, and 23.

[149] McKeag, op. cit., Unit 8.

Club.[150] The latter two properties were reclaimable partially because the elevated roadbed of the Southern Pacific branch line to lower Andrus Island provided a levee, as it did for small districts to the north. The borrow pit for the railroad provides both drainage and a source of irrigation water for flanking tracts.[151]

Levees occupy only 1.5 per cent of Reclamation District 1002, which contains a large area of land lying above the 10-foot contour. The lower reclamations are 7.4 per cent levee at the Ehrhardt Club and the McCormack-Williamson Tract, and 12 per cent levee and berm on Deadhorse Island. The club has 100 acres of pond within it, or about 16 per cent of the district's area.[152]

Yolo Basin Districts

The swamp and overflowed lands of the Yolo Basin were purchased by settlers and land agents from the state between 1858 and 1874,[153] but important gains in reclamation did not occur until after 1912. The reclamations are grouped as the Cache Slough and the Holland districts.

Cache Slough Districts

The Egbert Tract (R.D. 536) was farmed between 1870 and 1890, there being a modest levee protection at the time.

---

[150] Initially the Ehrhardt Club tract was a private duck-hunting ground.

[151] McKeag, loc. cit.

[152] Ibid.

[153] McKeag, op. cit., Units 9, 10, and 11.

Additional work, costing $71,000, was performed along Lindsey and Cache sloughs between 1892 and 1901. The 1902 flood ruined everything,[154] and the area was not improved again until 1909. It was fully protected with large levees in 1912, at a cost of $151,000.[155] In 1942-43 the Yolo By-Pass levee was extended through the Egbert District, thus placing Reclamation District 2084 within the By-Pass. Here, and within the flood channel zone to the north, the district levees are restricted to a height of 11½ feet so that flood flows may pass.

The districts that lie within the Yolo By-Pass are subject to flooding at any time that the flow of the Sacramento River system reaches a volume which requires opening weirs across from the Feather River mouth and upstream from the American River mouth. The other districts are leveed to withstand anticipated By-Pass flows.

Reclamation of the tracts to the north of Lindsey Slough occurred during the First World War. Until then the land had been used for pasture and for an occasional summer crop of beans. The new districts were diked by the Liberty Farms Company, the Holland Land Company, the Prospect Island Farms Company, and the Bay and River Dredging Company (W. H. and W. Q. Wright). Liberty Island, the Little Holland Tract,

---

[154] Mr. W. A. Beard on private reclamations, "Swamp Land Reclamation," Commonwealth Club of Calif., Transactions, IV (Sept. 1909), p. 302.

[155] McKeag, op. cit., Unit 9.

Prospect Island (R.D. 1667), Moore Tract, the Maine Prairie Tract, and the Hastings Tract were the areas involved.[156] Their levees occupy 5.3 to 7 per cent of district lands.

Holland District

The core of the Holland District (R.D. 999) was once owned by the Tide Land Reclamation Company and General T. H. Williams, but no reclamation occurred following the failure of the project which had been approved in the 1860's by the Board of Reclamation Commissioners. The present tract was created by a special act of the legislature in 1913. Its western edge adjoins the Yolo By-Pass, and it is flanked by Ryer, Sutter, and Merritt islands, and the Lisbon District.

The Netherlands Farms Company owned about 80 per cent of the district and was the active agent in the first modern reclamation attempt. Financial difficulties resulted in the transfer of ownership to the Holland Land Company in 1916,[157] which reclaimed the land within the next two years. In the process, over 10,000,000 cubic yards of earth were moved into levees by the 5 to 12 clamshell dredges which were used on the project. As many as 50 traction engines were operated to

---

[156] *Ibid.*, and Units 10 and 11; *Fourth Biennial Report of the Reclamation Board of California*, p. 31; *Control of Floods on the Mississippi and Sacramento Rivers*, p. 133.

[157] The backers of the company were J. V. Mendenhall, Mark L. Gerster, Wm. Timson, John H. Wheeler, Lawrence W. Harris, Fred W. Kiesel, John Daniel, W. A. Richardson, and Arthur J. Ottem.

improve the land. For drainage and irrigation, a main and 18 lesser pumping stations were erected.[158] No floods have damaged the tract since reclamation was completed.

Levees and berms occupy about 2.4 per cent of the 25,990-acre district. Water surfaces cover 1,060 acres, and the residences and sugar refinery of Clarksburg occupy 265 acres.[159]

---

[158] Russell *et al.*, *op. cit.*, p. 152; "Holland Land Company," *Sixth Special Booster Edition of the Byron Times*, p. 116.

[159] McKeag, *op. cit.*, Unit 6.

BIBLIOGRAPHY

U.S. Congressional Publications

U.S. Congress. House. California and New Mexico. 31st Cong., 1st Sess., Ex. Doc. No. 17. Washington: 1850.

________. House. Mining Debris in Sacramento River. 46th Cong., 2d Sess., Ex. Doc. No. 69. Washington: 1880.

________. House. Mining Debris in California Rivers. 47th Cong., 1st Sess., Ex. Doc. No. 98. Washington: 1882.

________. House. The Public Domain; Its History, with Statistics, ... 47th Cong., 2d Sess., Misc. Doc. 45, pt. 4. Washington: 1884.

________. House. Mining Debris, California. 51st Cong., 2d Sess., Ex. Doc. No. 267. Washington: 1891.

________. House. Improvement of Sacramento and Feather Rivers, California. 55th Cong., 3d Sess., H. Doc. 48. Washington: 1898.

________. House. Survey of San Joaquin River and Stockton and Mormon Channels, California. 55th Cong., 3d Sess., H. Doc. 152. Washington: 1899.

________. House. Sacramento River, California. 60th Cong., 2d Sess., H. Doc. 1123. Washington: 1908.

________. House. Reports on the Control of Floods in the River Systems of the Sacramento Valley and the Adjacent San Joaquin Valley, California. 62d Cong., 1st Sess., H. Doc. 81. Washington: 1911.

________. House. Stockton and Mormon Channels, San Joaquin River, California, Including the Diversion Canal. 63d Cong., 1st Sess., H. Doc. 256. Washington: 1913.

________. House. Control of Floods on the Mississippi and Sacramento Rivers. 64th Cong., 1st Sess., Report No. 616. Washington: 1916.

U.S. Congress. House. San Joaquin River, California, Up to Herndon. 65th Cong., 1st Sess., H. Doc. 332. Washington: 1917.

_________. House. Water Terminal and Transfer Facilities. 66th Cong., 2d Sess., H. Doc. 652, Vol. 26, pt. 1. Washington: 1921.

_________. House. San Joaquin River and Stockton Channel, California. 68th Cong., 2d Sess., H. Doc. 554. Washington: 1925.

_________. House. Sacramento and San Joaquin Rivers, California. 69th Cong., 1st Sess., H. Doc. 123. Washington: 1925.

_________. House. Partial Report from the Chief of Engineers on Sacramento, San Joaquin, and Kern Rivers, California, Covering Navigation, Flood Control, Power Development, and Irrigation. 71st Cong., 3d Sess., H. Doc. 791. Washington: 1931.

_________. House. Sacramento, San Joaquin, and Kern Rivers, California. 73d Cong., 2d Sess., H. Doc. 191. Washington: 1934.

_________. House. Sacramento Valley, California, within the Existing Flood-Control Project. 77th Cong., 1st Sess., H. Doc. 205. Washington: 1941.

_________. House. Sacramento River and Tributaries, California, from Collinsville to Shasta Dam. 78th Cong., 2d Sess., H. Doc. 649. Washington: 1944.

_________. House. San Joaquin River and Stockton Channel, California. 80th Cong., 2d Sess., H. Doc. 752. Washington: 1948.

_________. House. Sacramento-San Joaquin Basin Streams, California. 81st Cong., 1st Sess., H. Doc. 367. Washington: 1950.

_________. House. Committee on Interior and Insular Affairs. Authorizing Documents. Part One of Central Valley Project Documents. 84th Cong., 2d Sess., H. Doc. 416. Washington: 1956.

_________. Senate. Report of the Secretary of War, Communicating Information in Relation to the Geology and Topography of California. 31st Cong., 1st Sess., Ex. Doc. 47, pt. I. Washington: 1850.

U.S. Congress. Senate. Report of the Secretary of War, in Further Compliance with the Resolutions of the Senate Calling for Copies of Reports on the Geology and Topography of California. 31st Cong., 1st Sess., Ex. Doc. No. 47, pt. II. Washington: 1850.

________. Senate. Petition of John A. Sutter. 39th Cong., 1st Sess., Misc. Doc. No. 38. Washington: 1866.

________. Senate. Report of the Joint Special Committee to Investigate Chinese Immigration. 44th Cong., 2d Sess., Report No. 689. Washington: 1877.

________. Senate. Flood Control in the Sacramento and San Joaquin River Systems. 69th Cong., 1st Sess., S. Doc. 23. Washington: 1926.

________. Senate. Sacramento River, California. 79th Cong., 2d Sess., S. Doc. 142. Washington: 1946.

________. Senate. Department of the Interior. Bureau of Reclamation. Central Valley Basin. 81st Cong., 1st Sess., S. Doc. 113. Washington: 1949.

U.S. Departmental Publications

U.S. Department of Agriculture. Celery Growing, by W. R. Beattie. Farmers' Bulletin No. 1269. 2d rev. ed. Washington: 1944.

________. Climate and Man; Yearbook of Agriculture, 1941. Washington: 1941.

________. The Handling, Shipping, and Cold Storage of Bartlett Pears in the Pacific Coast States, by J. R. Magness. Bulletin No. 1072. Washington: 1922.

________. Pear Growing in the Pacific Coast States, by C. F. Kinman and J. R. Magness. Farmers' Bulletin No. 1739. Rev. ed. Washington: 1949.

________. Potato Growing in Western States, by W. C. Edmundson, L. A. Schaal, and B. J. Landis. Farmers' Bulletin No. 2034. Washington: 1951.

________. "Reclamation of Swamp and Overflowed Lands in California," in Report of the Commissioner of Agriculture for the Year 1872. Washington: 1874.

U.S. Department of Agriculture. Bureau of Chemistry and Soils. Peat Land in the Pacific Coast States in Relation to Land and Water Resources, by A. P. Dachnowski-Stokes. Misc. Pub. No. 248. Washington: 1936.

________. Bureau of Chemistry and Soils. In Cooperation with the University of California Agricultural Experiment Station. Soil Survey of Contra Costa County, California, by E. J. Carpenter and S. W. Cosby. Series 1933, No. 26. Washington: 1939.

________. Bureau of Chemistry and Soils. In Cooperation with the University of California Agricultural Experiment Station. Soil Survey of the Dixon Area, California, by S. W. Cosby and E. J. Carpenter. Series 1931, No. 7. Washington: 1935.

________. Bureau of Chemistry and Soils. In Cooperation with the University of California Agricultural Experiment Station. Soil Survey of the Lodi Area, California, by S. W. Cosby and E. J. Carpenter. Series 1932, No. 14. Washington: 1937.

________. Bureau of Chemistry and Soils. In Cooperation with the University of California Agricultural Experiment Station. Soil Survey of the Suisun Area, California, by E. J. Carpenter and S. W. Cosby. Series 1930, No. 18. Washington: 1930.

________. Bureau of Plant Industry. Potato Diseases in San Joaquin County, California, by W. A. Orton. Circular No. 23. Washington: 1909.

________. Bureau of Plant Industry. In Cooperation with the University of California Agricultural Experiment Station. Soil Survey of the Sacramento-San Joaquin Delta Area, California, by Stanley W. Cosby. Series 1935, No. 21. Washington: 1941.

________. Bureau of Plant Industry, Soils, and Agricultural Engineering. In Cooperation with the University of California Agricultural Experiment Station. Soil Survey of the Stockton Area, California, by John L. Retzer et al. Series 1939, No. 10. Washington: 1951.

________. Bureau of Plant Industry, Soils, and Agricultural Engineering and Soil Conservation Service. In Cooperation with the University of California Agricultural Experiment Station. Soil Survey of the Tracy Area, California, by Ralph C. Cole et al. Series 1938, No. 5. Washington: 1943.

U.S. Department of Agriculture. Bureau of Soils. "Reconnaissance Soil Survey of the Lower San Joaquin Valley, California," by J. W. Nelson et al., in _Field Operations of the Bureau of Soils, 1915 (Seventeenth Report)_. Washington: 1919.

________. Bureau of Soils. "Reconnaissance Soil Survey of the Sacramento Valley, California," by L. C. Holmes et al., in _Field Operations of the Bureau of Soils, 1913 (Fifteenth Report)_. Washington: 1916.

________. Bureau of Soils. _Soil Survey of the Woodland Area, California_, by C. W. Mann _et al_. Washington: 1911.

________. Office of Experiment Stations. _Irrigation in the Sacramento Valley, California_, by Samuel Fortier _et al_. Bulletin 207. Washington: 1909.

________. Office of Experiment Stations. _Irrigation Resources of California and Their Utilization_, by Frank Adams. Bulletin 254. Washington: 1913.

________. Soil Conservation Service. In Cooperation with the University of California Agricultural Experiment Station. _Soil Survey of the Sacramento Area, California_, by Ralph C. Cole. Series 1941, No. 11. Washington: 1954.

________. Weather Bureau. _The Rivers and Floods of the Sacramento and San Joaquin Watersheds_, by Nathaniel R. Taylor. Bulletin 43. Washington: 1913.

U.S. Department of Commerce and Labor. _The Salmon Fisheries of the Pacific Coast_, by John N. Cobb. Bureau of Fisheries Document No. 751. Washington: 1911.

U.S. Department of the Interior. Bureau of Land Management. "Report of the Director of the Bureau of Land Management, 1950," with Statistical Appendix. Washington: N.d. (Mimeographed.)

________. Bureau of Reclamation. "Allocation of Costs; Problems 8-9," Appendix E in _Report of Subcommittee on Salinity_. Central Valley Project Studies. Washington: 1947.

________. Bureau of Reclamation. _Economic Effects; Problem 24_. Central Valley Project Studies. Washington: 1949.

U.S. Department of the Interior. Bureau of Reclamation. "Report of Committee on Problem 10" (1944), in _Payments by Beneficiaries; Problems 10 to 13_. Washington: 1947.

________. General Land Office. "Field Notes of Rancho 'Los Meganos,'" surveyed by E. H. Dyer in December 1861. Field Notes 502, Folio 2E. [At Bureau of Land Management, Survey Records Office, Sacramento.] (Handwritten.)

________. General Land Office. "Field Notes of the Exterior Lines of Township 4 North, Range 3 East, Mount Diablo Meridian, California," surveyed by Wm. J. Lewis, completed in January 1859. Field Notes 66, Folio 4. [At Bureau of Land Management, Survey Records Office, Sacramento.] (Handwritten.)

________. General Land Office. "Field Notes of the Final Survey of Rancho Los Ulpinos, John Bidwell, California," surveyed by Wm. J. Lewis, completed in October 1858. Field Notes A, Folio 39. [At Bureau of Land Management, Survey Records Office, Sacramento.] (Typewritten.)

________. General Land Office. "Field Notes of the Meander Lines of Township 1 North, Range 5 East, Mount Diablo Meridian, California," surveyed by W. F. Benson, completed in January 1879. Field Notes 189, Folio 3. [At Bureau of Land Management, Survey Records Office, Sacramento.] (Handwritten.)

________. General Land Office. "Field Notes of the Subdivision Lines and Boundaries of Township 1 South, Range 3 East, Mount Diablo Meridian, California," surveyed by E. H. Dyer, completed in June 1862. Field Notes 191, Folio 8. [At Bureau of Land Management, Survey Records Office, Sacramento.] (Handwritten.)

________. General Land Office. "Field Notes of the Subdivision Lines and Meanders of Township 5 North, Range 4 East, Mount Diablo Meridian, California," surveyed by Wm. J. Lewis, completed in January 1859. Field Notes 66, Folio 11. [At Bureau of Land Management, Survey Records Office, Sacramento.] (Handwritten.)

________. General Land Office. "Field Notes of the Subdivision Lines and Meanders of Township 3 North, Range 2 East, Mount Diablo Meridian, California," [surveyed ca. 1862]. [At Bureau of Land Management, Survey Records Office, Sacramento.] (Copy.)

U.S. Department of the Interior. General Land Office. "Field Notes of the Subdivision Lines of Township 6 North, Range 4 East, Mount Diablo Meridian, California," surveyed by Wm. J. Lewis, completed in December 1856. Field Notes 66, Folio 14. [At Bureau of Land Management, Survey Records Office, Sacramento.] (Handwritten.)

________. General Land Office. "Field Notes of the Subdivision of Fractional Township 1 North, Range 3 East, of Mount Diablo Meridian, California," surveyed by E. H. Dyer, completed in June 1862. Field Notes 191, Folio 9. [At Bureau of Land Management, Survey Records Office, Sacramento.] (Handwritten.)

________. General Land Office. "Plat of the Rancho Los Ulpinos, Finally Confirmed to John Bidwell," surveyed by Wm. J. Lewis in October 1858. [At Bureau of Land Management, Survey Records Office, Sacramento.] (Copy.)

________. Geological Survey. Geology and Ground-Water Resources of Sacramento Valley, California, by Kirk Bryan. Water-Supply Paper 495. Washington: 1923.

________. Geological Survey. Geology and Water Resources of the Mokelumnc Area, California, by H. T. Stearns, T. W. Robinson, and G. H. Taylor. Water-Supply Paper 619. Washington: 1930.

________. Geological Survey. Ground Water in San Joaquin Valley, California, by W. C. Mendenhall, R. B. Dole, and Herman Stabler. Water-Supply Paper 398. Washington: 1916.

________. Geological Survey. Hydraulic-Mining Debris in the Sierra Nevada, by Grove Karl Gilbert. Professional Paper 105. Washington: 1917.

U.S. Treasury Department. Bureau of Statistics. The Commercial, Industrial, Agricultural, Transportation, and Other Interests of California, by Thomas J. Vivian. Washington: 1891.

Legal Documents

Federal

Federal Reporter.

Public Law No. 382, 61st Cong., 2d Sess. (1910).

Public Law No. 367, 64th Cong., 2d Sess. (1916).

Public Law No. 525, 79th Cong., 2d Sess. (1946). "River and Harbor Act."

U.S. Constitution.

U.S. District Court. Northern District, California. "Transcript of the Proceedings in /Private Land Claim Cases Nos. 107, 137, 170, 184, 213, 255, 267, 293, 298, 319, 357, and 364/." (Handwritten.)

U.S. Revised Statutes (1893).

U.S. Statutes at Large (1845-51).

________ (1905).

State

California. Joint Resolution in Relation to Swamp Lands, Approved March Twenty-sixth (1852).

California Reports.

California Statutes (1850).

________ (1851).

________ (1852).

________ (1855).

________ (1858).

________ (1859).

________ (1861).

________ (1877-78).

________ (1880).

________ (1893).

________ (1909).

________ (1911).

________ (Extra Session, 1911).

California Statutes (1913).

________ (1933).

________ (1953).

California Documents

Allard, R. W., and Smith, Francis L. Dry Edible Bean Production in California. University of California, Division of Agricultural Sciences, California Agricultural Experiment Station, Extension Service Circular 436. N.p.: 1954.

California. Board of Agriculture. Biennial Report . . . , for the Years 1870 and 1871, in Appendix to Journals of Senate and Assembly of the 19th Sess. of the Legis., Vol. III. Sacramento: 1872.

California. Board of Commissioners of the Sacramento River Drainage District. Report . . . to the Governor of California, in Appendix to Journals of Senate and Assembly of the 22d Sess. of the Legis., Vol. I. Sacramento: 1878.

________. Report . . . to the Governor of California, in Appendix to Journals of Senate and Assembly of the 23d Sess. of the Legis., Vol. I. Sacramento: 1880.

California. Board of Fish Commissioners. Biennial Report . . . for the Years 1891-1892, in Appendix to Journals of Senate and Assembly of the 30th Sess. of the Legis., Vol. VII. Sacramento: 1893.

________. /Thirteenth, Fourteenth, Fifteenth, Sixteenth, Seventeenth, Eighteenth, Nineteenth/ Biennial Report . . . for the Years /1893-1894, 1895-1896, 1897-1898, 1899-1900, 1901-1902, 1903-1904, 1905-1906/, in Appendix to Journals of Senate and Assembly of the /31st, 32d, 33d, 34th, 35th, 36th, 37th/ Sess. of the Legis. Sacramento: /1895, 1897, 1899, 1901, 1903, 1905, 1907/.

California. Board of Fish and Game Commissioners. Twenty-first Biennial Report . . . for the Years 1909-1910, in Appendix to Journals of Senate and Assembly of the 39th Sess. of the Legis., Vol. III. Sacramento: 1912.

California. Board of Health. Fourth Biennial Report . . . , for the Years 1876 and 1877, in Appendix to Journals of Senate and Assembly of the 22d Sess. of the Legis., Vol. III. Sacramento: 1878.

California. Board of Health. Report of the State Board of Health, in Appendix to Journals of Senate and Assembly of the 24th Sess. of the Legis., Vol. II. Sacramento: 1881.

California. Board of Horticulture. Proceedings of the Fifth Annual State Fruit Growers' Convention, Los Angeles, November 17, 1885 . . . . Sacramento: 1886.

________. Official Report of the Tenth Fruit Growers' Convention of the State of California, Chico, November 20-23, 1888. Sacramento: 1889.

________. "Synopsis of Proceedings of the Twelfth State Fruit Growers' Convention, Fresno, November 5-8, 1889," in Report of State Board of Horticulture. Sacramento: 1890.

________. Official Report of the Eighteenth Fruit Growers' Convention of the State of California, Sacramento, November 20-23, 1894. Sacramento: 1895.

________. Third Biennial Report . . . , for the Thirty-eighth and Thirty-ninth Fiscal Years, in Appendix to Journals of Senate and Assembly of the 28th Sess. of the Legis., Vol. V. Sacramento: 1888.

California. Board of Swampland Commissioners. Report . . . for the Years 1864 and 1865, in Appendix to Journals of Senate and Assembly of the 16th Sess. of the Legis., Vol. II. Sacramento: 1866.

California. Central Valley Regional Water Pollution Control Board. Study of Water Uses and Pollution in Mokelumne River Basin, San Joaquin River Watershed. Sacramento: 1952.

California. Commissioner of Public Works. Report . . . to the Governor of California, [1893-1894, 1895-1896, 1899-1900, 1904-1906], in Appendix to Journals of Senate and Assembly of the [31st, 32d, 34th, 37th] Sess. of the Legis. Sacramento: [1895, 1897, 1901, 1906].

________. Report . . . to the Governor of California, Together with the Report of the Commission of Engineers to the Commissioner of Public Works upon the Rectification of the Sacramento and San Joaquin Rivers and Their Principal Tributaries; and the Reclamation of the Overflowed Lands Adjacent Thereto, in Appendix to Journals of Senate and Assembly of the 36th Sess. of the Legis., Vol. II. Sacramento: 1905.

California. Commissioner of Public Works and Engineers. Report . . . to the Governor of California, 1901-1902, in Appendix to Journals of Senate and Assembly of the 35th Sess. of the Legis., Vol. II. Sacramento: 1903.

California. Commissioners of Fisheries. Report . . . for the Years [1876 and 1877, 1878 and 1879, 1880, 1883 and 1884], in Appendix to Journals of Senate and Assembly of the [22d, 23d, 24th, 26th] Sess. of the Legis. Sacramento: [1878, 1879, 1881, 1885].

________. Biennial Report . . . , for 1885-1886, in Appendix to Assembly Journals for the 27th Sess. of the Legis., Vol. I. Sacramento: 1887.

California. Committee on Mining Debris. Testimony Taken by . . . as Reported to the Assembly, in Appendix to Journals of Senate and Assembly of the 22d Sess. of the Legis., Vol. IV. Sacramento: 1877.

California. Conservation Commission. Report . . . , January 1, 1913, in Appendix to Journals of Senate and Assembly of the 40th Sess. of the Legis., Vol. III. Sacramento: 1913.

California. Controller of State. Annual Report . . . , for the Fifteenth and Sixteenth Fiscal Years, 1864 and 1865, in Appendix to Assembly Journals for the 16th Sess. of the Legis., Vol. I. Sacramento: 1866.

________. Biennial Report . . . for the Seventeenth and Eighteenth Fiscal Years, 1865-6, 1866-7, in Appendix to Journals of Senate and Assembly of the 17th Sess. of the Legis., Vol. I. Sacramento: 1868.

________. Biennial Report . . . for the Nineteenth and Twentieth Fiscal Years, 1867-8, 1868-9, in Appendix to Journals of Senate and Assembly of the 18th Sess. of the Legis., Vol. I. Sacramento: 1870.

California. Debris Commissioner. Report . . . from December 1, 1902, to November 1, 1904, in Appendix to Journals of Senate and Assembly of the 36th Sess. of the Legis., Vol. II. Sacramento: 1905.

________. Report . . . from November 1, 1904, to December 31, 1906, in Appendix to the Journals of Senate and Assembly of the 37th Sess. of the Legis., Vol. III. Sacramento: 1907.

California. Department of Natural Resources. Division of Mines and Mining. Bulletin No. 99 (by Waldemar Fenn Dietrich). Sacramento: 1928.

California. Department of Natural Resources. Division of Mines. Geologic Formations and Economic Development of the Oil and Gas Fields of California. Bulletin No. 118. Sacramento: 1943.

________. Division of Mines. Mineral Commodities of California. Sacramento: 1950.

________. Division of Oil and Gas. Thirtieth Annual Report of the State Oil and Gas Supervisor. Vol. 30, No. 1. San Francisco: 1944.

California. Department of Public Works. Division of Engineering and Irrigation. Irrigation Districts in California, by Frank Adams. Bulletin No. 21. Sacramento: 1929.

________. Division of Engineering and Irrigation. Sacramento Flood Control Project, Revised Plans. Prepared by E. A. Bailey. Sacramento: 1927.

________. Division of Water Resources. Economic Aspects of a Salt Water Barrier Below Confluence of Sacramento and San Joaquin Rivers. Bulletin No. 28. Sacramento: 1932.

________. Division of Water Resources. Financial and General Data Pertaining to Irrigation, Reclamation and Other Public Districts in California. Bulletin No. 37. Prepared under the direction of California Irrigation and Reclamation Financing and Refinancing Commission, by Harmon S. Bonte. Sacramento: 1931.

________. Division of Water Resources. Industrial Survey of Upper San Francisco Bay Area, with Special Reference to a Salt Water Barrier Below Confluence of Sacramento and San Joaquin Rivers. Bulletin No. 28-A (an appendix to Bulletin No. 28). Sacramento: 1930.

________. Division of Water Resources. Report of Sacramento-San Joaquin Water Supervision for 1953. Sacramento: 1954.

________. Division of Water Resources. Report of Sacramento-San Joaquin Water Supervisor for the Period 1924-1928, by Harlowe M. Stafford. Bulletin No. 23. Sacramento: 1930.

________. Division of Water Resources. Report on Salt Water Barrier Below Confluence of Sacramento and San Joaquin Rivers, California, by Walker R. Young. Vol. I of 2 vols. Bulletin No. 22. Sacramento: 1929.

California. Department of Public Works. Division of Water Resources. _Report to the Water Project Authority of the State of California on Feasibility of Construction by the State of Barriers in San Francisco Bay System._ Sacramento: 1955.

________. Division of Water Resources. _Sacramento River Basin._ Bulletin No. 26. Sacramento: 1933.

________. Division of Water Resources. _State Legislation and Federal Regulations Governing Maintenance and Operation of Sacramento River Flood Control Project._ Sacramento: 1947.

________. Division of Water Resources. _Use of Water by Native Vegetation._ Bulletin No. 50. Sacramento: 1942.

________. Division of Water Resources. _Variation and Control of Salinity in Sacramento-San Joaquin Delta and Upper San Francisco Bay._ Bulletin No. 27. Sacramento: 1932.

________. Division of Water Rights. _Biennial Report of the Division of Water Rights._ Part III. Sacramento: 1925.

________. Division of Water Rights. _Biennial Report of the Division of Water Rights._ Part III. Sacramento: 1927.

________. Division of Water Rights. _Proceedings of the Sacramento River Problems Conference . . . on January 25 and 26, 1924._ Bulletin No. 3. Sacramento: 1924.

________. Division of Water Rights. _Proceedings of the Second Sacramento-San Joaquin River Problems Conference and Water Supervisor's Report . . . December 12, 1924._ Bulletin No. 4. Sacramento: 1925.

________. Division of Water Rights. _Report of the Division of Water Rights, Part IV;_ to Accompany the First Biennial Report of That Department. Sacramento: 1923.

________. _Report of Director of Public Works on Emergency Flood Conditions,_ by Frank W. Clark. Sacramento: 1940.

________. Water Resources Board. _Report on Feasibility of Feather River Project and Sacramento-San Joaquin Delta Diversion Projects Proposed as Features of the California Water Plan._ Sacramento: 1951.

California. Department of Water Resources. Division of Resources Planning. Interim Report to the California State Legislature on the Salinity Control Barrier Investigation. Bulletin No. 60. Sacramento: 1957.

California. Examining Commission on Rivers and Harbors. Report . . . to the Governor of California, in Appendix to Journals of Senate and Assembly of the 29th Sess. of the Legis., Vol. I. Sacramento: 1891.

California. Governor. Message from Governor George C. Perkins Relative to Swamp Land Districts (to Senate of State of California), in Appendix to Journals of Senate and Assembly of the 24th Sess. of the Legis., Vol. I. Sacramento: 1881.

________. Special Message of Governor George Perkins, to the Legislature of California . . . , in Appendix to Journals of Senate and Assembly of the 24th Sess. of the Legis. Sacramento: 1881.

California. Joint Committees on Swamp and Overflowed Lands, and Land Monopoly. Reports . . . Presented at the Twentieth Session of the Legislature of California, in Appendix to Journals of Senate and Assembly of the 20th Sess. of the Legis., Vol. V. Sacramento: 1874.

California. Legislature. Senate Fact-finding Committee on San Francisco Bay Ports. Final Report . . . : Ports of the San Francisco Bay Area; Their Commerce Facilities, Problems, and Progress. 1951 General Sess. Sacramento: 1951.

California. Mining Bureau. Mining in California. Vol. 21, No. 1. Sacramento: 1925.

California. Reclamation Board. Fourth Biennial Report of the Reclamation Board of California. Sacramento: 1918.

________. Fifth Biennial Report of the Reclamation Board of California, 1919 and 1920. Sacramento: 1921.

________. Letter from the Reclamation Board of California to Honorable C. F. Curry, Member of Congress, Third California District; to Accompany Historical Summary of Federal Action and Its Resulting Effect upon the Sacramento Flood Control Project. Sacramento: 1924.

________. Reclamation Board Act of the State of California; as in Effect on and after August 8, 1915. Sacramento: 1915.

California. Reclamation Board. Reclamation Board Act of the State of California; as in Effect on and after July 27, 1919. Sacramento: 1920.

________. Reclamation District Laws of the State of California, by Charles F. Metteer. Sacramento: 1922.

________. Report of the Reclamation Board of California, by W. T. Ellis, Jr., Peter Cook, and V. S. McClatchy, in Appendix to Journals of Senate and Assembly of the 40th Sess. of the Legis. Sacramento: 1912.

________. Report of the Reclamation Board of California, 1914. Sacramento: 1914.

________. Report of the Reclamation Board of California, 1916. Sacramento: 1916.

________. Sacramento and San Joaquin Drainage District Refunding Act, Reclamation Board Act and Reclamation Board Bond Act of the State of California; as in Effect on and after July 29, 1927, with All Amendments to and Including Those of 1927. Compiled and annotated by Fred R. Pierce. Sacramento: 1928.

California. Report of Special Committee on Resolutions of Mr. Barker, of Nevada, Concerning Land Monopoly, Etc., in Appendix to Journals of Senate and Assembly of the 19th Sess. of the Legis., Vol. II. Sacramento: 1872.

California. Report of the Commissioners Appointed by an Act of March 28, 1868, on the Reclamation of Swamp Lands in the Sacramento Valley, in Appendix to Journals of Senate and Assembly of the 18th Sess. of the Legis., Vol. II. Sacramento: 1870.

California. Reports of the Select Committee to Whom Was Referred Assembly Bills No. 206, 207 & 208, with Reference to Foreign Miners, in Appendix to Journals of Senate and Assembly of the 6th Sess. of the Legis. Sacramento: 1855.

California. State Agricultural Society. Transactions . . ., During the Years /1864 and 1865, 1866 and 1867, 1868 and 1869, 1870 and 1871, 1872, 1874, 1887, 1889, 1890, 1895, 1901/, in Appendix to Journals of Senate and Assembly of the /16th, 17th, 18th, 19th, 20th, 21st, 29th, 30th, 32d, 35th, 37th/ Sess. of the Legis. Sacramento: /1866, 1868, 1870, 1872, 1873, 1875, 1888, 1890, 1891, 1897, 1903, 1907/.

California. State Agricultural Society. Report . . . for the Year /1905, 1906, 1907, 1908, 1909, 1910/, in Appendix to Journals of Senate and Assembly of the /37th, 38th, 39th/ Sess. of the Legis. Sacramento: /1906, 1907, 1908, 1909, 1910, 1911/.

California. State Engineer. Report . . . from November 1, 1865, to November 1, 1867, in Appendix to Journals of Senate and Assembly of the 17th Sess. of the Legis., Vol. I. Sacramento: 1868.

________. Report . . . from November 1, 1867, to November 1, 1869, in Appendix to Journals of Senate and Assembly of the 18th Sess. of the Legis., Vol. I. Sacramento: 1870.

________. Report . . . from May 11, 1907, to November 30, 1908, in Appendix to Journals of Senate and Assembly of the 38th Sess. of the Legis., Vol. II. Sacramento: 1909.

________. Report . . . from November 30, 1908, to November 30, 1910, in Appendix to Journals of Senate and Assembly of the 39th Sess. of the Legis., Vol. III. Sacramento: 1912.

California. State Land Commission. Report . . . to the Legislature of the State of California, in Appendix to Journals of Senate and Assembly of the 22d Sess. of the Legis., Vol. IV. Sacramento: 1877.

________. Report . . . to the Legislature of the State of California--Session of 1880, in Appendix to Journals of Senate and Assembly of the 23d Sess. of the Legis., Vol. IV. Sacramento: 1880.

California. Surveyor General. Annual Report . . . /for 1854 through 1862/, in Appendix to Assembly Journals for the /6th through 14th/ Sess. of the Legis. Sacramento: /1855 through 1863/.

________. Biennial Report . . . /for 1871-1873 through 1877-1879/, in Appendix to Journals of Senate and Assembly of the /20th through 23d/ Sess. of the Legis. Sacramento: /1874 through 1880/.

________. Report . . . from August 1, 1880, to August 1, 1882, in Appendix to Journals of Senate and Assembly of the 25th Sess. of the Legis., Vol. I. Sacramento: 1883.

California. Surveyor General. Report . . . in Response to Resolutions of the Assembly, in Appendix to Journals of Senate and Assembly of the 13th Sess. of the Legis. Sacramento: 1862.

________. Statistical Report . . . , for the Years 1869, 1870, and 1871, in Appendix to Journals of Senate and Assembly of the 19th Sess. of the Legis., Vol. I. Sacramento: 1872.

California. Swamp Land Commissioners. First Annual Report . . . , December 15, 1861, in Appendix to Journals of Senate and Assembly of the 30th Sess. of the Legis. Sacramento: 1862.

California. Swamp Land Committee. Evidence Taken before the Swamp Land Committee, in Appendix to Journals of Senate and Assembly of the 12th Sess. of the Legis. Sacramento: 1861.

California. Water Project Authority. Report to the California State Legislature Pursuant to the Abshire-Kelly Salinity Control Barrier Act of 1953 on Feasibility of Construction by the State of Barriers in the San Francisco Bay System. Sacramento: 1955.

California. Water Resources Board. San Joaquin County Investigation. Bulletin No. 11. Sacramento: 1955.

________. Water Resources of California. Bulletin No. 1. Sacramento: 1951.

Carlson, Denton W. "Mines and Mineral Resources of Sacramento County, California," California Journal of Mines and Geology, LI (April 1955), 117-99.

Clark, William B. "Mines and Mineral Resources of San Joaquin County, California," California Journal of Mines and Geology, LI (January 1955), 21-95.

Davis, Fenelon F., and Vernon, James W. "Mines and Mineral Resources of Contra Costa County," California Journal of Mines and Geology, XLVII (October 1951), 561-617.

Davis, Glen N. Onion Production in California. University of California, College of Agriculture, Agricultural Experiment Station, Circular 357. Berkeley: 1943.

Hinds, Norman E. A. Evolution of the California Landscape. California, Department of Natural Resources, Division of Mines, Bulletin 158. Sacramento: 1952.

Knowles, P. F. *Shall I Grow Sunflowers?* University of California, College of Agriculture, Agricultural Extension Service, /c. 1950/.

________, and Davis, L. L. *Safflower, a New Oil Crop*. University of California, College of Agriculture, Agricultural Extension Service, 1951.

________. *Sunflowers as a Field Crop*. University of California, College of Agriculture, Agricultural Extension Service, /c. 1954/.

Lindt, John, Lyons, Torrey, and Reed, Doyle. "Milo in the Sacramento Valley." University of California, Agricultural Extension Service, Sacramento County, 1955. (Mimeographed.)

Lyons, Torrey. "Field Seeding of Tomatoes in Sacramento County." Rev. ed. University of California, College of Agriculture, Extension Service, Sacramento County, 1954. (Mimeographed.)

________, and Reed, A. D. "Growing Field Corn in Sacramento County on Peat Soil." University of California, Agricultural Extension Service, Sacramento County, 1955. (Mimeographed.)

May, J. C., and Hewitt, R. L. "The Basement Complex in Well Samples from the Sacramento and San Joaquin Valleys, California," *California Journal of Mines and Geology*, XLIV (April 1948), 129-58.

McClatchy, V. S. "Flood Control and Reclamation in California." Paper presented at annual meeting of the National Drainage Congress, in Cairo, Illinois, January 20, 1916. Sacramento: 1916.

Minges, P. A. *et al*. *Tomato Propagation*. University of California, College of Agriculture, Agricultural Extension Service, Circular 160. Berkeley: 1950.

"Minutes of the First Annual Horticultural Convention," held in Sacramento, December 6 and 7, 1881. N.p., n.d.

O'Brien, J. C. "Mines and Mineral Resources of Yolo County," *California Journal of Mines and Geology*, XLVI (July 1950), 421-36.

Pendleton, Ray A., and Robbins, W. W. *Fertilizers for Sugar Beets on Some California Soils*. University of California, College of Agriculture, Agricultural Experiment Station, Bulletin 694. Berkeley: 1945.

Petition of Henry M. Naglee, in Appendix to Journals of Senate and Assembly of the 22d Sess. of the Legis., Vol. IV. Sacramento: 1878.

Price, J. R. Report on the Condition of the Sacramento River during the High Water of January, 1896, in Appendix to Journals of Senate and Assembly of the 32d Sess. of the Legis., Vol. VII. Sacramento: 1897.

Shear, S. W. Economic Aspects of the Pear Industry. University of California, College of Agriculture, Agricultural Experiment Station, Bulletin 452. Berkeley: 1928.

Smeltzer, Dale G., and Baskett, R. S. "Hybrid Corn Varieties, Eleven Years' Tests." University of California, Agricultural Extension Service, San Joaquin County, 1954. (Mimeographed.)

Waring, Clarence A. "Sacramento County," in Mines and Mineral Resources of the Counties of El Dorado, Placer, Sacramento, Yuba, by W. Burling Tucker and Clarence A. Waring. Sacramento: 1917.

Weir, Walter W. Soils of Sacramento County, California. University of California, Agricultural Experiment Station, Division of Soils. Berkeley: 1950.

________. Soils of San Joaquin County, California. University of California, Agricultural Experiment Station, Division of Soils. Berkeley: 1952.

Books

Atwood, Wallace W. The Physiographic Provinces of North America. Boston: Ginn and Co., 1940.

Audubon, John W. Audubon's Western Journal: 1849-1850. Cleveland: The Arthur H. Clark Co., 1906.

Bancroft, Hubert Howe. The Works of Hubert Howe Bancroft. Vol. I. The Native Races. Vol I: Wild Tribes. San Francisco: The History Co., Pub., 1886.

________. The Works of Hubert Howe Bancroft. Vol. XIX. History of California. Vol. II: 1801-1824. San Francisco: The History Co., Pub., 1886.

________. The Works of Hubert Howe Bancroft. Vol. XX. History of California. Vol. III: 1825-1840. San Francisco: The History Co., Pub., 1886.

Bancroft, Hubert Howe. The Works of Hubert Howe Bancroft. Vol. XXI. History of California. Vol. IV: 1840-1845. San Francisco: The History Co., Pub., 1886.

________. The Works of Hubert Howe Bancroft. Vol. XXII. History of California. Vol. V: 1846-1848. San Francisco: The History Co., Pub., 1886.

________. The Works of Hubert Howe Bancroft. Vol. XXIII. History of California. Vol. VI: 1848-1859. San Francisco: The History Co., Pub., 1888.

The Bee. Where California Fruits Grow: Sacramento County and Its Resources; a Souvenir of The Bee. Sacramento: H. S. Crocker Co., 1894.

Beechey, Captain F. W. Narrative of a Voyage to the Pacific and Beering's Strait; to Co-operate with the Polar Expeditions . . . . Vol. II. London: Henry Colburn and Richard Bentley, 1831.

Bolton, Herbert Eugene. Font's Complete Diary: A Chronicle of the Founding of San Francisco. Berkeley: University of California Press, 1933.

________. Fray Juan Crespi: Missionary Explorer on the Pacific Coast, 1769-1774. Berkeley: University of California Press, 1927.

Borthwick. J. D. The Gold Hunters. Edited by Horace Kephart. New York: The Macmillan Co., 1924.

Browne, John Ross. Resources of the Pacific Slope. San Francisco: H. H. Bancroft and Co., 1869.

Burnett, Peter H. An Old California Pioneer. Foreward by Joseph A. Sullivan. Oakland: Biobooks, 1946.

California Promotion Committee. California Today. Compiled by Charles Sedgwick Aiken. San Francisco: California Promotion Committee, 1903.

California Sketches with Recollections of the Gold Mines. Albany: Erastus H. Pease and Co., 1850.

Carson, James H. Recollections of the California Mines. Reprinted from the Stockton edition of 1852. Oakland: Biobooks, 1950.

Christman, Enos. One Man's Gold; the Letters and Journal of a Forty-Niner. Edited by Florence M. Christman. New York: Whittlesey House, 1930.

Cleland, Robert Glass. This Reckless Breed of Men; the Trappers and Fur Traders of the Southwest. New York: Alfred A. Knopf, 1952.

Cole, Major William L. California: Its Scenery, Climate, Productions and Inhabitants. New York: Irish-American Office, 1871.

Cone, Mary. Two Years in California. Chicago: S. C. Griggs and Co., 1876.

Cook, S. F. The Conflict between the California Indian and White Civilization. Vols. II and III. Berkeley: University of California Press, 1943.

Cotton, C. A. Geomorphology. 4th ed. New York: John Wiley Sons, Inc., 1945.

Cowan, Robert G. Ranchos of California; a List of Spanish Concessions 1775-1822 and Mexican Grants 1822-1846. Fresno: Academy Library Guild, 1956.

Cronise, Titus Fey. The Agricultural Resources of California. San Francisco: A. Roman and Co., 1870.

________. The Natural Wealth of California. San Francisco: H. H. Bancroft and Co., 1868.

Dana, Julian. The Sacramento: River of Gold. New York: Farrar and Rinehart, Inc., 1939.

Erickson, C. W. Sunset Sportsman's Atlas: San Francisco Bay and Delta Area. Menlo Park, Calif.: Lane Publishing Co., 1952.

Etcheverry, Bernard A. Land Drainage and Flood Protection. Stanford University: Stanford University Press, 1940.

Fabian, Bentham. The Agricultural Lands of California. San Francisco: H. H. Bancroft and Co., 1869.

Farquhar, Francis P. (ed.). Up and Down California in 1860-1864; the Journal of William H. Brewer, Professor of Agriculture in the Sheffield Scientific School from 1864 to 1903. New Haven: Yale University Press, 1931 (2d printing).

Fenneman, Nevin M. Physiography of Western United States. 1st ed. New York: McGraw-Hill Book Co., Inc., 1931.

Fremont, John Charles. Geographical Memoir upon Upper California, in Illustration of His Map of Oregon and California. (U.S., 30th Cong., 1st Sess., S. Misc. Doc. 148.) Washington: Wendell and Van Benthuysen, 1848.

Fremont, John Charles. Oregon and California; the Exploring Expedition to the Rocky Mountains, Oregon and California. Buffalo: Geo. H. Derby and Co., Pub., 1851.

Frignet, Ernest. La Californie. 12th ed. Paris: Schlesinger Freres, Libraires-Editeurs, 1867.

Frost, John. History of the State of California. Auburn, N.Y.: Derby and Miller, 1851.

Gift, George W. The Settler's Guide. Stockton: Printed by Rasey Biven, 1857.

Gregory, Tom, et al. History of Solano and Napa Counties, California, with Biographical Sketches . . . . Los Angeles: Historic Record Co., 1912.

________. History of Yolo County, California. Los Angeles: Historic Record Co., 1913.

Guinn, J. M. History of the State of California and Biographical Record of the San Joaquin Valley, California. Chicago: The Chapman Publishing Co., 1905.

Gunn, Lewis C., and Gunn, Elizabeth Le Breton. Records of a California Family. Edited by Anna Lee Marston. San Diego, Calif.: Johnck and Seeger, Printer, 1928.

Harlan, Jacob Wright. California '46 to '88. Oakland: By the author, 1896.

Hastings, Lansford W. The Emigrants' Guide to Oregon and California. Reproduced in facsimile from the original edition of 1845, with historical note and bibliography by Charles Henry Carry. Princeton: Princeton University Press, 1932.

Helper, Hinton R. The Land of Gold; Reality versus Fiction. Baltimore: Published for the author by Henry Taylor, 1855.

Hibbard, Benjamin Horace. A History of the Public Land Policies. New York: Peter Smith, 1939.

Hinds, Norman E. A. Geomorphology. New York: Prentice-Hall, Inc., 1943.

History of Sacramento County, California. Oakland: Thompson and West, 1880.

History of San Joaquin County, California. Oakland: Thompson and West, 1879.

Hittell, John S. A History of the City of San Francisco; and Incidentally of the State of California. San Francisco: A. L. Bancroft and Co., 1878.

________. The Resources of California. San Francisco: A. Roman and Co., 1863.

Hittell, Theodore H. History of California. San Francisco: Pacific Press Publishing House and Occidental Publishing Co., 1885.

Hulaniski, F. J. (ed.). The History of Contra Costa County, California. Berkeley: The Elms Publishing Co., Inc., 1917.

Hunt, Rockwell D. John Bidwell: Prince of California Pioneers. Caldwell, Idaho: The Caxton Printers, Ltd., 1942.

Hutchings, . . M. Scenes of Wonder and Curiosity in California. San Francisco: Hutchings and Rosenfield, Pub., 1860.

________. Scenes of Wonder and Curiosity in California. San Francisco: A. Roman and Co., 1870.

Hutchison, Claude B. (ed.). California Agriculture. Berkeley: University of California Press, 1946.

Ichihashi, Yamato. Japanese in the United States. Stanford University: Stanford University Press, 1932.

An Illustrated History of San Joaquin County, California. Chicago: The Lewis Publishing Co., 1890.

Illustrations of Contra Costa Co., California, with Historical Sketch. Oakland: Smith and Elliott (1879?), /c. 1952, by Contra Costa Co. Historical Society; The Sacramento Lithograph Co., Sacramento/.

Johnson, Theodore T. California and Oregon; or Sights in the Gold Region, and Scenes by the Way. Philadelphia: J. P. Lippincott and Co., 1865, /1st ed., 1850/.

Kawakami, K. K. The Real Japanese Question. New York: The Macmillan Co., 1921.

Kip, Right Reverend Wm. Ingraham, Bishop of California. The Early Days of My Episcopate. New York: Thomas Whittaker, 1892.

Kroeber, A. L. Handbook of the Indians of California. Smithsonian Institution, Bureau of American Ethnology, Bulletin No. 78. Washington: Government Printing Office, 1925.

Langley, Henry G. (comp.). The Pacific Coast Almanac and Year Book of Facts for 1868. 2d ed. San Francisco: Henry G. Langley; Towne and Bacon, Printers, 1868.

Leale, John (with interpolations by Marian Leale). Recollections of a Tule Sailor. San Francisco: George Fields, 1939.

Le Couvreur, Frank. From East Prussia to the Golden Gate. Translated and compiled by Julius C. Behnke. Los Angeles: Angelino Book Concern, 1906.

Leet, L. Don, and Judson, Sheldon. Physical Geology. New York: Prentice-Hall, Inc., 1954.

Lewis, William S., and Phillips, Paul C. (eds.). The Journal of John Work. Cleveland: The Arthur H. Clark Co., 1923.

Lobeck, A. K. Geomorphology. 1st ed. New York: McGraw-Hill Book Co., Inc., 1939.

MacMullen, Jerry. Paddle Wheel Days in California. Stanford University: Stanford University Press, 1944.

Mahr, August C. The Visit of the "Rurik" to San Francisco in 1816. Stanford University Publications: History, Economics, and Political Science, Vol. II, No. 2. Stanford: Stanford University Press, 1950.

Marryat, Frank. Mountains and Molehills. Reprinted in facsimile from the first American edition of 1855 with introduction and notes by Marguerite Eyer Wilbur. Stanford: Stanford University Press, 1952.

McWilliams, Carey. Factories in the Field; the Story of Migratory Farm Labor in California. Boston: Little, Brown and Co., 1939.

Meyer, Carl. Bound for Sacramento (1850-52). Claremont, Calif.: Saunders Studio Press, 1938.

Millis, H. A. The Japanese Problem in the United States. New York: The Macmillan Co., 1915.

Munro-Fraser, J. P. History of Contra Costa County, California; Including Its Geography, Geology, Topography, Climatography, and Description . . . . San Francisco: W. A. Slocum and Co., Pub., 1882.

________. History of Solano County, ... San Francisco: H. S. Crocker and Co., 1879.

Nordhoff, Charles. Northern California, Oregon, and the Sandwich Islands. New York: Harper and Brothers, Pub., 1874.

Ottley, Allan R. (ed.). John A. Sutter, Jr., Statement Regarding Early California Experiences. Sacramento: Sacramento Collectors Club, 1943.

Perkins, William. El Campo de los Sonoraenses; Tres Anos de Residencia en California, 1849-1851. (Anonymous translator.) Buenos Aires: Editorial Tor, 1937.

Purcell, Mae Fisher. History of Contra Costa County. Berkeley: The Gillick Press, 1940.

Rae, William Fraser. Westward by Rail. New York: D. Appleton and Co., 1871.

Reed, Ralph D. Geology of California. Reprint of 1933 ed. Tulsa, Okla.: The American Association of Petroleum Geologists, 1951.

Rensch, H. E., Rensch, E. G., and Hoover, Mildred Brooke. Historic Spots in California Valley and Sierra Counties. Stanford University: Stanford University Press, 1913.

A Returned Californian [J. M. Letts]. California Illustrated; Including a Description of the Panama and Nicaragua Routes. New York: William Holdredge, Pub., 1852.

Rich, E. E. (ed.). The Letters of John McLoughlin, from Fort Vancouver to the Governor and Committee; First Series, 1825-38. Toronto: The Champlain Society, 1941.

________. The Letters of John McLoughlin, from Fort Vancouver to the Governor and Committee; Second Series, 1839-44. Toronto: The Champlain Society, 1943.

________. The Letters of John McLoughlin, from Fort Vancouver to the Governor and Committee; Third Series, 1844-46. Toronto: The Champlain Society, 1944.

Ringgold, Cadwalader. A Series of Charts, with Sailing Directions, Embracing Surveys of the Farallones, Entrance to the Bay of San Francisco, ... 3d ed., with additions. Washington: J. T. Towers, Printer, 1852.

Robinson, W. W. Land in California. Berkeley: University of California Press, 1948.

Royce, Sarah. A Frontier Lady. Edited by Ralph Henry Gabriel. New Haven: Yale University Press, 1932.

Russell, Israel C. Rivers of North America. New York: G. P. Putnam's Sons, 1898.

Russell, Thomas C. (ed. and trans.). Langsdorff's Narrative of the Rezanov Voyage to Nueva California in 1806. San Francisco: The Private Press of Thomas C. Russell, 1927.

Russell, William O. (ed. in chief), et al. History of Yolo County, California; Its Resources and Its People. Woodland, Calif.: /Pub. not given/, 1940.

Sacramento: The Commercial Metropolis of Northern and Central California. Sacramento: A. J. Johnston and Co., Pub., 1888.

Salisbury, Rollin D. Physiography. 2d ed., rev. New York: Henry Holt and Co., 1909.

San Francisco Tool Company. Irrigation and Reclamation Machinery. San Francisco: Mysell and Rollins, 1894.

San Joaquin Co. ty; Its Products and Resources. Stockton: Ruggles and Robinson, 1888.

Schaeffer, L. M. Sketches of Travels in South America, Mexico and California. New York: James Egbert, Printer, 1860.

Schoonover, T. J. The Life and Times of Gen. John A. Sutter. Rev. and enl. ed. Sacramento: Bullock-Carpenter Printing Co., 1907.

Shaw, D. A. El Dorado or California, as Seen by a Pioneer, 1850-1900. Los Angeles: B. R. Baumgardt and Co., 1900.

Tarr, Ralph S. Elementary Physical Geography. New York: The Macmillan Co., 1896.

Taylor, Bayard. El Dorado; or Adventures in the Path of Empire . . . . London: Richard Bentley, 1850.

Thornbury, William D. Principles of Geomorphology. New York: John Wiley and Sons., Inc., 1954.

Tide Land Reclamation Company. Fresh Water Tide Lands of California. San Francisco: M. D. Carr and Co., 1869.

Tide Land Reclamation Company. Fresh Water Tide Lands of California. San Francisco: Carr, Dunn and Newhoff, Printers, 1872.

Tinkham, George H. California: Men and Events. 2d ed., rev. Stockton: Record Publishing Co., 1915.

________. A History of Stockton. San Francisco: W. M. Hinton and Co., 1880.

Upham, Samuel C. Notes of a Voyage to California via Cape Horn, Together with Scenes in El Dorado in the Years 1849-50. Philadelphia: By the author; Press of Franklin Printing House, 1878.

Von Engeln, O. D. Geomorphology. New York: The Macmillan Co., 1942.

Webster, Kimball. The Gold Seekers of '49. With an introduction and biographical sketch by George Waldo Browne. Manchester, N.H.: Standard Book Co., 1917.

Wells, A. J. The Sacramento Valley of California. San Francisco: Southern Pacific Co., 1905.

________. The San Joaquin Valley of California. San Francisco: Southern Pacific Co., 1905.

The Western Shore Gazetteer and Commercial Directory for the State of California, Yolo County. Compiled by C. P. Sprague and H. W. Atwell. Woodland, Calif.: C. P. Sprague and H. W. Atwell, 1870.

Wickson, Edward J. The California Fruits and How to Grow Them. 1st ed. San Francisco: Pacific Rural Press, 1889.

________. The California Vegetables in Garden and Field. 2d ed. San Francisco: Pacific Rural Press, 1910.

________. The California Vegetables in Garden and Field. 5th ed. San Francisco: Pacific Rural Press, 1923.

Wierzbicki, F. P. California as It Is and as It May Be; or a Guide to the Gold Region. San Francisco: The Grabhorn Press, 1933.

Wilbur, Marguerite Eyer (ed.). Duflot de Mofras' Travels on the Pacific Coast. Vol. I. Translated and annotated by the editor. Santa Ana, Calif.: The Fine Arts Press, 1937.

Wilkes, Charles. Narrative of the United States Exploring Expedition During the Years 1838, 1839, 1840, 1841, 1842. Vol. V. Philadelphia: Lea and Blanchard, 1845.

Winther, Oscar Osburn. Express and Stagecoach Days in California. Stanford University: Stanford University Press, 1936.

Worcester, Philip G. A Textbook of Geomorphology. New York: D. Van Nostrand Co., Inc., 1939.

Articles and Periodicals

Adams, Edward F. "Swamp Land Reclamation," Commonwealth Club of California, Transactions, I (October 1904), 3-48.

Allen, R. H. "The Spanish Land-Grant System as an Influence in the Agricultural Development of California," Agricultural History, IX (July 1935), 127-42.

"The Amazing Story of California's Fabulous 'Prima Donna' Crop--Asparagus," Tideways, IV (April 1954), 3.

Andrus, Glen. "The Nile of the West," Sunset, XXVI (May 1911), 475-88, 571-72.

Antioch Ledger. The Golden Link. Antioch, Calif.: 1924.

Atherton, George A. "Reclamation and Development in the Sacramento-San Joaquin Delta," Agricultural Engineering, XII (April 1931), 129-30.

Berrigan, Darrell. "They Escaped from Civilization," Saturday Evening Post, CCXXVII (August 14, 1954), 24-25, 70-71.

Blake, Anson. "The Hudson's Bay Company in San Francisco," California Historical Society, Quarterly, XXVIII (June 1949), 97-112; XXVIII (September 1949), 243-58.

Brown, Colvin B. "Millions in Potatoes," Sunset, IX (May 1902), 13-17.

Bryant, Berryman, M.D. "Reminiscences of California, 1849-1852," California Historical Society, Quarterly, XI (March 1932), 35-39.

Byers, Horace R. "Summer Sea Fogs of the Central California Coast," University of California Publications in Geography, III:5 (1930), 291-338.

ByJac News. "Venice Island," San Joaquin Valley Rancher, X (November 1951), 12-14.

Byron Times. Special Booster Edition of the Byron Times. Byron, Calif.: 1908-9.

________. Sixth Special Booster Edition of the Byron Times. Byron, Calif.: 1918.

________. Tenth Development Edition of the Byron Times. Byron, Calif.: 1927.

________. Twelfth Development Edition of the Byron Times. Byron, Calif.: 1931.

________. Fourteenth Development Edition of the Byron Times. Byron, Calif.: 1933.

________. Sixteenth Development Edition of the Byron Times. Byron, Calif.: 1937.

Camp, Charles L. (ed.). "An Irishman in the Gold Rush--The Journal of Thomas Kerr," California Historical Society, Quarterly, VIII (March 1929), 17-25; VIII (June 1929), 167-82.

________. "The Chronicles of George C. Yount, California Pioneer of 1826," California Historical Society, Quarterly, II (April 1923), 3-66.

Chapman, Charles Edward (ed.). "Expedition on the Sacramento and San Joaquin Rivers in 1817; Diary of Fray Narciso Duran," Academy of Pacific Coast History, Publications, II (December 1911), 331-49.

Clapp, W. B., Murphy, E. C., and Martin, W. F. "The Flood of March, 1907, in the Sacramento and San Joaquin River Basins, California," American Society of Civil Engineers, Transactions, LXI (December 1908), 281-330, 331-76.

Clark, Bruce L. "Tectonics of the Valle Grande of California," American Association of Petroleum Geologists, Bulletin, XIII (March 1929), 199-238.

Commonwealth Club of California. "Hydraulic Miners vs. Valley Farmers," Transactions, XXIII (May 1928), 139-207.

________. "Internal Waterways," Transactions, VIII (November 1913), 533-603.

________. "The Malaria Problem," Transactions, XI (March 1916), 1-40.

Commonwealth Club of California. "The Salt Water Barrier," _Transactions_, XXIV (December 1929), 419-29.

________. Swamp Land Reclamation," _Transactions_, IV (September 1909), 199-314.

Contra Costa Gazette. _Contra Costa Development Number_. Supplement. Martinez, Calif.: 1916.

Corcoran, Captain H. J. "River Navigation in Early Days," in "Internal Waterways," Commonwealth Club of California, _Transactions_, VIII (November 1913), 581-86.

Cox, Edwin E. "Farm Tenantry in California," Commonwealth Club of California, _Transactions_, XI (December 1916), 444-56.

Demorest, Richard. "In Yolo, Almost Anything Grows Everywhere," _San Francisco Chronicle_, December 28, 1952, "This World," pp. 2-3.

________. "Solano County--A Clearinghouse for Defense," _San Francisco Chronicle_, October 4, 1953, "This World," pp. 2-3, 10.

Edwards, Clarence E. "California's Inland Waterways," _The World Today_, XV (September 1908), 963-66.

Evans, Elliot. "Some Letters of William S. Jewett, California Artist," California Historical Society, _Quarterly_, XXIII (September 1944), 227-46.

F [Wilson Flint]. "Reclamation of Tule Lands," _The California Culturist_, III (September 1860), 109-12.

Fay, Oliver H. "Fields and Factories," _Sunset_, XXIV (May 1910), 587-90.

Fisher, Lloyd M. "The Harvest Labor Market in California," _Quarterly Journal of Economics_, LXV (November 1951), 463-91.

Fleming, W. C. "History of Beef Cattle in San Joaquin," _Holt's San Joaquin County Gazette_, VI (April 1952), 1.

Fletcher, E. H. "Floods in the Sacramento Valley, February 27-March 6, 1940," _Monthly Weather Review_, LXVIII (March 1940), 71-74.

Gilliam, Harold, "Contra Costa--The Golden State in Miniature," _San Francisco Chronicle_, July 20, 1952, "This World," pp. 2-3, 10.

Gilliam, Harold. "San Joaquin County--The Conquest of the Delta," _San Francisco Chronicle_, December 7, 1952, "This World," pp. 2-3, 11.

"A Glowing Past--A Promising Future," _Tideways_, I (February 1952), 10-11.

Grunsky, C. E. "The Relief Outlets and By-Passes of the Sacramento Valley Flood-Control Project," American Society of Civil Engineers, _Transactions_, XCIII (January 1929), 791-814.

________. "Silt Transportation by Sacramento and Colorado Rivers and by the Imperial Canal," American Society of Civil Engineers, _Transactions_, XCIV (January 1930), 1104-51.

________. "Some Factors Affecting the Problem of Flood Control," American Society of Civil Engineers, _Transactions_, XXCV (May 1922), 1488-1502.

Gudde, Erwin G. (ed. and trans.). "The Memoirs of Theodor Cordua," California Historical Society, _Quarterly_, XII (December 1933), 279-311.

Hall, Don. "Sacramento--Where Men and the Rivers Meet," _San Francisco Chronicle_, May 3, 1953, "This World," pp. 2-3, 8.

Harts, William W. "The Control of Hydraulic Mining in California by the Federal Government," American Society of Civil Engineers, _Transactions_, LVII (December 1906), 1-30.

Heuer, Colonel W. H. "What the Government Has Done for California Waterways," in "Internal Waterways," Commonwealth Club of California, _Transactions_, VIII (November 1913), 543-68.

Hunt, Rockwell D. "Boyhood Days on the Banks of the Sacramento in the Seventies," _Overland Monthly_, LXVIII (June 1917), 521-26.

Jarvis, C. S. "Control of Flood and Tidal Flow in the Sacramento and San Joaquin Rivers, California," American Society of Civil Engineers, _Transactions_, XXCIV (January 1921), 455-85.

Johnson, Major F. M. S. "The Effect of Shasta Dam on Navigation and Flood Control," _The Reclamation Era_, XXX (February 1940), 38-41.

Jones, Philip Mills. "Mound Excavations Near Stockton," University of California Publications in American Archaeology and Ethnology, XX (1923), 113-22.

Jordan, David Starr, and Gilbert, Charles H. "The Salmon Fishing Interests of the Pacific Coast, Part XIII," The Fisheries and Fishery Industries of the United States; Commission of Fish and Fisheries, Section V, Vol. I (Washington: 1887), 731-53.

Kuhnel, John W. "A Reference Plane of Flood Volumes in the Sacramento-San Joaquin Basin, California," American Geophysical Union, Transactions, XXX (February 1949), 98-115.

Lawson, Andrew C. "The Geomorphogeny of the Coast of Northern California," University of California, Department of Geology, Bulletin, I (November 1894), 241-72.

________. "The Isostasy of Large Deltas," Geological Society of America, Bulletin, XLIX (March 1938), 401-16.

________. "The Sierra Nevada in the Light of Isostasy," Geological Society of America, Bulletin, XLVII (November 1936), 1691-1712.

Maloney, Alice Bay. "Fur Brigade to the Bonaventura," California Historical Society, Quarterly, XXII (September 1943), 193-222; XXII (December 1943), 323-48; XXIII (March 1944), 19-40; XXIII (June 1944), 123-46.

________. "John Work of the Hudson's Bay Company," California Historical Society, Quarterly, XXII (June 1943), 97-109.

Manson, Marsden. "The Swamp and Marsh Lands of California," Technical Society of the Pacific Coast, Transactions, V (December 1888), 83-99.

Mining and Scientific Press, January 1880-December 1892; January 1899-June 1902; July 1906-June 1907.

Nesbit, D. M. (ed.). "Reclamation of Marsh Lands in California," Pacific Rural Press, XXIX (May 30, 1885), 510.

Olney, Caroline M. "Orchards, Vineyards and Farms of Yolo County," Overland Monthly, XL (August 1902), 171-94.

Pacific Rural Press, January-June 1875; January 1878-June 1879; January 1880-December 1880; January 1885-December 1886; January 1890-December 1890; January 1892-December 1892; July 1894-June 1896; January 1900-December 1904; July 1905-December 1906; January 1910-December 1910; July 1911-June 1912.

Ransome, F. Leslie. "The Great Valley of California," University of California, Department of Geology, Bulletin, I (April 1896), 37-428.

River News. The Eden of California--1925 Biennial Deluxe Edition, River News. Rio Vista, Calif.: 1925.

Rogers, William J. "The Delta Story," Stockton Record, July 2-28, 1951.

Russell, R. J. "Climates of California," University of California Publications in Geography, II (October 1926), 73-84.

Sacramento Bee. Progress Edition, September 1, 1948.

Sacramento Union, February-March 1904; December 1955-January 1956.

________. 1920 California State Fair Annual.

________. 90th Anniversary Edition, March 23, 1941.

San Francisco Chronicle, March 1904; July 1906.

Scaglione, John (ed.). "Ogden's Report of His 1829-1830 Expedition," California Historical Society, Quarterly, XXVII (June 1949), 117-24.

Schenck, W. Egbert, and Dawson, Elmer J. "Archaeology of the Northern San Joaquin Valley," University of California Publications in American Archaeology and Ethnology, XXV:4 (1929), 289-413; plates, 74-102.

________. "Historic Aboriginal Groups of the California Delta Region," University of California Publications in American Archaeology and Ethnology, XXIII:2 (1926), 123-46.

"Sherman Was There; the Recollections of Major Edwin A. Sherman," with introduction by Allen Banks Sherman, California Historical Society, Quarterly, XXIV (June 1945), 165-80; XXIV (September 1945), 271-79.

Shipp, Cameron. "The Land Where Whoppers Come True," Saturday Evening Post, CCXXI (November 20, 1948), 38-39, 150, 153, 158.

Smith, Arthur C. "Delta Experiments," American Geographical Society, Bulletin, XLI:12 (1909), 729-42.

Sprague, Irvine. "The Port Story," Stockton Record, January 19-31, 1953.

Sprague, Roger. "Along a California Water Way," Overland Monthly, LXII (July 1913), 169-79.

Stockton Evening Mail. San Joaquin Valley Development Edition, July 22, 1911.

Stockton Record, February 1938.

Stockton Weekly Independent, January 1868-December 1878.

Stoy, Herbert. /Series of articles on "wetback" problem/, Stockton Record, June 14-19, 1954.

Taylor, Paul S. "Foundations of California Rural Society," California Historical Society, Quarterly, XXIV (September 1945), 193-228.

Teggart, Frederick J. (ed.). "Diary of Nelson Kingsley, a California Argonaut of 1849," Academy of Pacific Coast History, Publications, III (December 1914), 237-413.

________ (ed.). "The Gold Rush; Extracts from the Diary of C. S. Lyman, 1848-1849," California Historical Society, Quarterly, II (October 1923), 181-202.

Van Loben Sels, E. D. "How Rich Land Is Saved from California Rivers," Pacific Rural Press, LXX (July 1, 1905), 4.

Warner, Colonel J. J. "Reminiscences of Early California from 1831 to 1846," Historical Society of Southern California, Publications, VII (1909), 176-93.

Weir, Walter W. "Peat Lands of the Delta," California Agriculture, III (July 1949), 6, 16.

________. "Subsidence of Peat Lands of the Sacramento-San Joaquin Delta, California," Hilgardia, XX (June 1950), 37-56.

Wells, A. J. "San Joaquin County, California," Sunset, XXVI (June 1911), 693-96.

________. "Tilling the 'Tules' of California," The American Monthly Review of Reviews, XXX (September 1904), 312-17.

Whitington, Robert B. /Series of articles on "Peat Dust Nuisance"/, Stockton Record, June 10-12, 1954.

Wilstsee, Ernest A. "The City of New York of the Pacific," California Historical Society, Quarterly, XII (March 1933), 25-34.

Wright, William Q. "Closing Breaks in Tidal Levees," Engineering News-Record, April 4, 1946, pp. 71-74.

Wyman, Walker D. (comp.). "California Emigrant Letters" (concluded), California Historical Society, Quarterly, XXIV (December 1945), 343-64.

Manuscripts and Clipping Collections

Avina, Rose Hollenbaugh. "Spanish and Mexican Land Grants in California." Unpublished Master's thesis, Department of History, University of California, 1934.

Bancroft Library Scrapbooks, No. 8. "California Counties; Contra Costa." Bancroft Library, University of California, Berkeley.

________, No. 21. "California Counties; Sacramento." Bancroft Library, University of California, Berkeley.

________, No. 28. "California Counties; San Joaquin." Bancroft Library, University of California, Berkeley.

________, No. 33. "California Counties; Solano." Bancroft Library, University of California, Berkeley.

________, No. 37. "California Counties; Ventura, Yolo, Yuba." Bancroft Library, University of California, Berkeley.

________, No. 44. "California Lands." Bancroft Library, University of California, Berkeley.

________, No. 45. "Agriculture; Corn, Grain Crops, Milling." Bancroft Library, University of California, Berkeley.

________, No. 46. "Agriculture; Corn." Bancroft Library, University of California, Berkeley.

________, No. 47. "Agriculture; Wheat, Coffee, Tea, Hops, Weeds." Bancroft Library, University of California, Berkeley.

________, No. 48. "Agriculture; Citrus Fruits, Gardening." Bancroft Library, University of California, Berkeley.

Bancroft Scraps, Set W 1. "California Counties; Alameda to Los Angeles." Bancroft Library, University of California, Berkeley.

Bancroft Scraps, Set W 3. "California Counties; Placer to San Diego." Bancroft Library, University of California, Berkeley.

________, Set W 4. "California Counties; San Diego to Santa Cruz." Bancroft Library, University of California, Berkeley.

________, Set W 5. "California Counties; Santa Cruz to Yuba." Bancroft Library, University of California, Berkeley.

________, Set W 18:1. "California Agriculture." Bancroft Library, University of California, Berkeley.

________, Set W 18:2. "California Agriculture." Bancroft Library, University of California, Berkeley.

________, Set W 19:1. "California Agriculture." Bancroft Library, University of California, Berkeley.

________, Set W 19:2. "California Agriculture." Bancroft Library, University of California, Berkeley.

________, Set W 33. "California Fisheries." Bancroft Library, University of California, Berkeley.

________, Set W 34. "California Floods." Bancroft Library, University of California, Berkeley.

________, Set W 66. "California Roads and Routes." Bancroft Library, University of California, Berkeley.

________, Set W 73. "California Hunting and Fishing." Bancroft Library, University of California, Berkeley.

Belding, Lyman. "Autobiography." N.p., [ca. 1917]. (In files of San Joaquin County and Stockton Public Library.) (Typewritten.)

Bowman, J. N. "The Date of Sutter's Landing at Sacramento." Unpublished MS, n.d.

________. "The First Map of Sacramento Valley." MS in Bowman's file. N.p., n.d. (Typewritten.)

________. "The Second Map of Sacramento Valley." MS in Bowman's file. N.p., n.d. (Typewritten.)

________. "The Third Map of Sacramento Valley." MS in Bowman's file. N.p., n.d. (Typewritten.)

Cary, Edward Shepard. "Pollution Studies of the San Joaquin River Near Stockton." Unpublished thesis for the Degree of Engineer, Department of Civil Engineering, Stanford University, October 1947.

Casey, Jack Tull. "The Indians in the Settlement of California (1769-1869)." Unpublished Master's thesis, Department of History, University of California, n.d.

Chaffee, Everett Barker. "Jedediah Smith in California." Unpublished Master's thesis, Department of History, University of California, 1929.

Connor, Forrest Pershing. "The Opposition to Hydraulic Mining in California." Unpublished Master's thesis, Department of History, University of California, 1950.

Cosby, Stanley W. "The California Peat Lands." Seminar Report, Soil Technology 104. University of California, October 18, 1934. (Typewritten.)

________. "Delta Field Notes." (Handwritten.)

________. "Delta History Notes." (Handwritten.)

________. "Notes." (Handwritten.)

________. "Peat Soils of California." MS, November 21, 1934. (Typewritten.)

Cutter, Donald Colgett. "Spanish Exploration of California's Central Valley." Unpublished Ph.D. dissertation, Department of History, University of California, 1950.

Dyke, Dorothy Jeannette. "Transportation in the Sacramento Valley, 1849-1860." Unpublished Master's thesis, Department of History, University of California, 1932.

Engelson, Lester Gorden. "Interests and Activities of the Hudson's Bay Company in California, 1820-1846." Unpublished Master's thesis, Department of History, University of California, 1939.

Fariss, Jessie. "Ewing Young, Western Pioneer." Unpublished Master's thesis, Department of History, University of California, 1928.

Fleming, W. C. "California's San Joaquin River Delta Has Great Production Potential." (In files of San Joaquin County Agricultural Extension Service, Stockton.) August 31, 1955. (Typewritten.)

Fleming, W. C. "Economic Importance of the Delta Area." Paper read to Peat Dust Committee Meeting, December 10, 1954. (Typewritten.)

________. "Factual Information--San Joaquin Peat Soil Delta Area." (In files of San Joaquin County Agricultural Extension Service, Stockton.) September 17, 1954. (Typewritten.)

Foote, A. de Wint. "Scrapbook of Clippings on Flood Control and Reclamation," 1911. Bancroft Library, University of California, Berkeley.

Gein, Carl A. "Charles M. Weber, 1841-1850." Unpublished Master's thesis, Department of History, University of California, 1942.

Johnson, William D. "Inland Steam Navigation in California." Unpublished Master's thesis, Department of History, Stanford University, 1952.

Kelley, Robert Lloyd. "The Hydraulic Mining Controversy in California, 1856-1895: A Case Study in Sectionalism." Unpublished Ph.D. dissertation, Department of History, Stanford University, 1953.

Key, Leon Godwin. "The History of the Policies in Disposing of the Public Lands in California." Unpublished Master's thesis, Department of Economics, University of California, 1938.

McClain, Marcia. "The Distribution of Asparagus Production in the Sacramento-San Joaquin Delta." Unpublished Master's thesis, Department of Geography, University of California, 1954.

McKeag, John A. "Delta Report." 7 folios. Prepared for Bureau of Reclamation, U.S. Department of the Interior, Sacramento, 1954. (Typewritten and handwritten.)

Meldrum, George Weston. "The History of the Treatment of Foreign and Minority Groups in California, 1830-1860." Unpublished Ph.D. dissertation, Department of History, Stanford University, 1948.

Roberts, Doyle Loman. "A History of the Reclamation of the Delta Lands of California." Unpublished Master's thesis, Department of History, College of the Pacific, 1951.

<u>Sacramento River Floods of 1878 and 1881</u>. A collection of <u>Sacramento Bee</u> clippings, Bancroft Library, University of California, Berkeley.

U.S. Department of the Interior. Bureau of Reclamation. "Report of Undeveloped Land, Water and Power Resources of California and Their Utilization in a Post-War Construction Program." Prepared for presentation at Sub-Committee hearings under Senate Resolution 205, 78th Cong., 1st Sess. Sacramento, 1944. (Mimeographed.)

Woodward, Vallena Gifford. "The Early History of Stockton." Unpublished Master's thesis, Department of History, University of California, 1925.

Wright, William Q. Letter to Jack Williams, Stockton, [1950.] (In Wright's files.)

________. "Statement on the Reber Plan to the Senate Committee on Public Works." San Francisco, December 12, 1949. (In Wright's files.) (Mimeographed.)

Miscellaneous Reports

Chipman, M. M. Mining Debris Deposits. Report of the Committee on Medical Topography, Meteorology, Endemics and Epidemics, Made to the Medical Society of the State of California, at the Annual Session, Held at San Francisco, April 1881. San Francisco: W. M. Hinton and Co., Printers, 1881.

Cobb, N. A. The California Wheat Industry. Department of Agriculture, Sydney, New South Wales, Misc. Pub. No. 519. Sydney: William Applegate Gullick, Gov't. Printer, 1901.

Contra Costa County. Board of Trade. Contra Costa County, California: Its Climate, Its Soil, Productions, and Location. San Francisco: W. B. Bancroft and Co., 1887.

Grunsky, C. E., and Cox, Leonard M. Report on the Economic Aspects of a Sacramento Deep Water Ship Canal with a Terminal Port at Sacramento. Sacramento: H. S. Crocker Co., Inc., [ca. 1925].

Hall, William Ham(mond). Sacramento Valley River Improvement; Government Policy and Works. Letter addressed to Board of Engineers for Improvement of the Sacramento and Tributary Rivers. N.p., 1905.

Haviland, P. A., and Tibbetts, F. H. Great American Levees; a Comparative Report on Flood Protection in the Mississippi and Sacramento Valleys Made for the West Sacramento Company. San Francisco: Taylor, Nash and Taylor, 1913.

Hogan, W. B. "Request for Flood Control and Water Conservation of San Joaquin River and Tributaries." Presented to Sub-Committee of the Appropriations Committee on Civil Functions of the War Department of the United States Senate. San Joaquin County Chamber of Commerce, Water Conservation and Flood Control Committee, June 1951. (Mimeographed.)

Means, Thomas H. Salt Water Problem: San Francisco Bay and Delta of Sacramento and San Joaquin Rivers. Prepared for Association of Industrial Water Users of Contra Costa and Solano Counties. Martinez: Martinez Daily Standard, April 1928.

Naglee, Henry M. Letter to Wm. H. Hall and Board of Engineers of the State of California upon the Subject of the Reclamation of the Overflown Lands of the San Joaquin Valley; dated September 20, 1879. McNeil Bros., San Jose, California, 1879.

Requa, M. L., and Cory, H. T. "The California Irrigated Farm Problem." Washington, March 1, 1919. (Mimeographed.)

Sacramento-Yolo Port District. "The Sacramento Deep Water Channel." April 18, 1956. (Mimeographed.)

San Joaquin County. Board of Supervisors. San Joaquin County, California, for the Farmer. Published by Sunset Magazine Homeseekers Bureau for the Board of Supervisors of San Joaquin County. N.p., [ca. 1915].

Stockton. Board of Trade. The City of Stockton and Its Surroundings; The Great San Joaquin Basin and Its Wonderful Resources. Edited by N. M. Orr. Stockton: Daily Independent Steam Presses, 1883.

Stockton. Chamber of Commerce. Department of Industry. "Stockton, California, as a Factory Location." Report No. 22. Stockton, [ca. June 1929]. (Mimeographed.)

________. Marine Committee. Salt Water Problem and Barrier Proposal. A Report Published by the Stockton Chamber of Commerce, May 1930.

Technical Committee, Peat Land Conservation and Peat Dust Abatement Project. "Interim Report." N.p., July 20, 1955. (In files of San Joaquin County Agricultural Extension Service, Stockton.) (Typewritten.)

Ware, Louis W., and Cedergren, H. R. "Report of Inspection of Venice Island Levees." N.p., January 5, 1950. (In files of San Joaquin County and Stockton Public Library.) (Typewritten.)

Zuckerman, Alfred. "Peat Soil Area Project--San Joaquin County." Peat Dust Committee, Stockton Chamber of Commerce, February 14, 1955. (Typewritten.)

Interviews

Baskett, R. S., Farm Advisor, Field Crops. Agricultural Extension Service, San Joaquin County, Stockton. Personal interview. February 25, 1957.

Brown, J. S. Personal interview. Walnut Grove, July 14, 1955.

Carlton, Alan, Coordinator, University of California Peat Soil Conservation and Dust Abatement. Personal interview. February 25, 1957.

Dickensen, D. D., Plant Breeder and Pathologist, Holly Sugar Co., Tracy. Personal interview. February 25, 1957.

Fleming, W. C., County Director, Agricultural Extension Service, San Joaquin County, Stockton. Personal interview. February 25, 1957.

Gardiner, Bob. Gardiner Improvement Co., Isleton, California. Personal interview. July 21, 1955.

Golden, John, Solano County Agriculture Commissioner Representative, Rio Vista. Personal interview. August 2, 1955.

Higgins, F. Hal. Personal interview. Walnut Creek, July 6, 1956.

Johnson, Alex. Personal interview. Walnut Grove, July 15, 1955.

Oberg (U.S.N.), Lieutenant Owen Henry. Personal interview. Stanford, April 2, 1957.

Raab, George. Personal interview. Stockton, October 15, 1955.

Spurlock, John, County Director, Agricultural Extension Service, Sacramento County. Personal interview. Sacramento, July 12, 1955.

Underhill, John P., Farm Advisor, Vegetables. Agricultural Extension Service, San Joaquin County, Stockton. Personal interview. February 25, 1957.

Upham, Charles. Personal interview. Sherman Island, California, August 28, 1955.

Viera, Frank. Personal interview. Ida Island, California, July 23, 1955.

Wilcox, John F. Personal interview. Brannan Island, California, August 28, 1955.

Wright, William Q., Consulting Engineer. Personal interview. Los Gatos, California, July 20, 1956.

Topographic Sheets of the Delta (U.S. Department of the Interior, Geological Survey; 7½' Quadrangles, Scale 1:24,000)

Antioch North, 1907-53

Antioch South, 1913-53

Bethany, 1911-52

Birds Landing, 1953

Bouldin Island, 1931-52

Brentwood, 1911-54

Bruceville, 1908-53

Byron Hot Springs, 1953

Clarksburg, 1952

Courtland, 1952

Dozier, 1952

Florin, 1907-53

Galt, 1908-53

Holt, 1952

Honker Bay, 1907-53

Isleton, 1952

Jersey Island, 1908-52

Lathrop, 1952

Liberty Island, 1952

Lodi North, 1908-53

Lodi South, 1908-53

Manteca, 1952

New Hope, 1931-52

Rio Vista, 1953

Ripon, 1913-52

Sacramento East, 1909-54

Sacramento West, 1909-48

Saxon, 1952

Stockton East, 1952

Stockton West, 1952

Terminous, 1952

Tracy, 1912-54

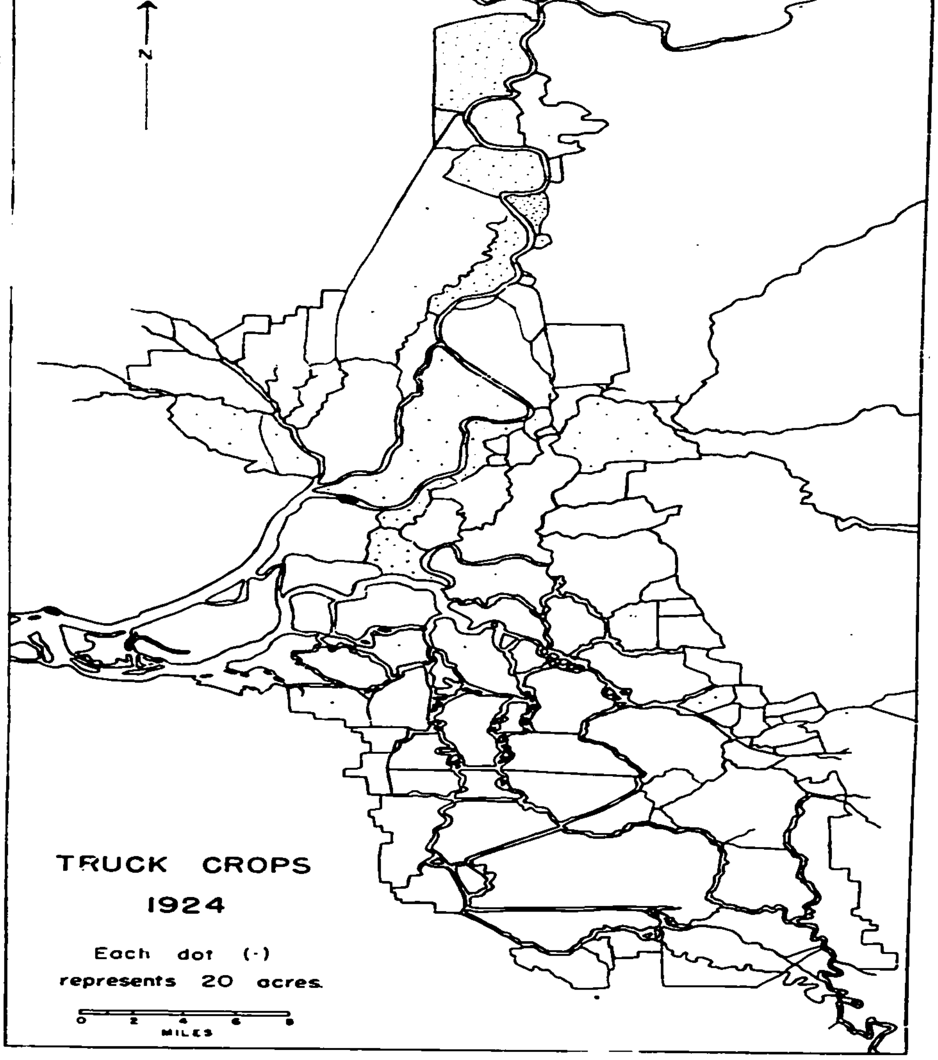
Union Island, 1952

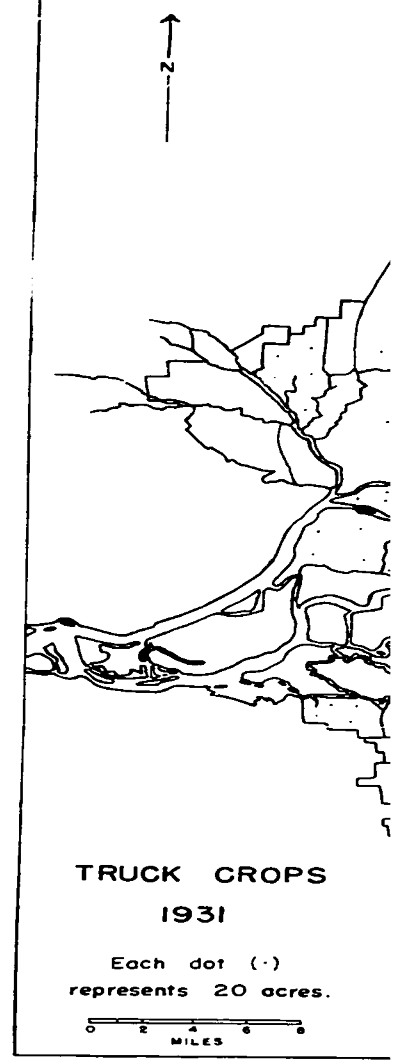
Vernalis, 1912-52

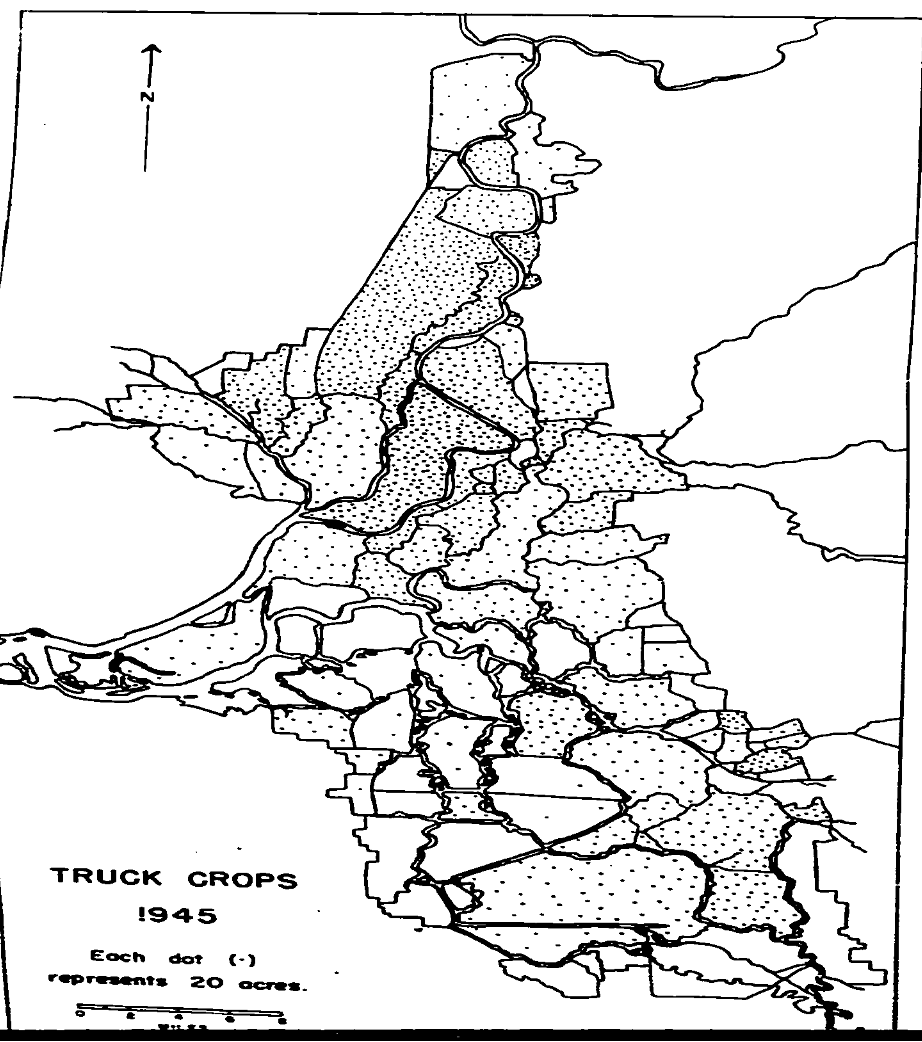
Woodward Island, 1952

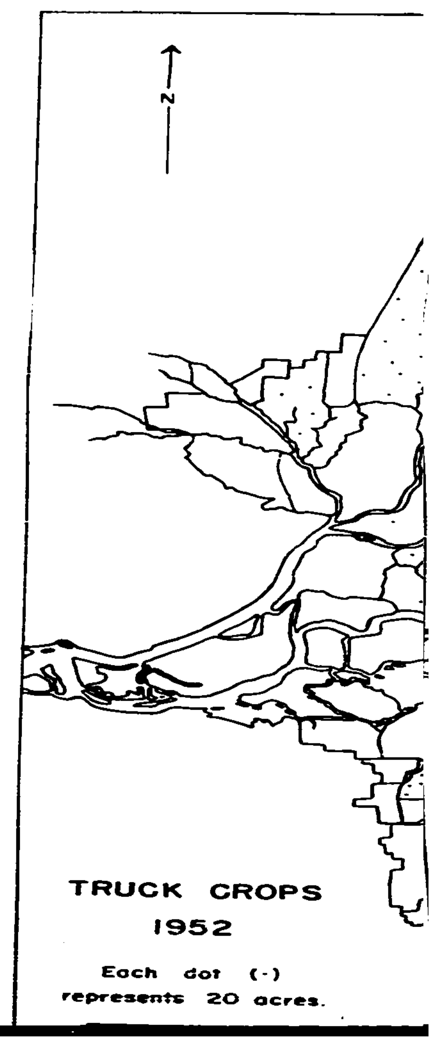
MAP PLATE A: Truck Crops and Tomatoes

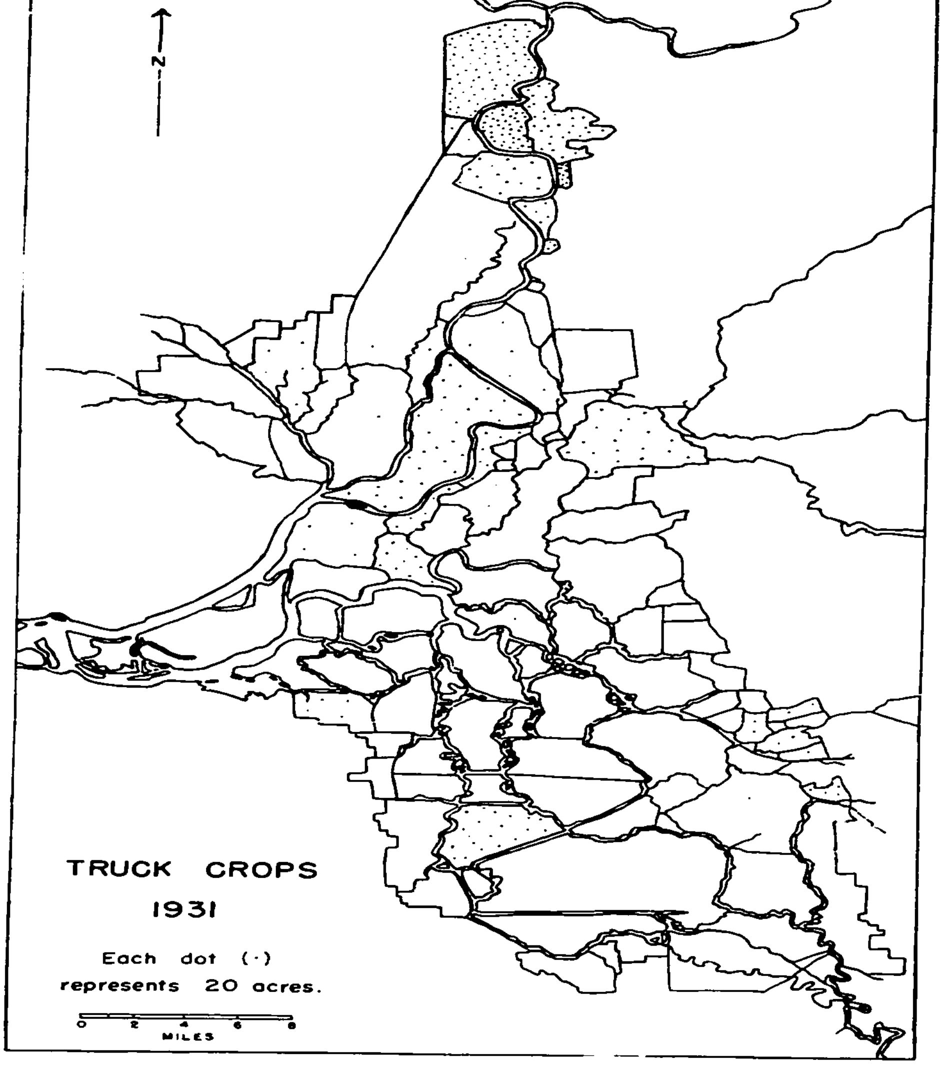
Source: County Agricultural Commissioner's Reports

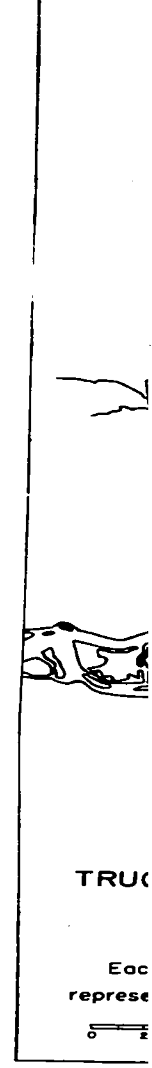

N
TRUCK CROPS
1924
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

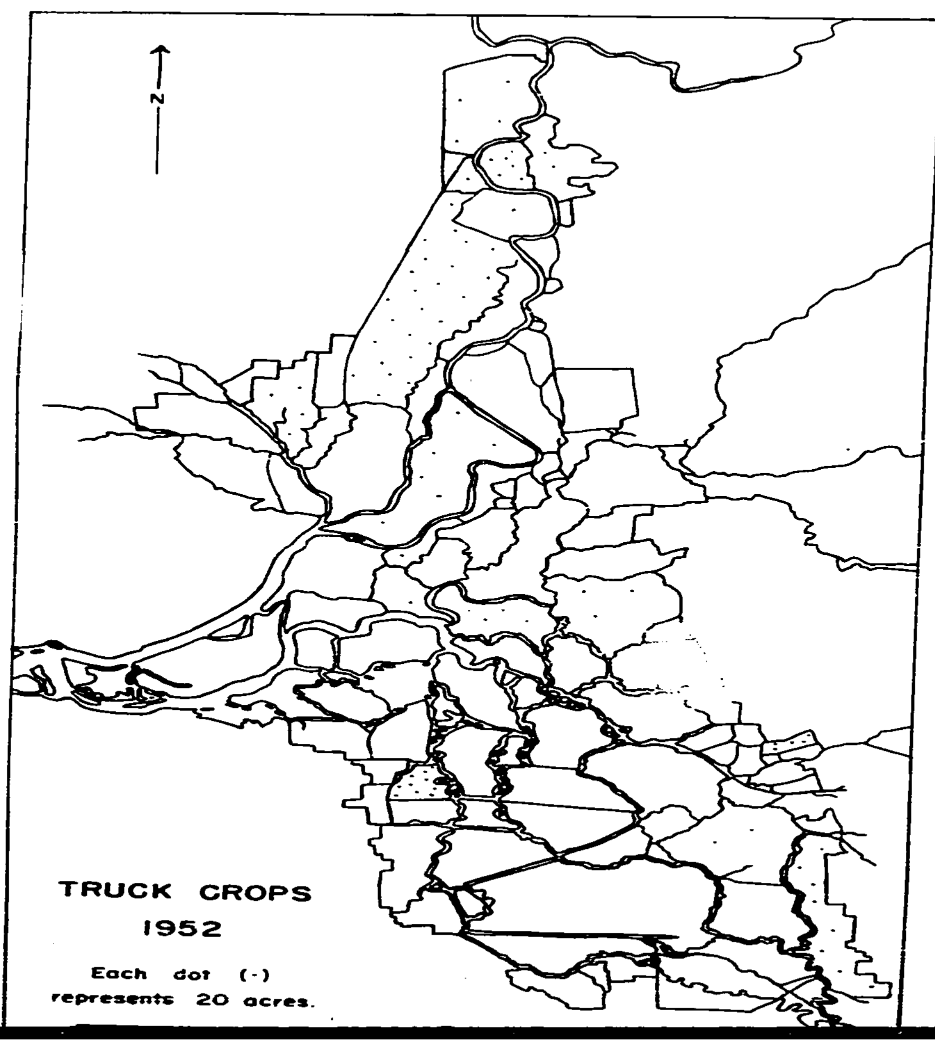

N
TRUCK CROPS
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES


N
TRUCK CROPS
1945
Each dot (·)
represents 20 acres.

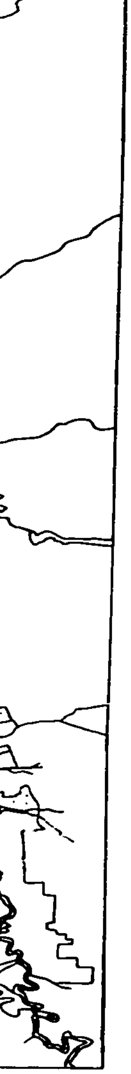

N
TRUCK CROPS
1952
Each dot (·)
represents 20 acres.

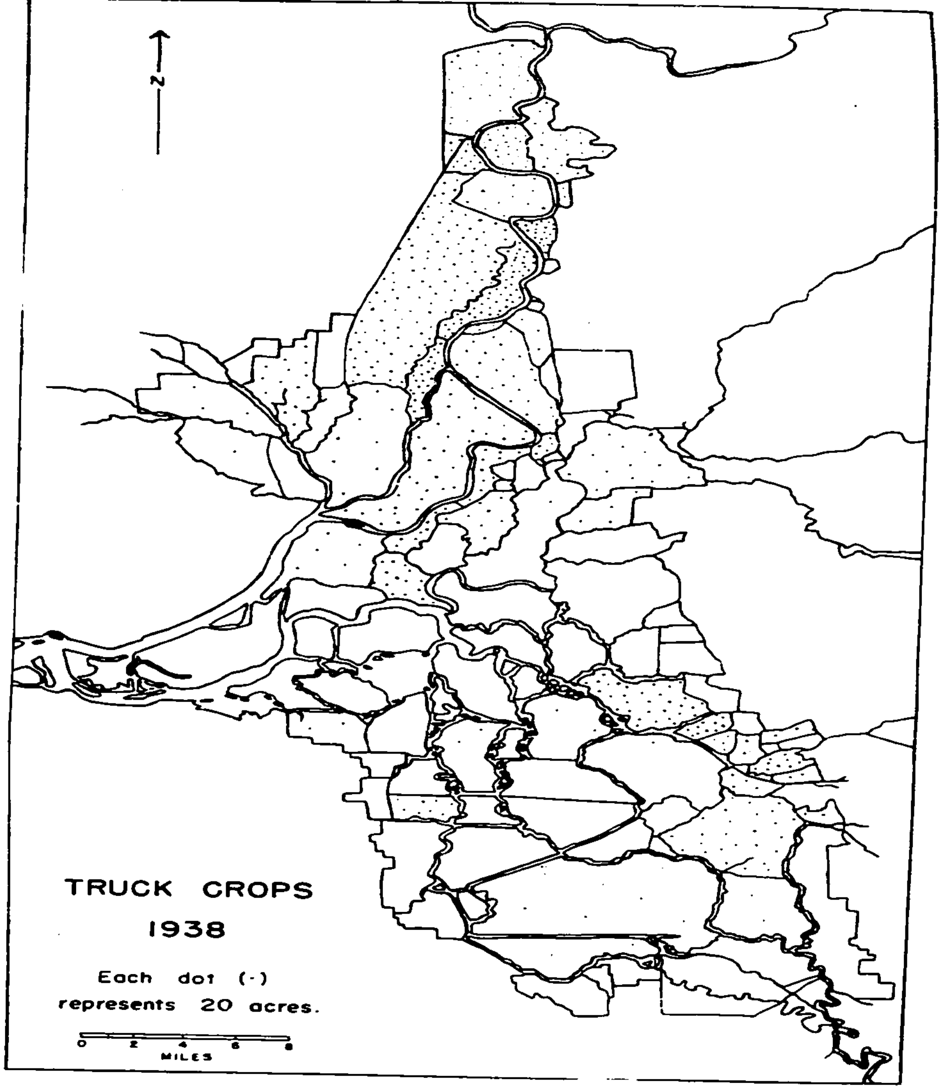

N
TRUCK CROPS
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES


TRUC
Eac
represe

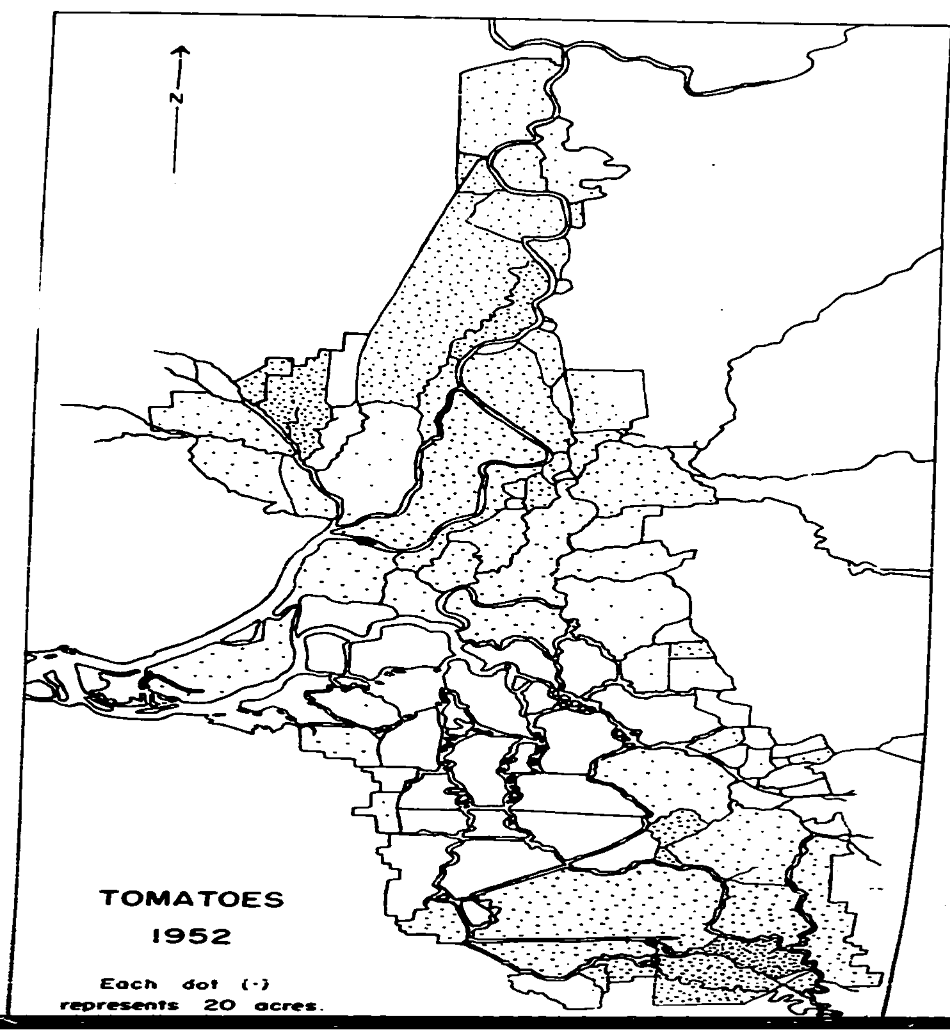

N
TRUCK CROPS
1952
Each dot (·)
represents 20 acres.


N
TOMA
Each
represents

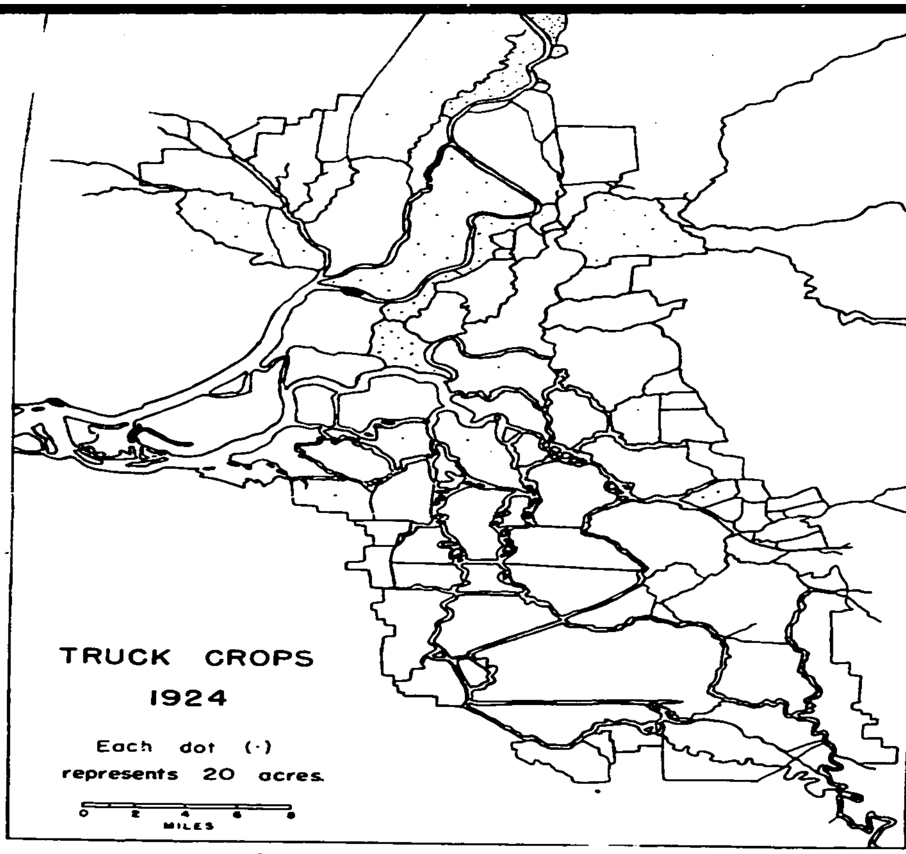




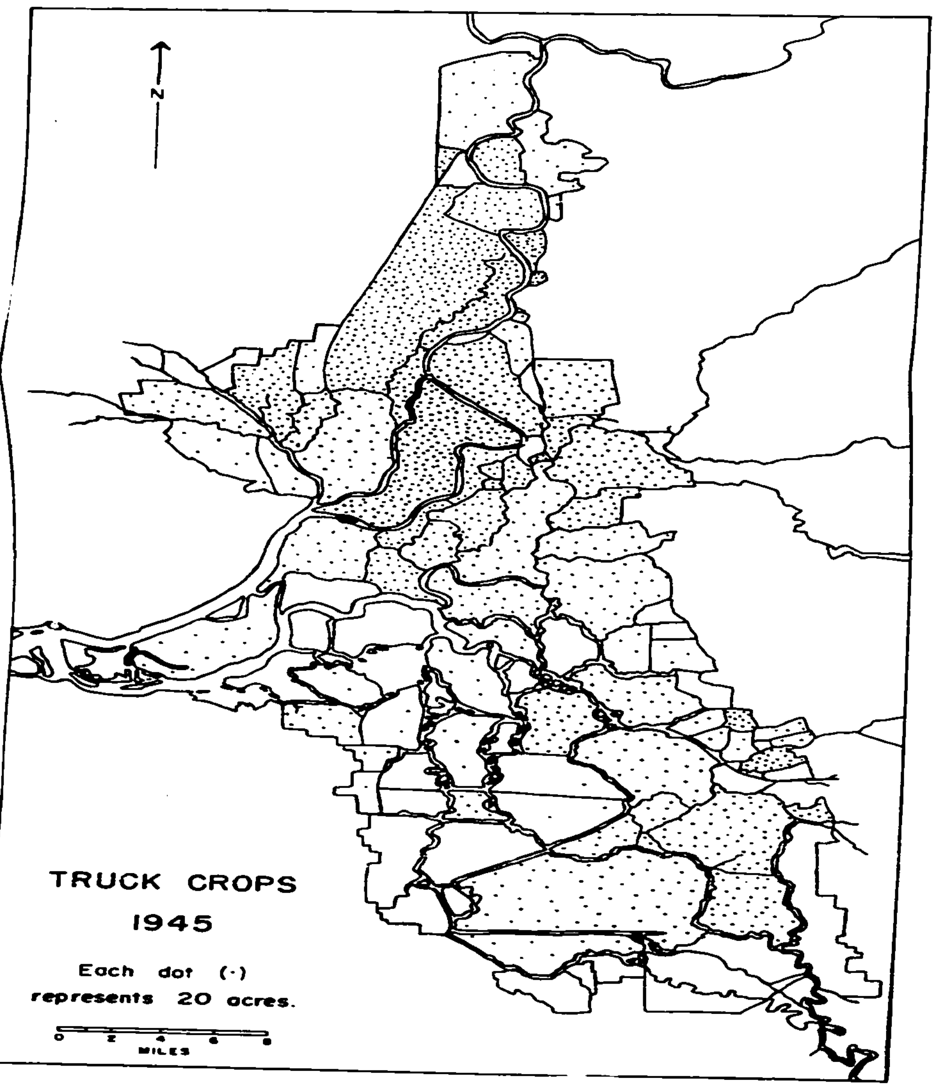
TRUCK CROPS
1938
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

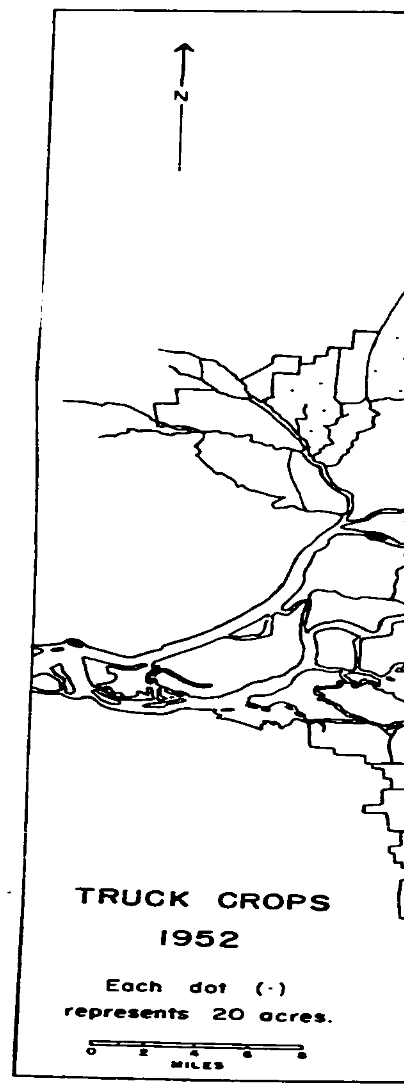


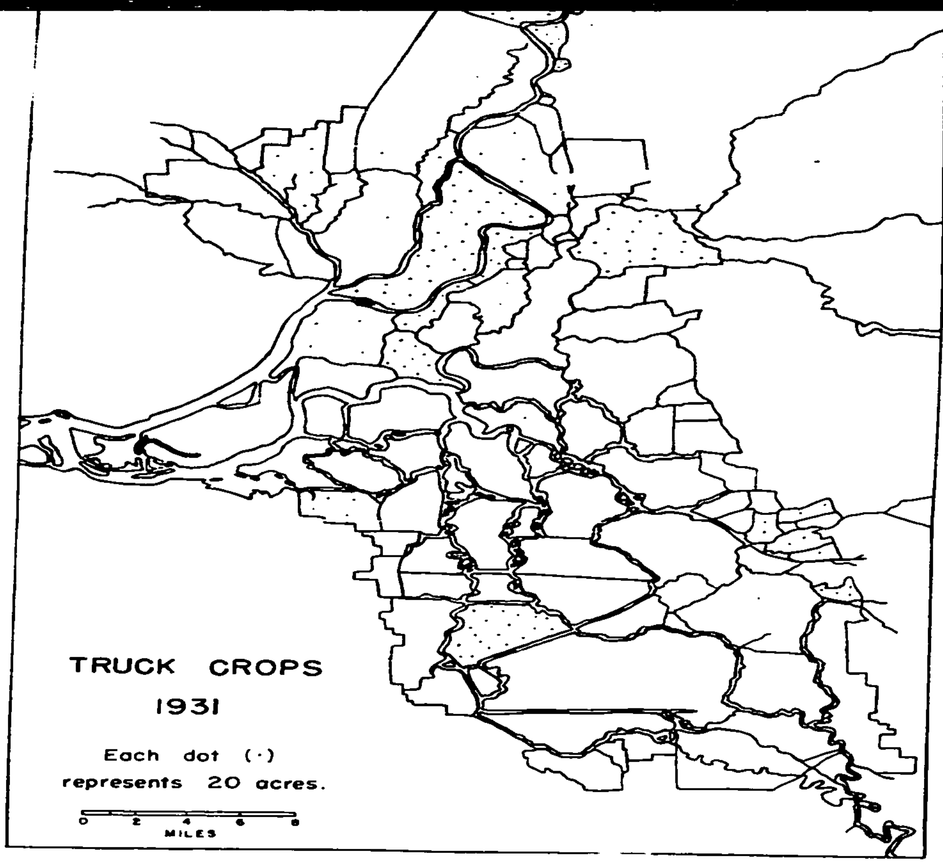
TOMATOES
1952
Each dot (·) represents 20 acres.

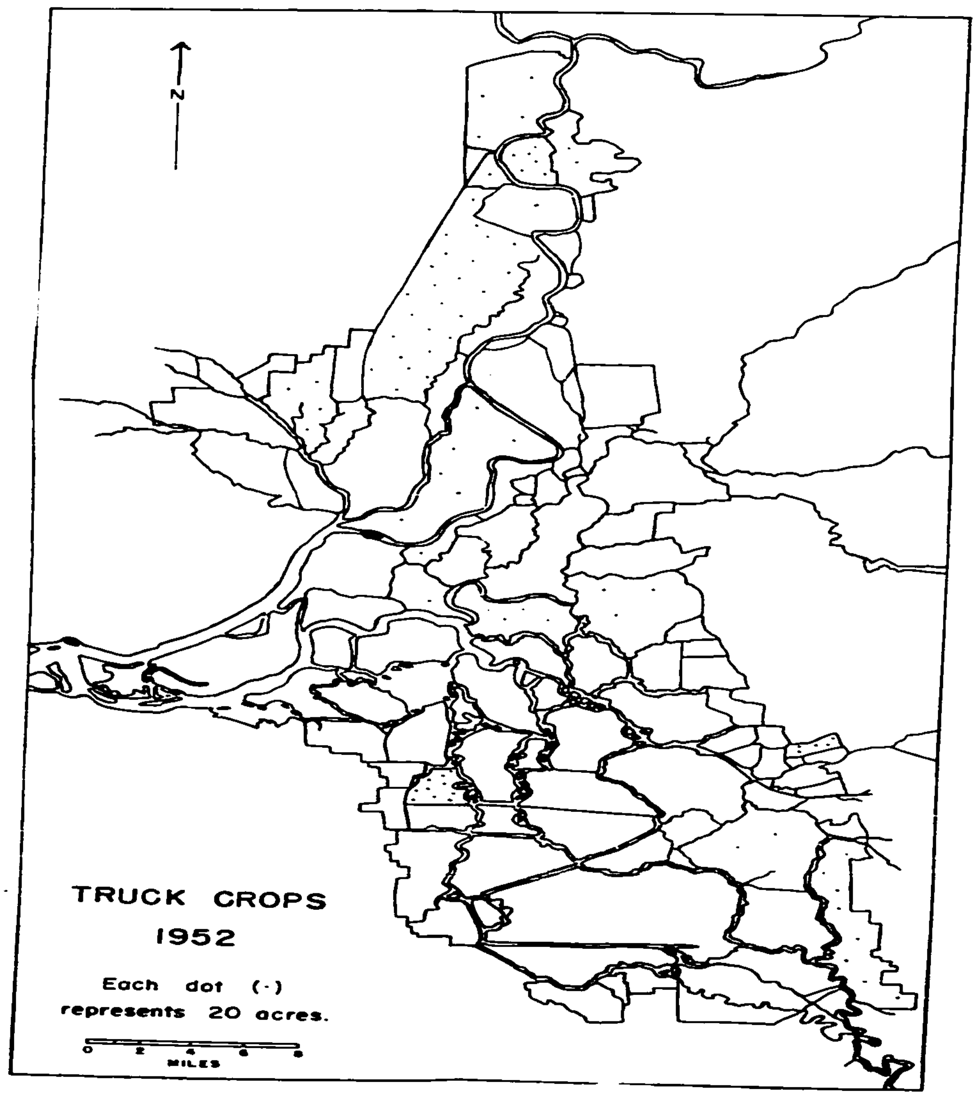

TRUCK CROPS
1924
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

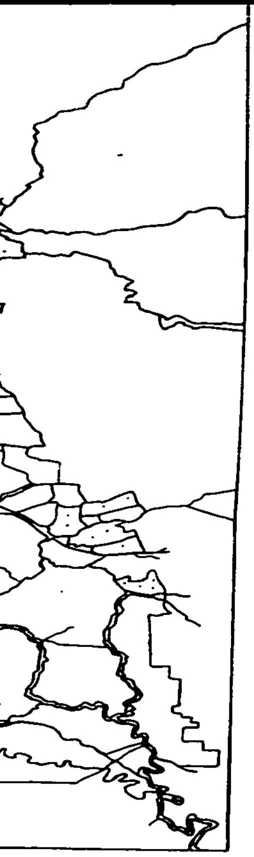

TRUCK CROPS
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

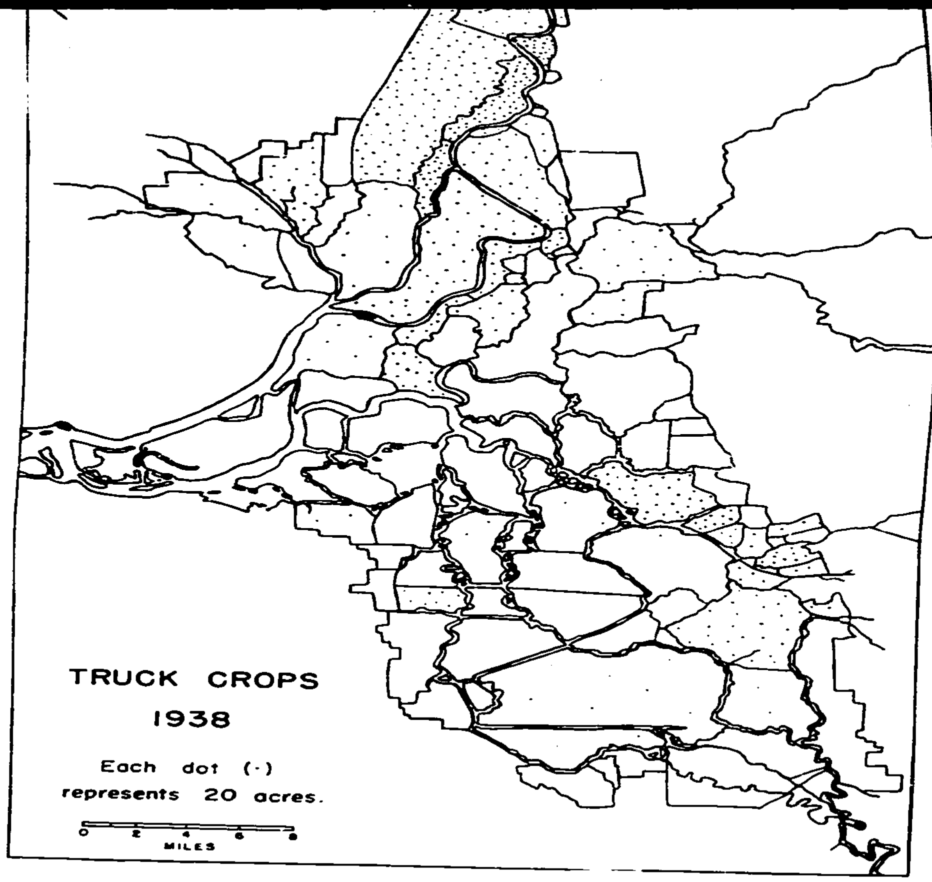

N
TRUCK CROPS
1945
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

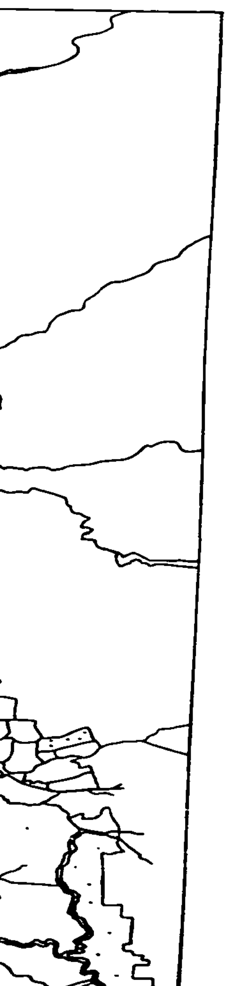

N
TRUCK CROPS
1952
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

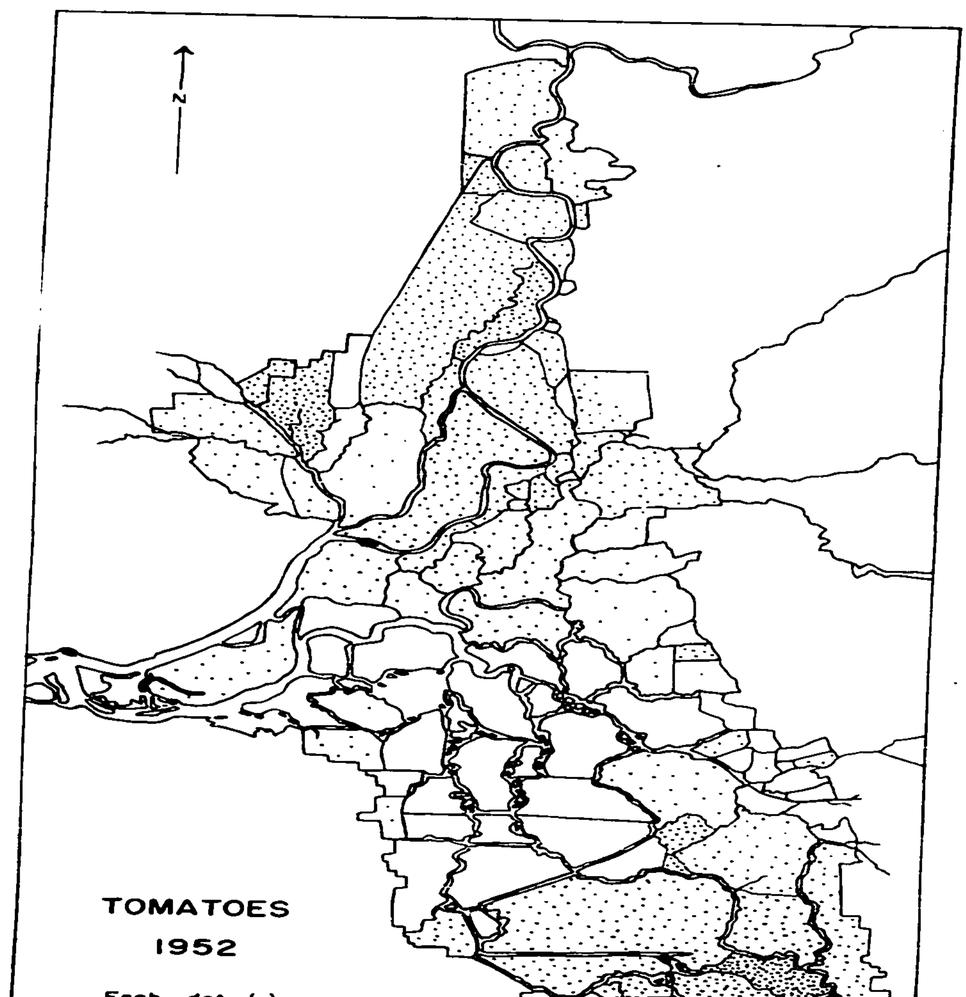

TRUCK CROPS
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES


N
TRUCK CROPS
1952
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES



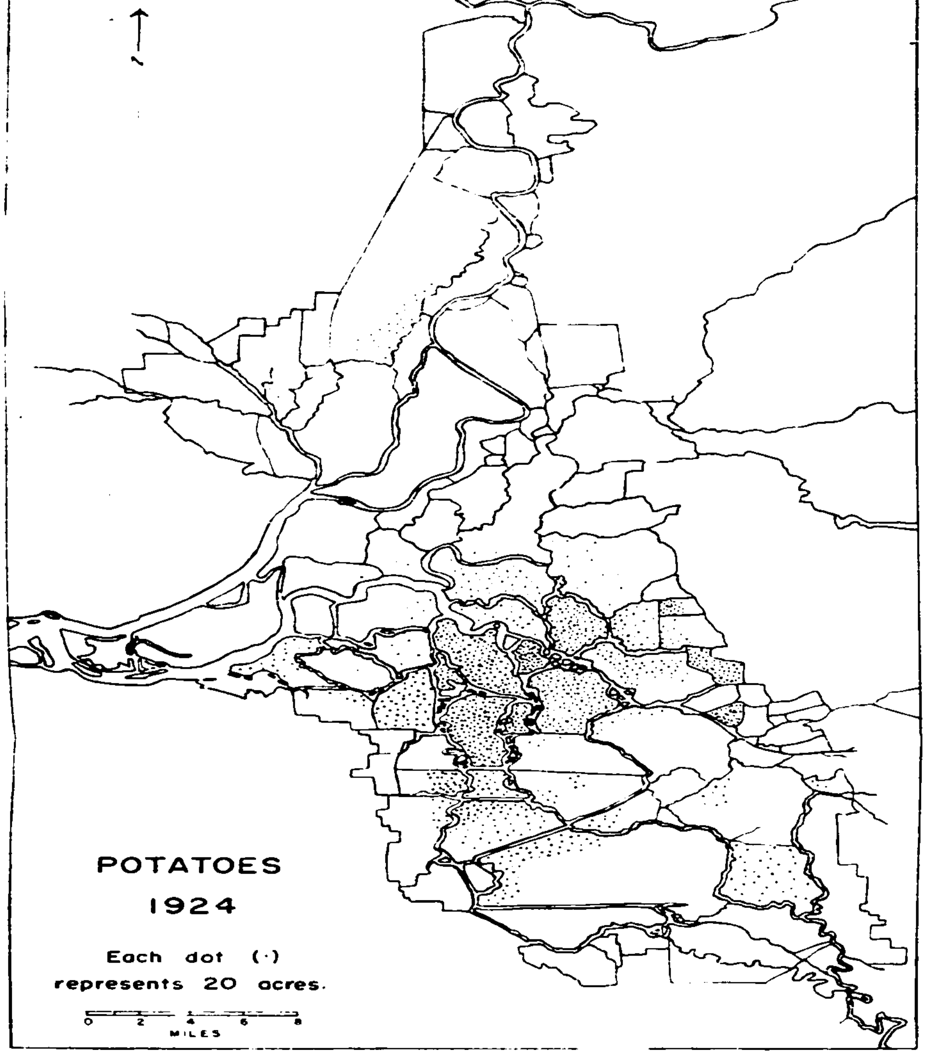

TRUCK CROPS
1938
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

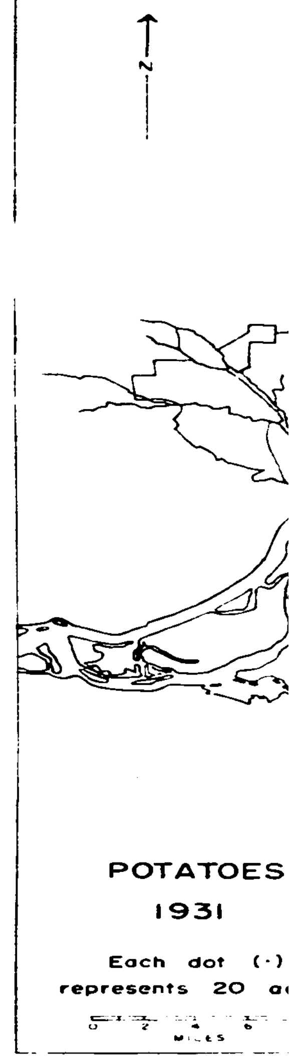


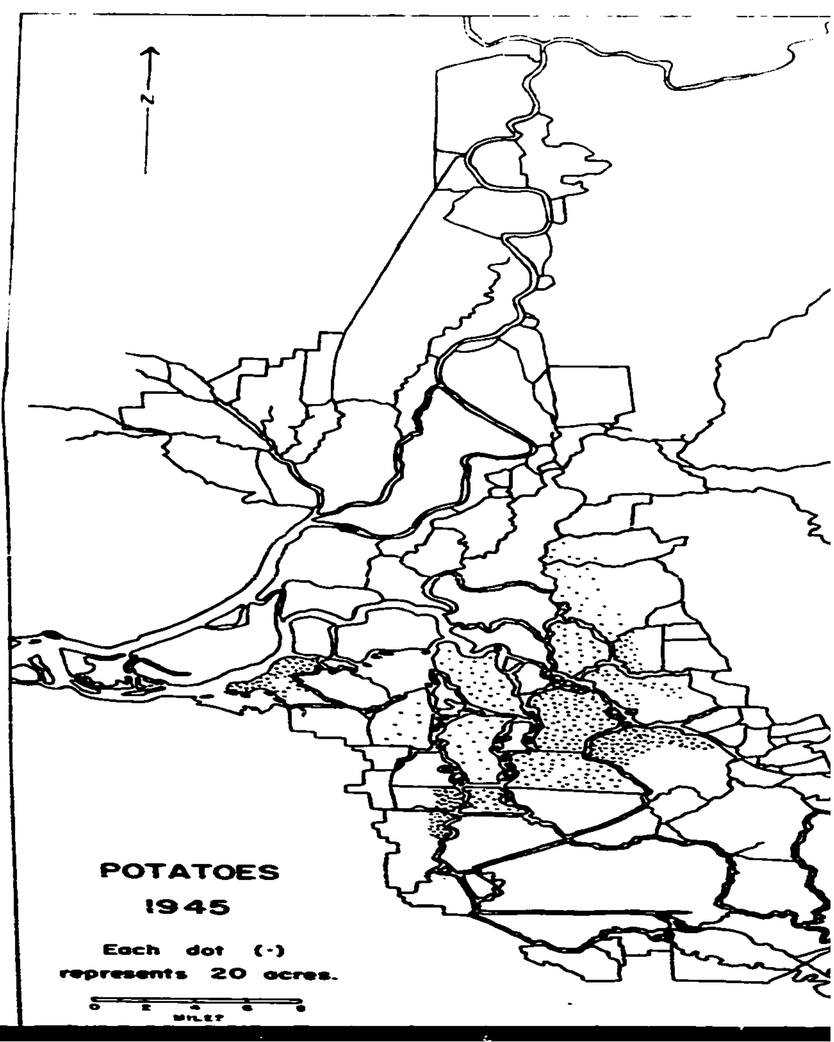

N
TOMATOES
1952
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

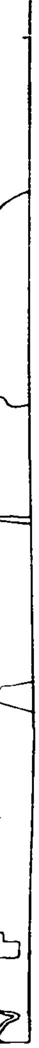
MAP PLATE B: Potatoes

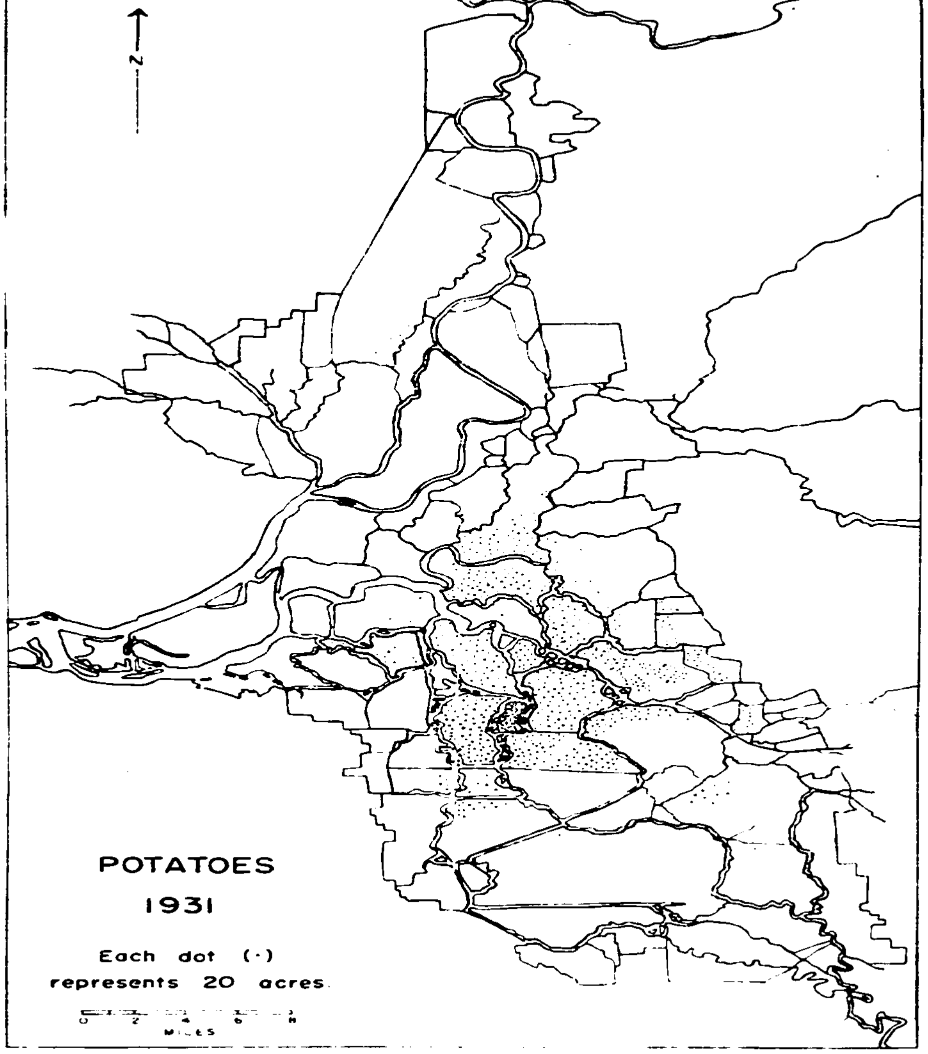
Source: County Agricultural Commissioner's Reports

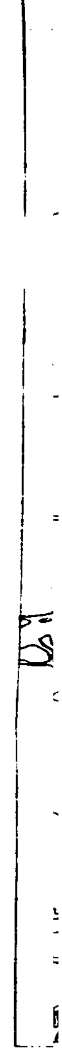

POTATOES
1924
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

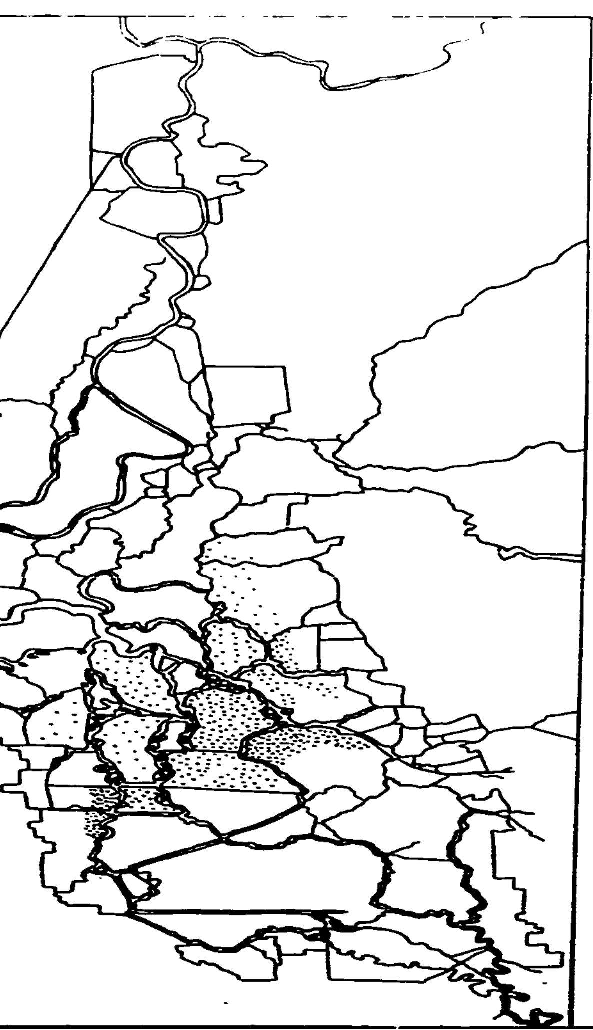

POTATOES
1931
Each dot (·)
represents 20 a

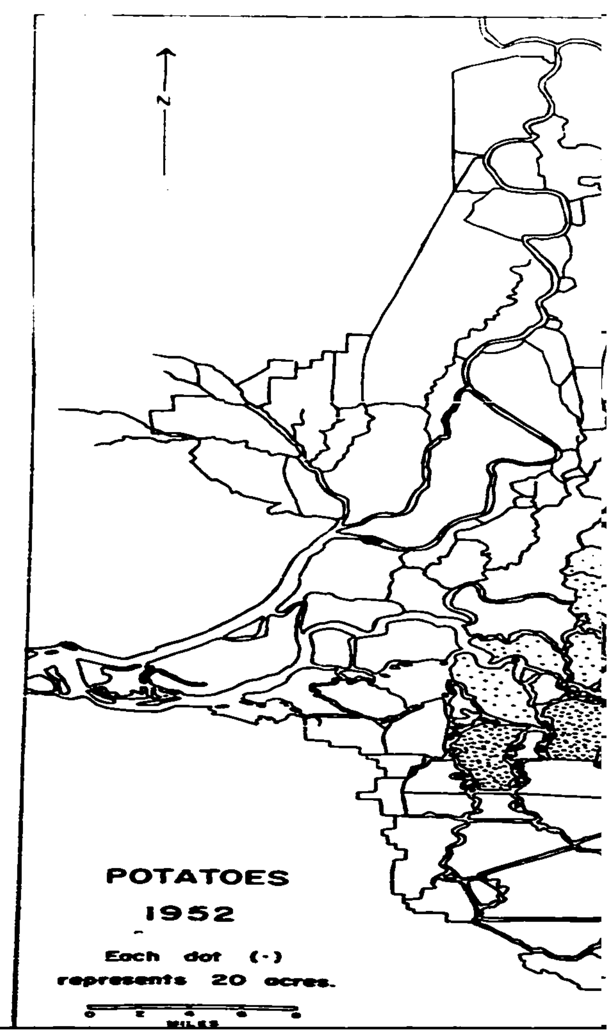

POTATOES
1945
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

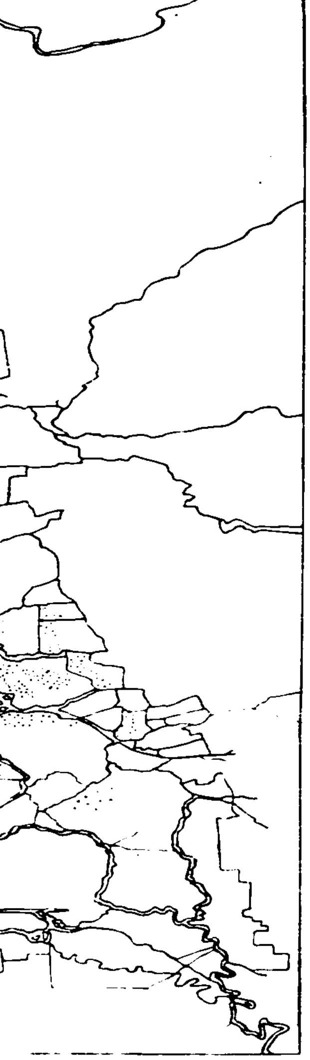


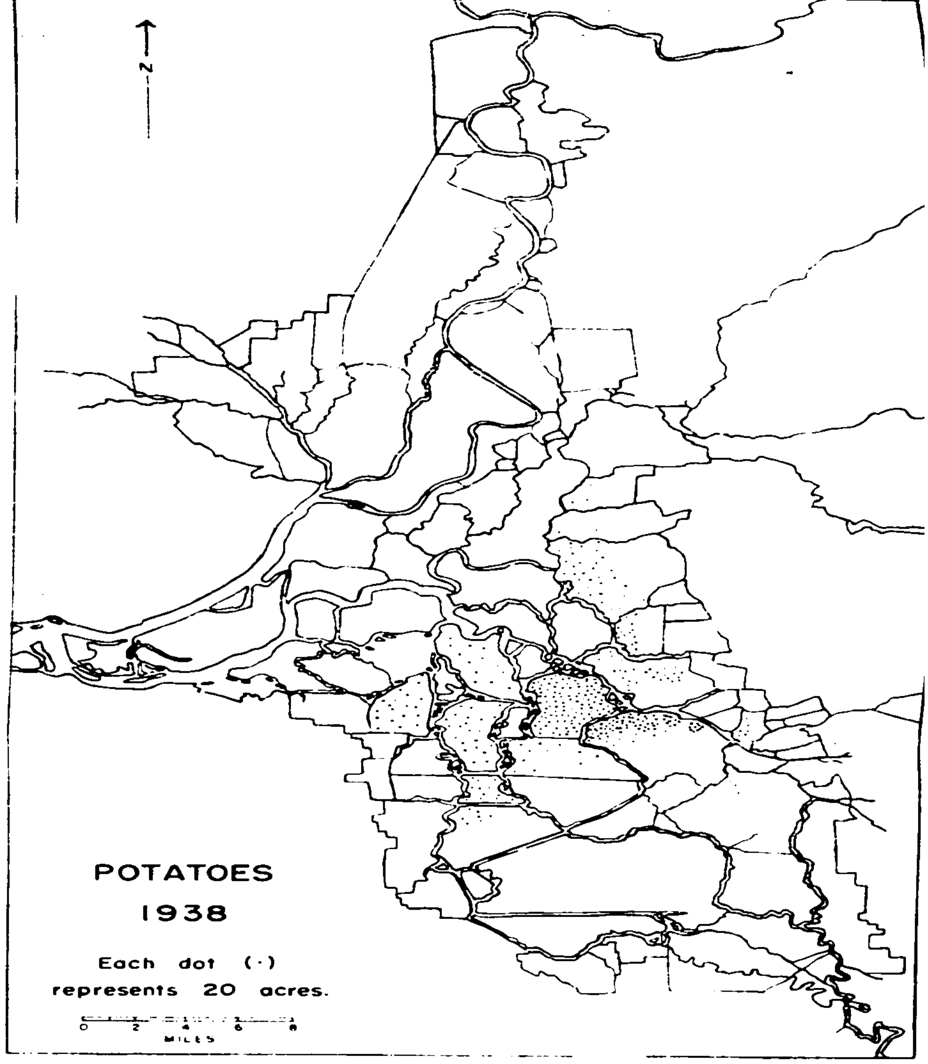

N
POTATOES
1931
Each dot (·)
represents 20 acres.
MILES

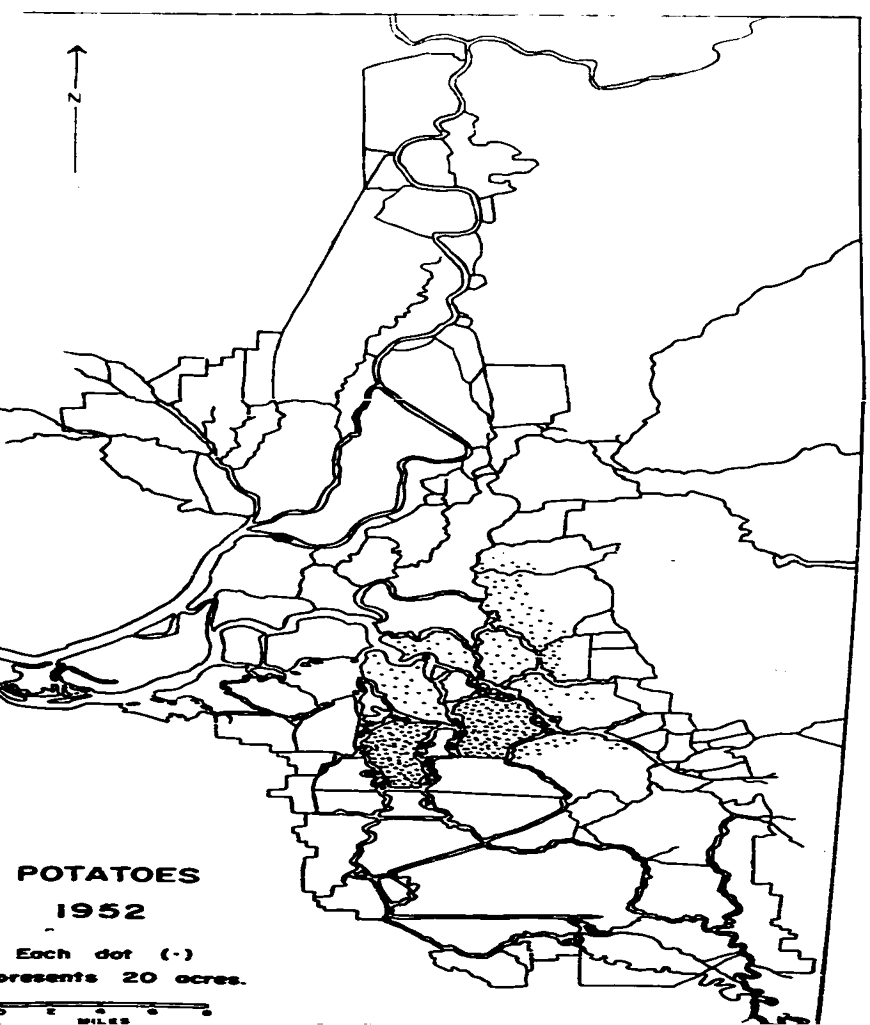


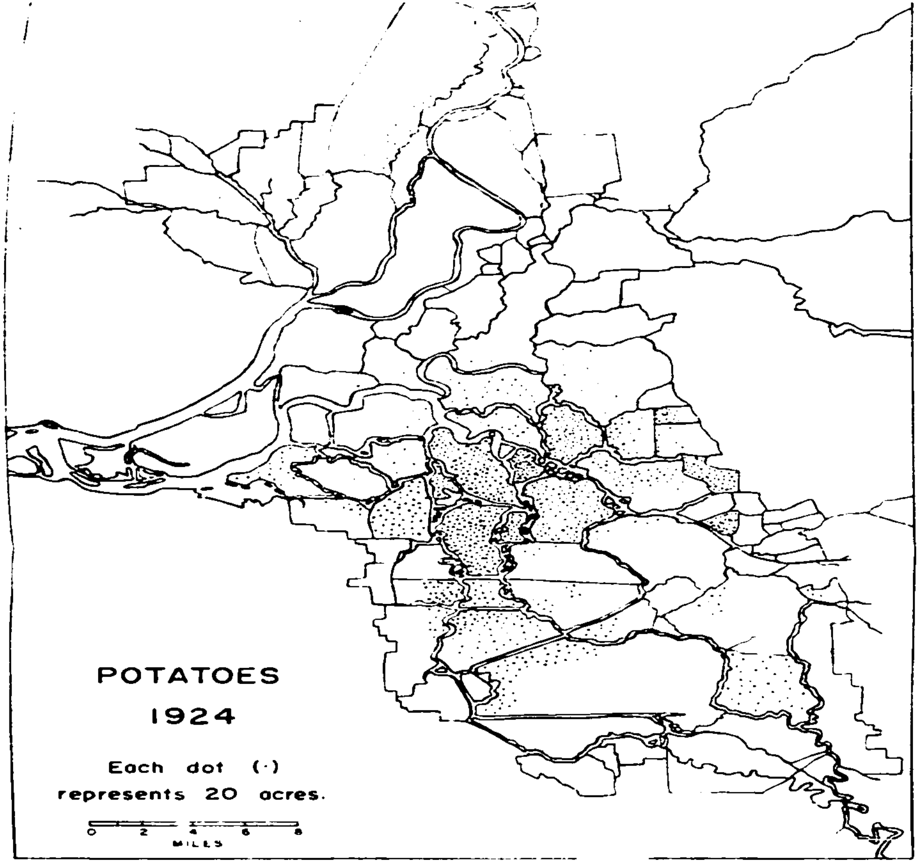


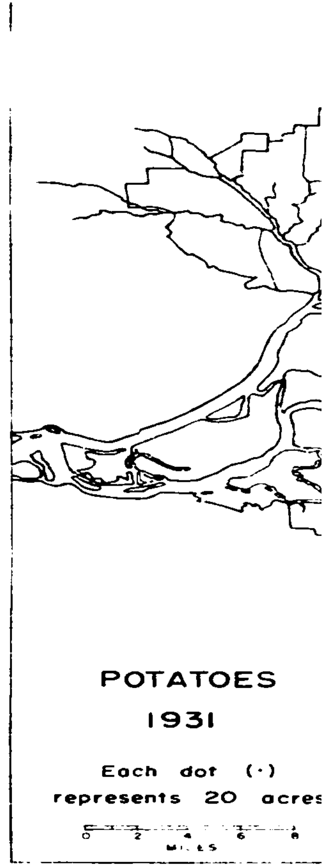

N
POTATOES
1952
Each dot (·)
represents 20 acres.
MILES

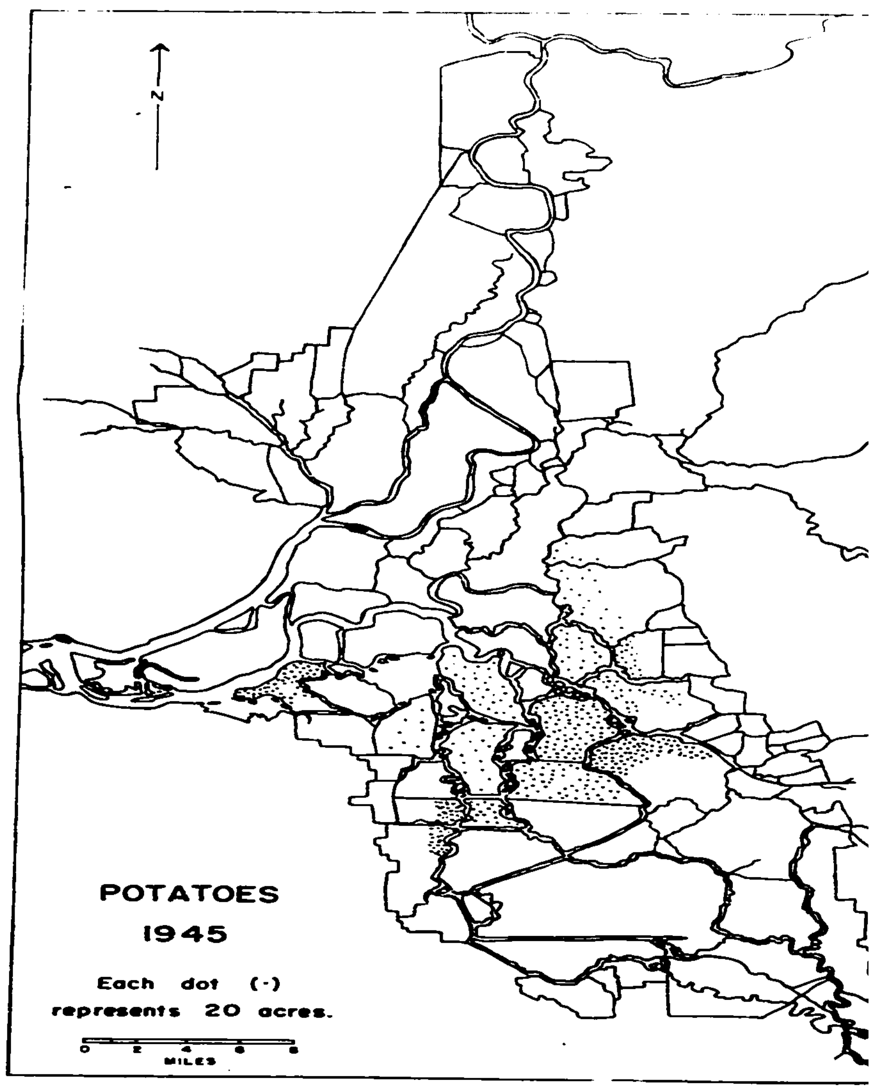


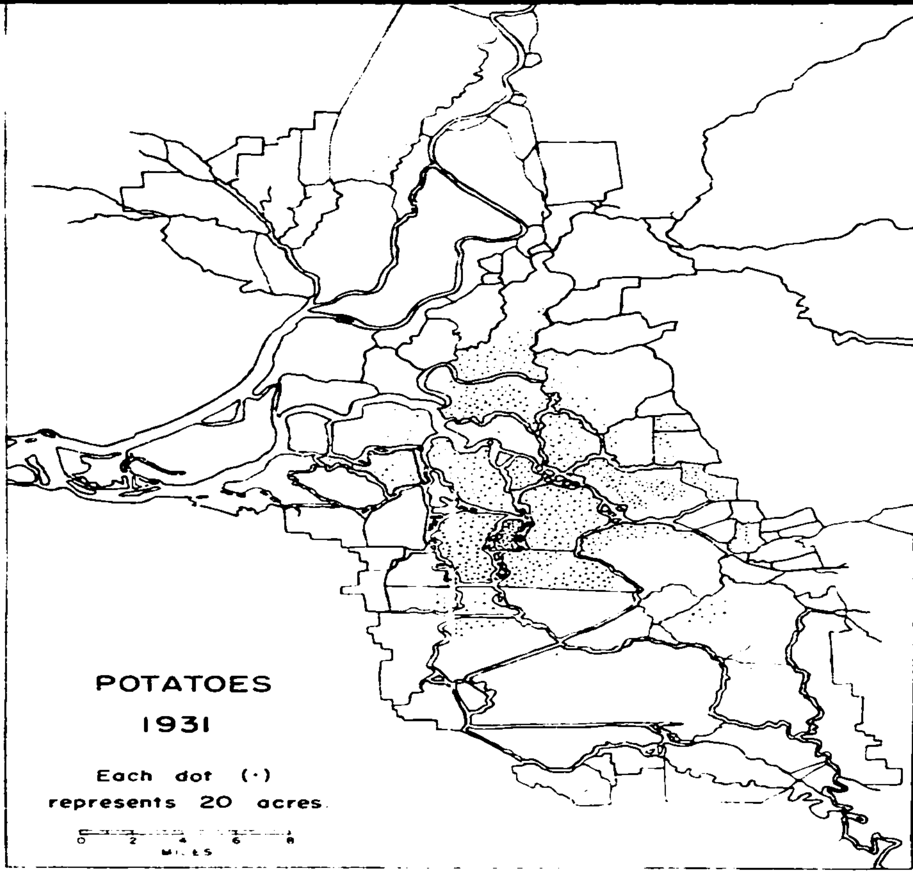

N
POTATOES
1938
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

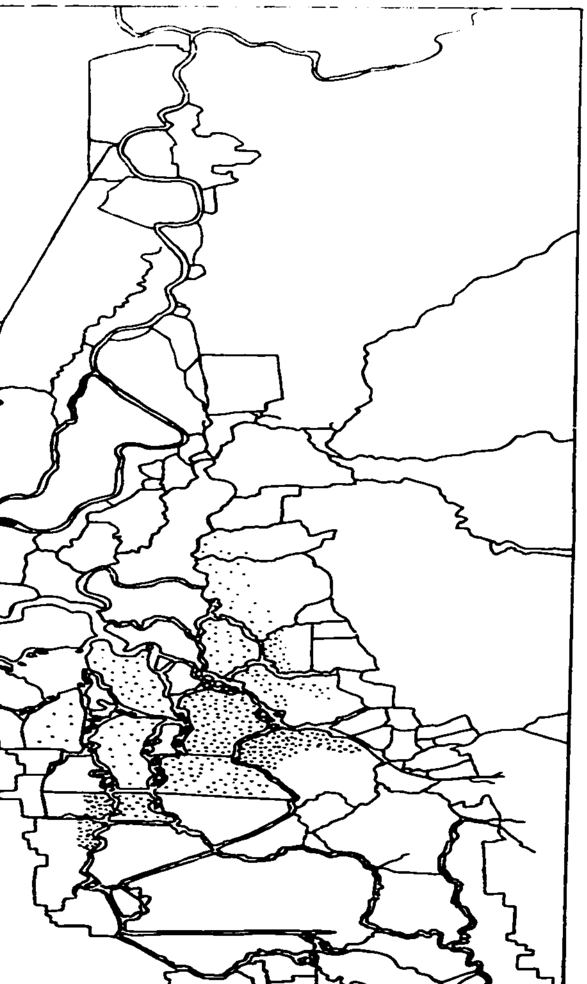

N
POTATOES
1952
Each dot (·)
represents 20 acres.
MILES

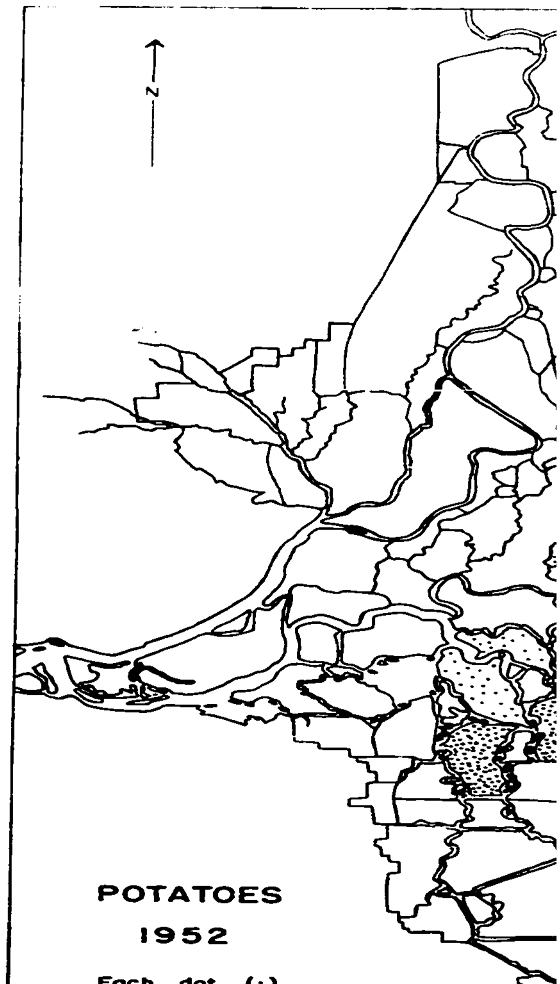

POTATOES
1924
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

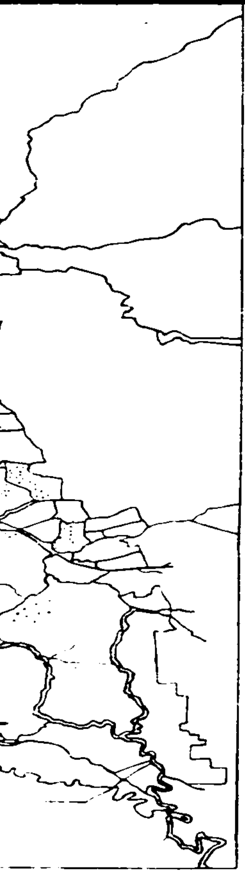

POTATOES
1931
Each dot (·)
represents 20 acres
0 2 4 6 8
MILES

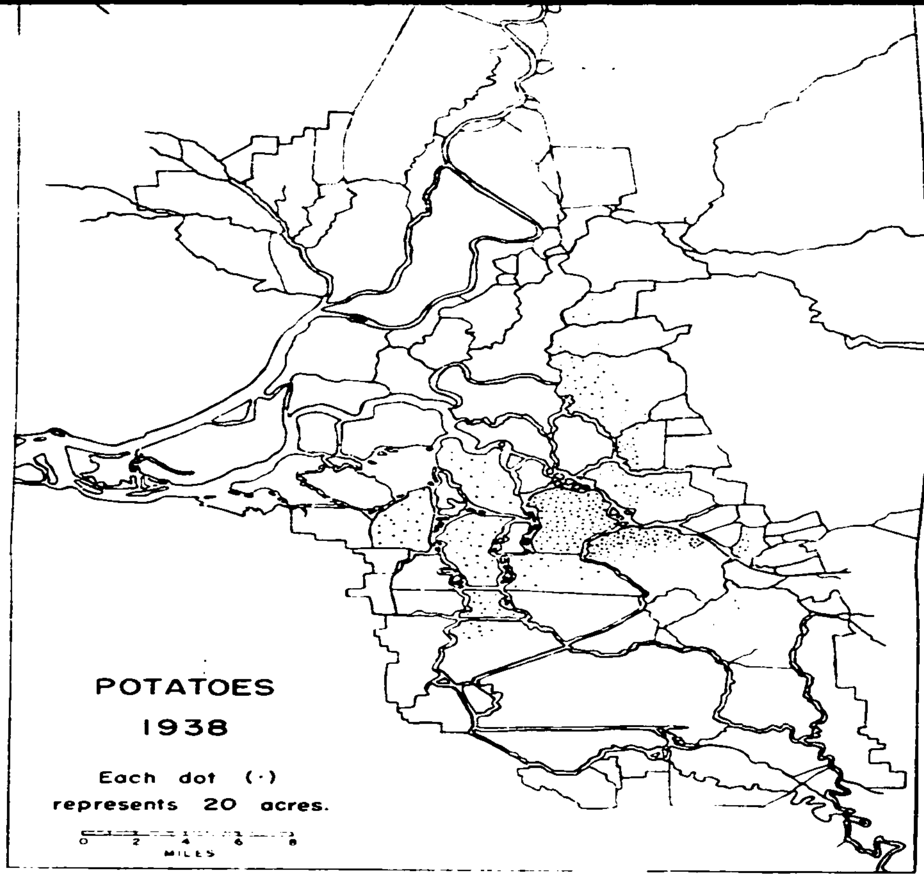

N
POTATOES
1945
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

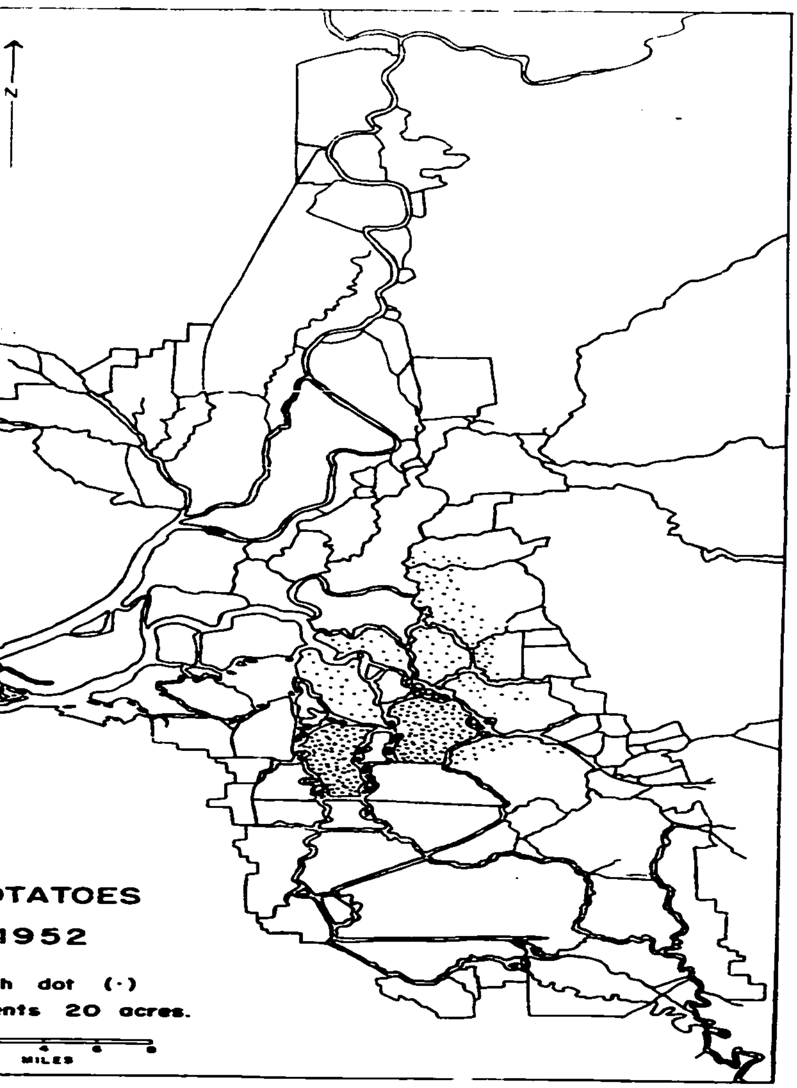

POTATOES
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES




N
POTATOES
1952
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

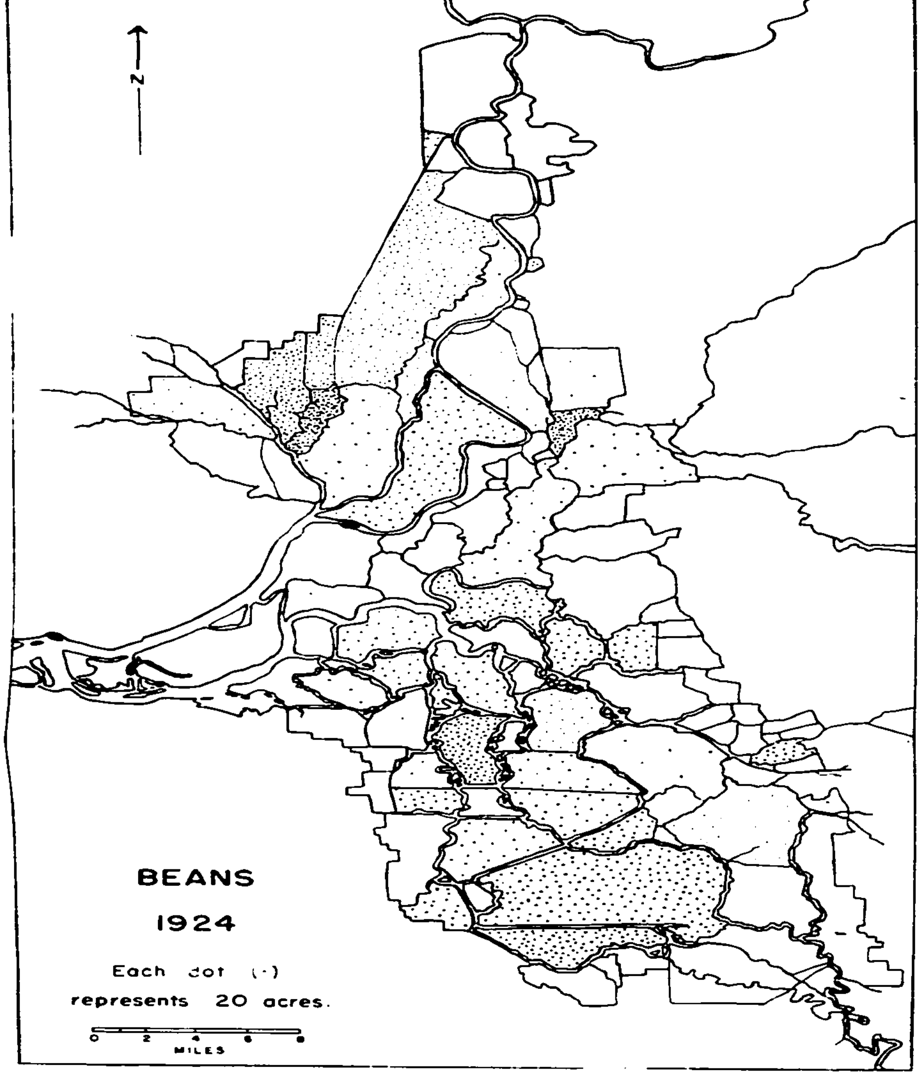



POTATOES
1938
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

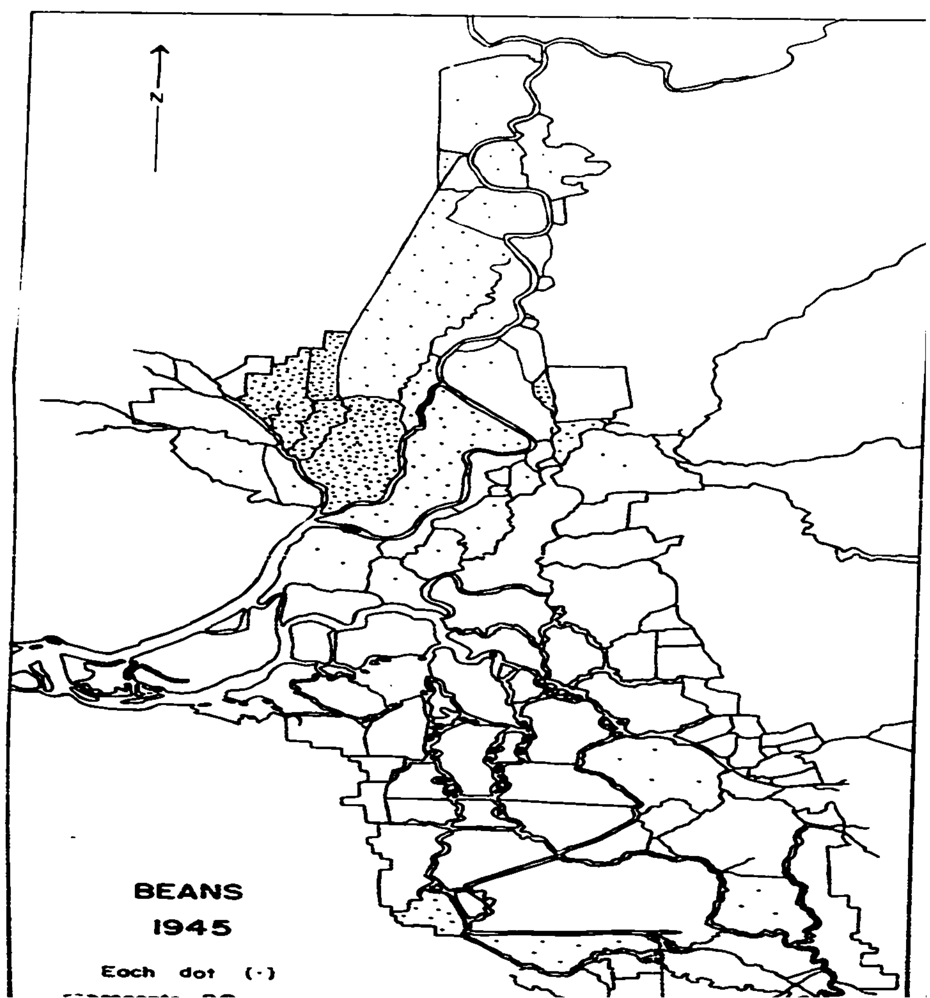

N
OTATOES
952
h dot (·)
ents 20 acres.
MILES

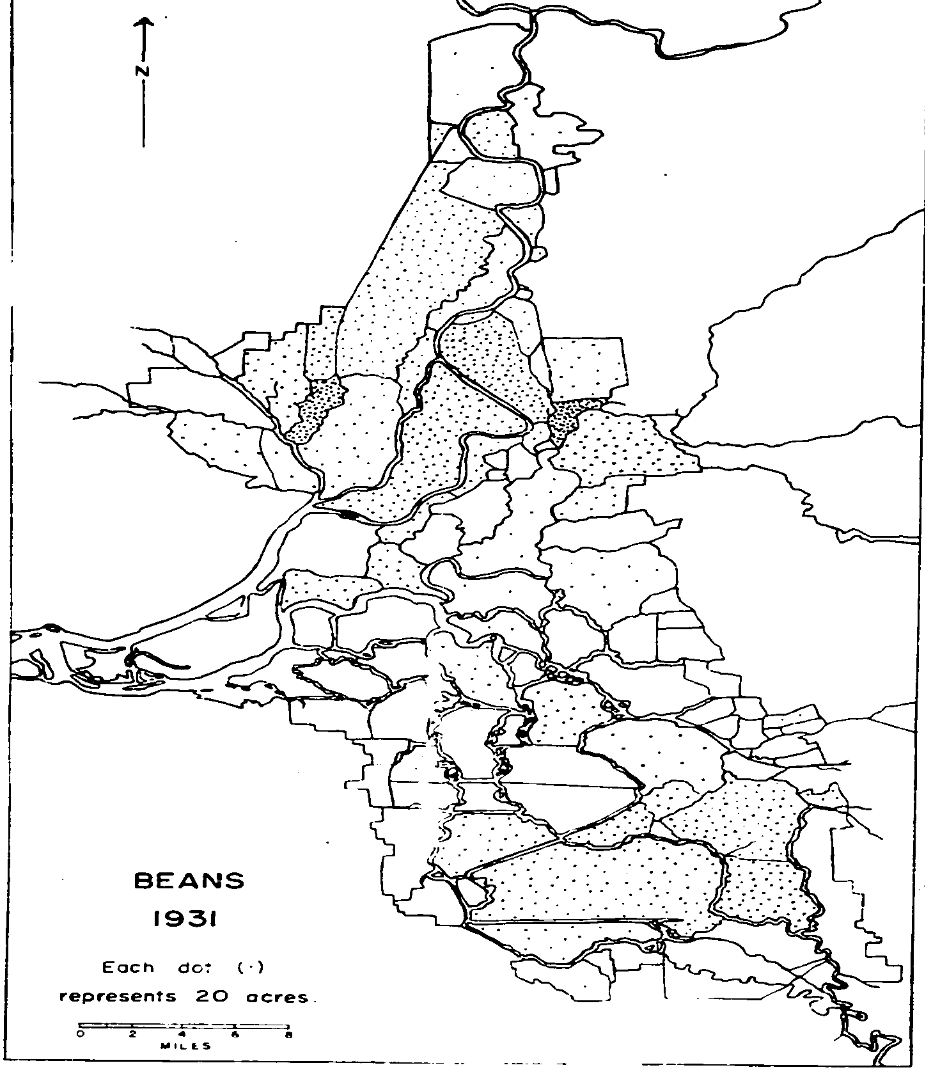
MAP PLATE C: Beans

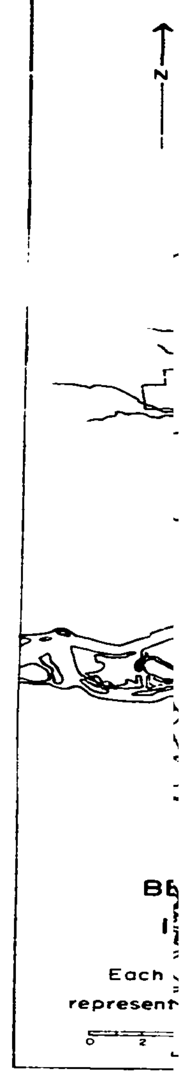
Source: County Agricultural Commissioner's Reports

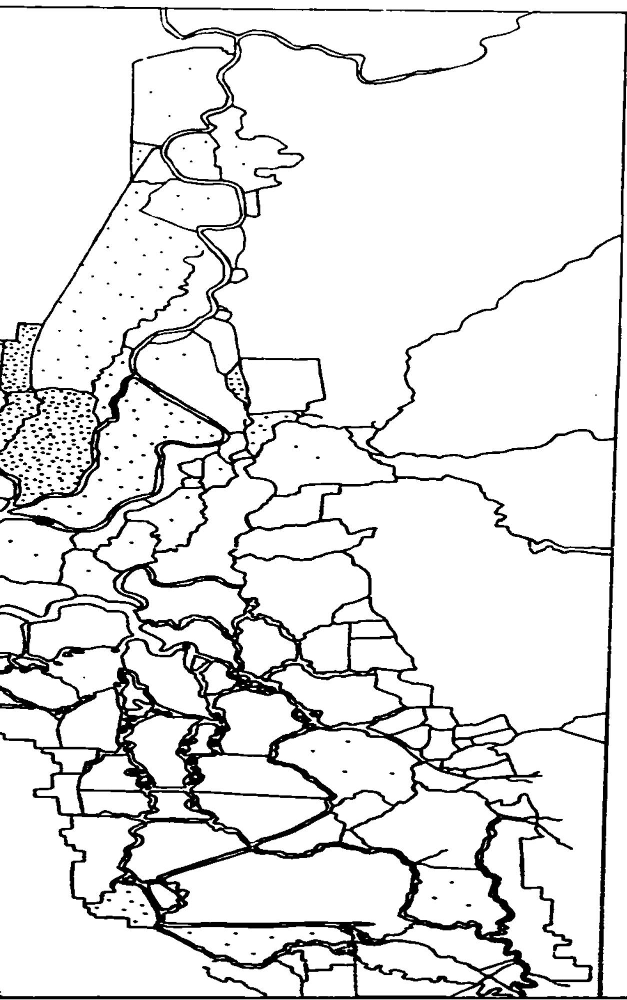

N
BEANS
1924
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

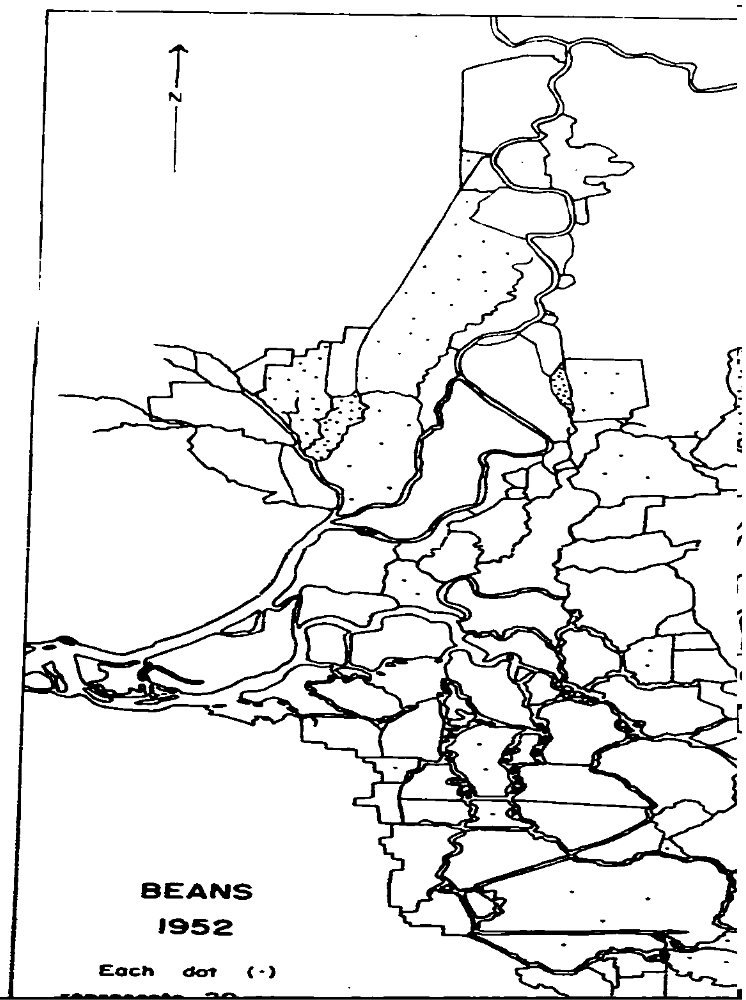

N
BEANS
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

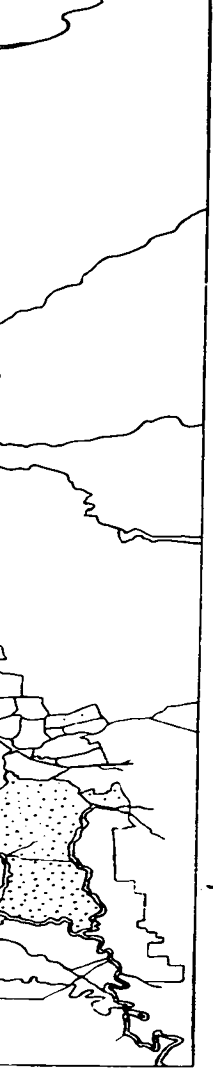

N
BEANS
1945
Each dot (·)

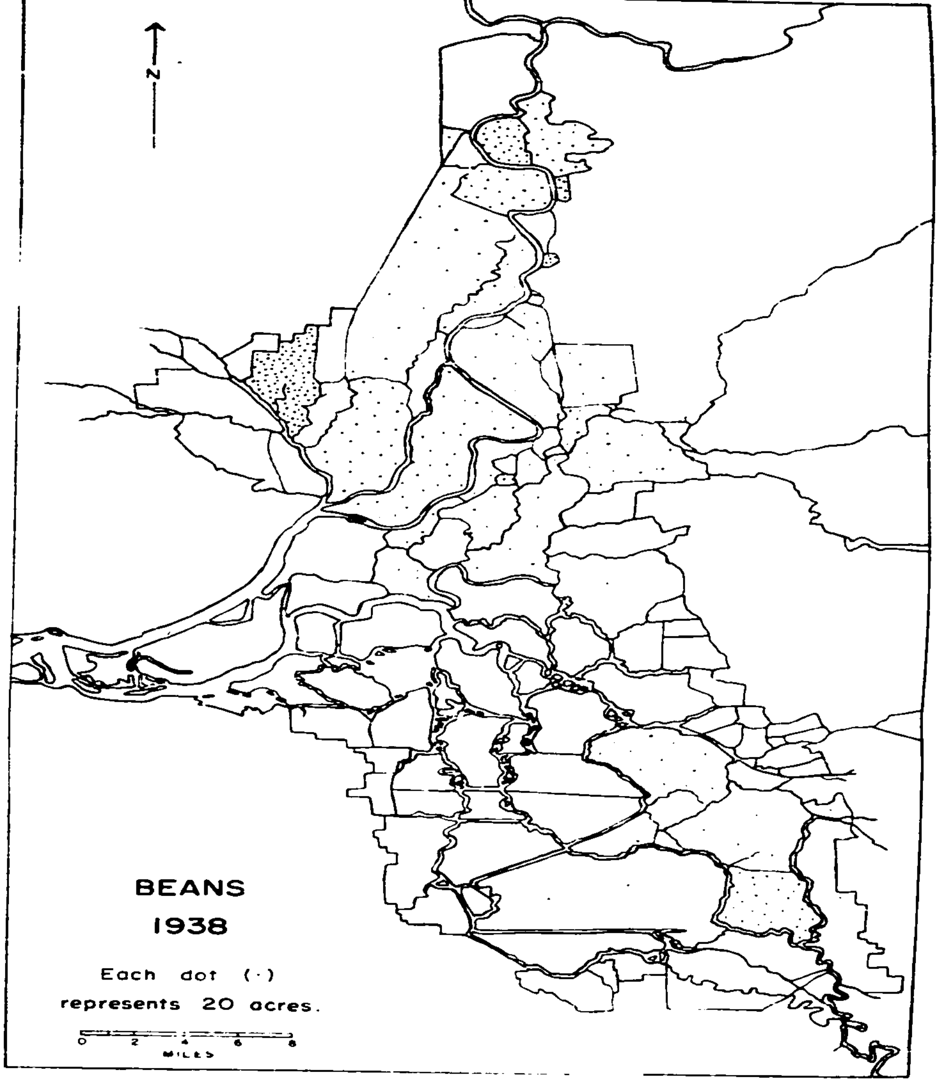

N
BEANS
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

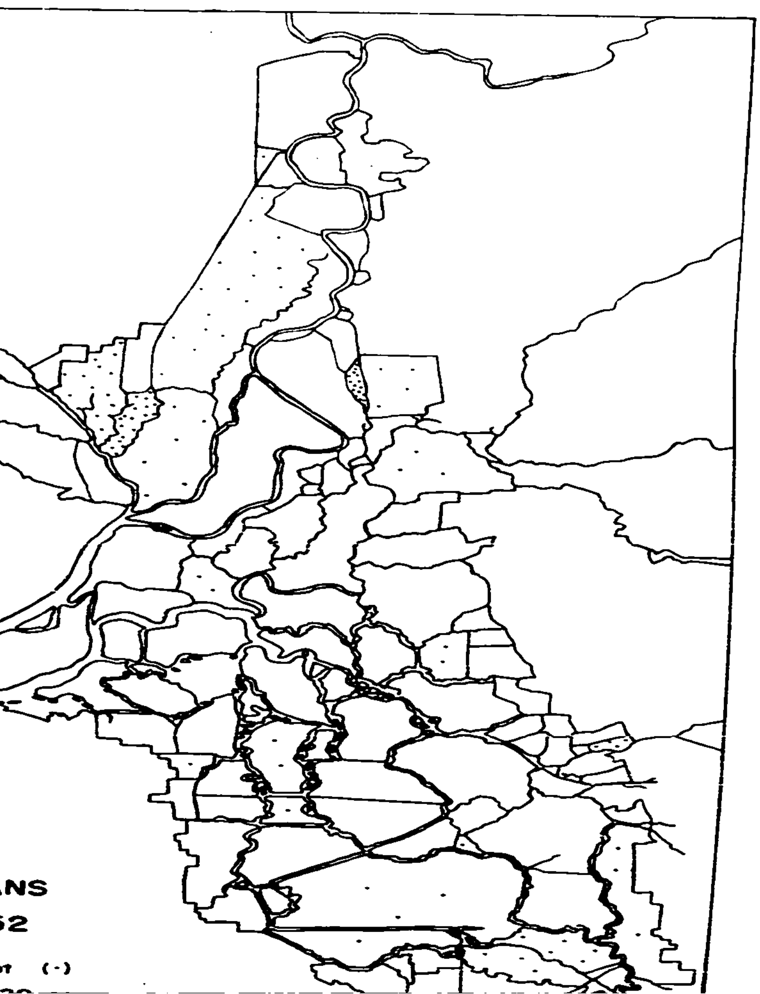

N

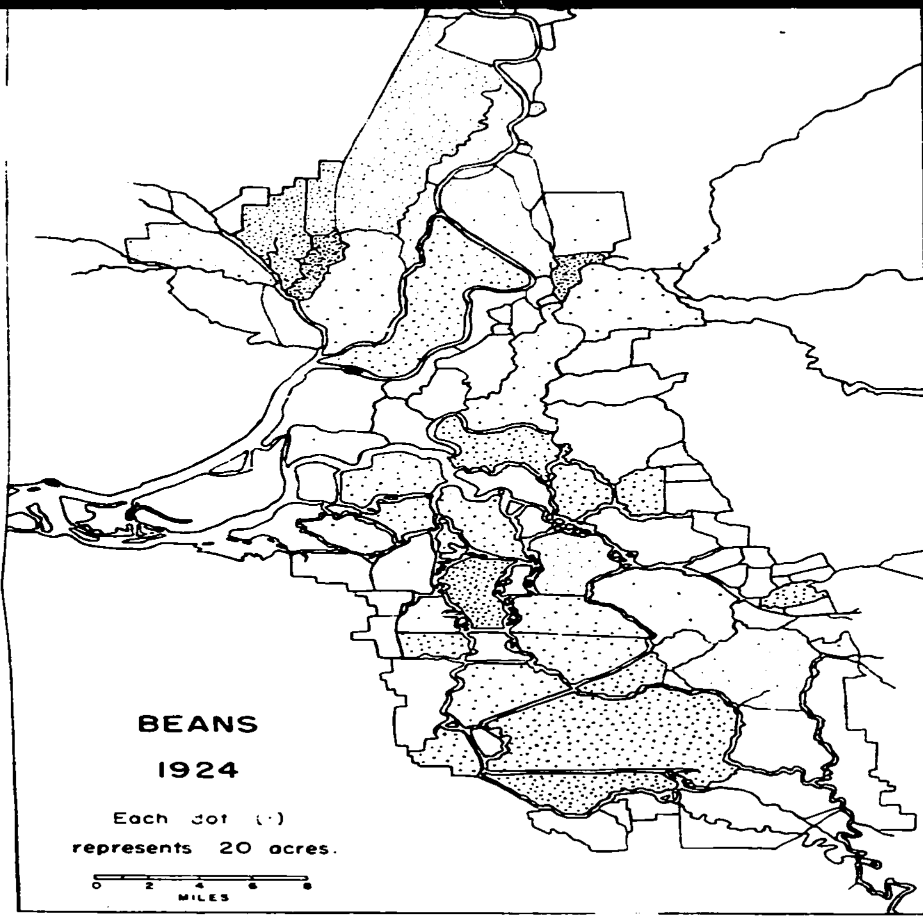


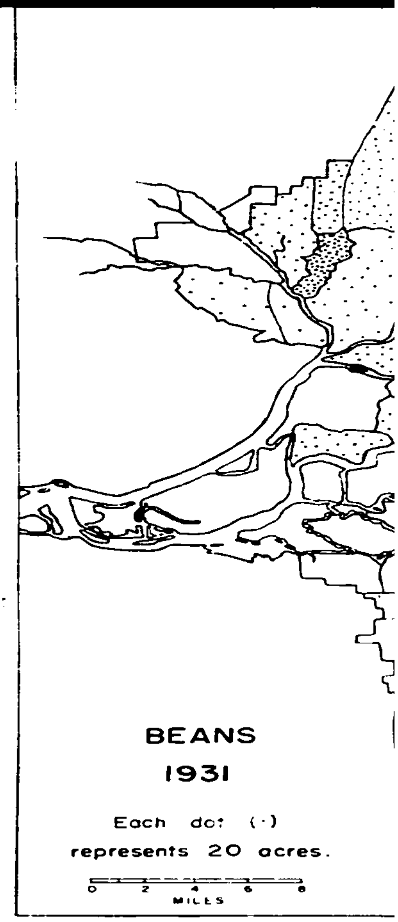

N
BEANS
1952
Each dot (·)

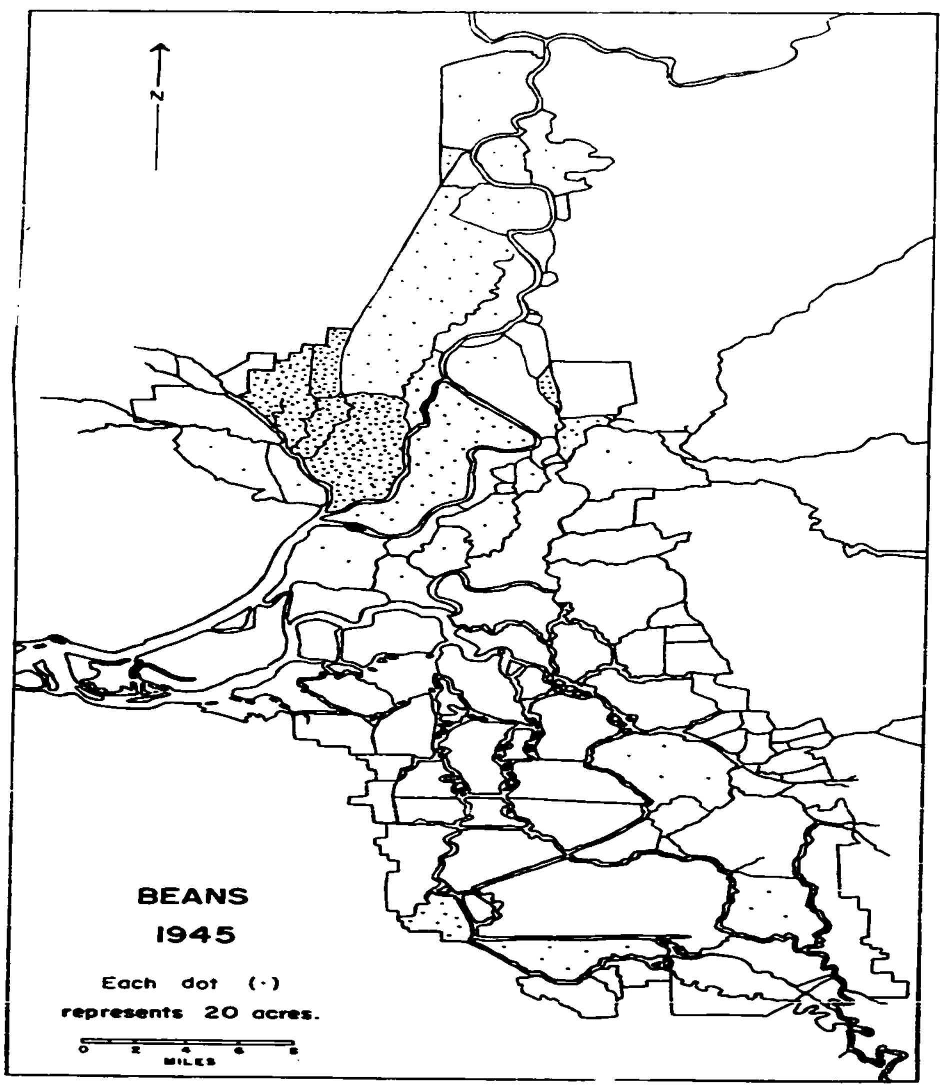


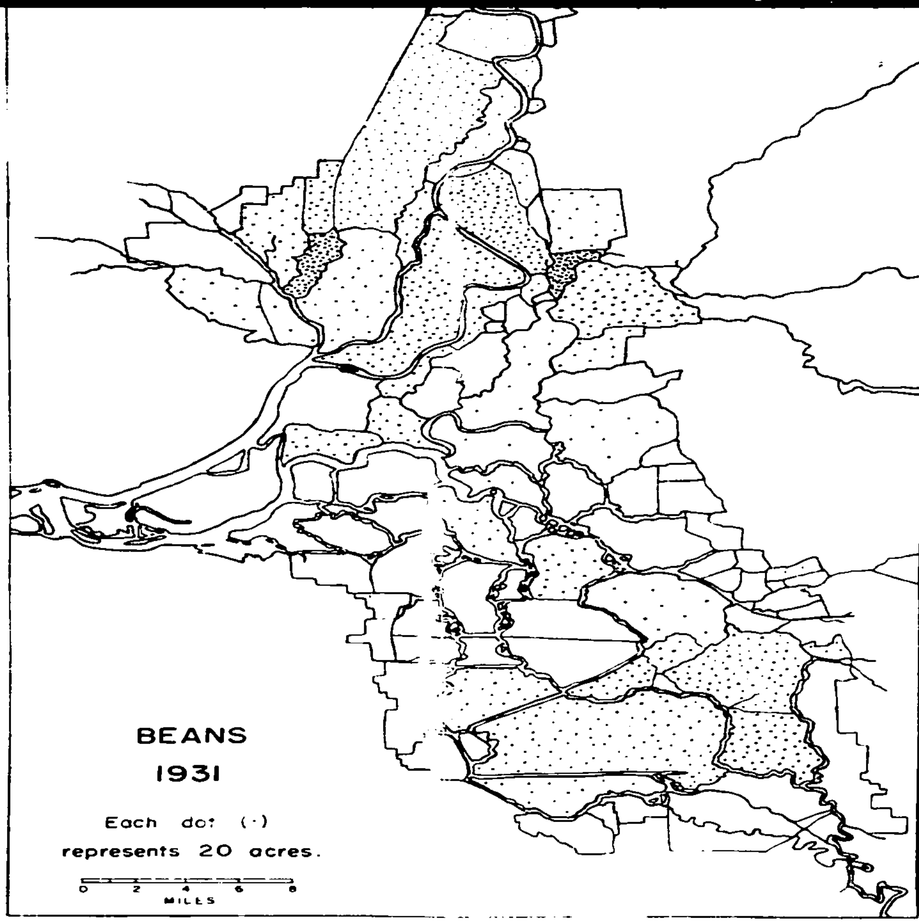

N
BEANS
1938
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

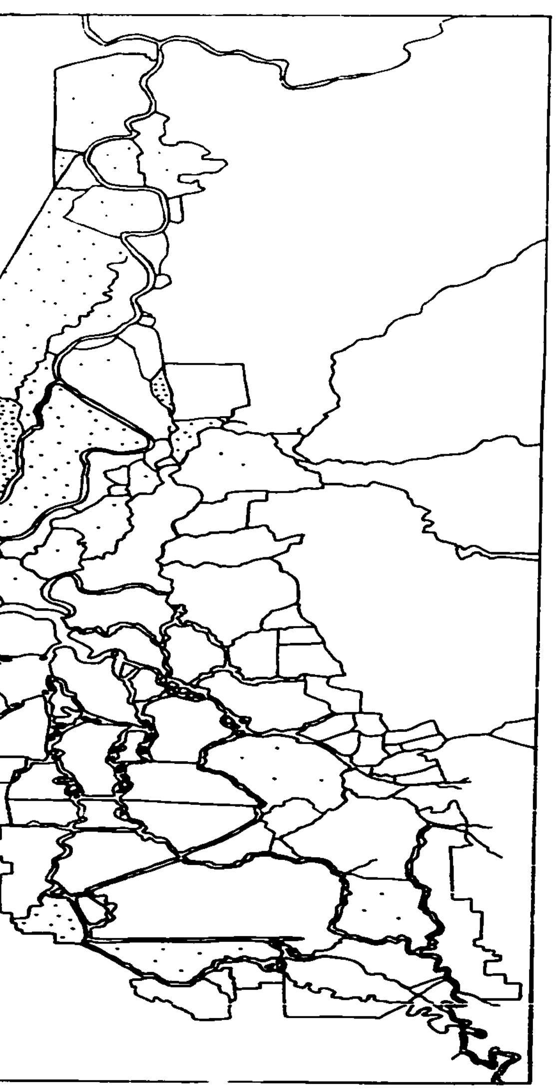


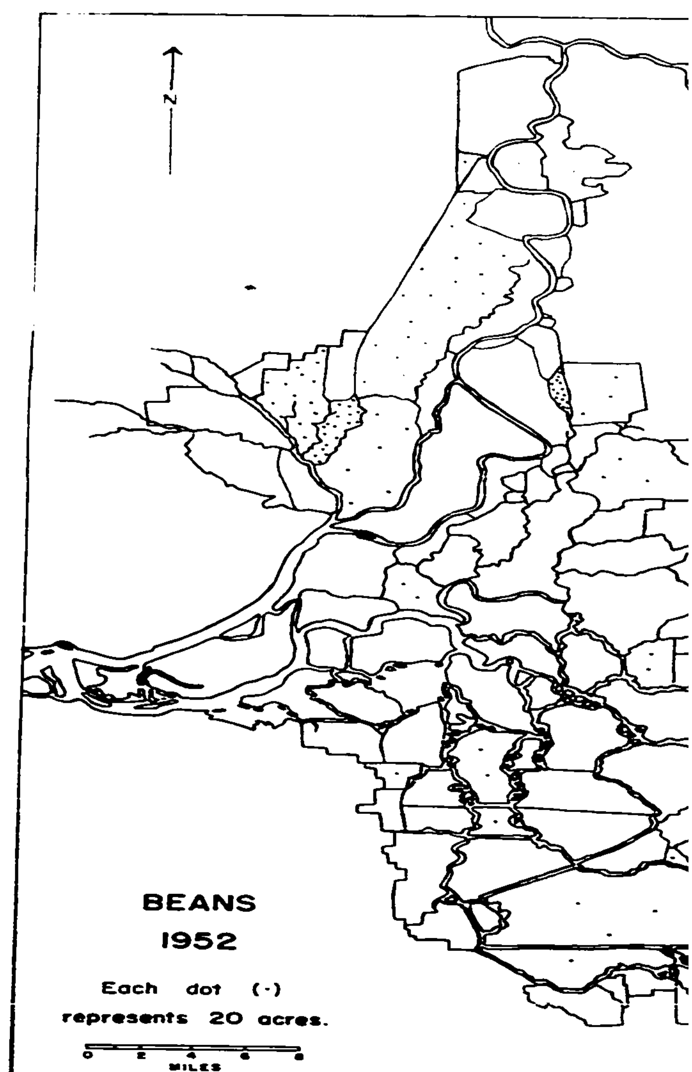

BEANS
1924
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

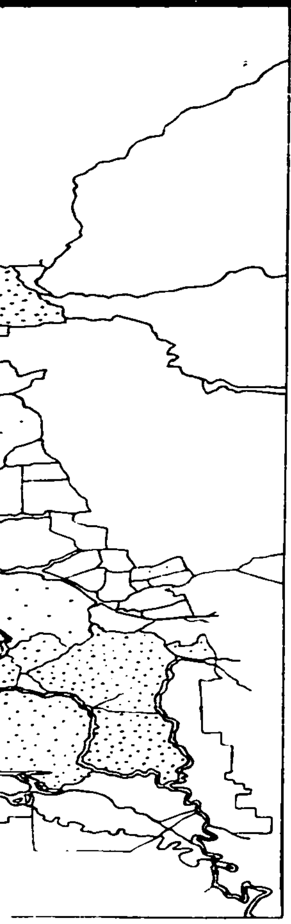

BEANS
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

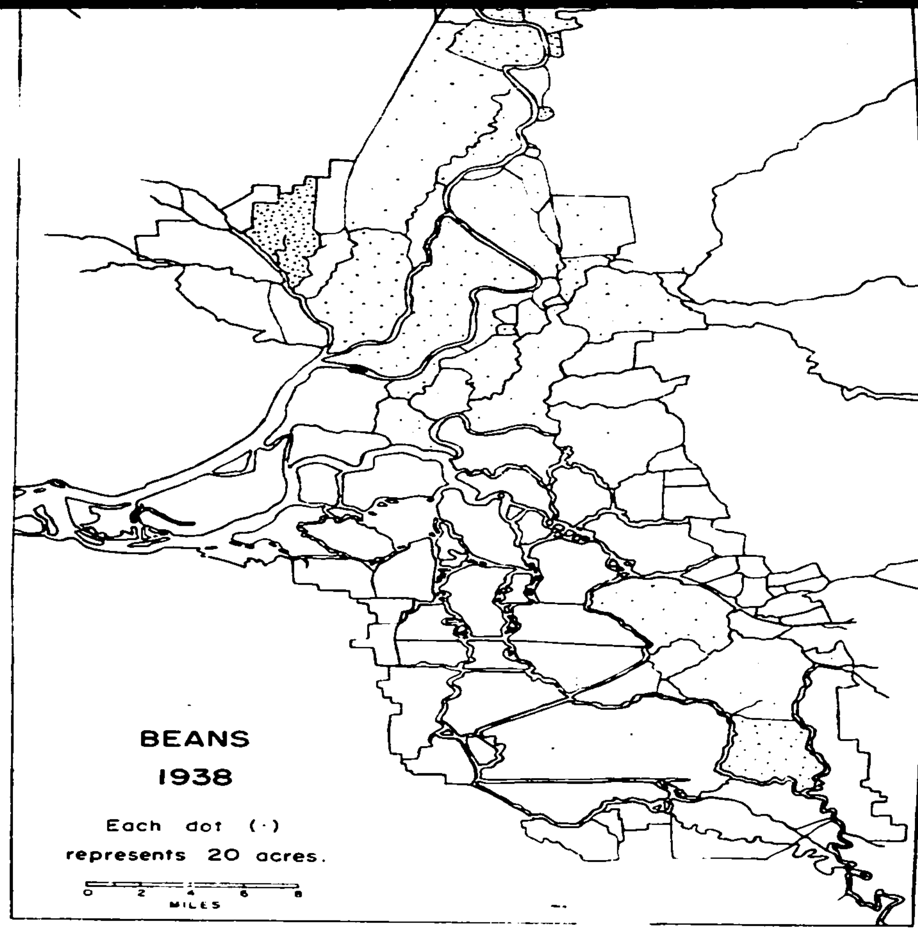

N
BEANS
1945
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES


BEANS
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

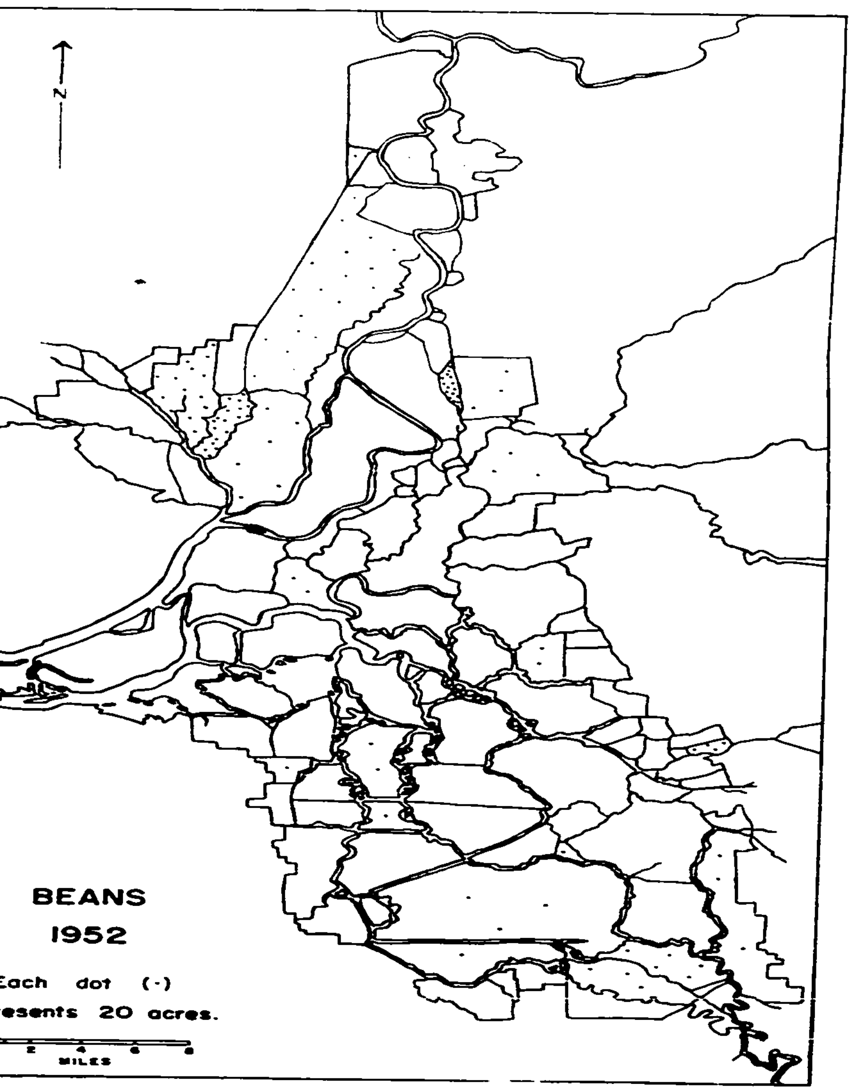



N
BEANS
1952
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES





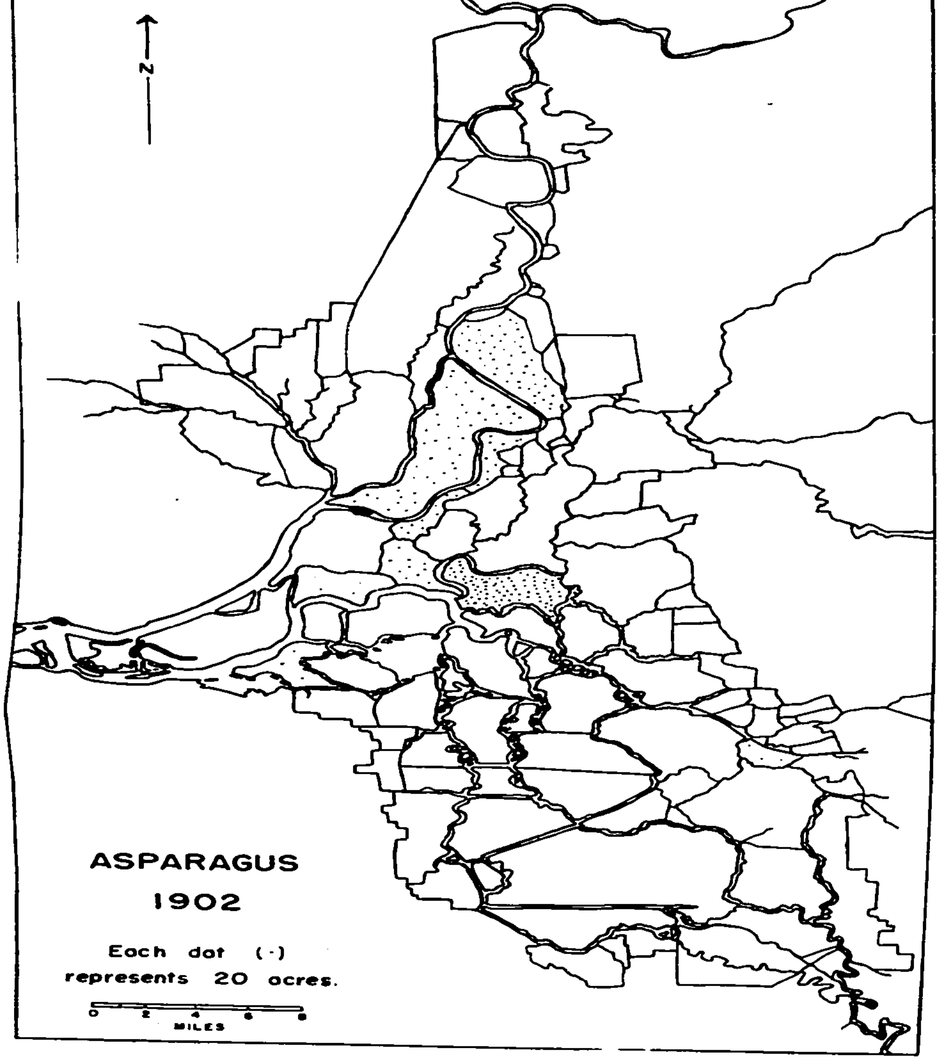
BEANS
1938
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES



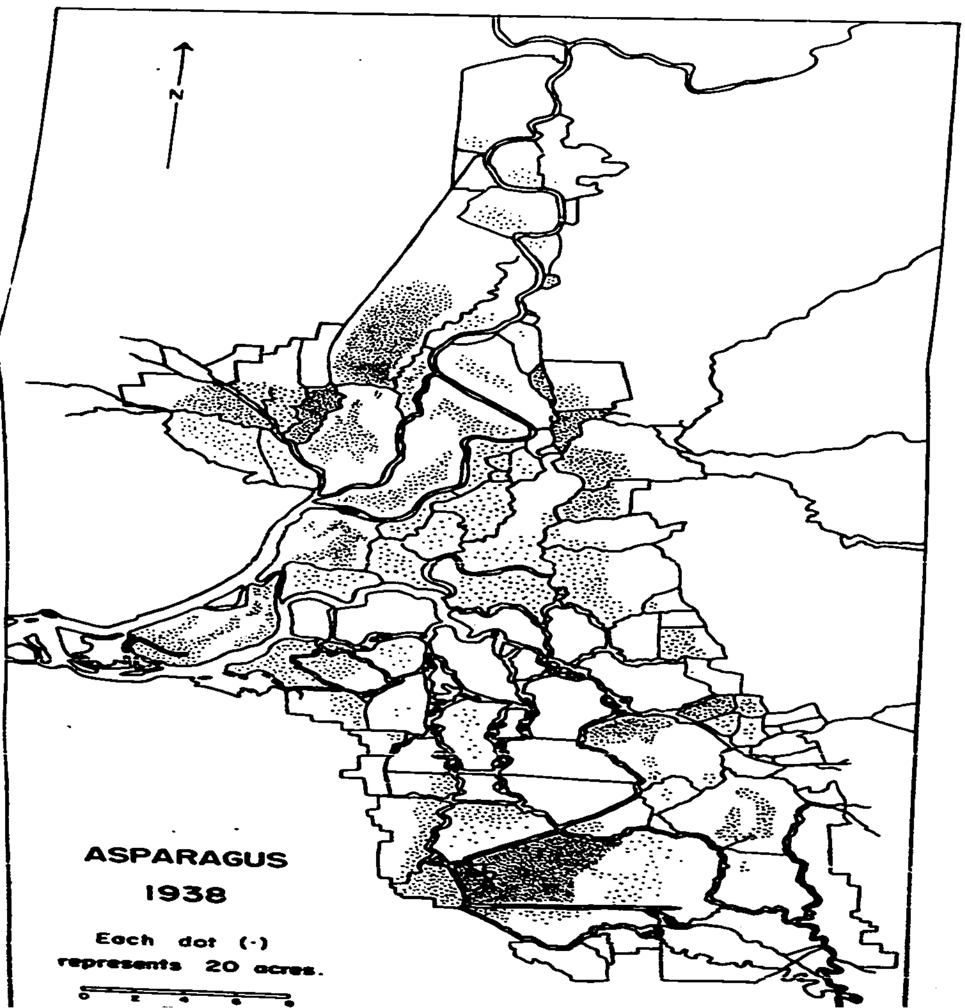
N
BEANS
1952
ach dot (·)
esents 20 acres.
2 4 6 8
MILES

MAP PLATE D: Asparagus

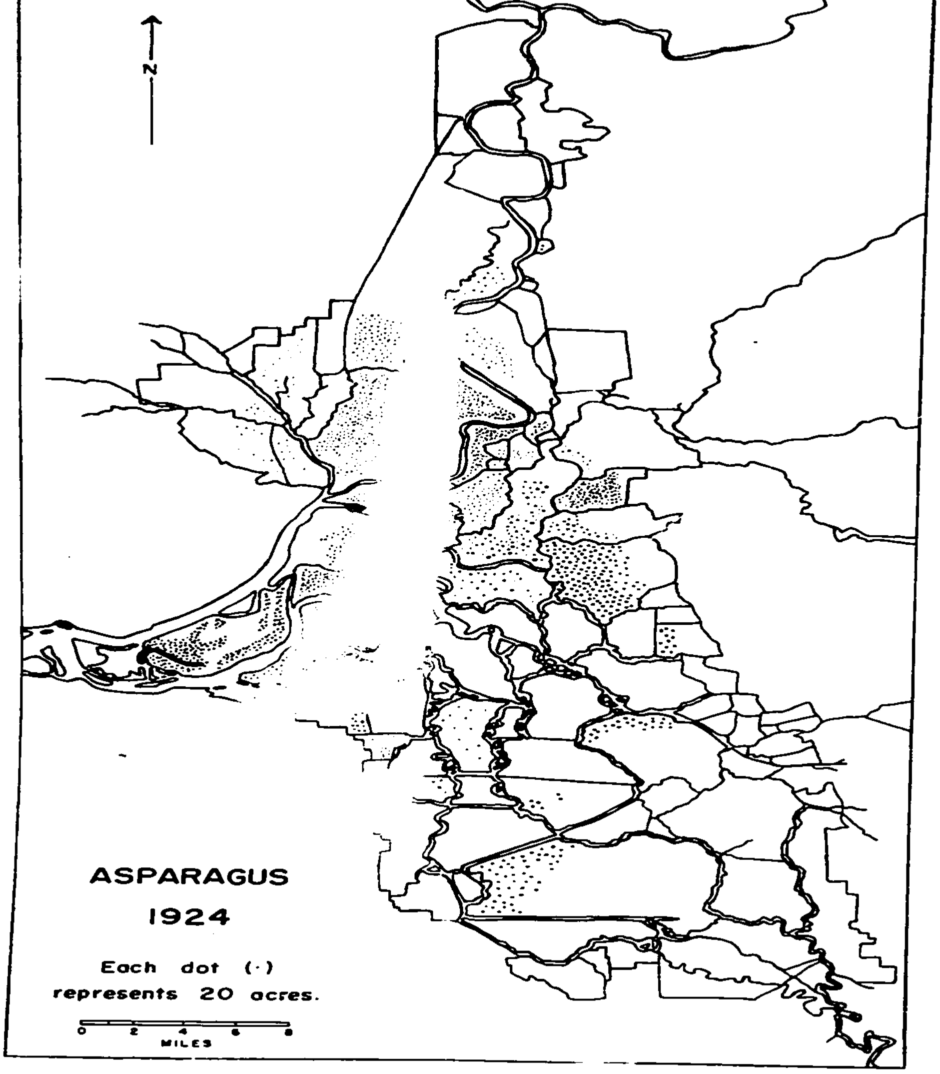
Source: County Agricultural Commissioner's Reports

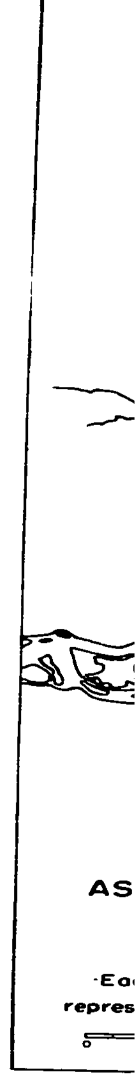

N
ASPARAGUS
1902
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

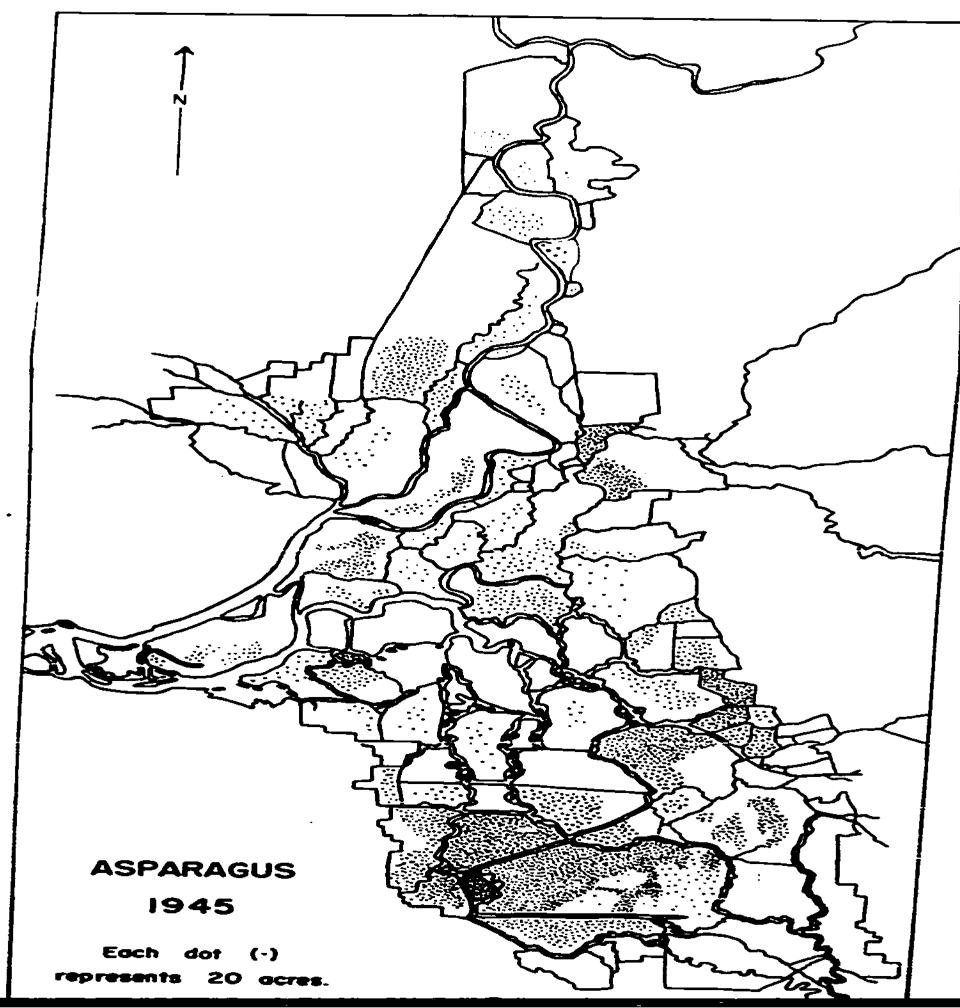

N
ASPARAGUS
1924
Each dot (·)
represents 20 acres
0 2 4 6 8
MILES

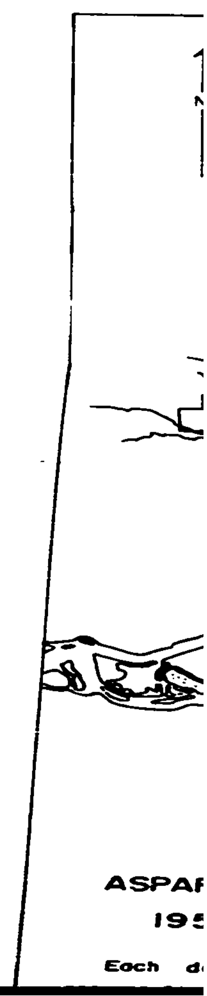

N
ASPARAGUS
1938
Each dot (·)
represents 20 acres.

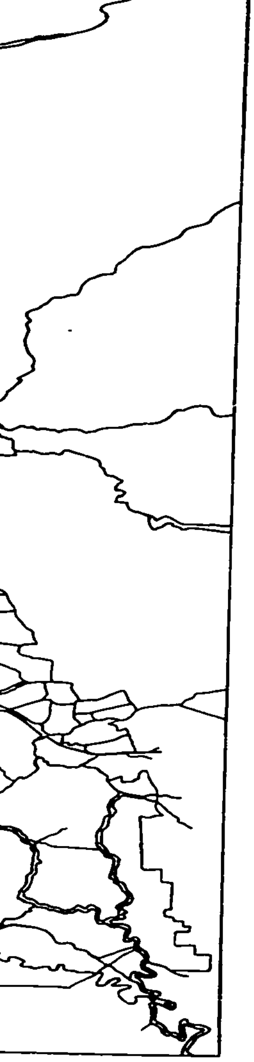

N
ASPARAGUS
1945
Each dot (·)
represents 20 acres.

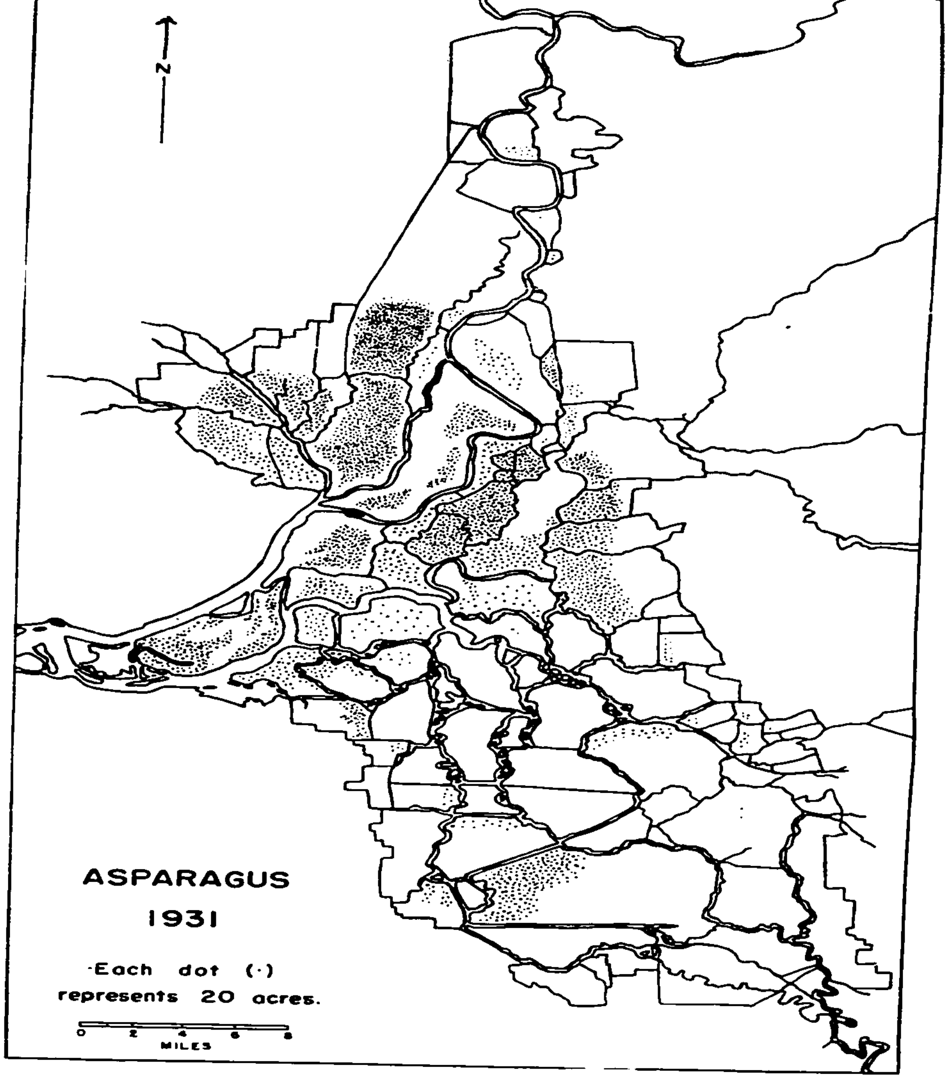

N
ASPARAGUS
1924
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

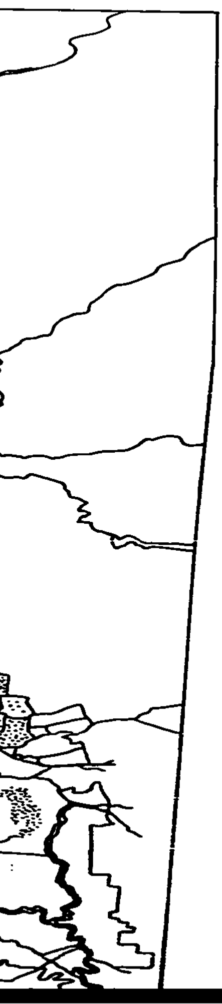


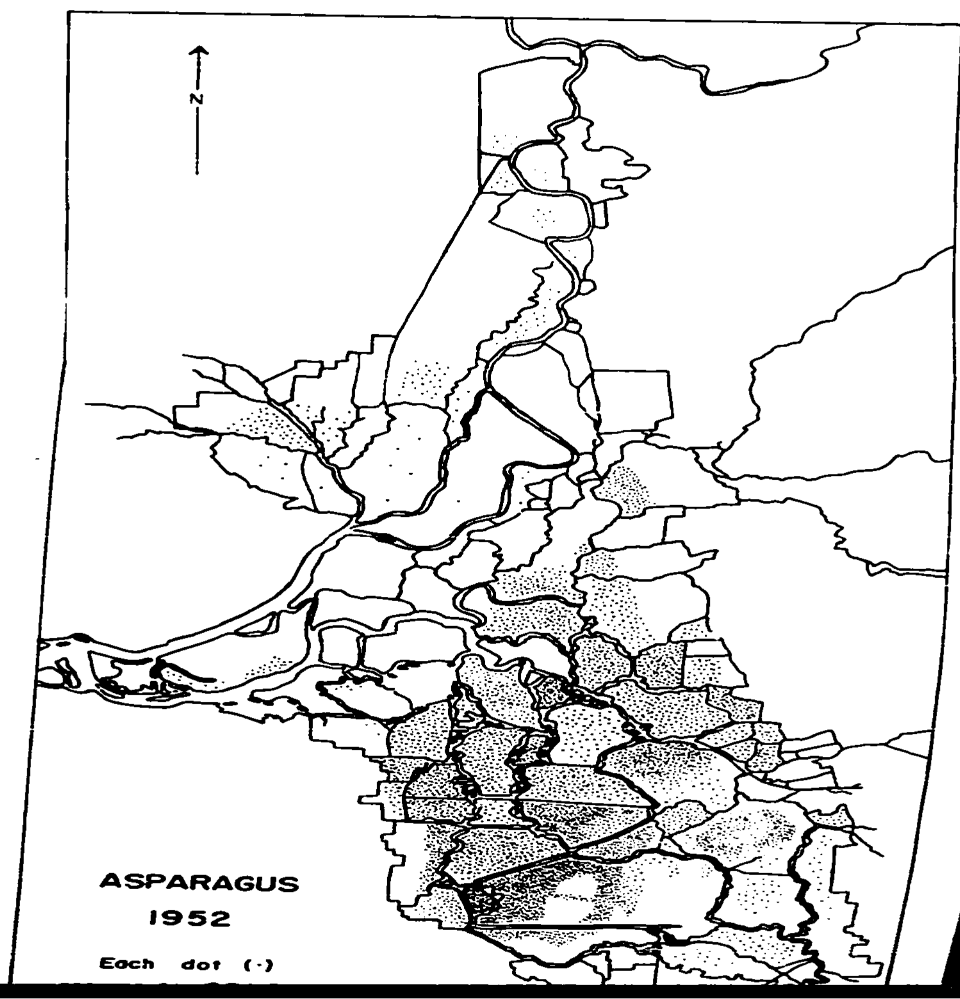

N
ASPARAGUS
1945
Each dot (·)
represents 20 acres.

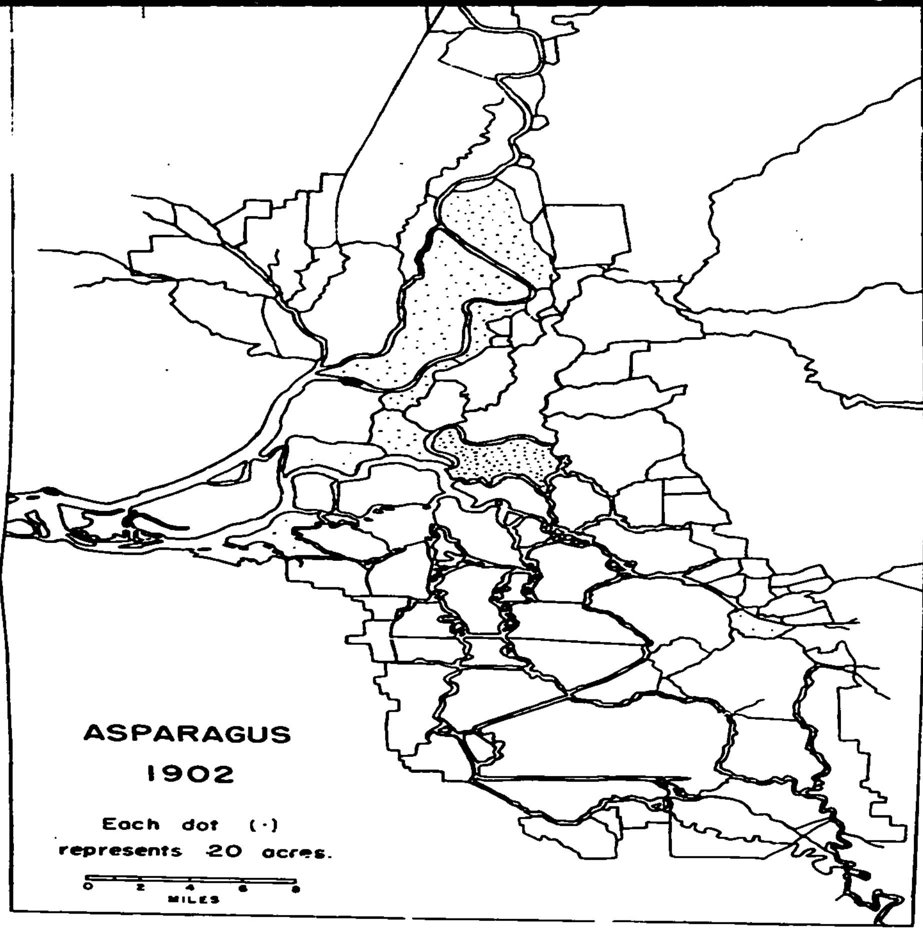




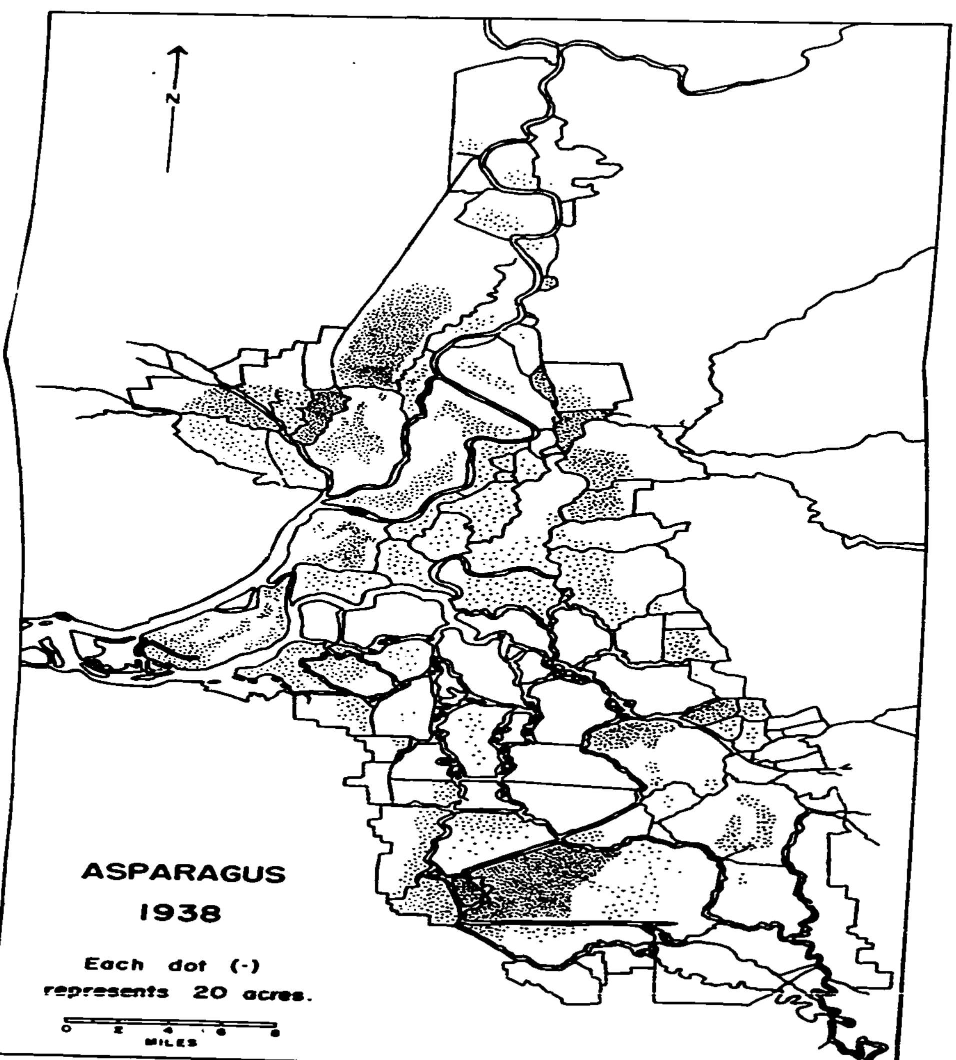

N
ASPARAGUS
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES



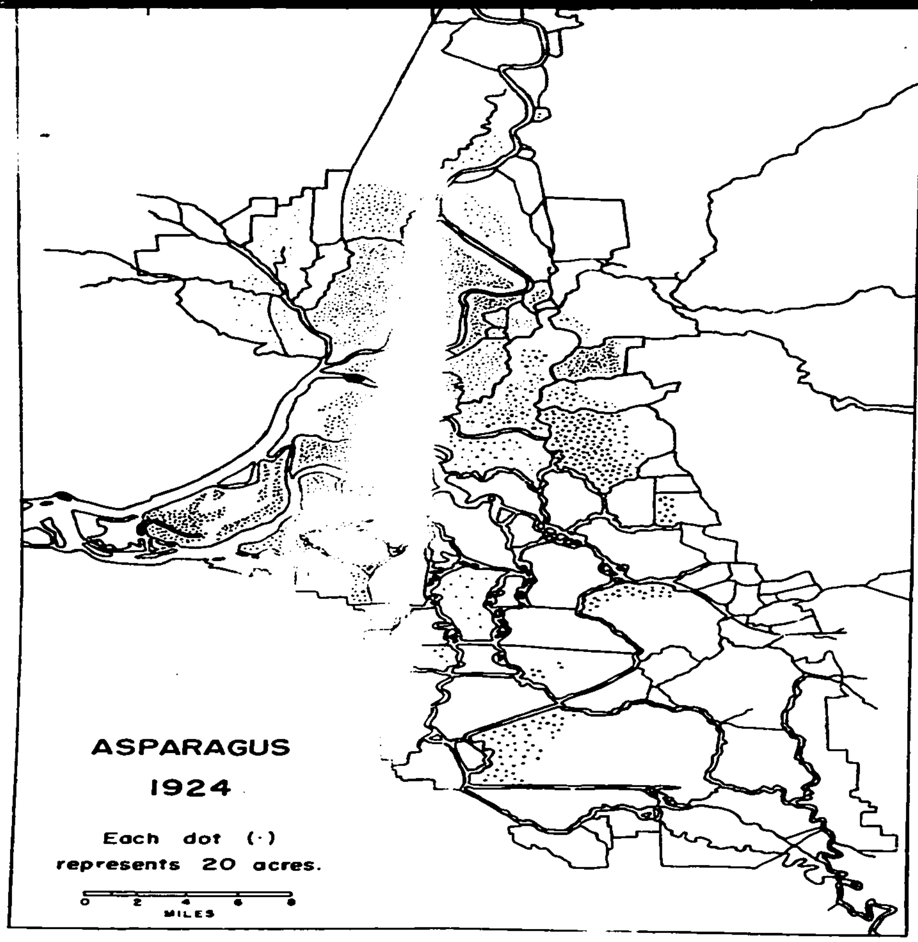

N
ASPARAGUS
1952
Each dot (·)

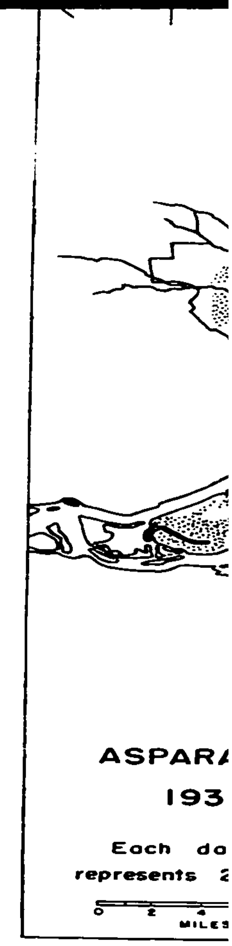

ASPARAGUS
1902
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

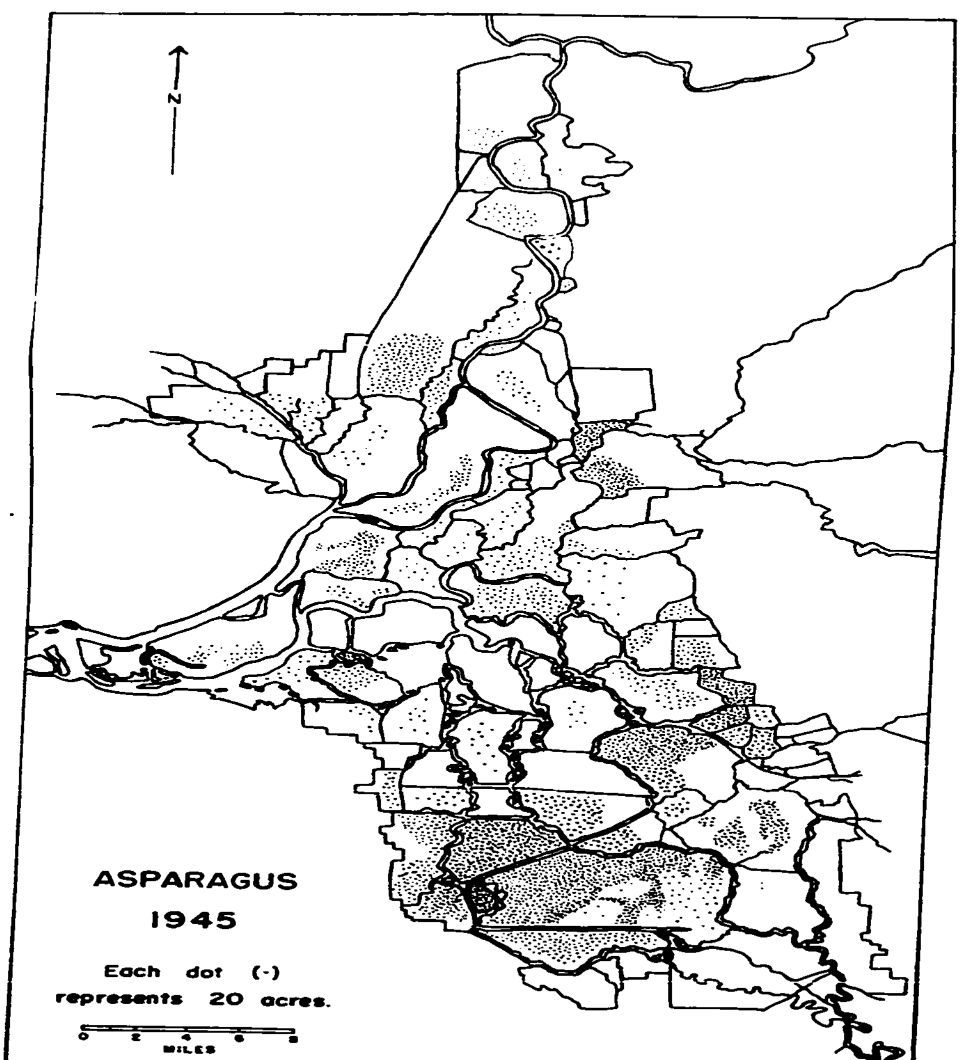

ASPARAGUS
1924
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

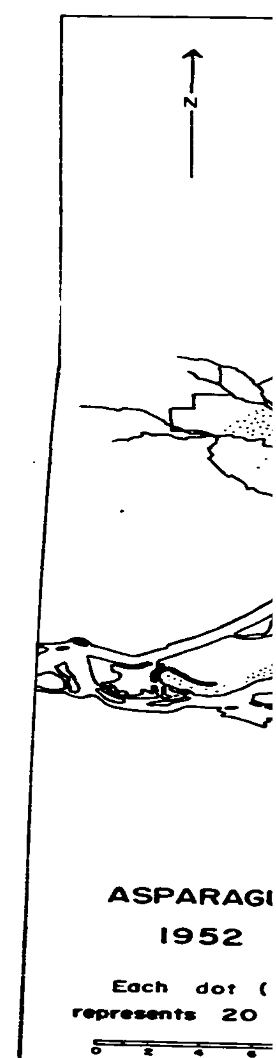

N
ASPARAGUS
1938
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

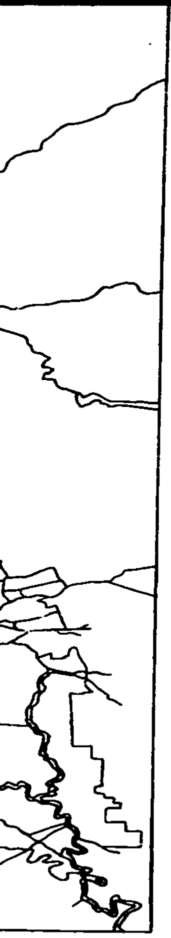

N
ASPARAGUS
1945
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

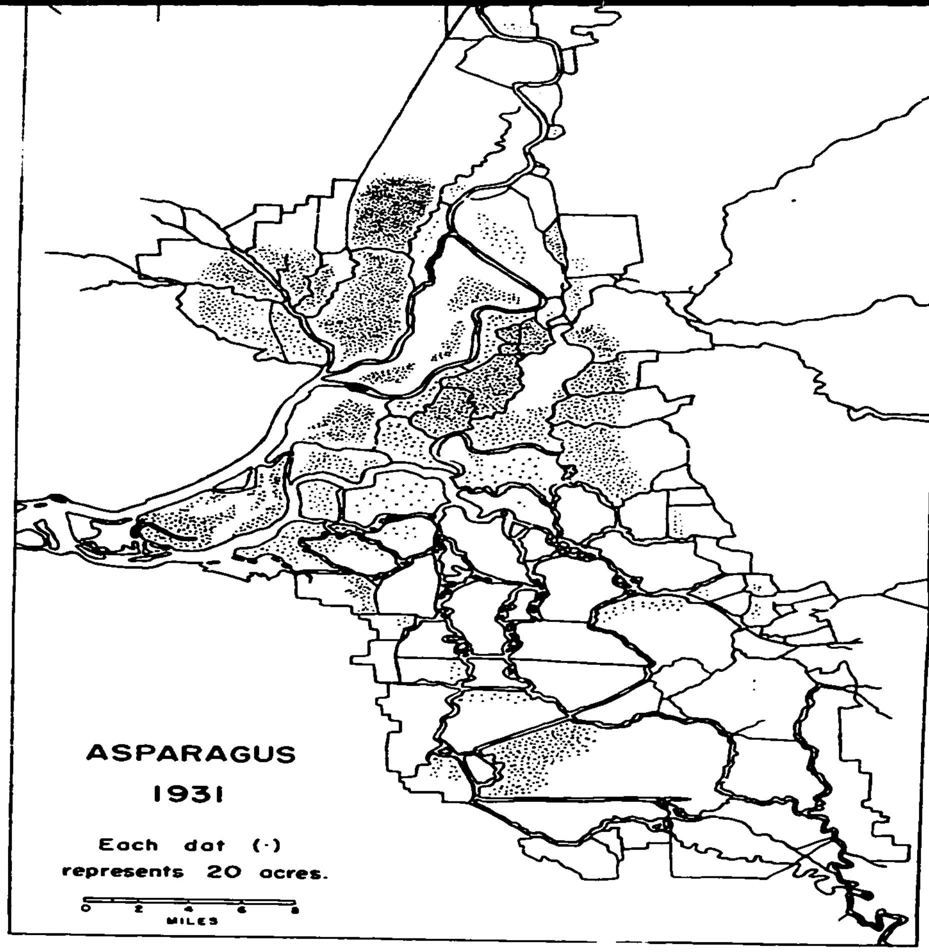

ASPARAGUS
1924
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

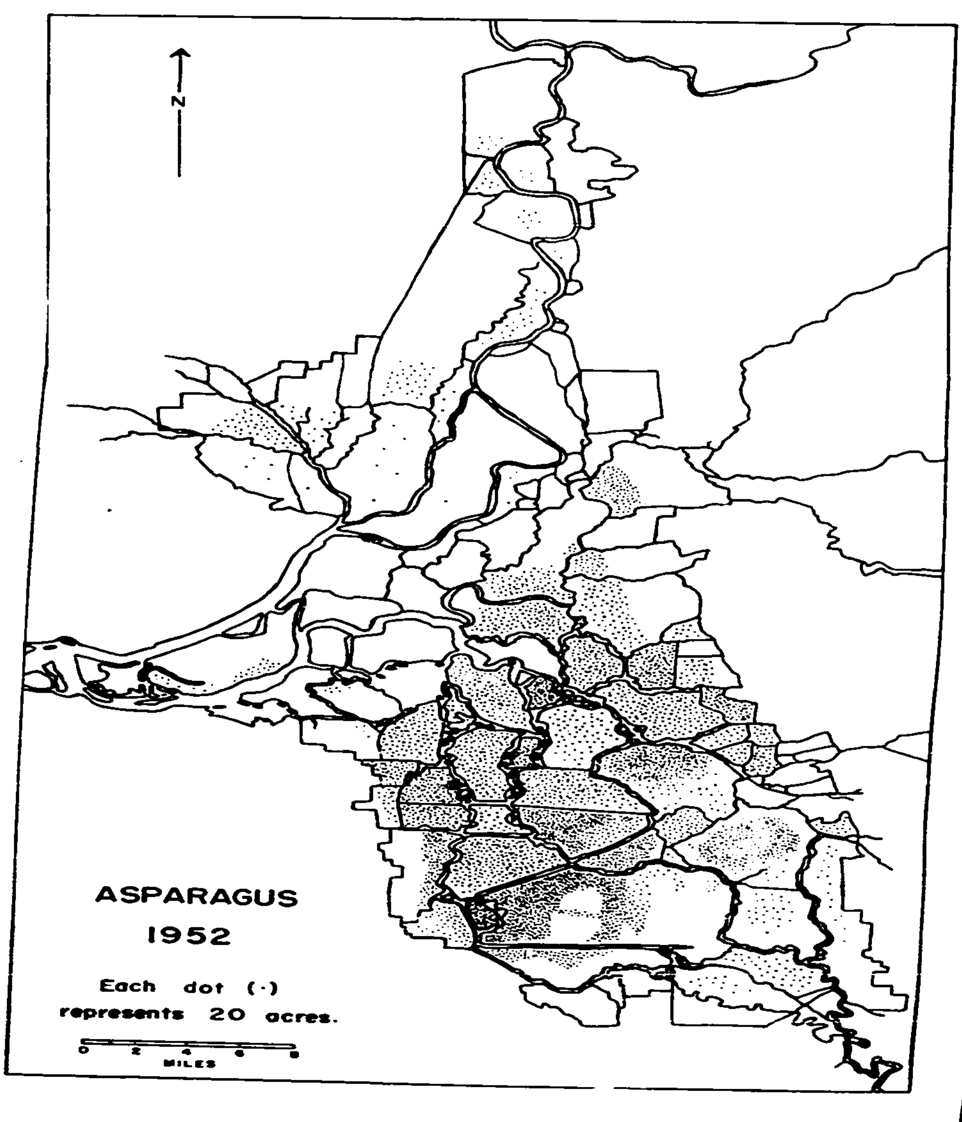

ASPAR
193
Each do
represents 2
0 2 4
MILES


N
ASPARAGUS
1945
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES


N
ASPARAGU
1952
Each dot (
represents 20
0 2 4 6
MILES

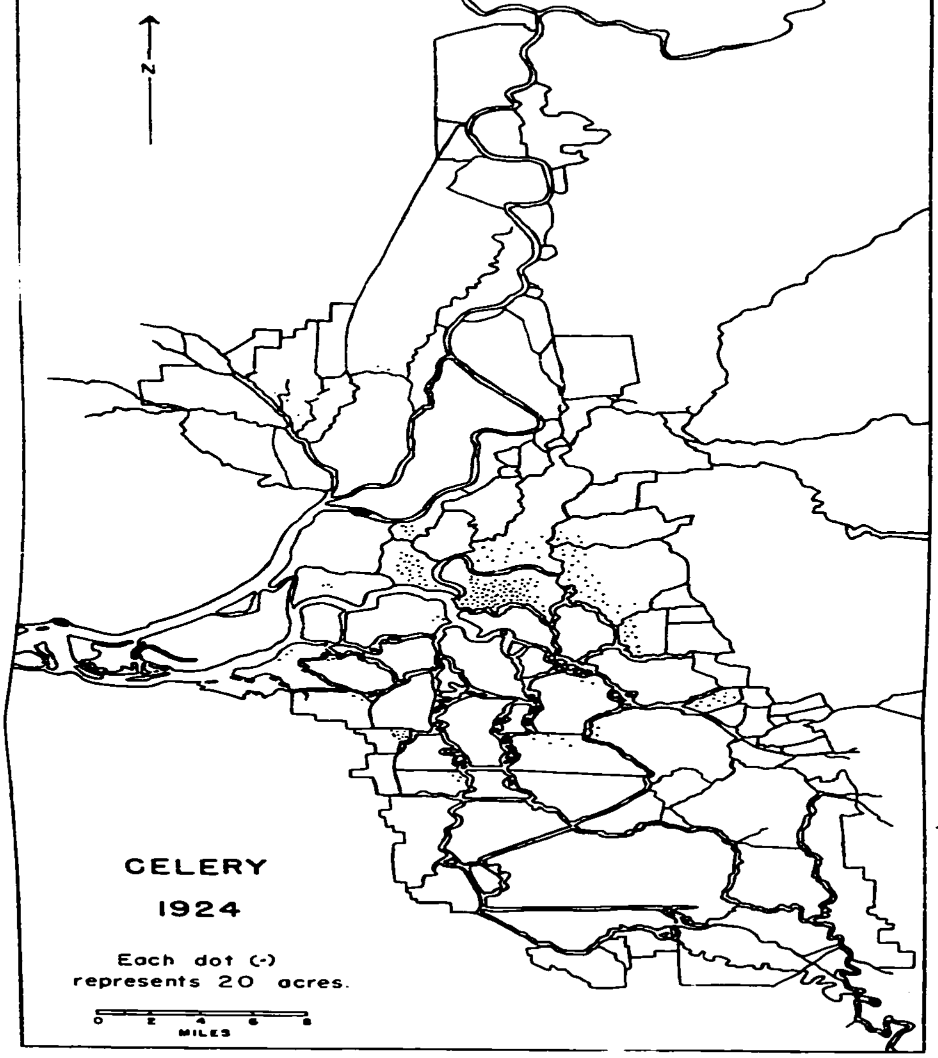



ASPARAGUS
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

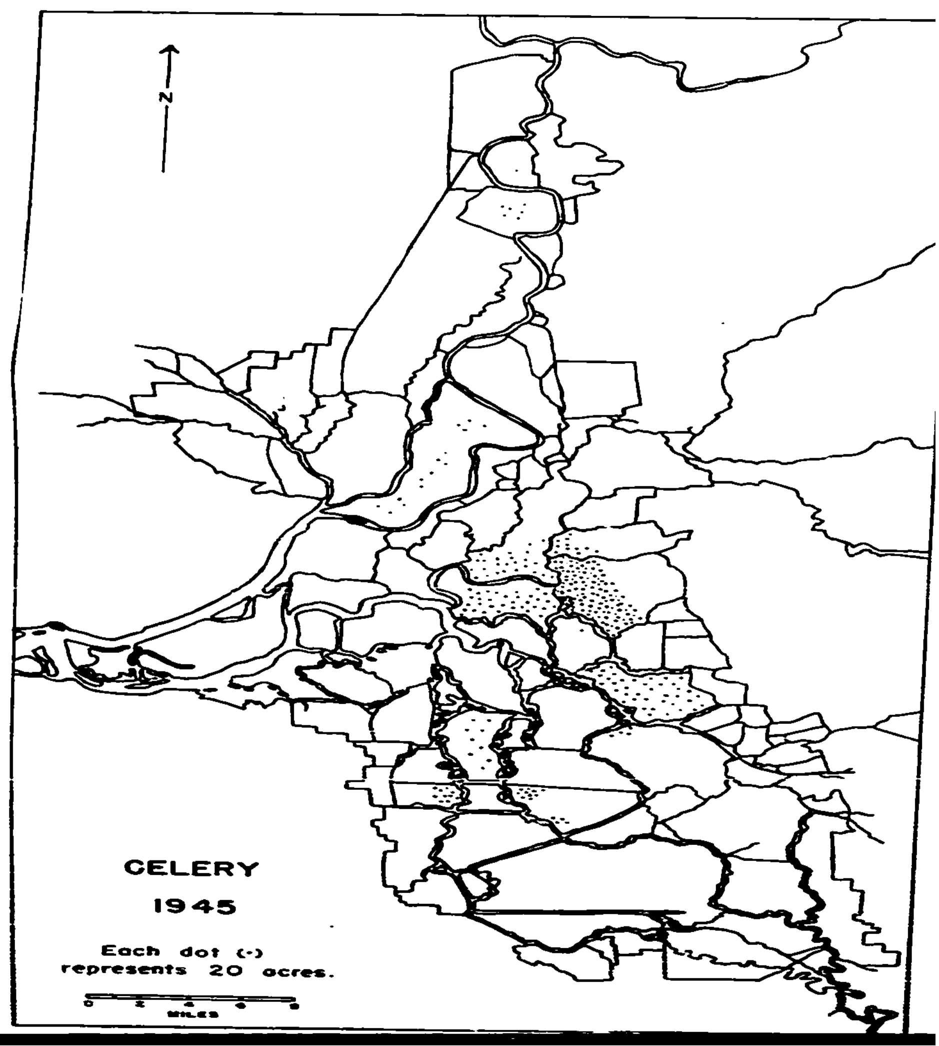

N
ASPARAGUS
1952
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

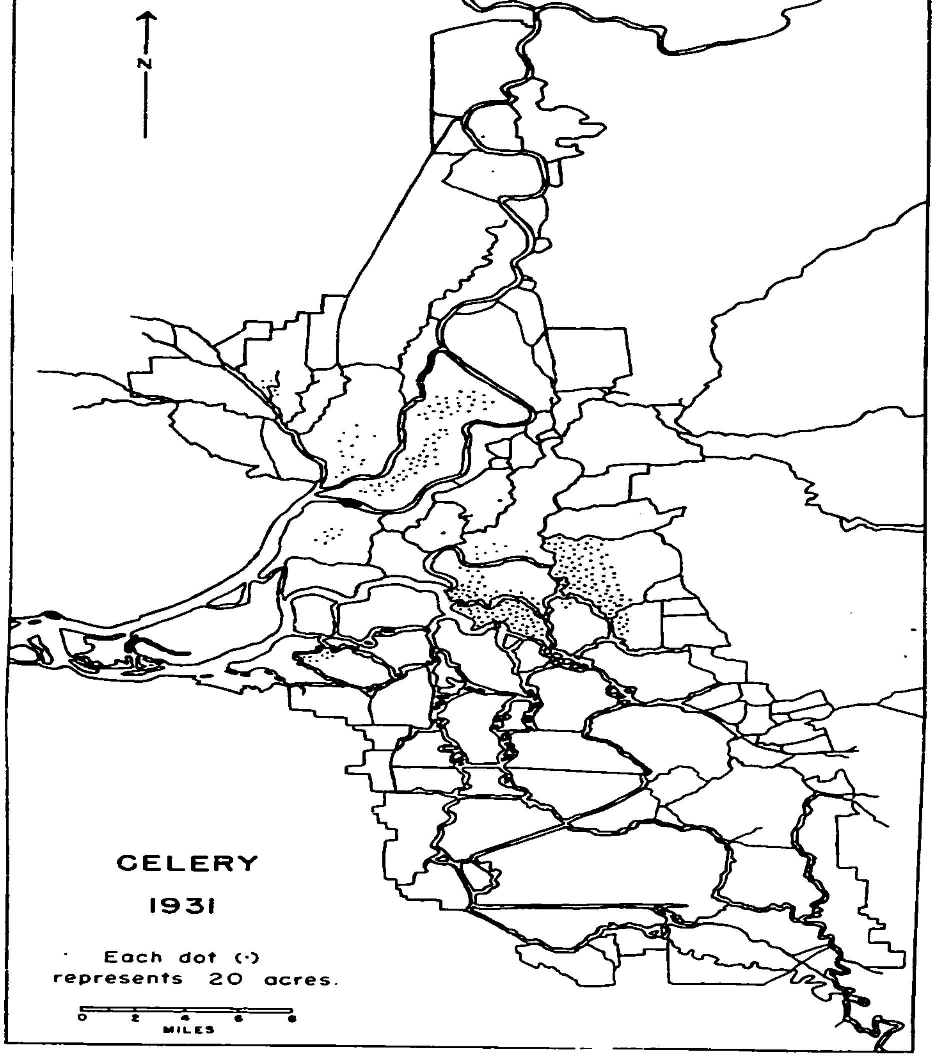
MAP PLATE E: Celery

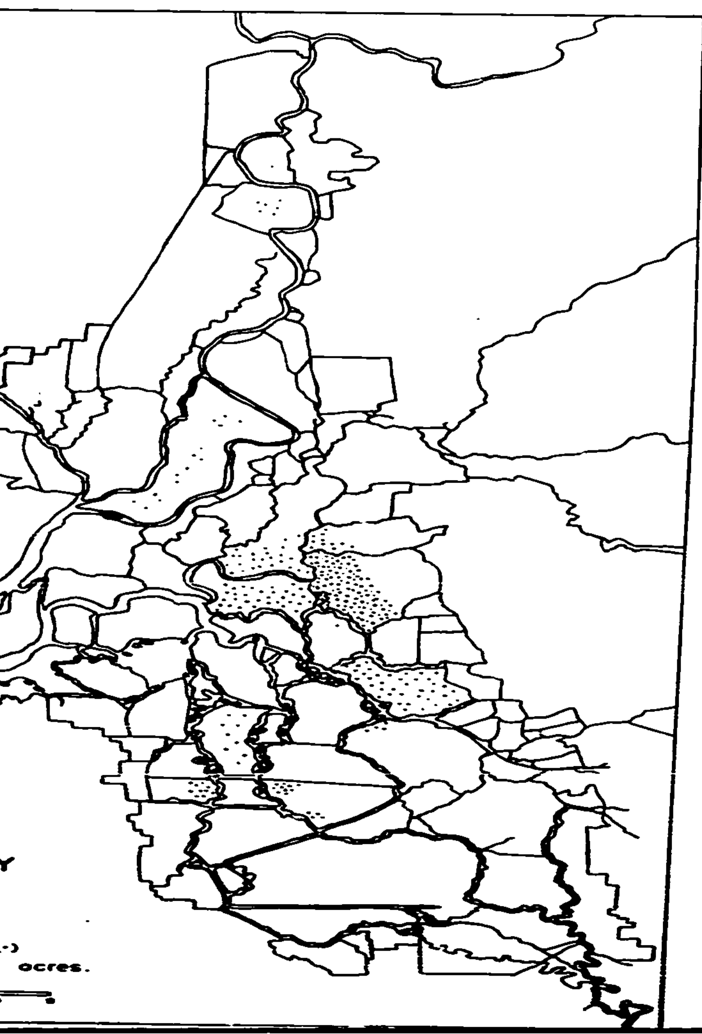
Source: County Agricultural Commissioner's Reports

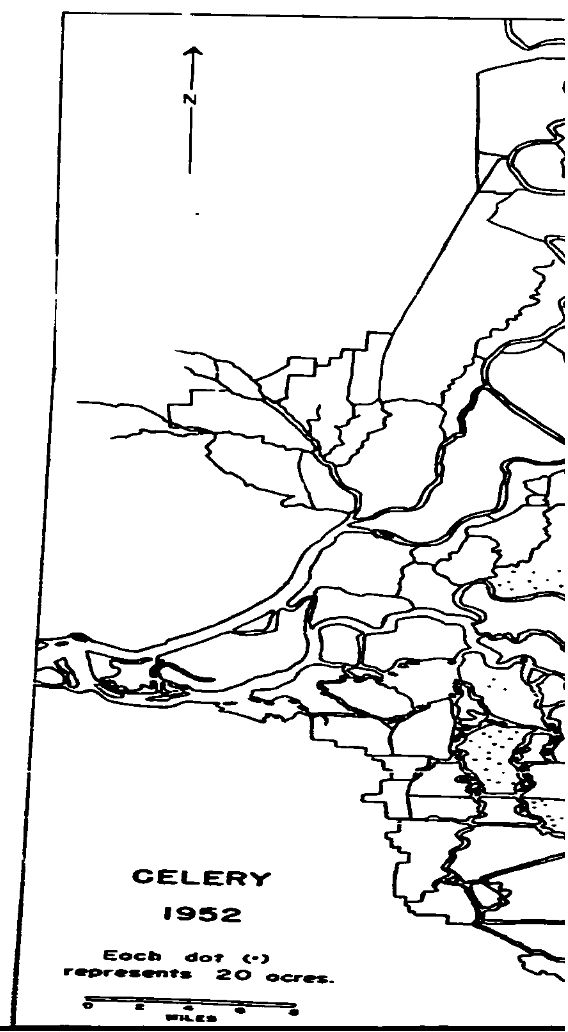

N
CELERY
1924
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

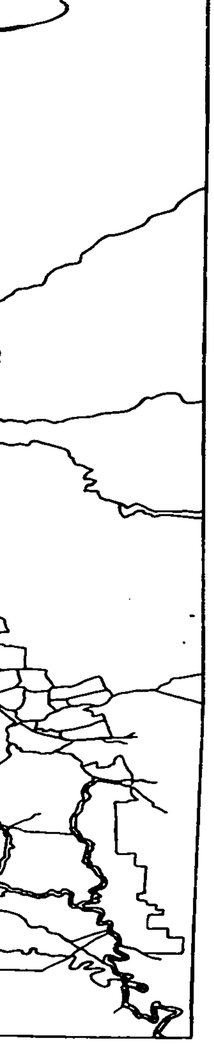

N
CELERY
1931
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

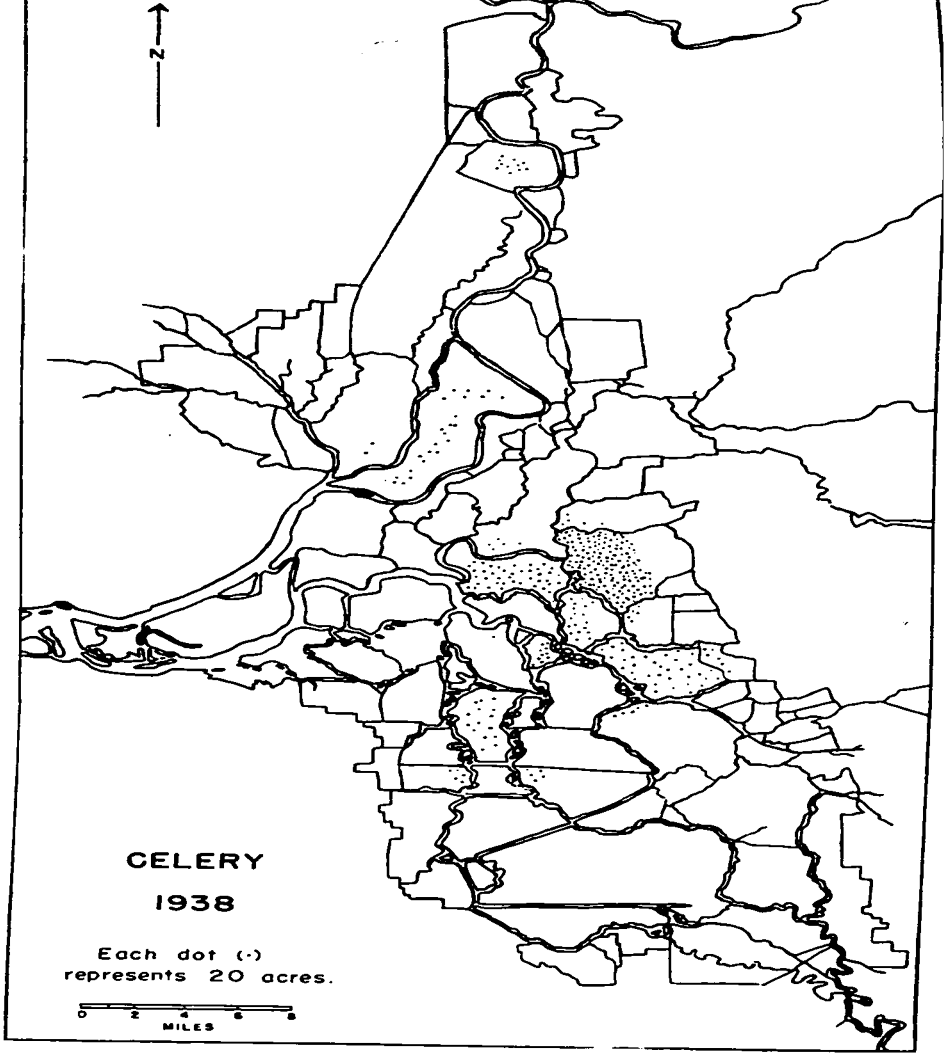

N
CELERY
1945
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

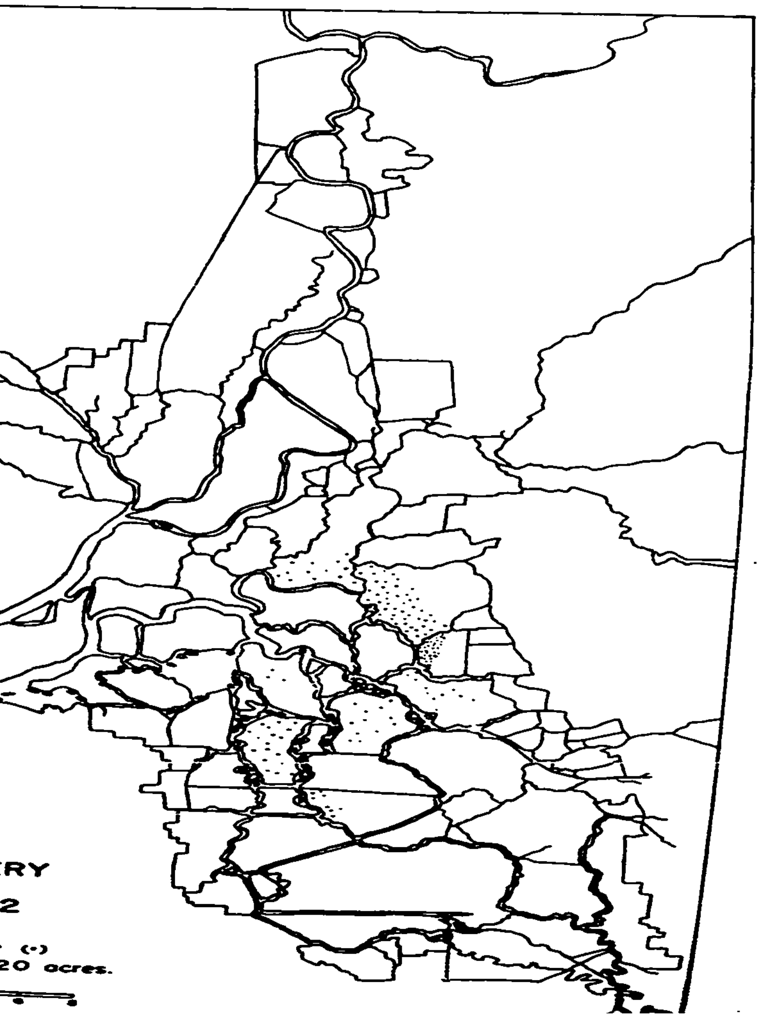

N
CELERY
1931
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

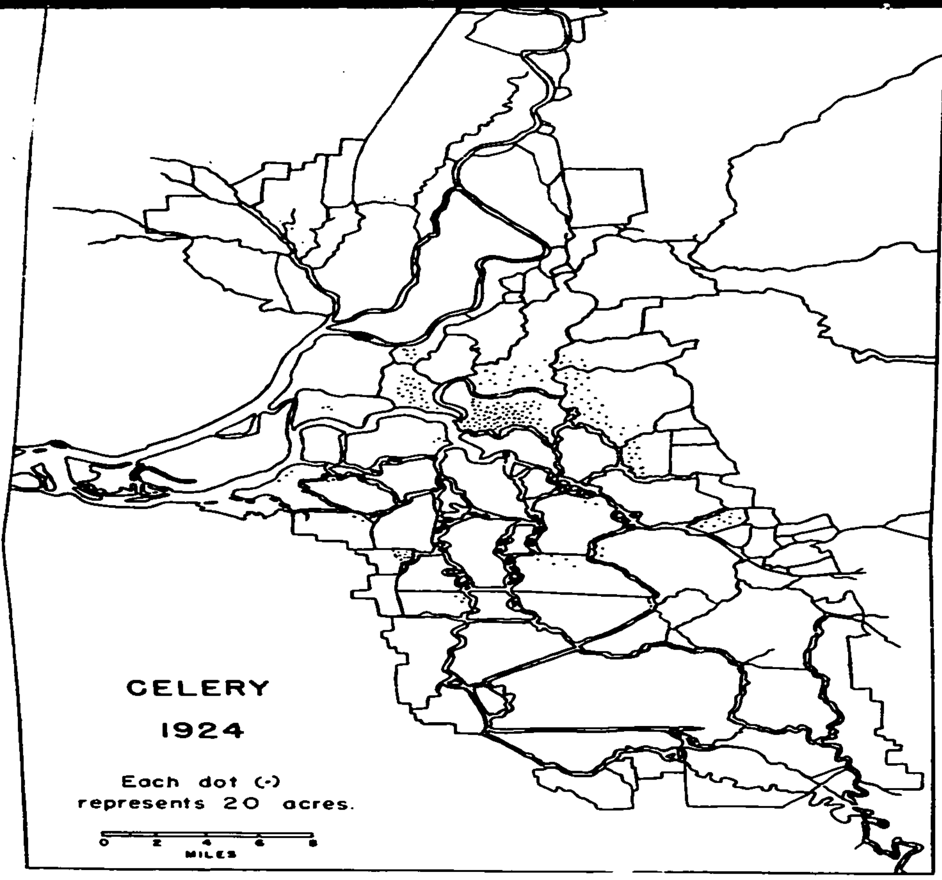



N
CELERY
1952
Each dot (·) represents 20 acres.
MILES

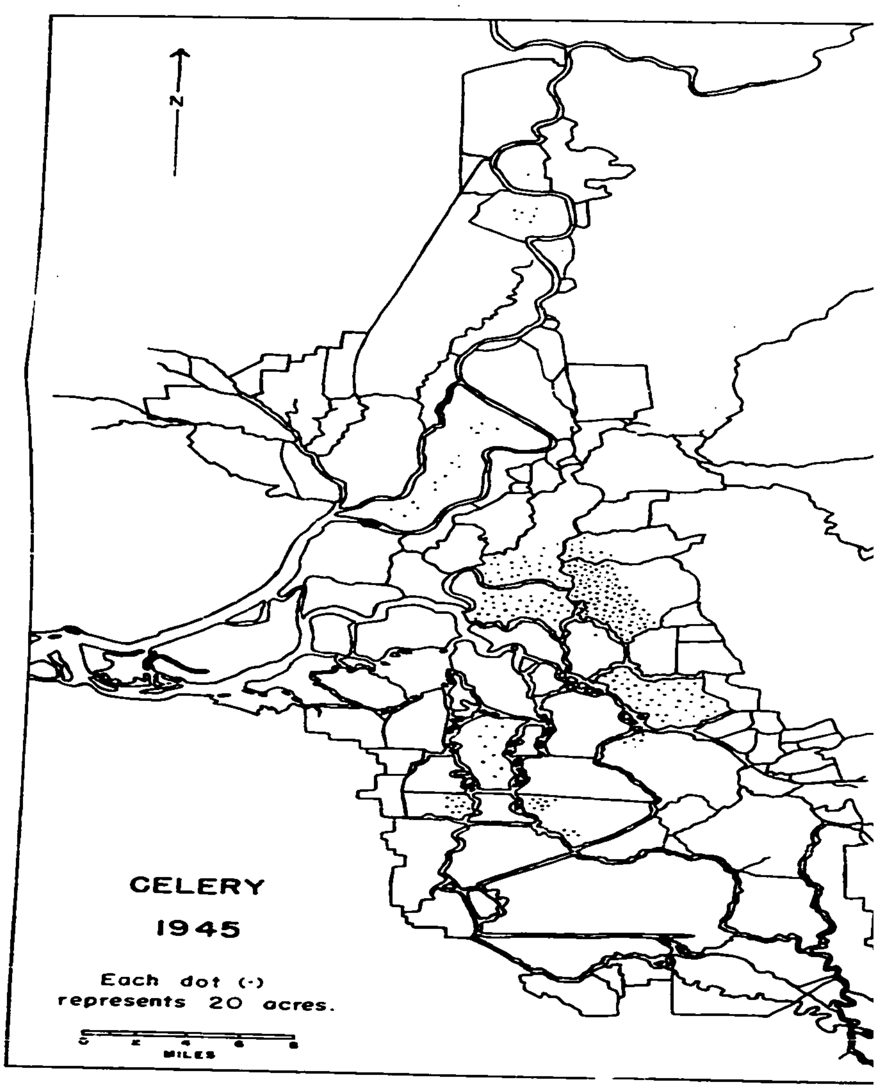


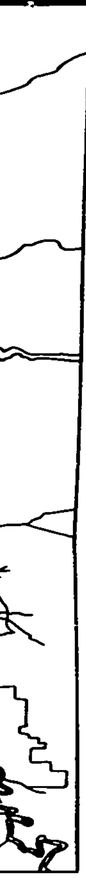

N
CELERY
1938
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

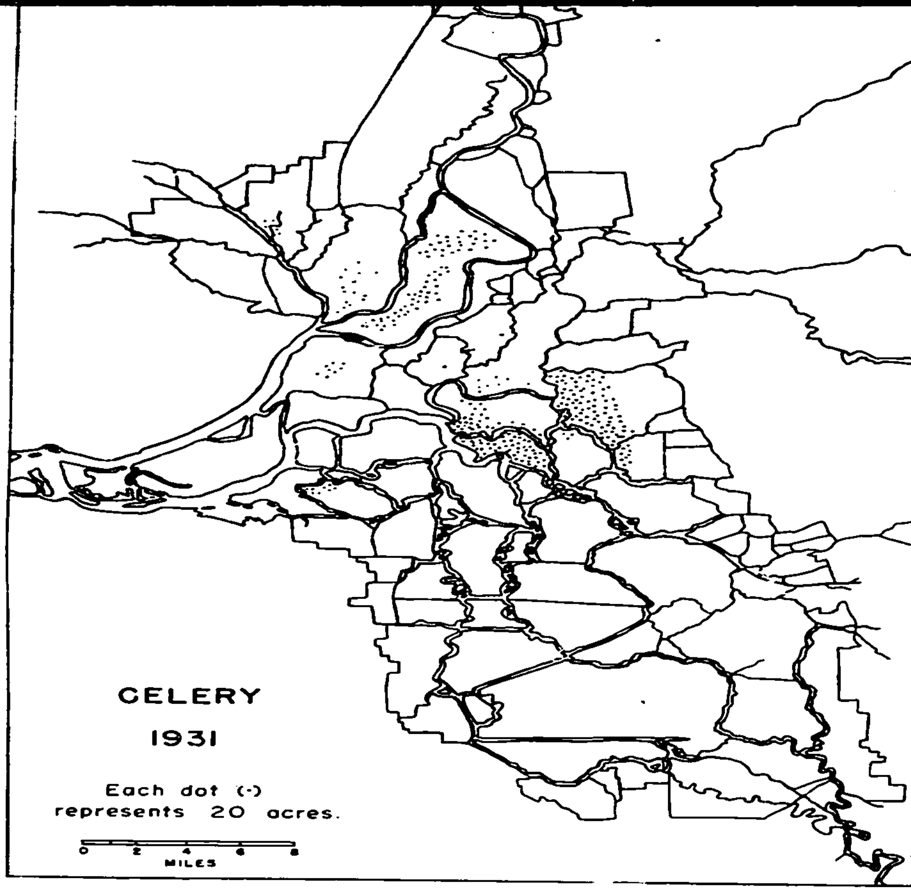

RY
2
(·)
20 acres.

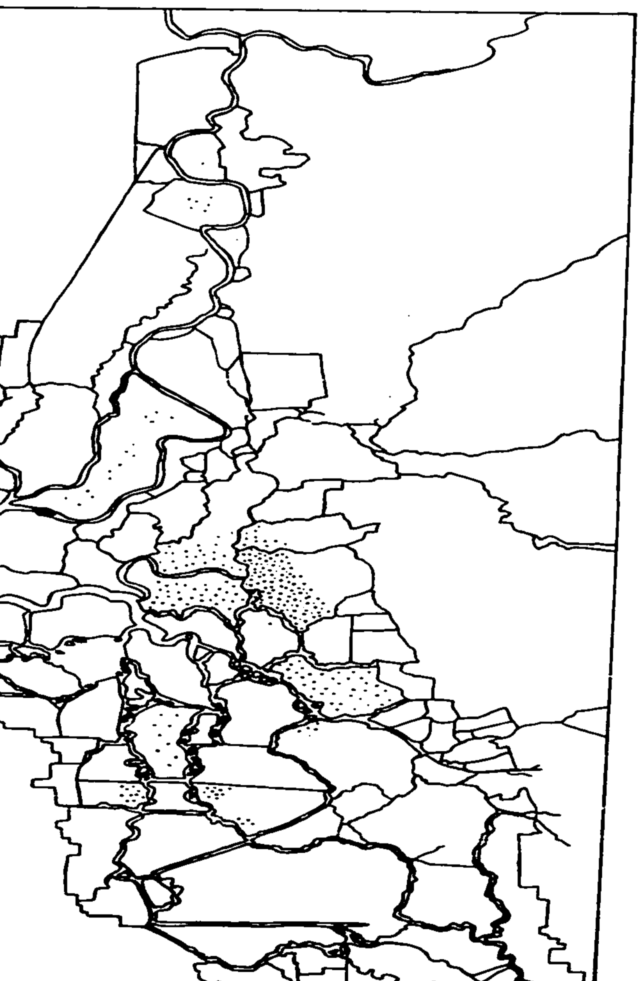

CELERY
1924
Each dot (·) represents 20 acres.
MILES

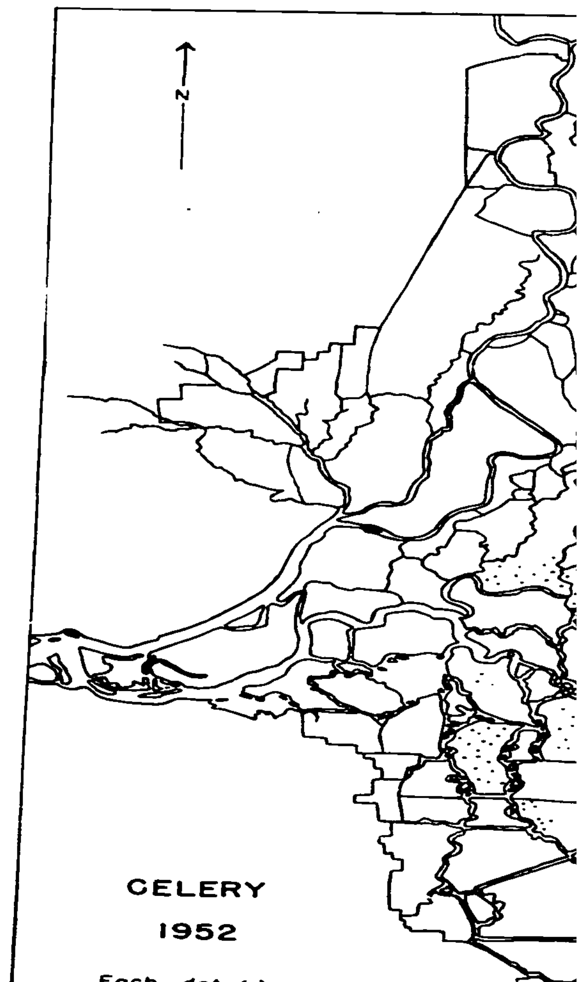

CELERY
1931
Each dot (·) represents 20 ac
MILES

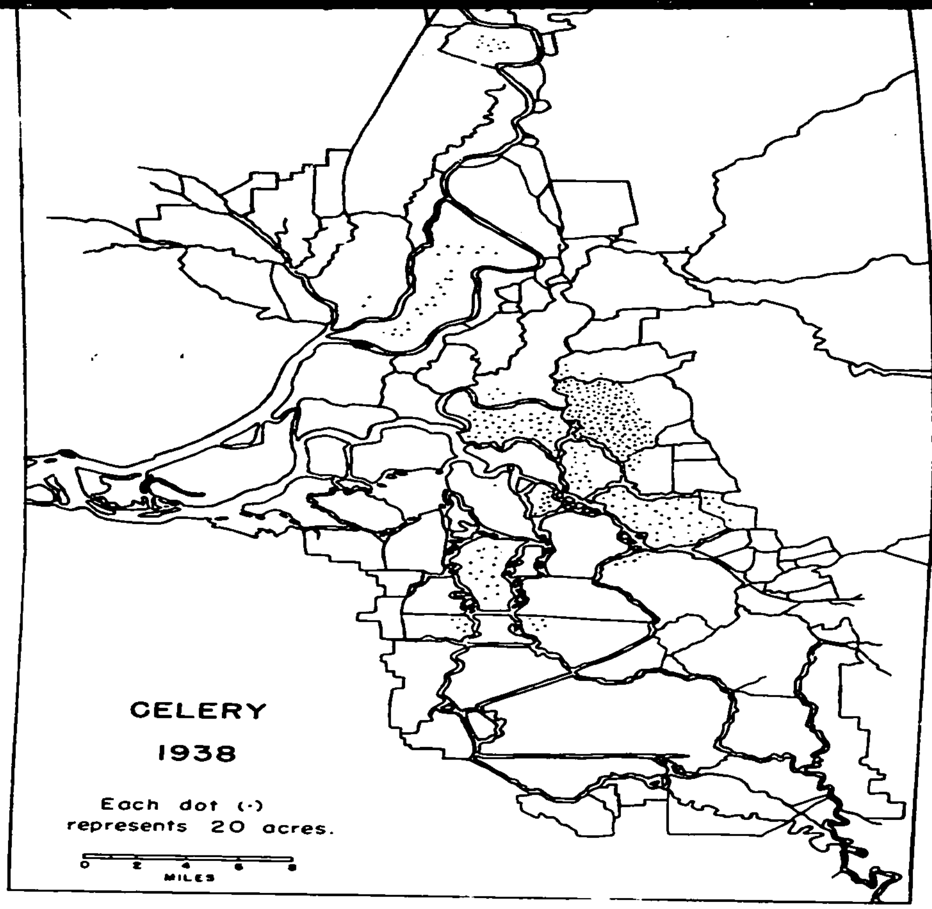

N
CELERY
1945
Each dot (·) represents 20 acres.
MILES

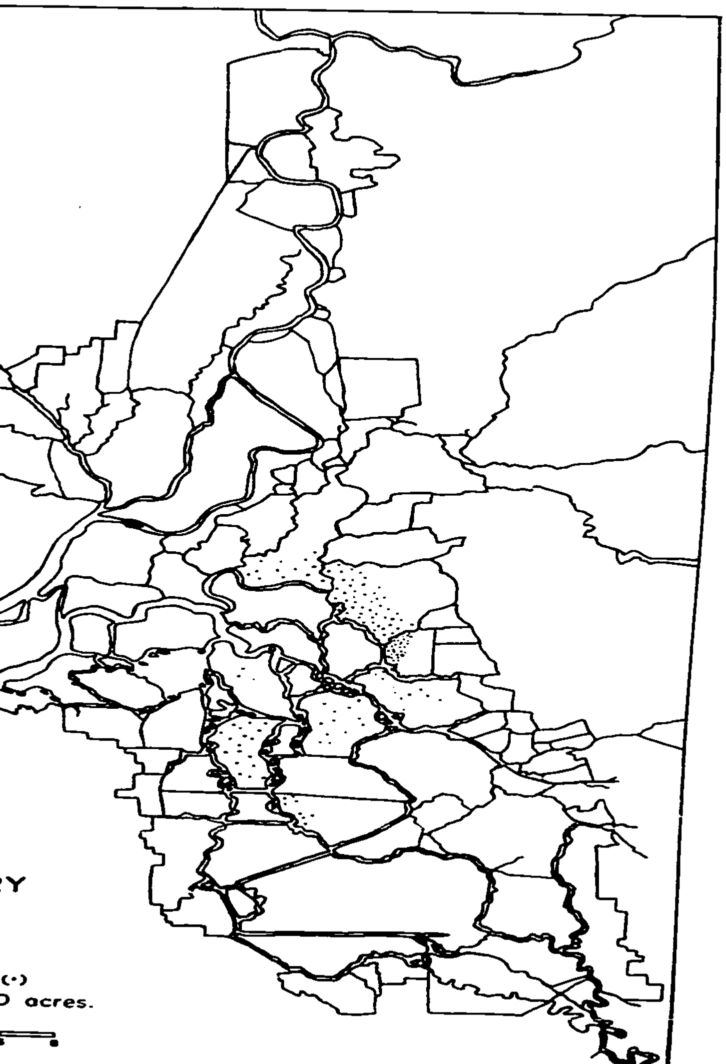



CELERY
1931
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES



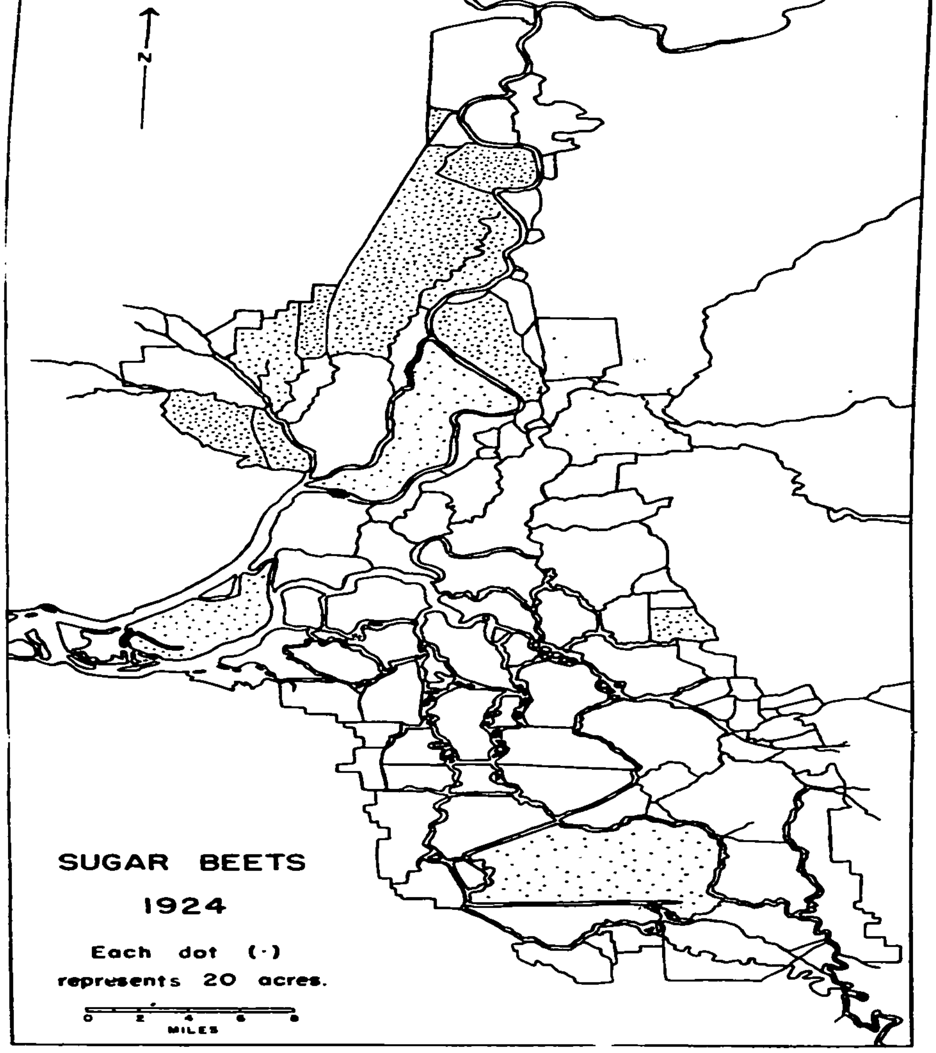

N
CELERY
1952
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES


CELERY
1938
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

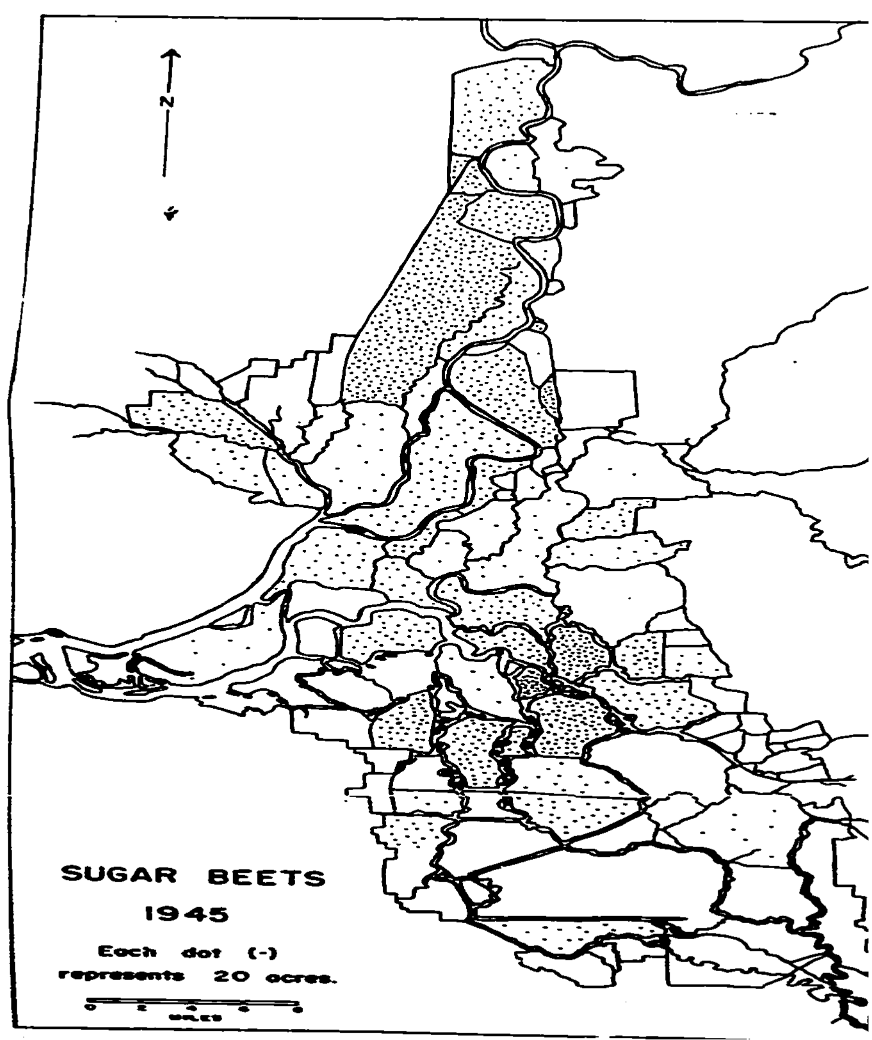

(·)
acres.

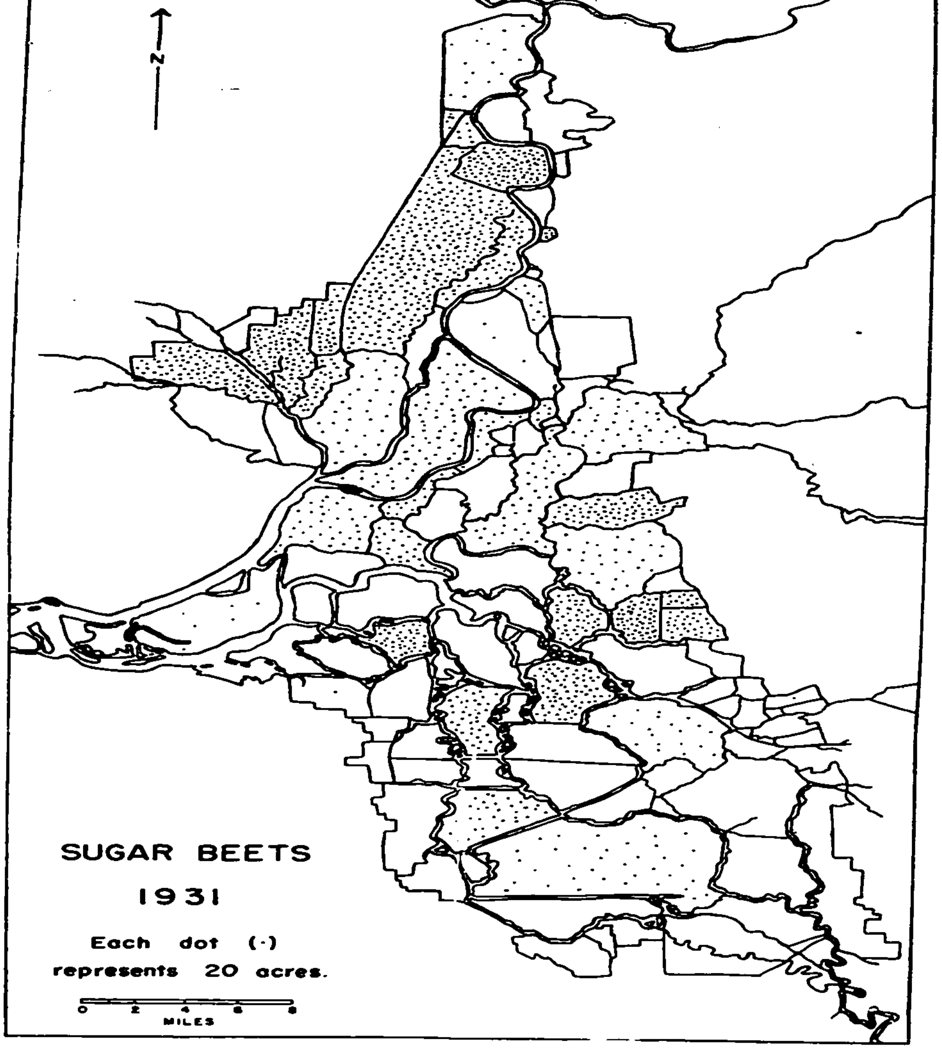
MAP PLATE F: Sugar Beets

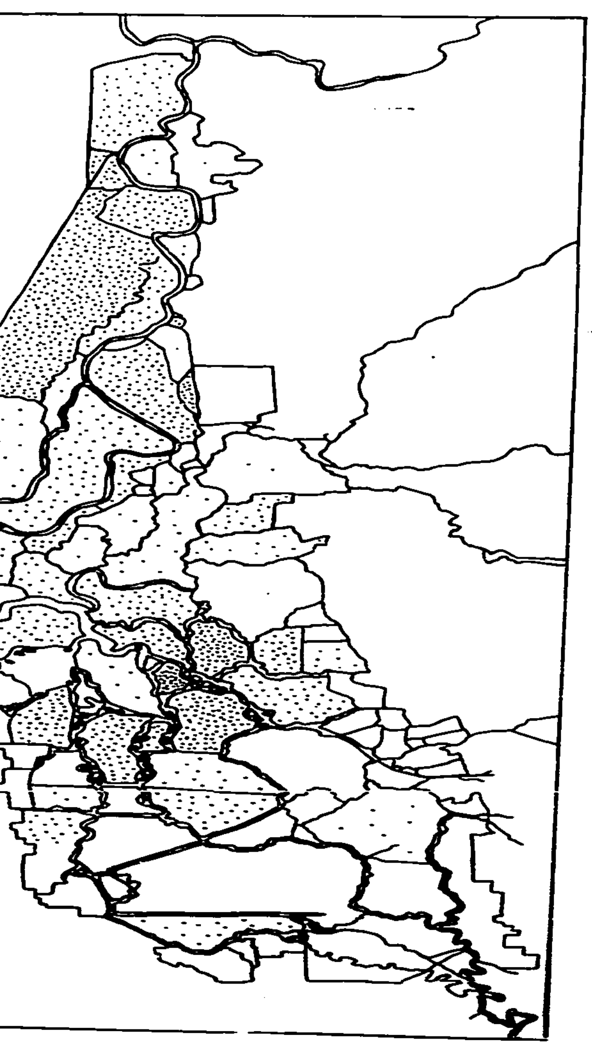
Source: County Agricultural Commissioner's Reports

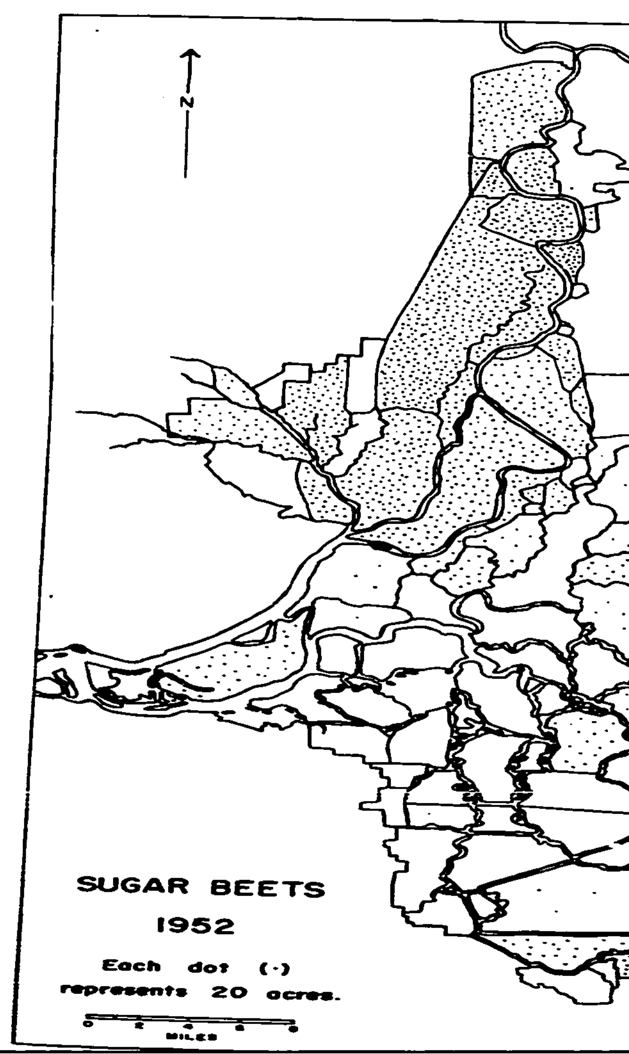

N
SUGAR BEETS
1924
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

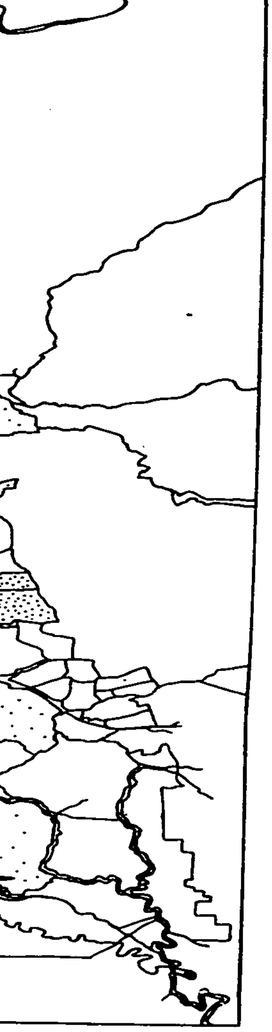

N
SUGAR BEETS
1931
Each dot (·)
represents 20 acr
0 2 4 6 8
MILES

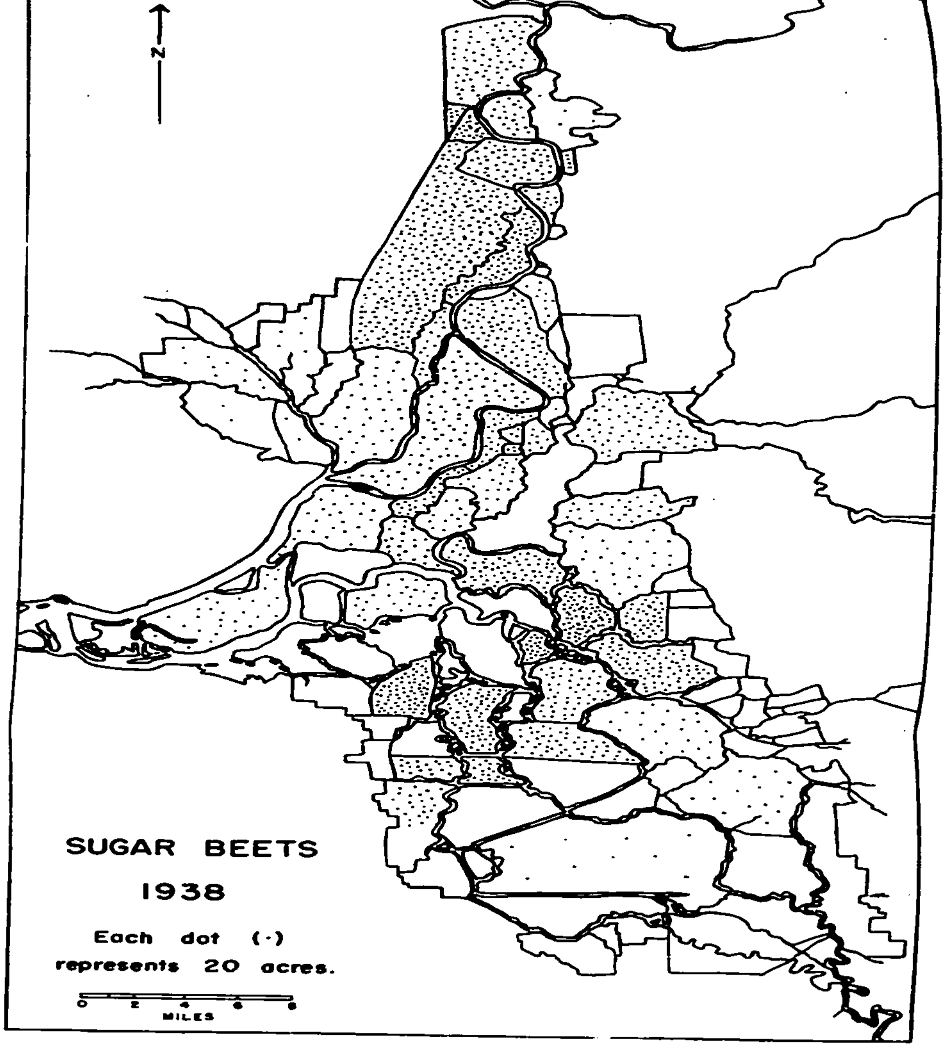

N
SUGAR BEETS
1945
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

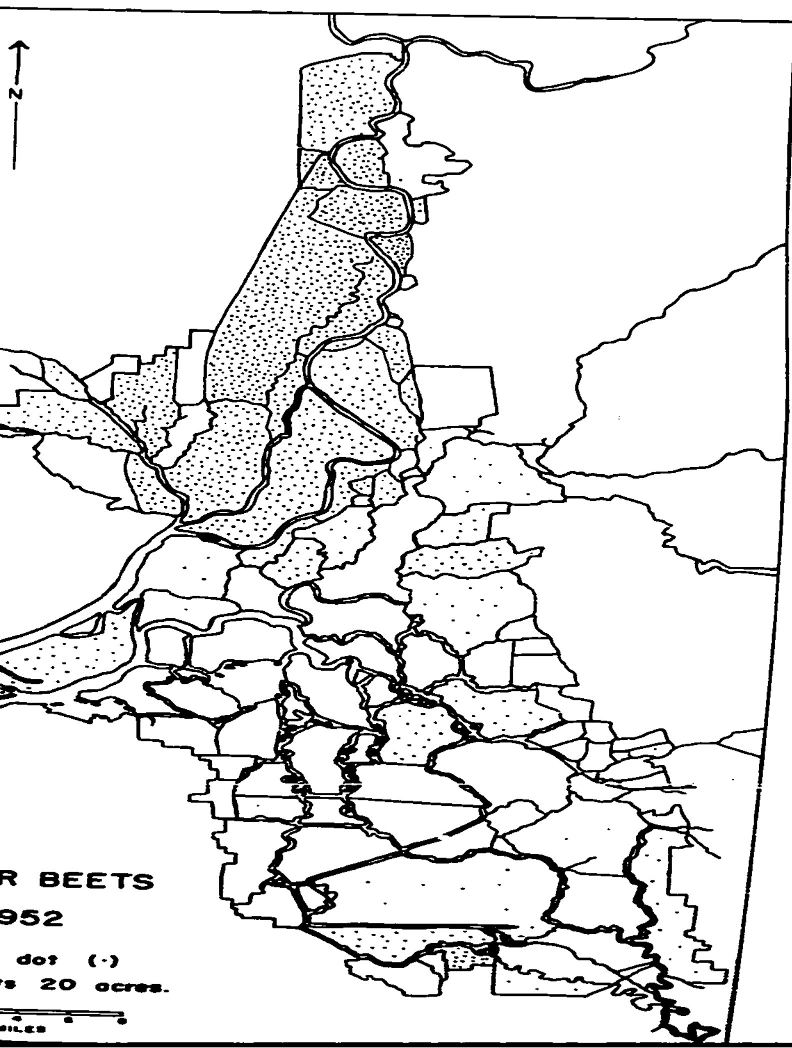

N
SUGAR BEETS
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

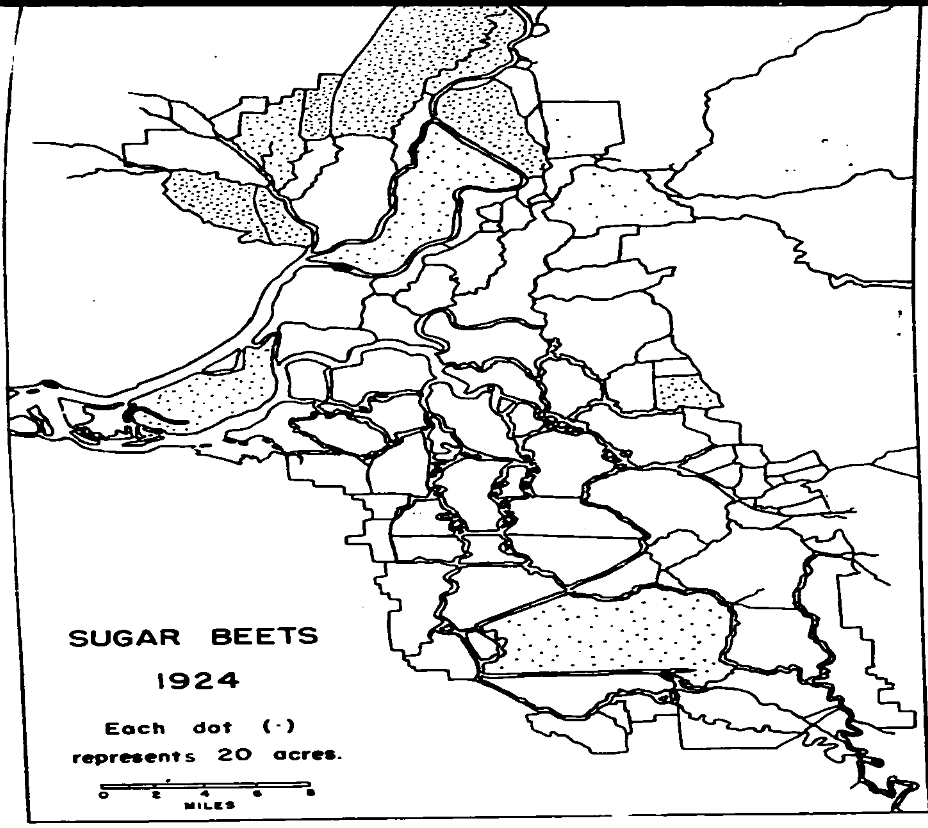


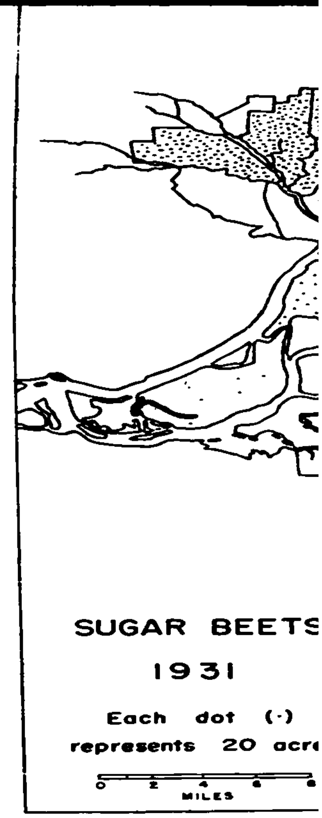

N
SUGAR BEETS
1952
Each dot (·)
represents 20 acres.
MILES

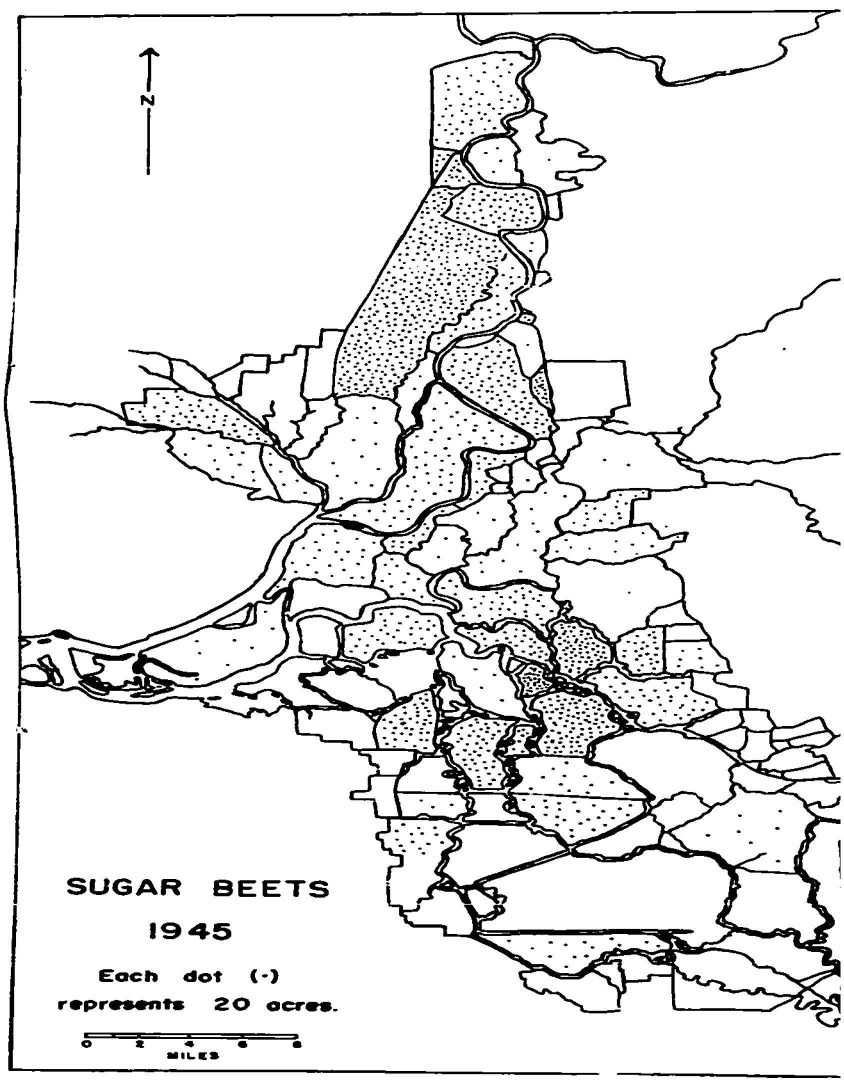


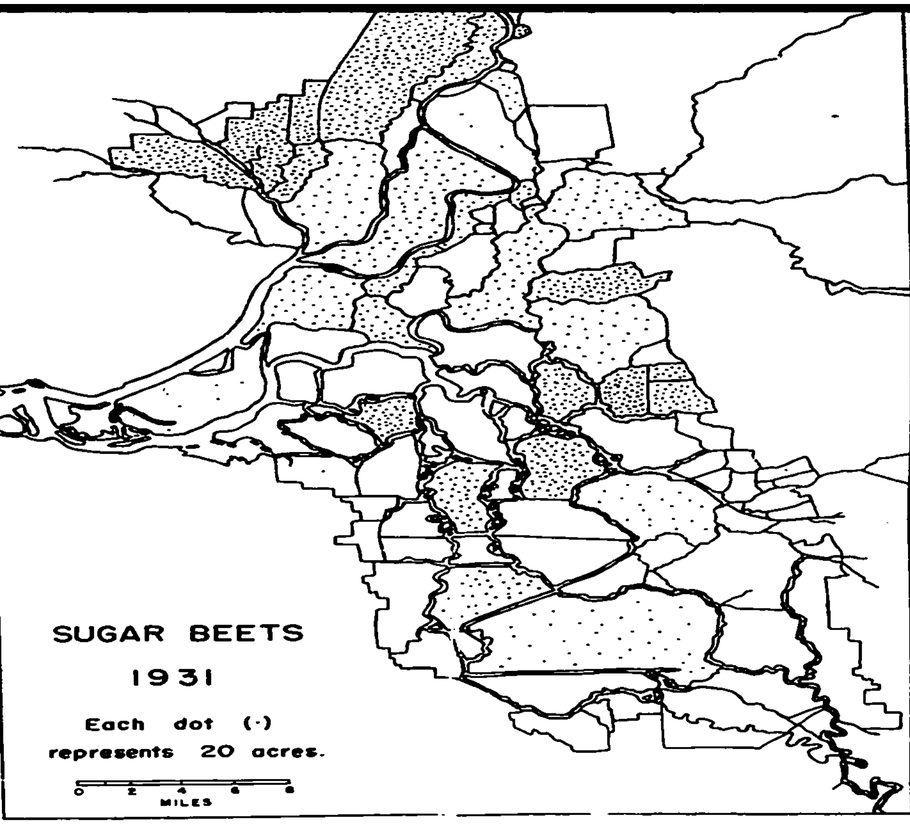

N
SUGAR BEETS
1938
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

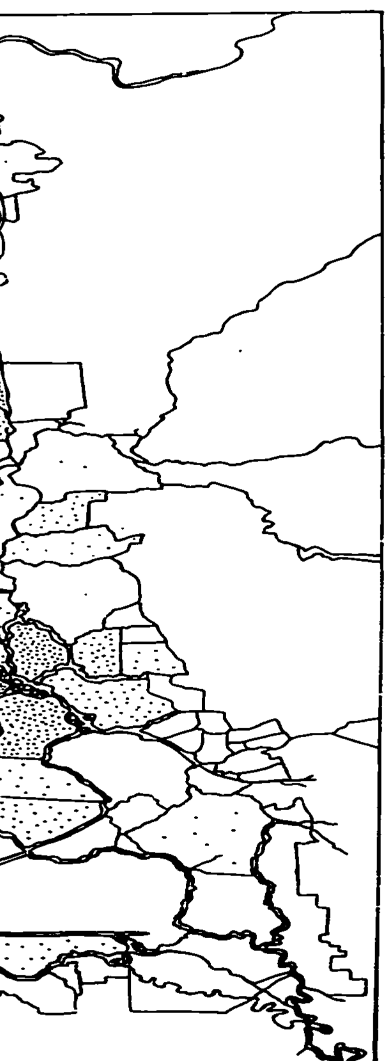

N
R BEETS
952
dot (·)
s 20 acres.
MILES

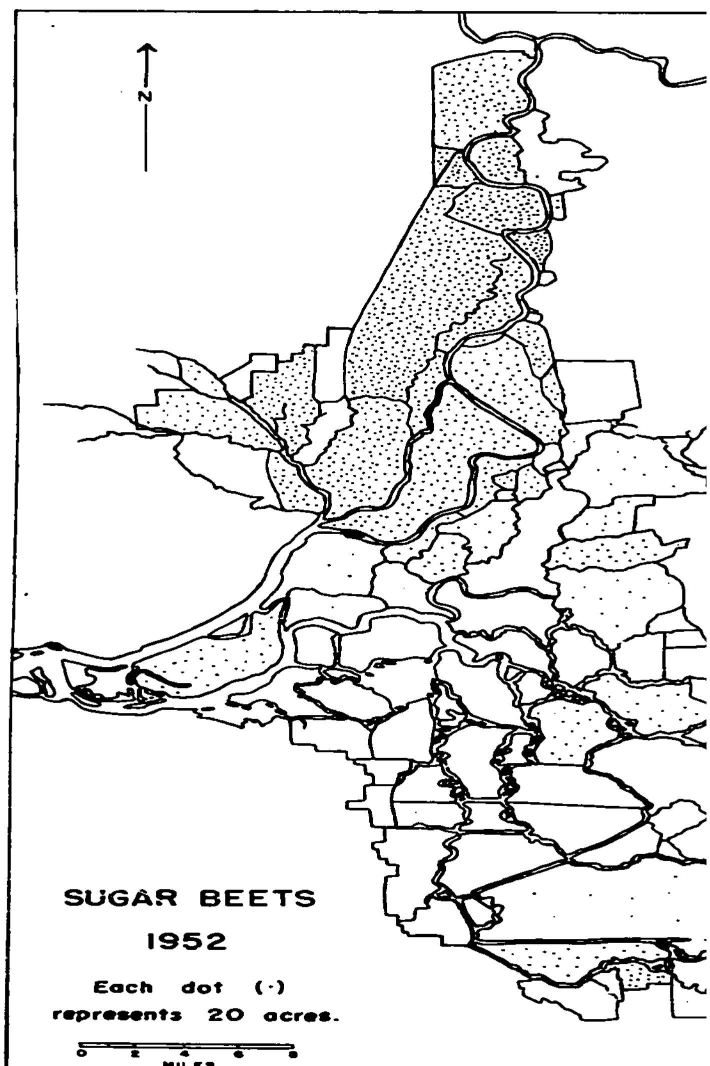

SUGAR BEETS
1924
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

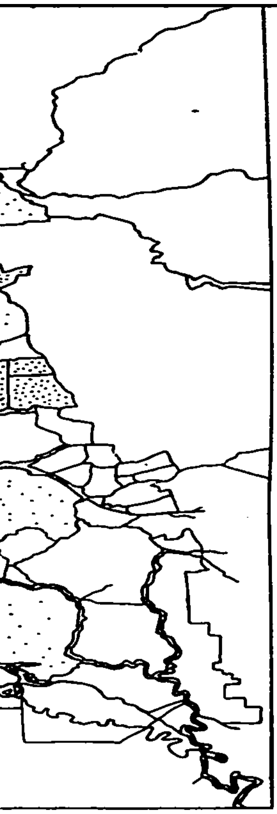

SUGAR BEETS
1931
Each dot (·)
represents 20
MILES

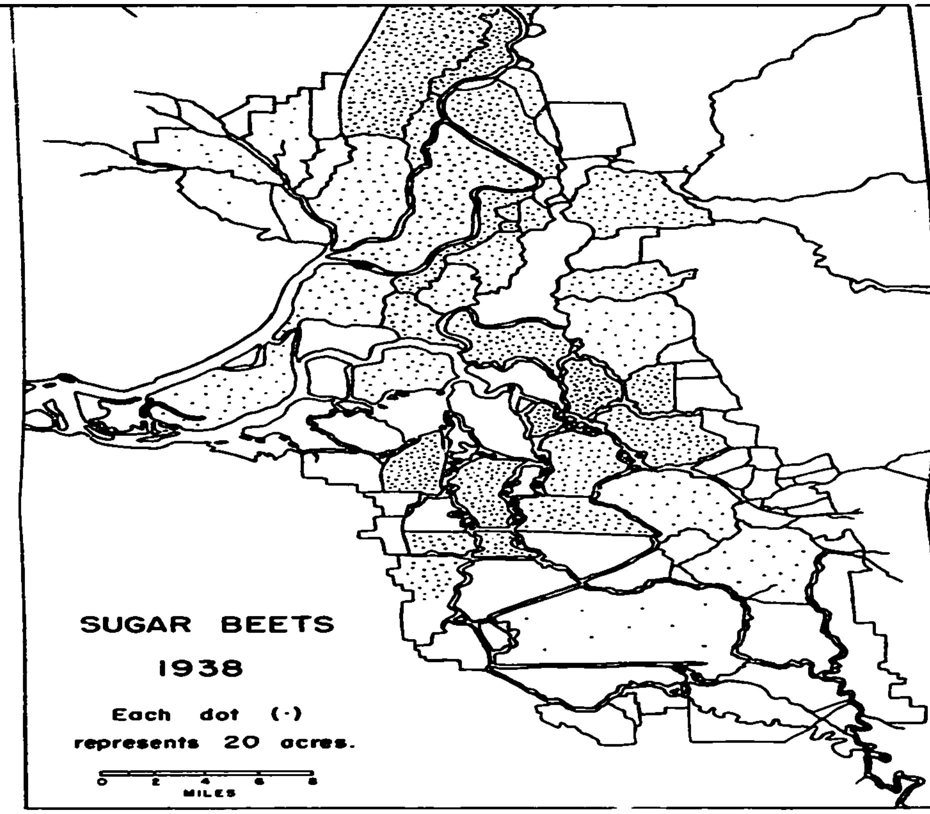

N
SUGAR BEETS
1945
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

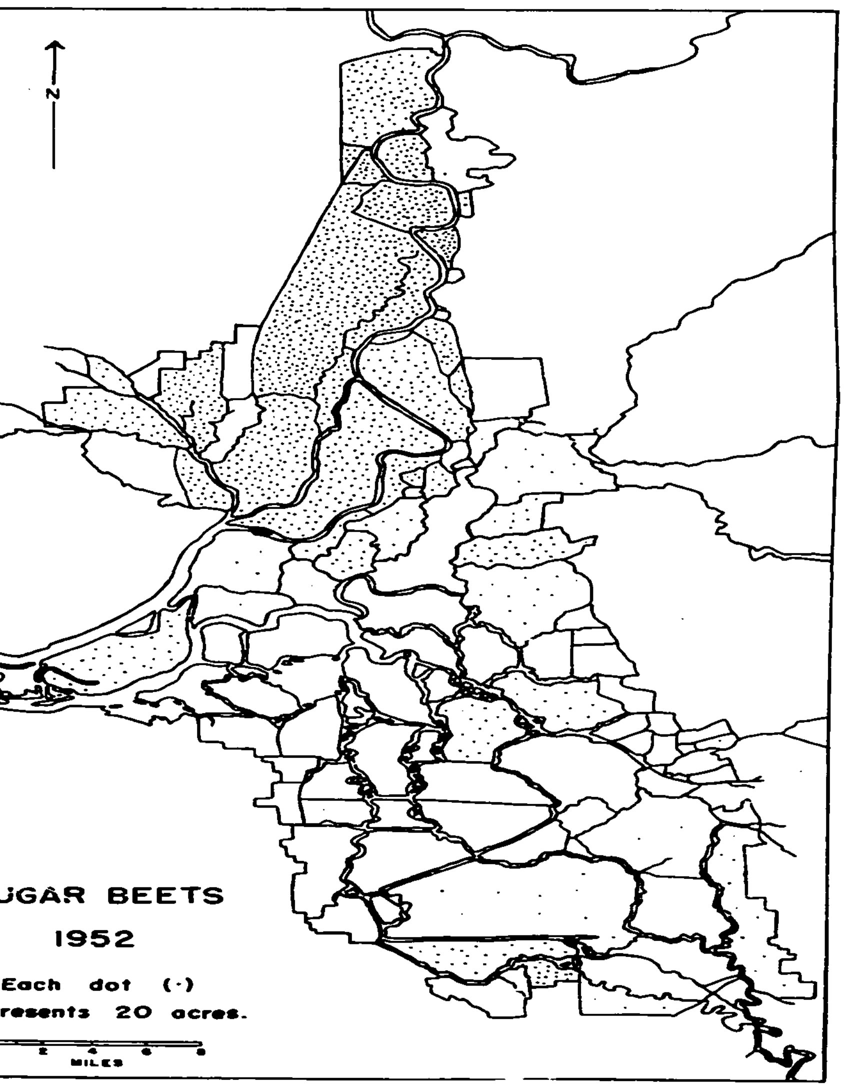

SUGAR BEETS
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

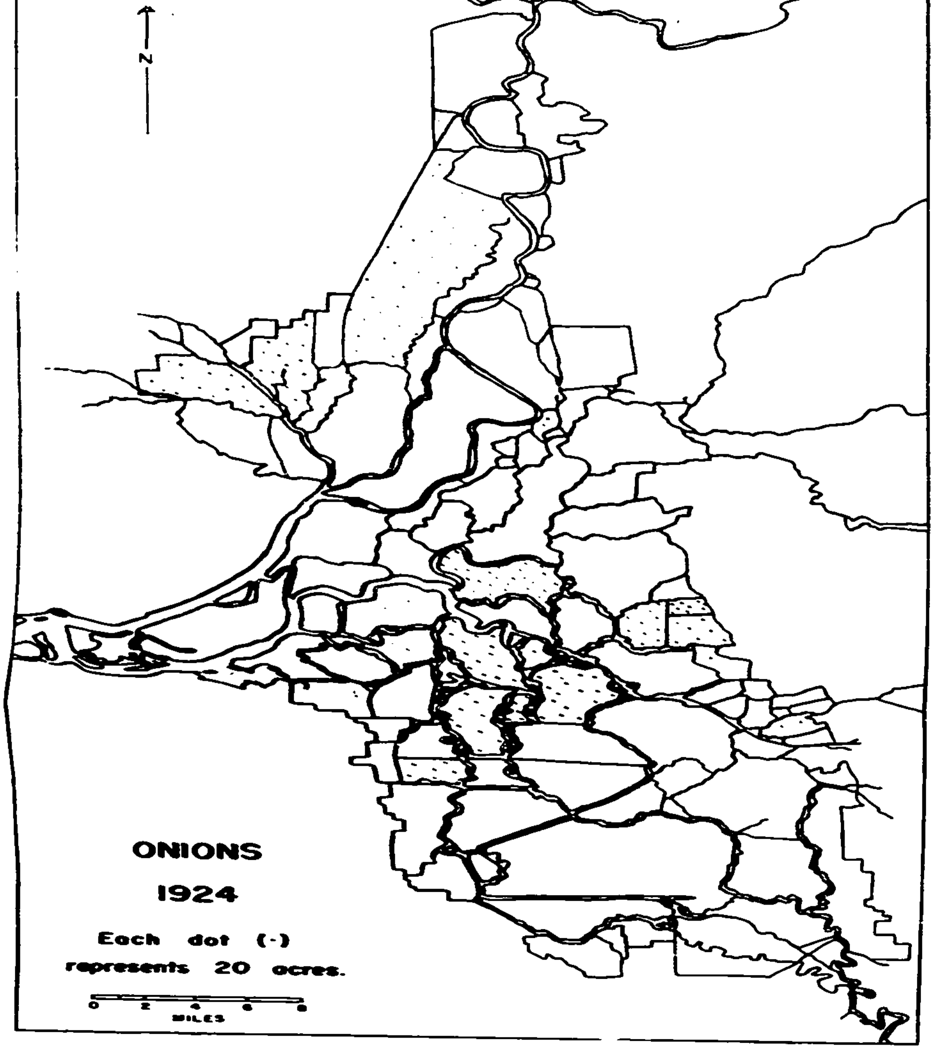


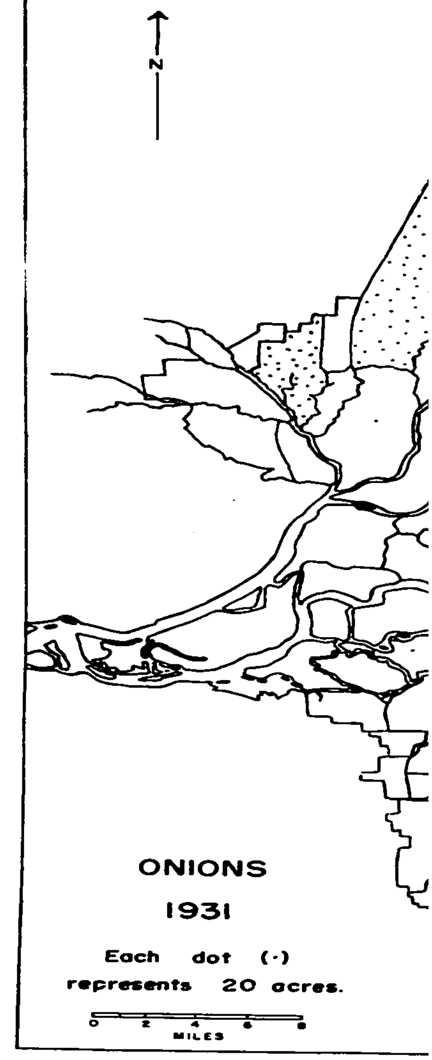

N
SUGAR BEETS
1952
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

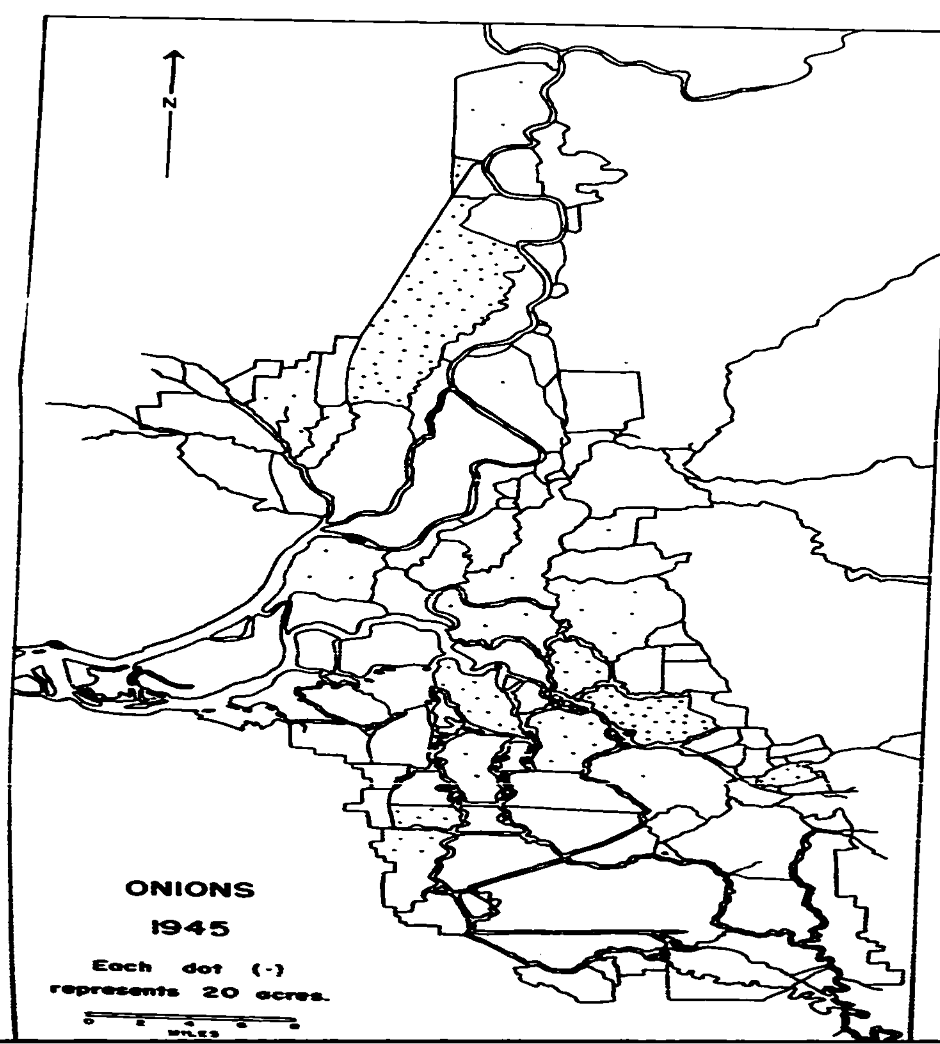


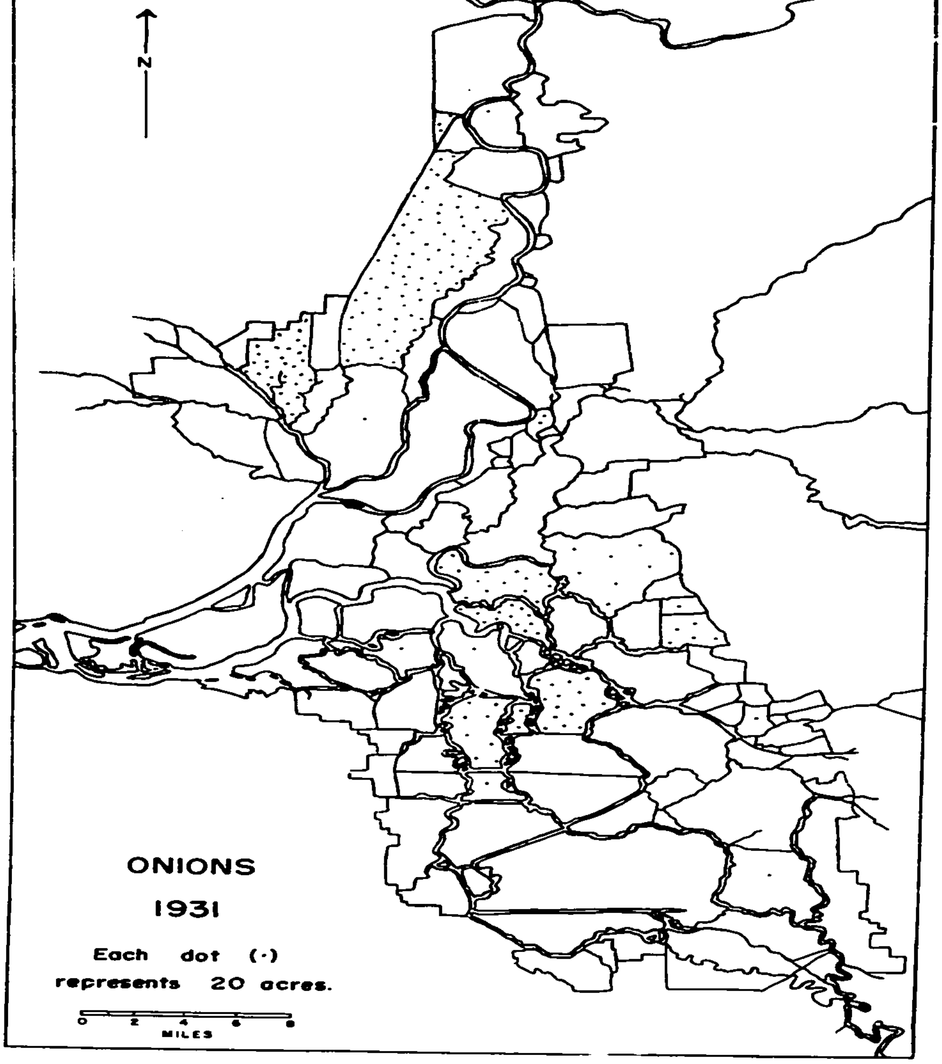

SUGAR BEETS
1938
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

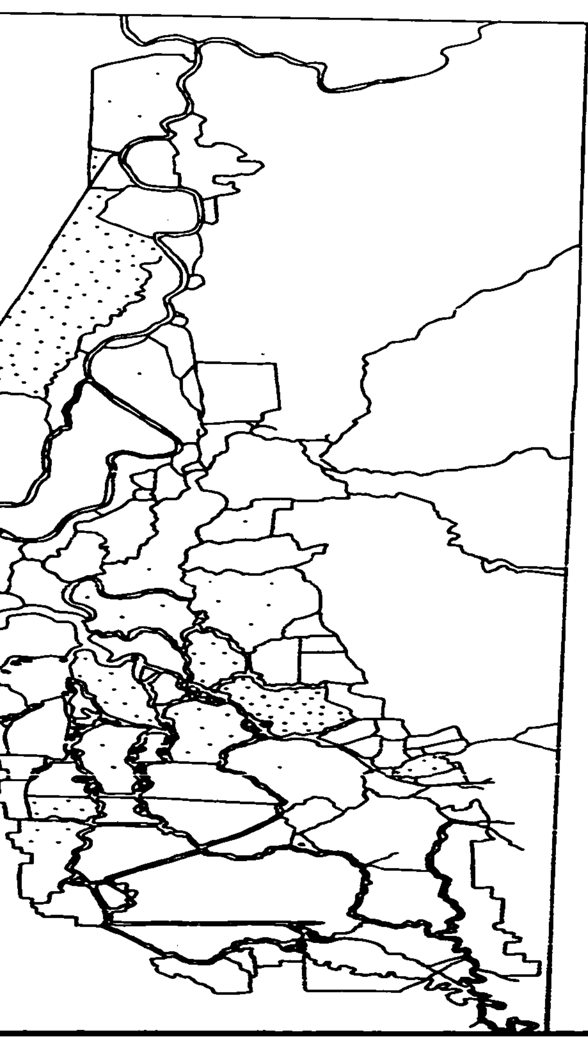

N
UGAR BEETS
1952
Each dot (·)
resents 20 acres.
2 4 6 8
MILES

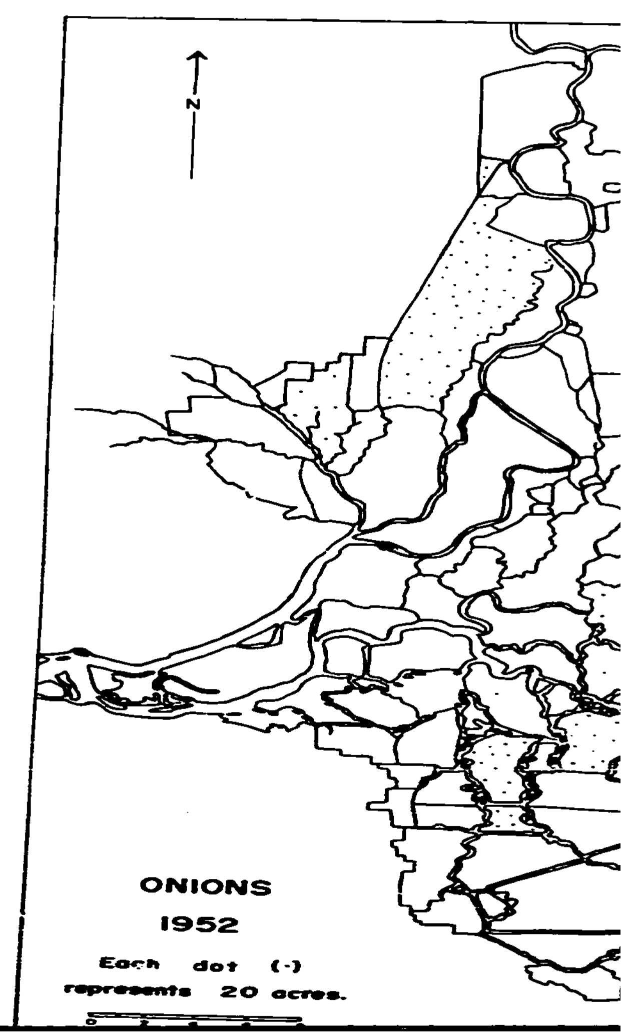

N
ONIONS
1924
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

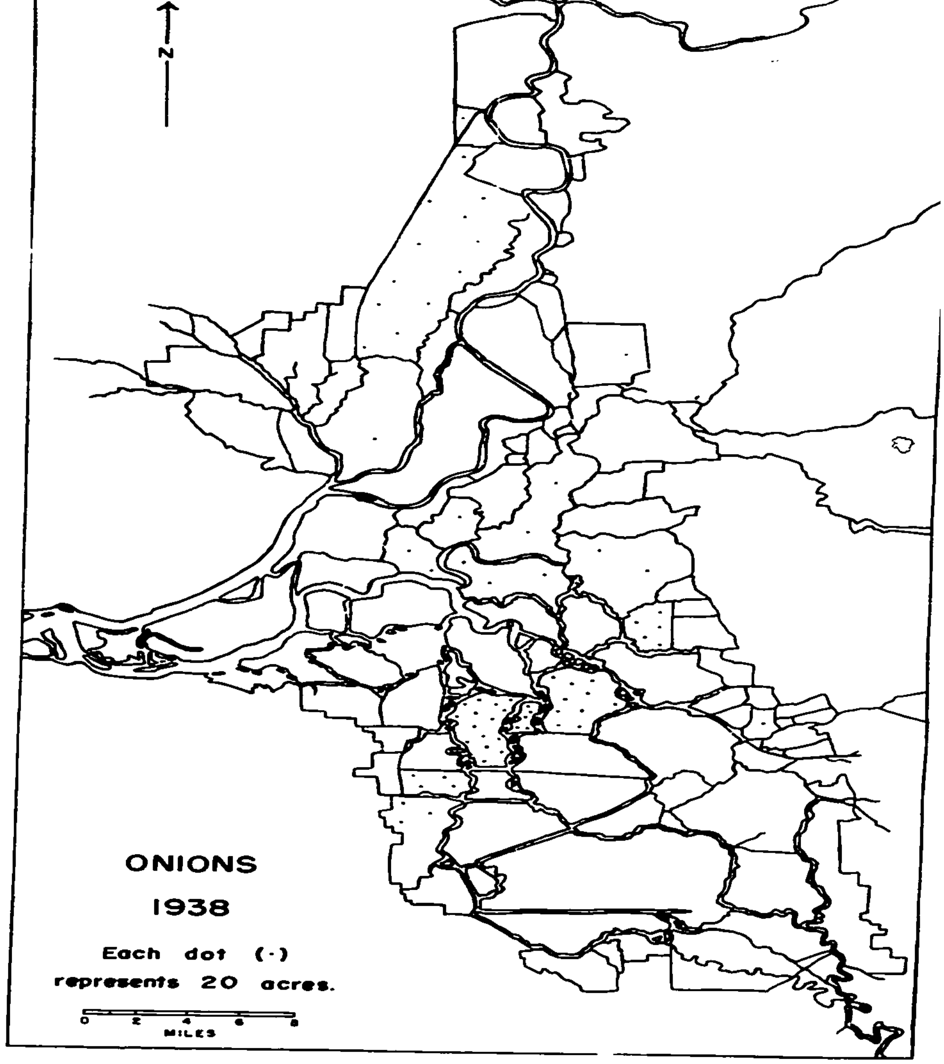

N
ONIONS
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

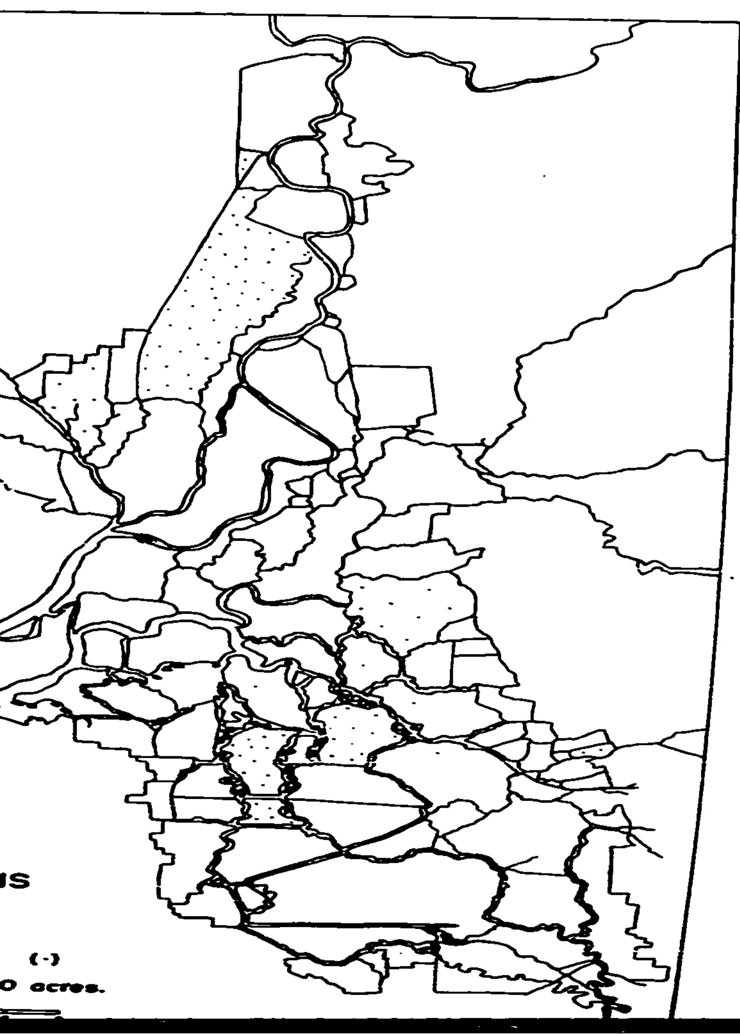

N
ONIONS
1945
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

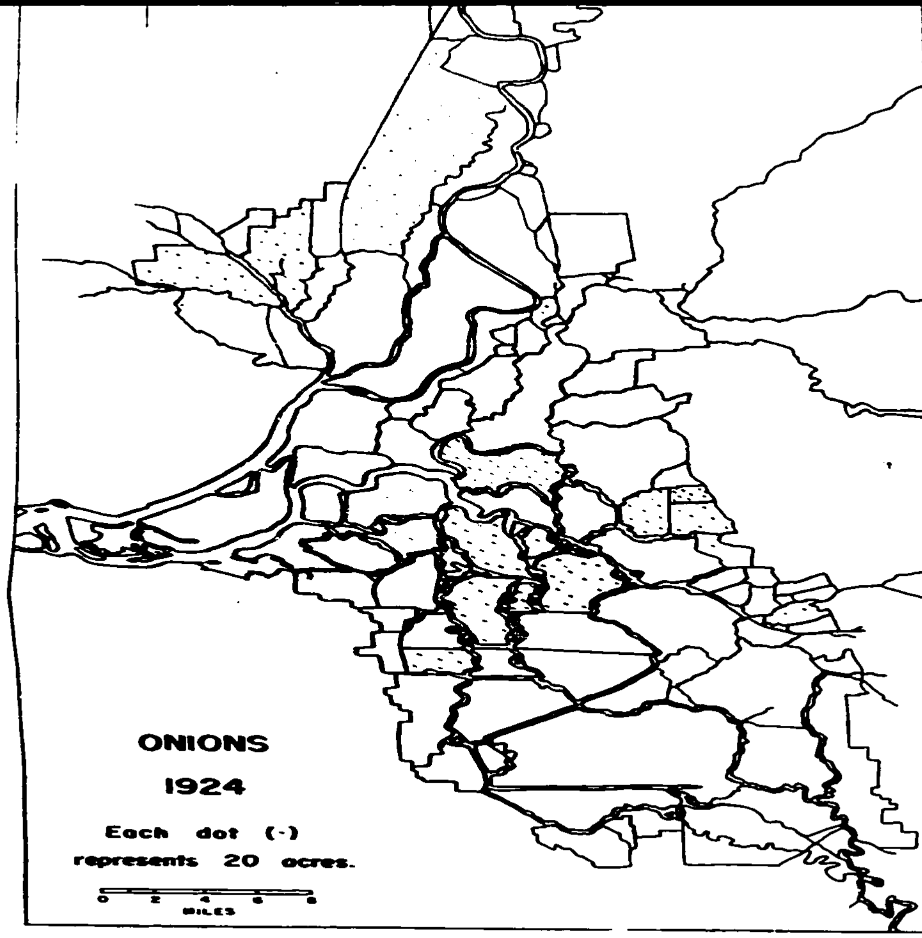

N
ONIONS
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES



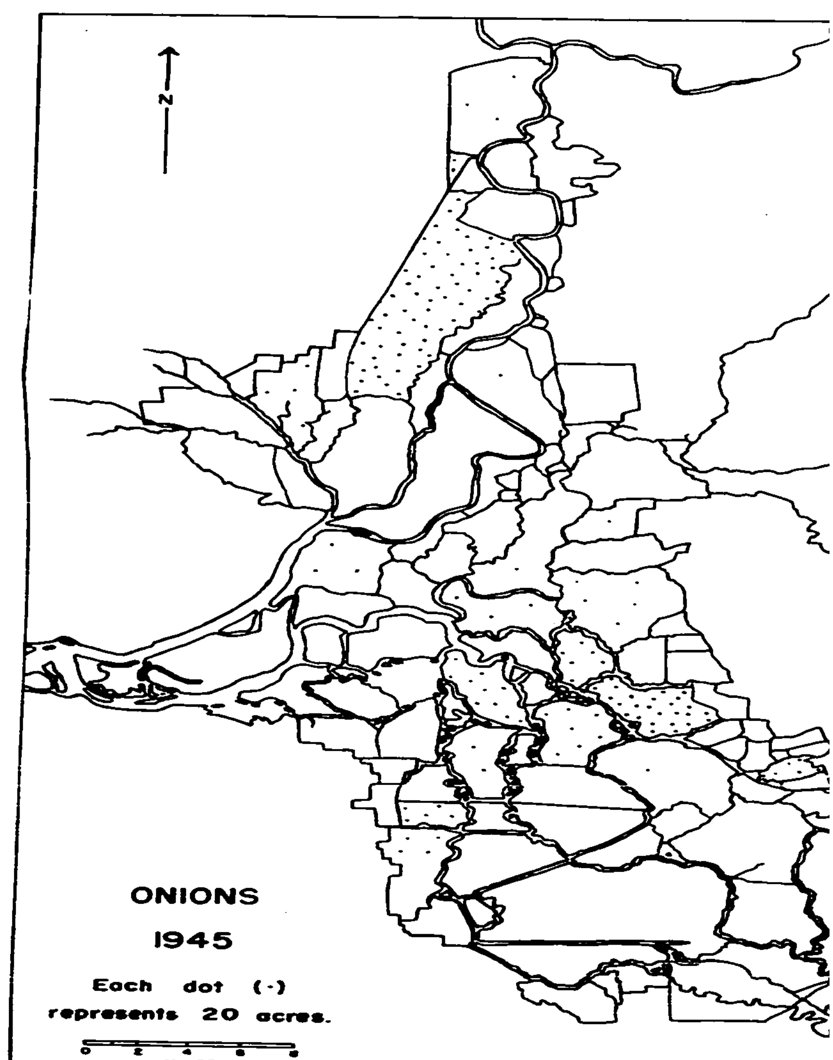

N
ONIONS
1952
Each dot (·)
represents 20 acres.

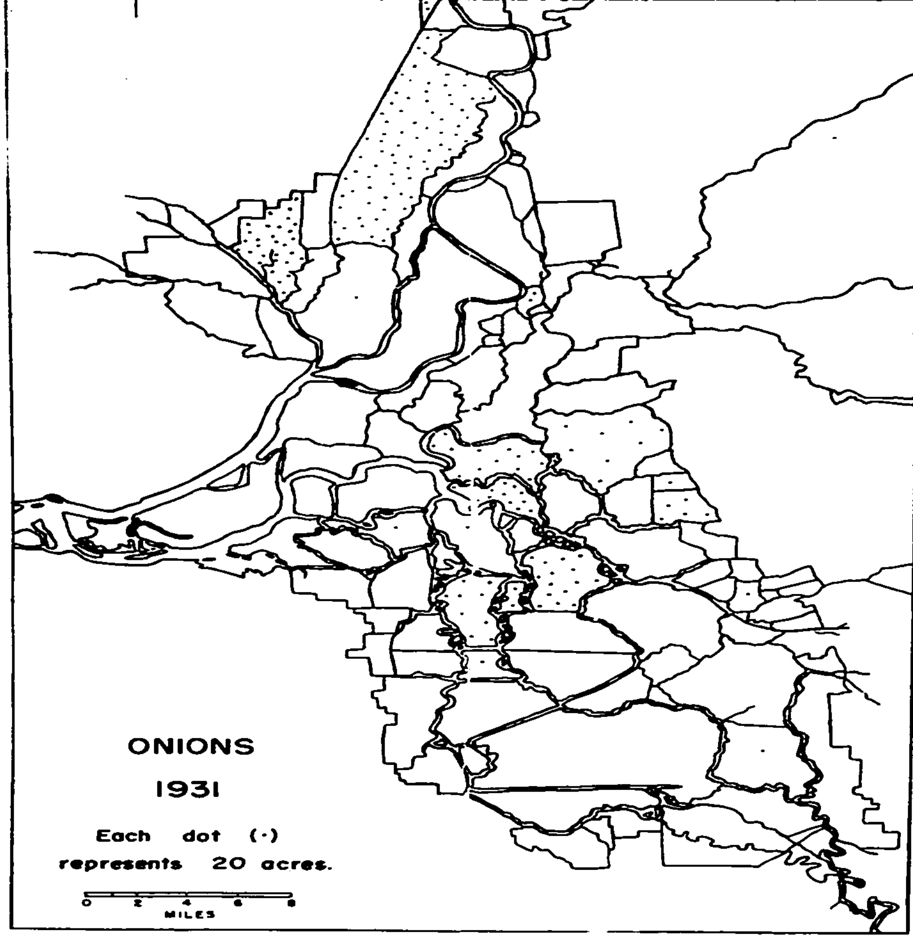

N
ONIONS
1938
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

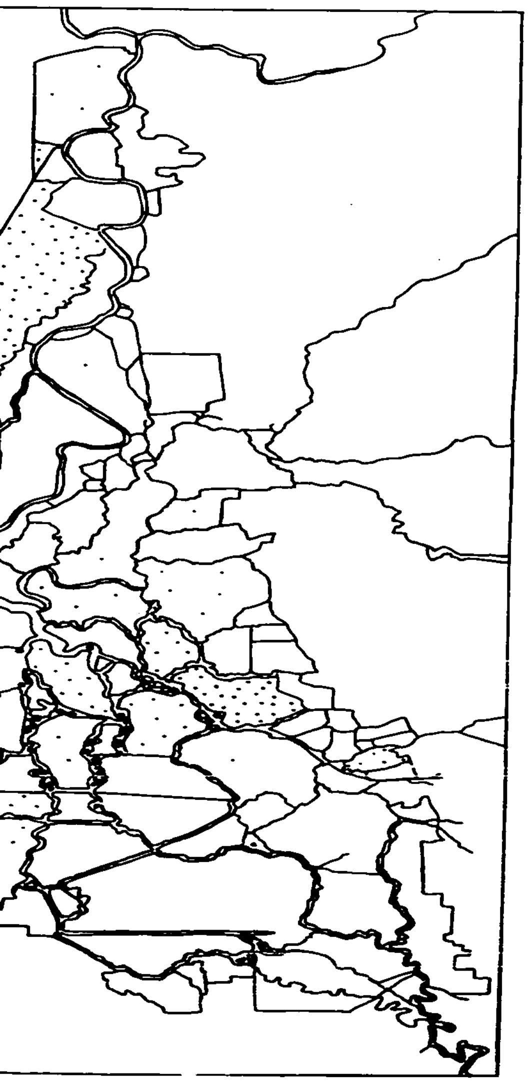

IS
(·)
0 acres.

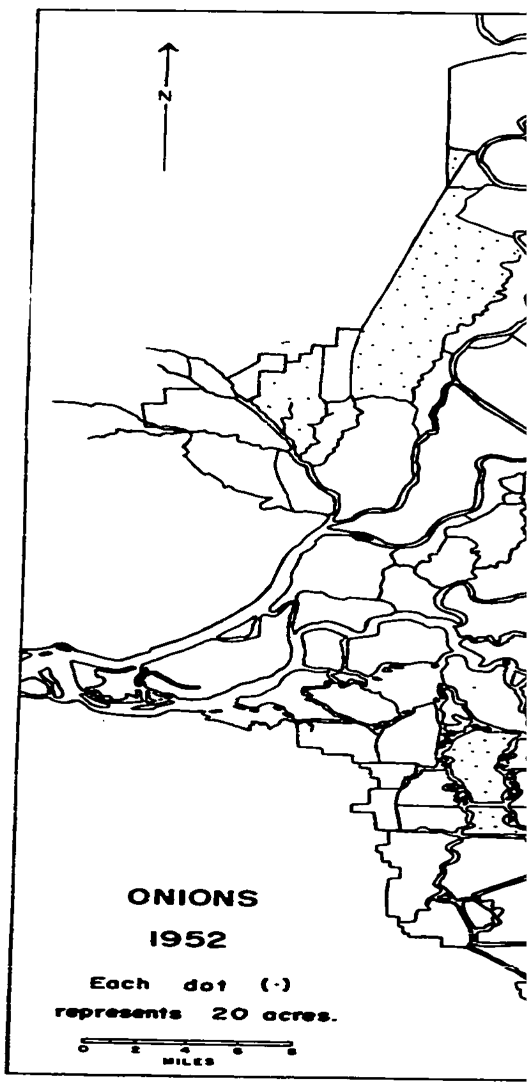

ONIONS
1924
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

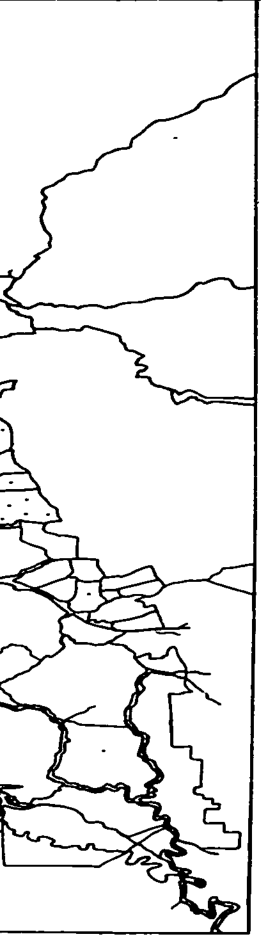

ONIONS
1931
Each dot
represents 20
MILES

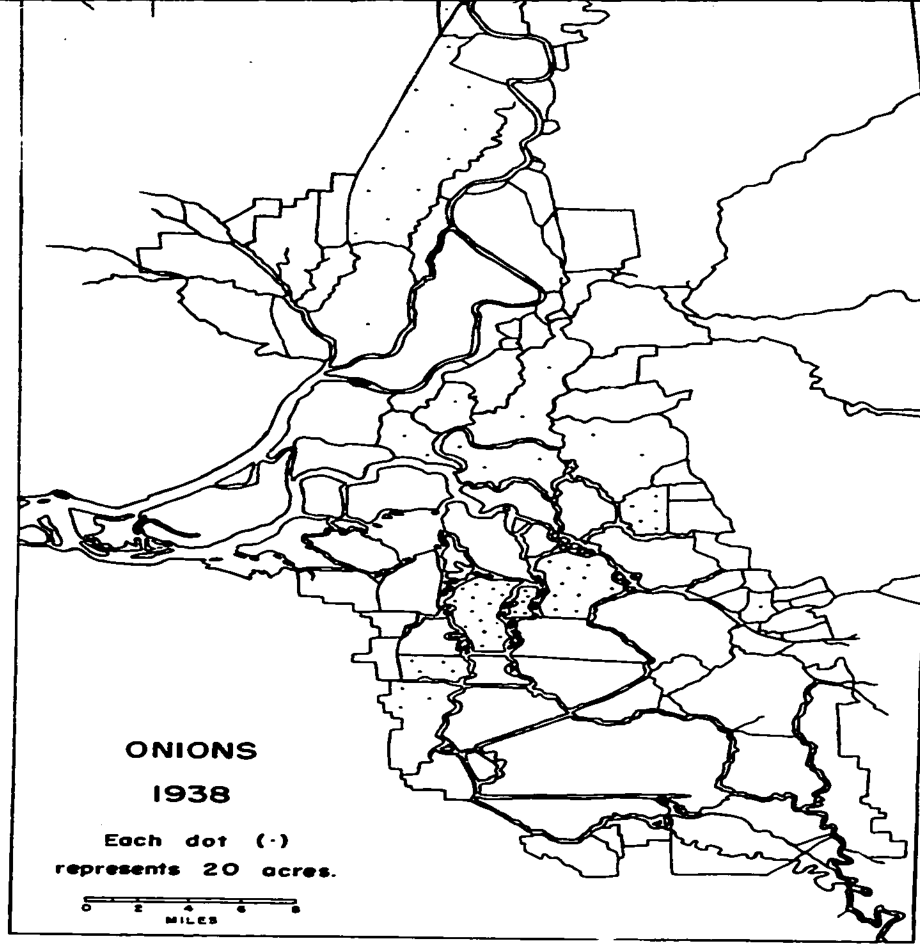

N
ONIONS
1945
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

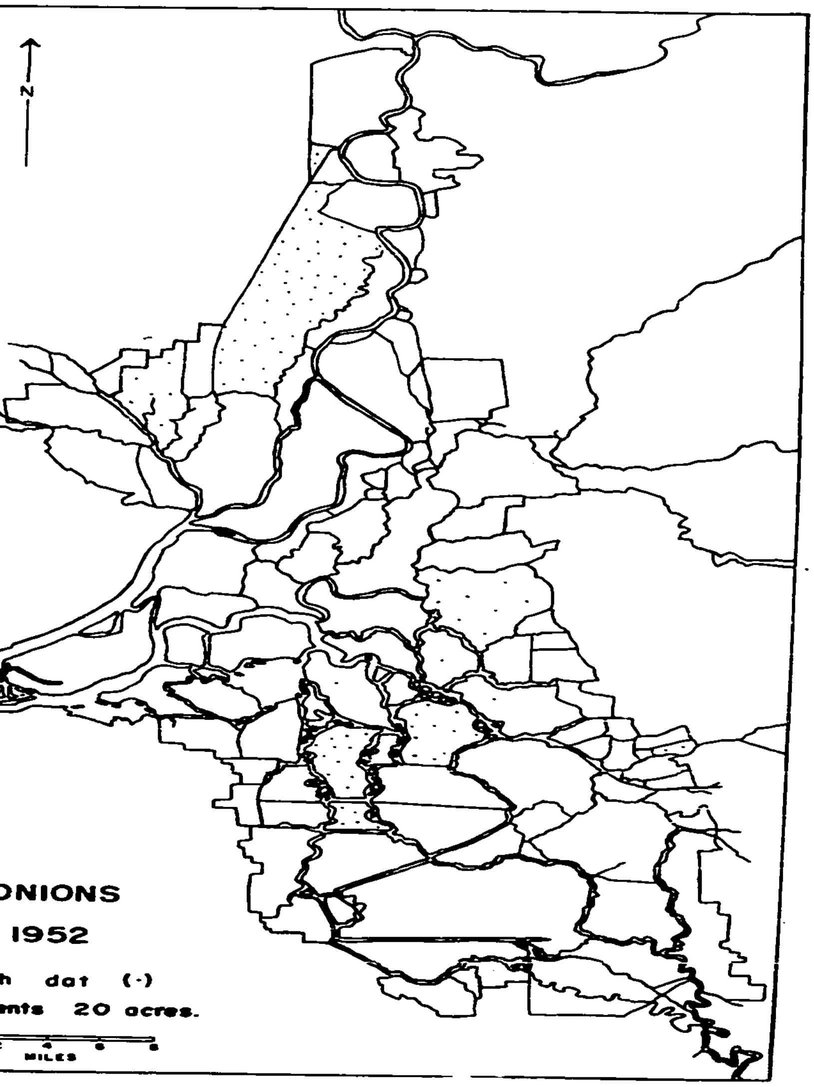

ONIONS
1931
Each dot (·)
represents 20 acres.
MILES

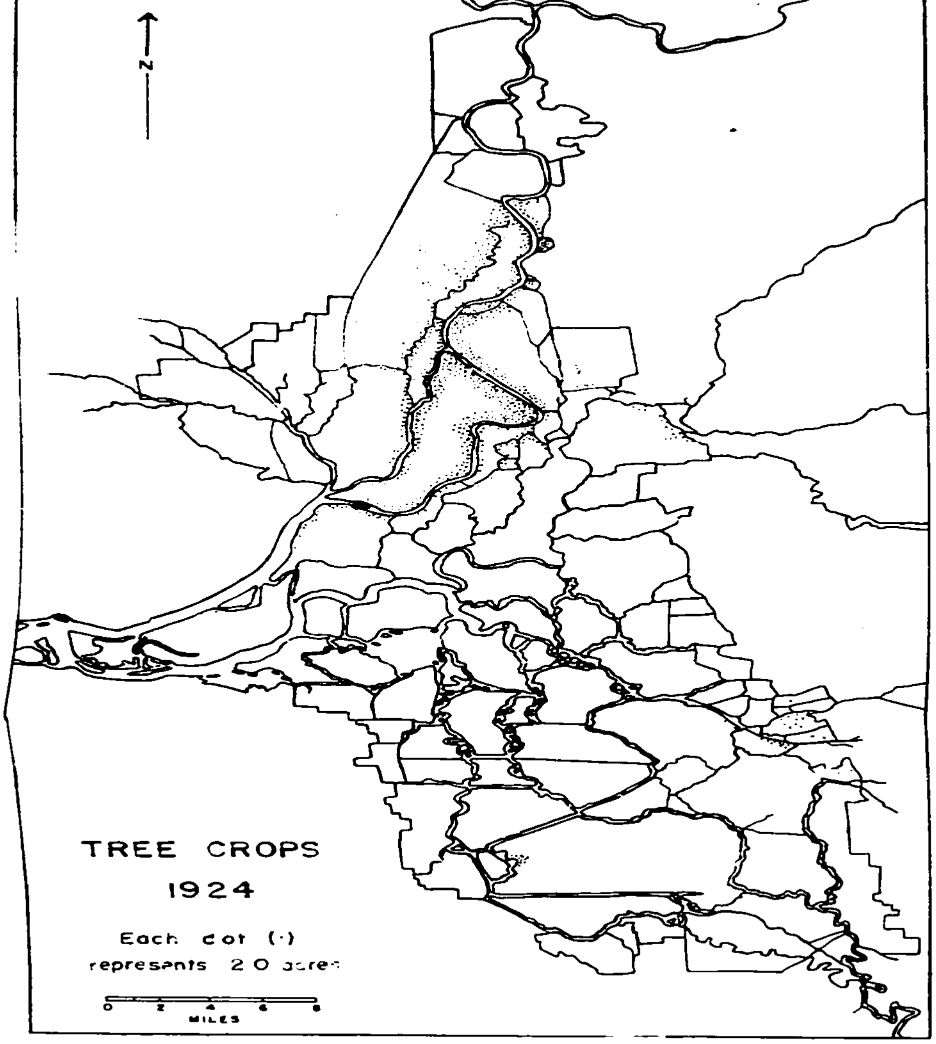


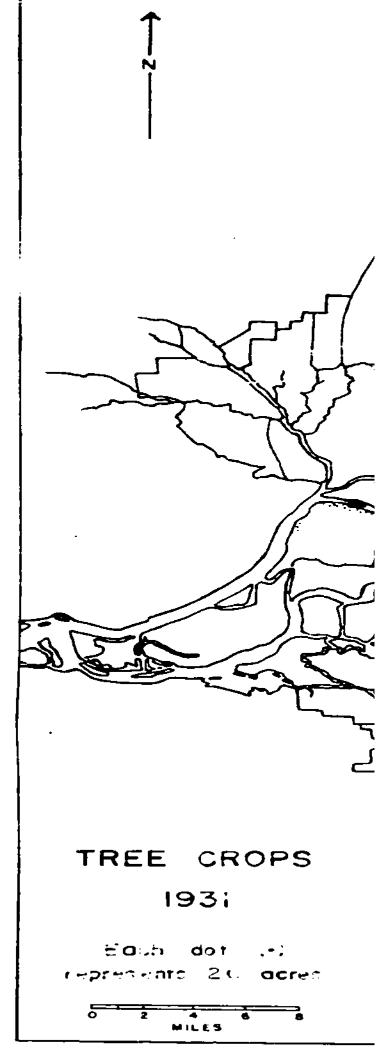

N
ONIONS
1952
Each dot (·)
represents 20 acres.
MILES

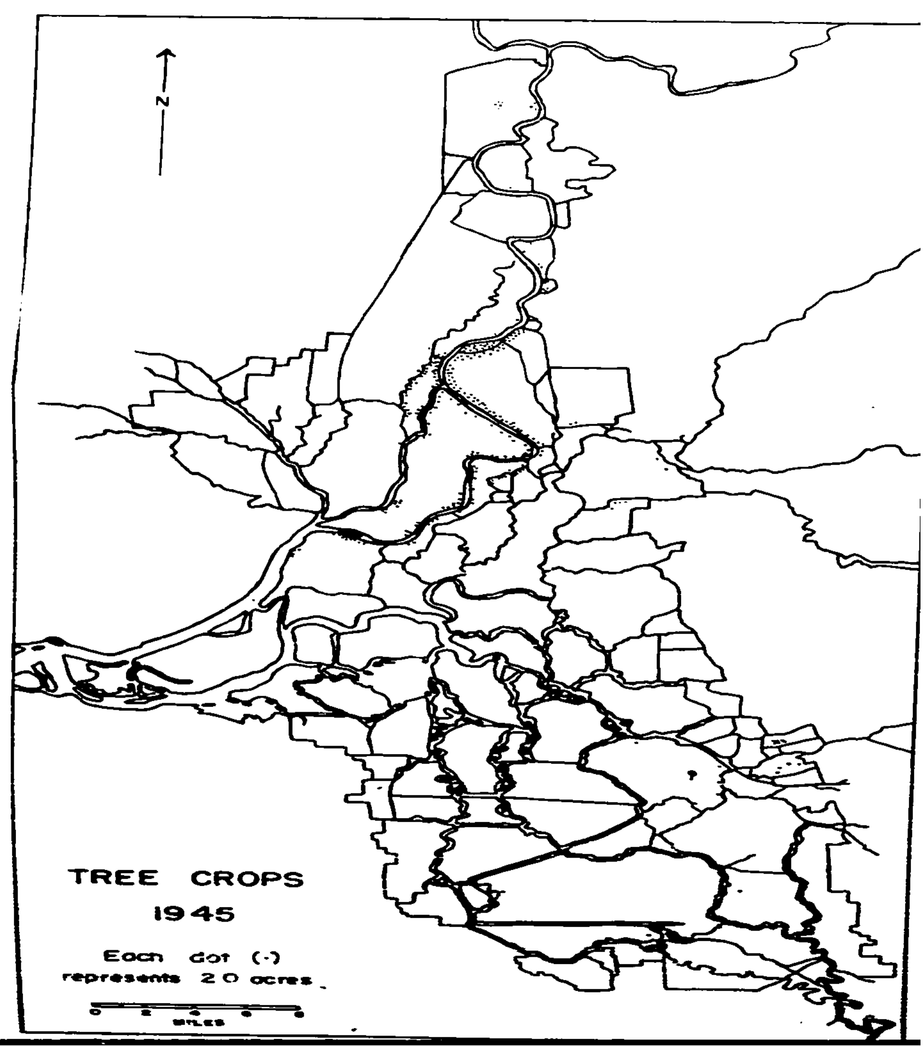


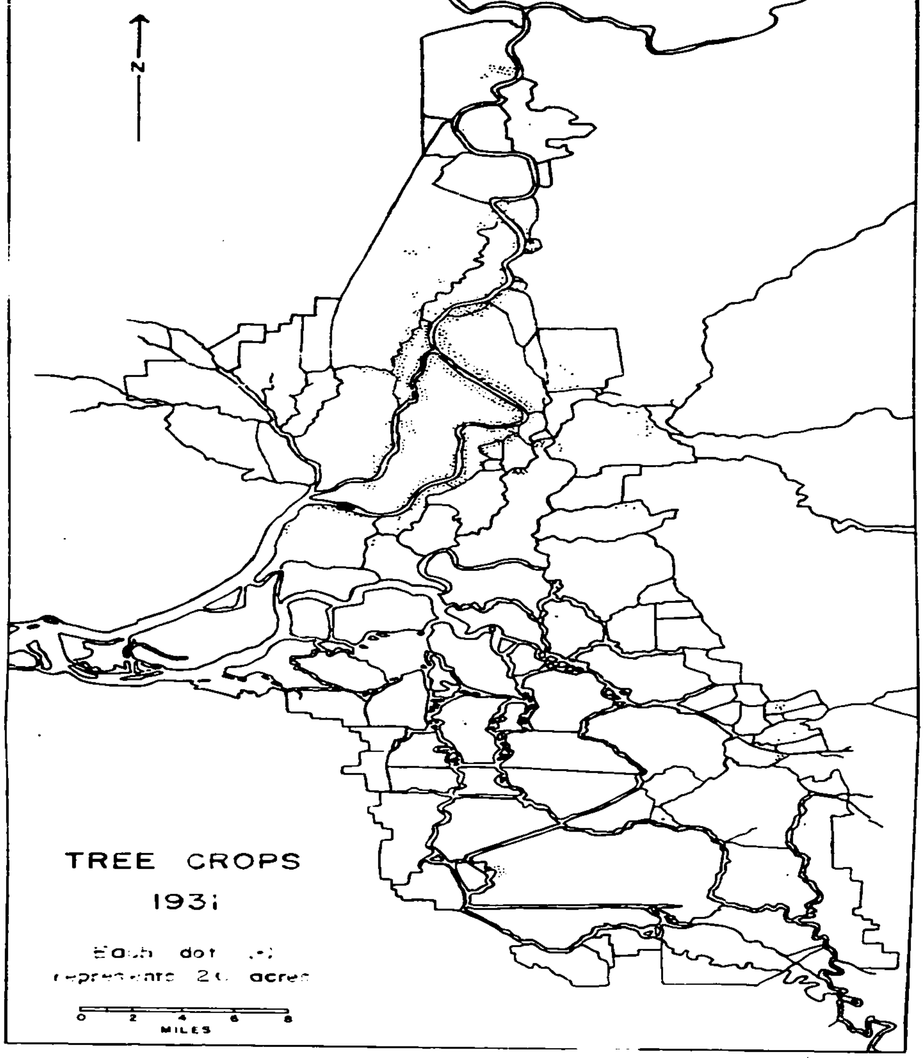

ONIONS
1938
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

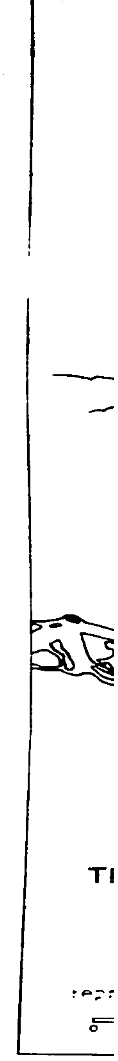

N
ONIONS
1952
dot (·)
20 acres.
MILES

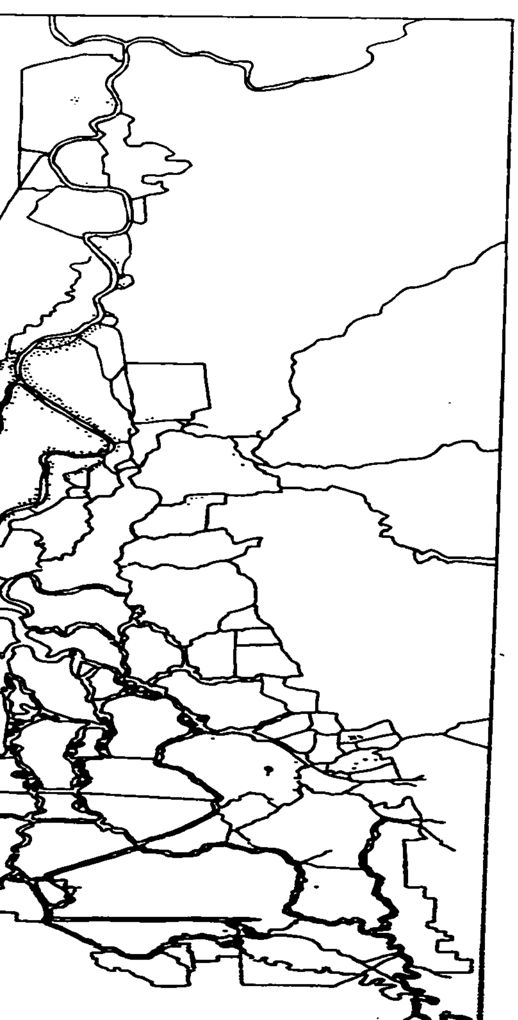

N
TREE CROPS
1924
Each dot (·)
represents 20 acres
MILES

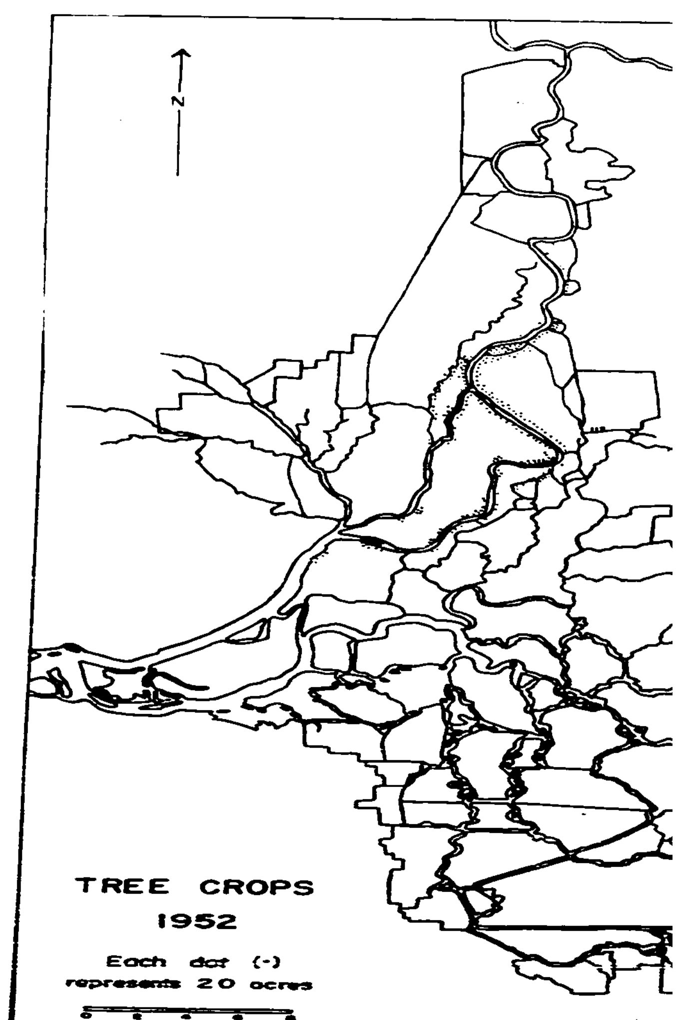

N
TREE CROPS
1931
MILES

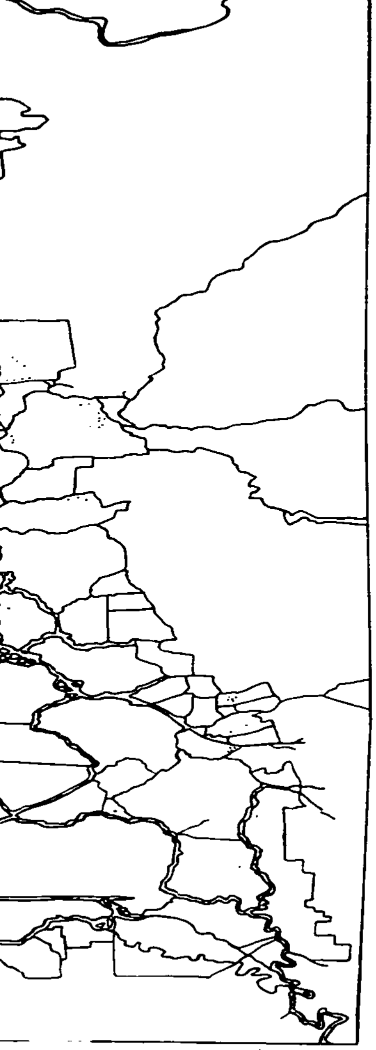

N
TREE CROPS
1945
Each dot (·)
represents 20 acres
MILES

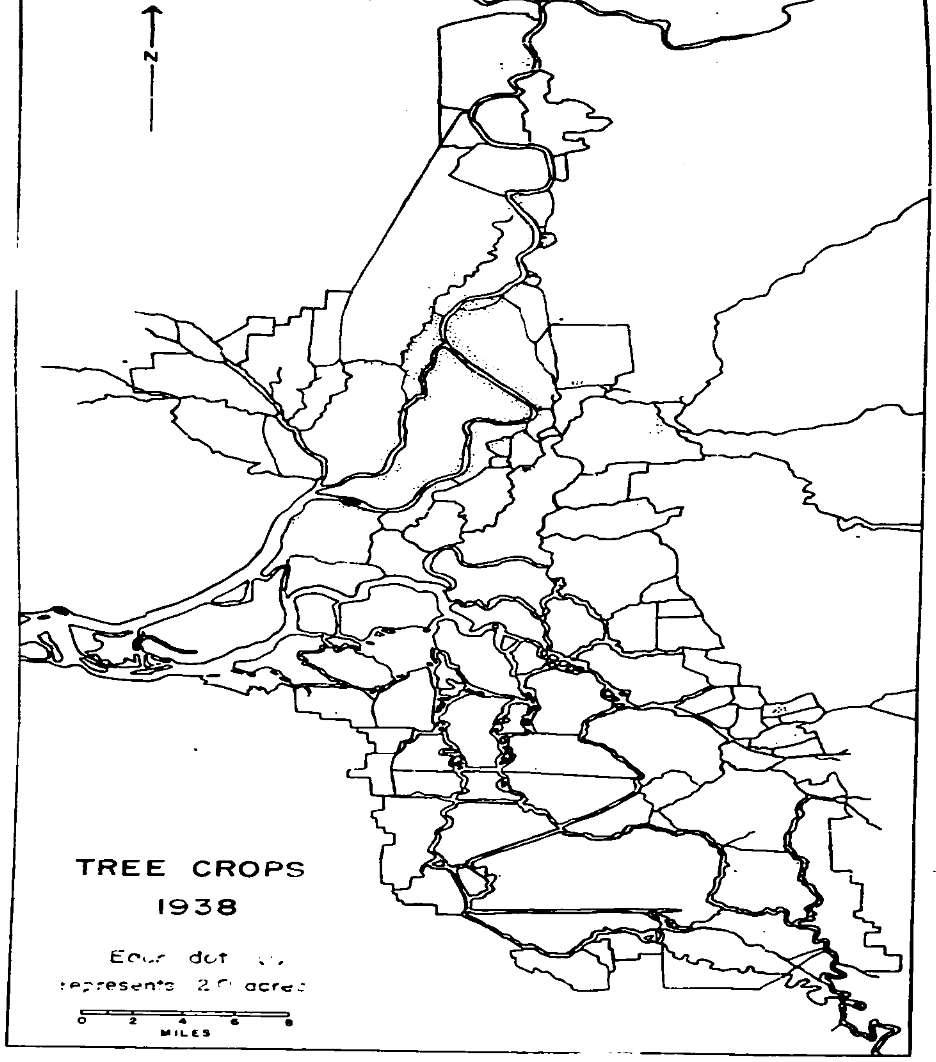

N
TREE CROPS
1931
0 2 4 6 8
MILES

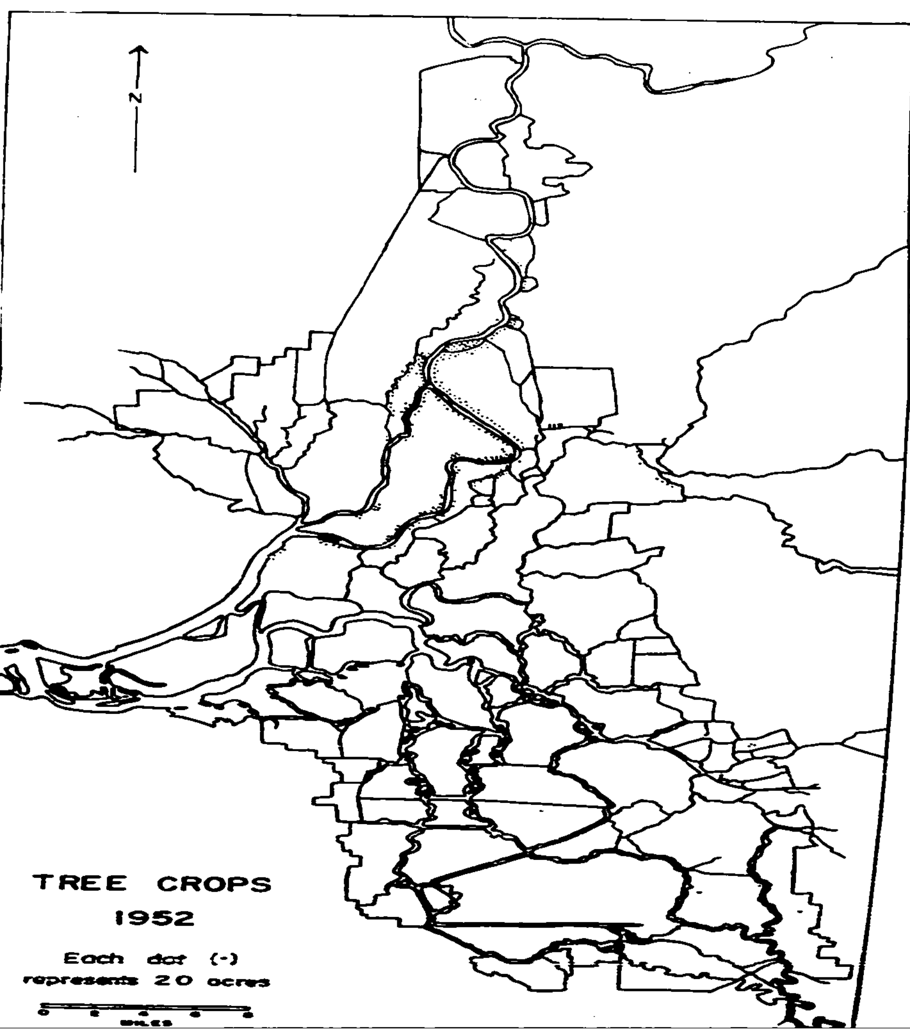


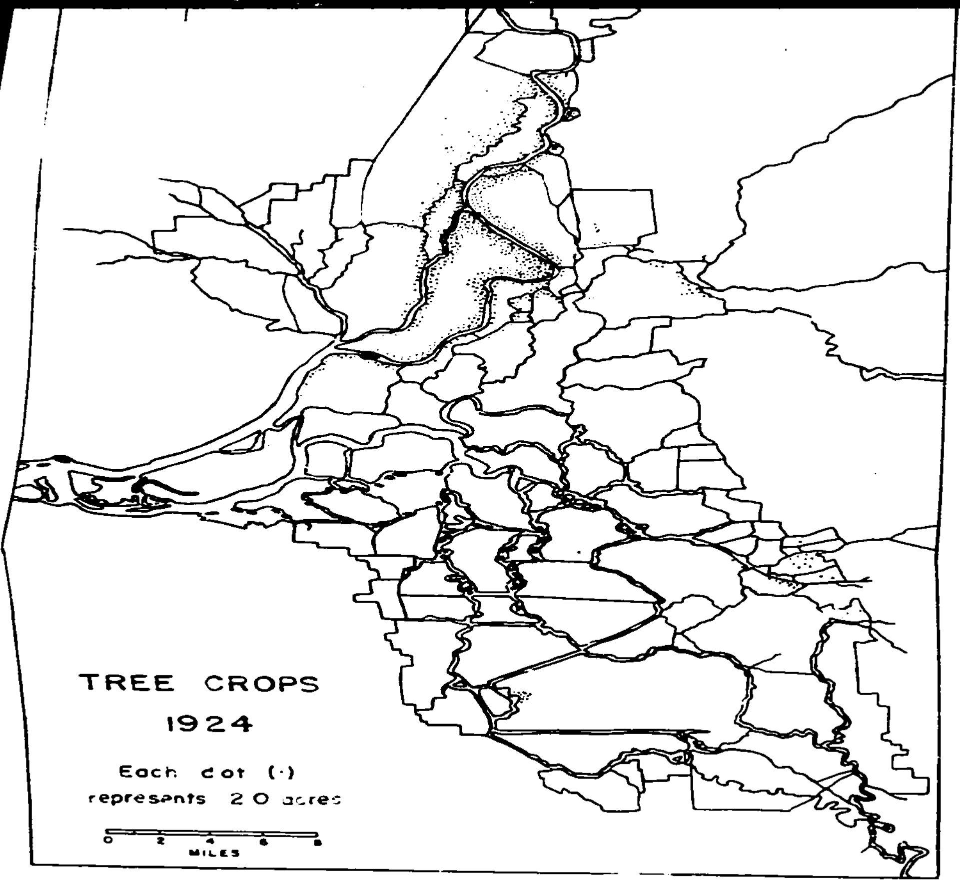



N
TREE CROPS
1952
Each dot (·)
represents 20 acres

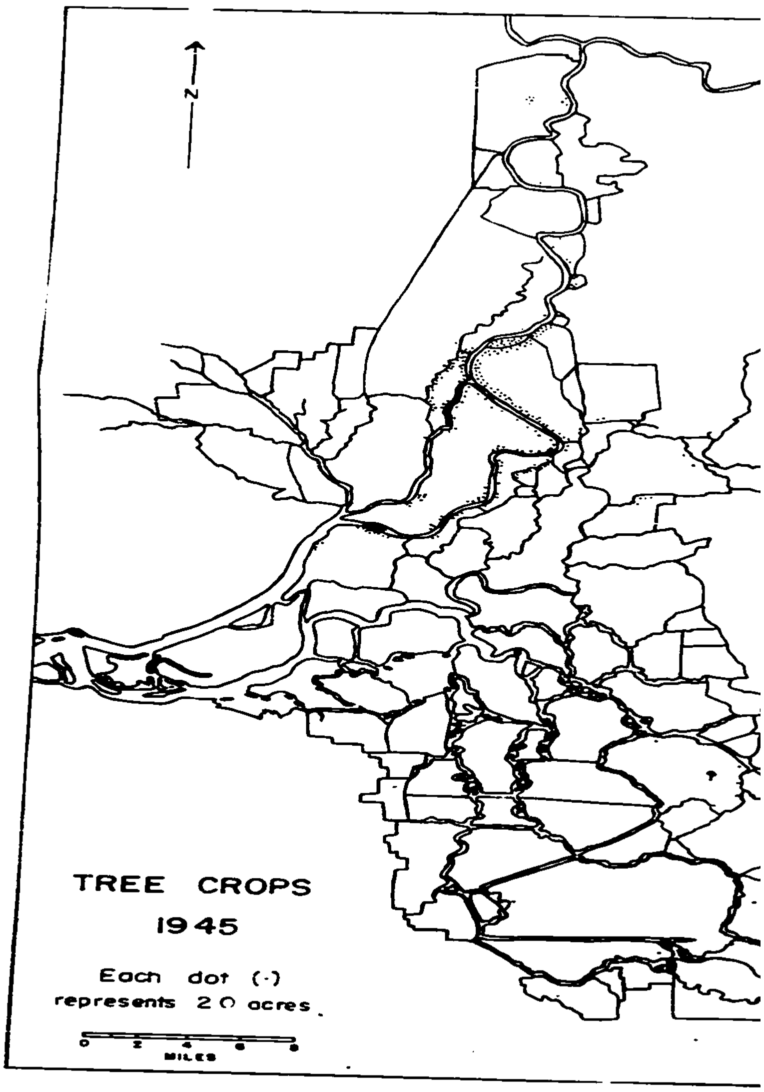


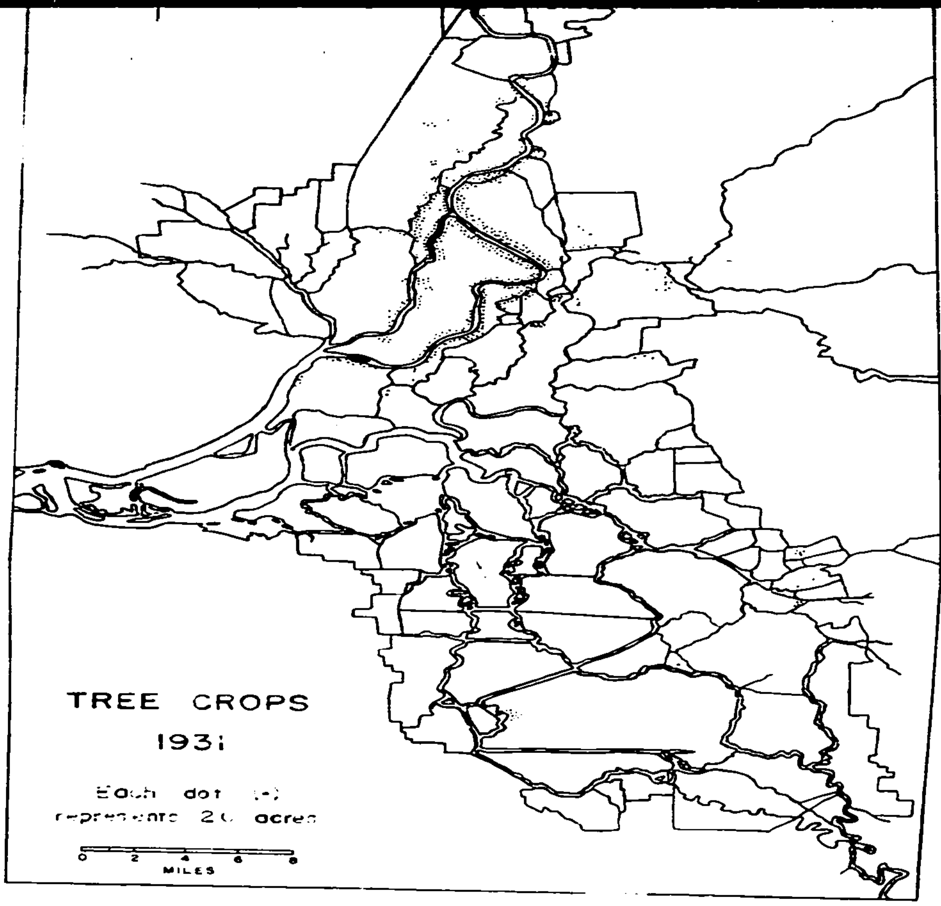

N
TREE CROPS
1938
0 2 4 6 8
MILES

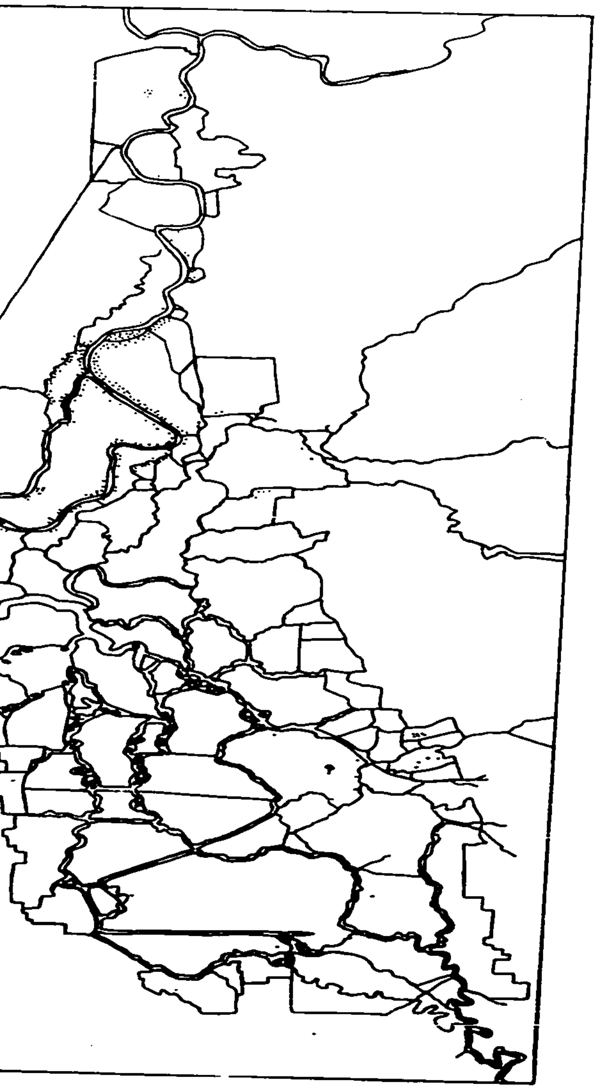

N
TREE CROPS
1952
Each dot (-)
represents 20 acres

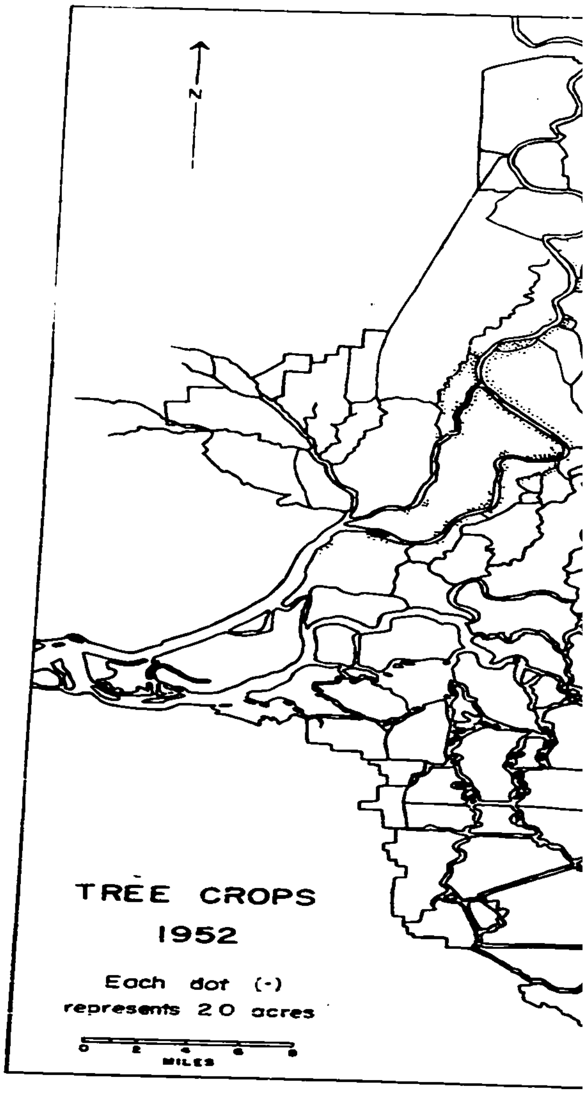

TREE CROPS
1924
Each dot (·) represents 20 acres
0 2 4 6 8
MILES

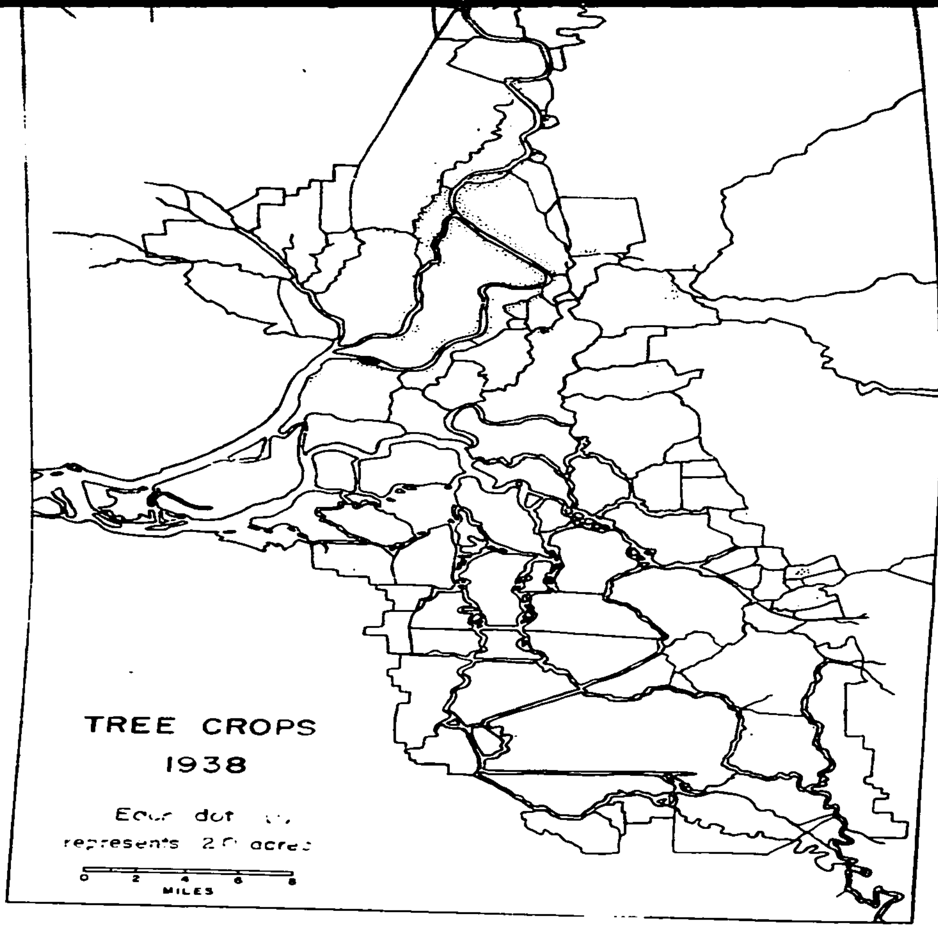

TREE

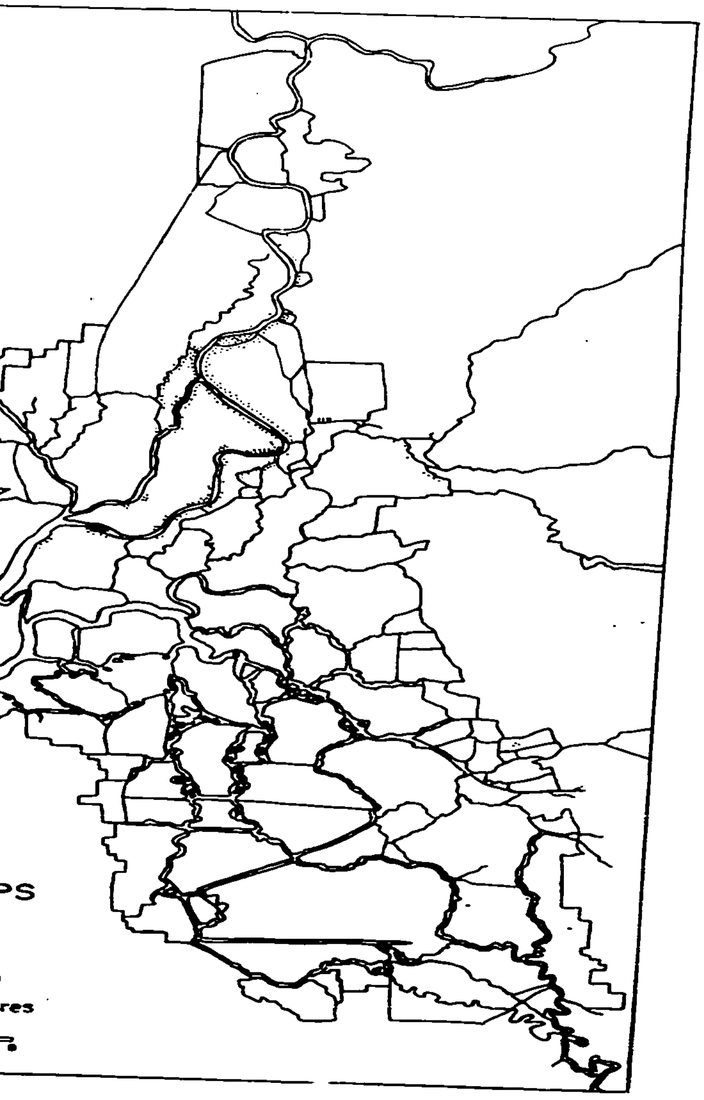

N
TREE CROPS
1945
Each dot (·) represents 20 acres
0 2 4 6 8
MILES

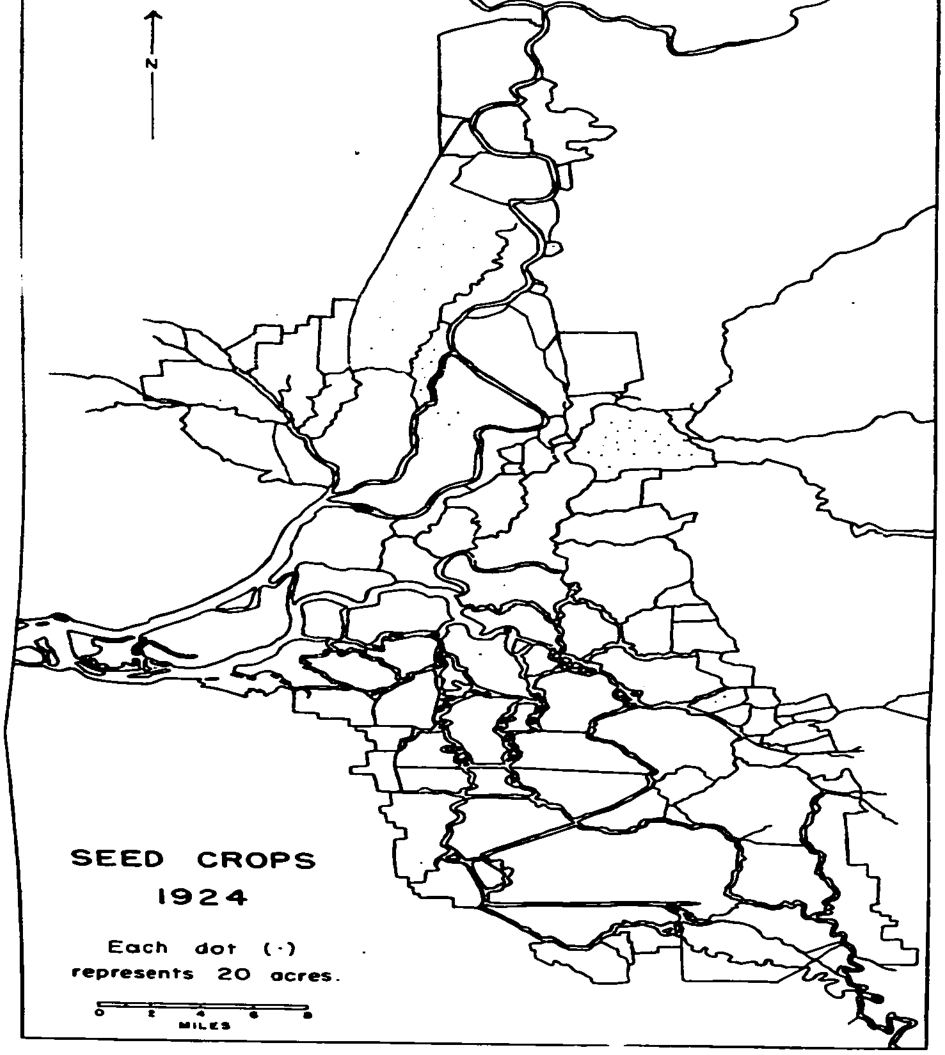

TREE CROPS
1931
Each dot (·)
represents 20 acres
0 2 4 6 8
MILES

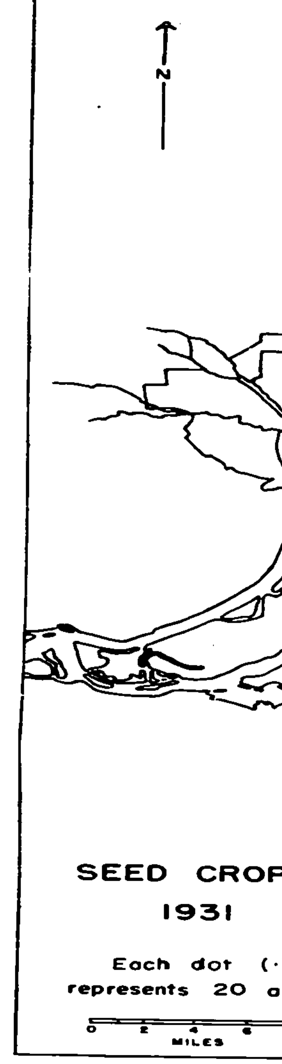


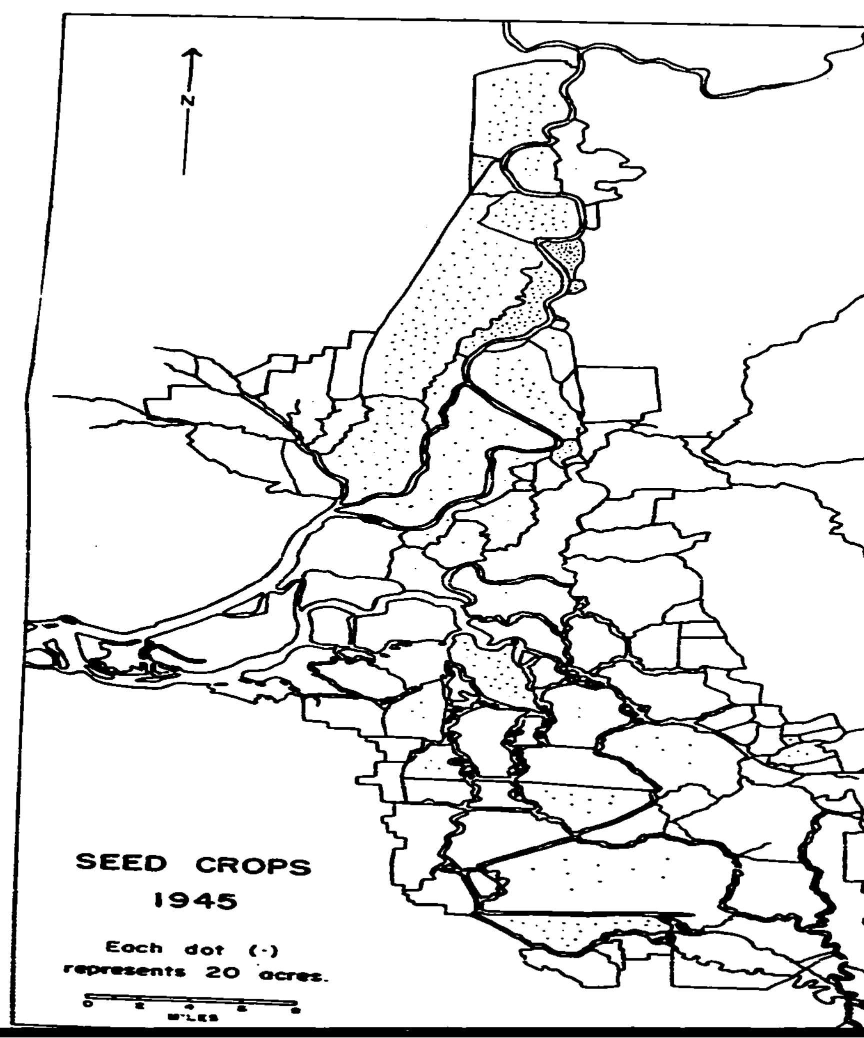

N
TREE CROPS
1952
Each dot (·)
represents 20 acres
0 2 4 6 8
MILES

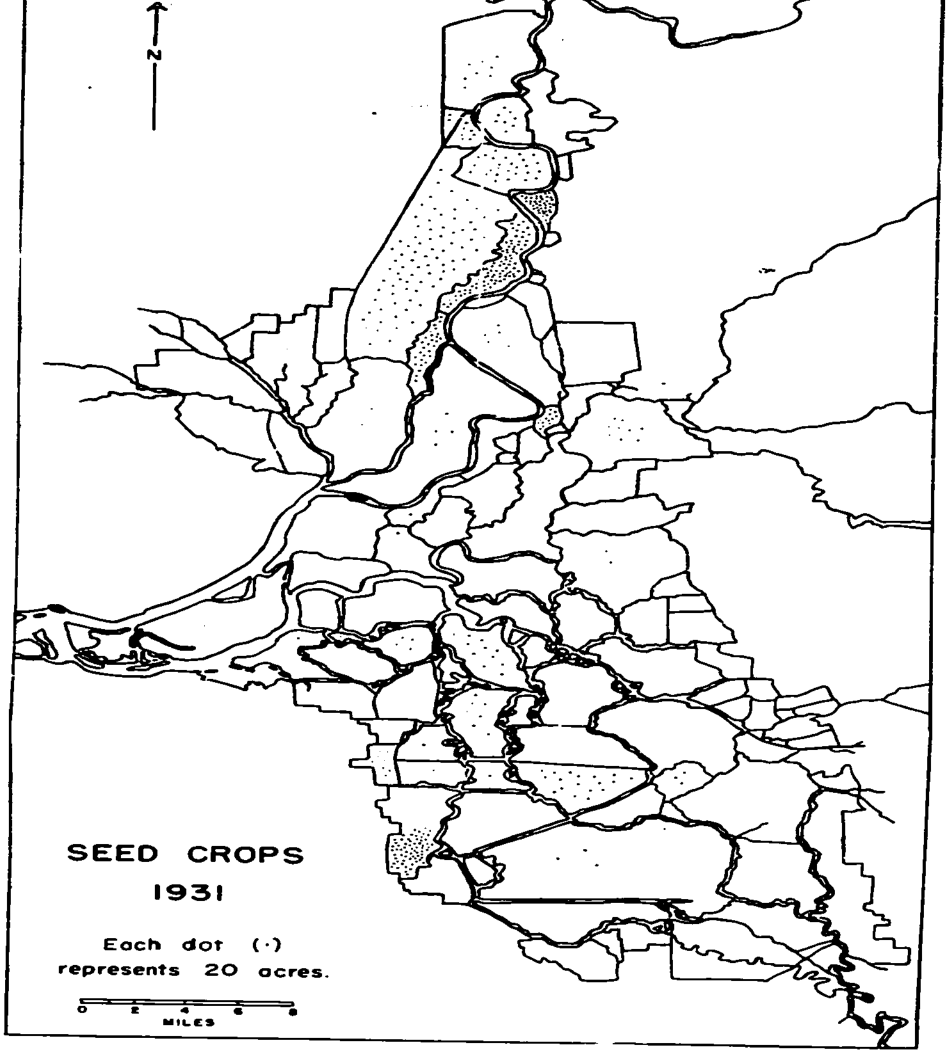

TREE CROPS
1938
0 2 4 6 8
MILES

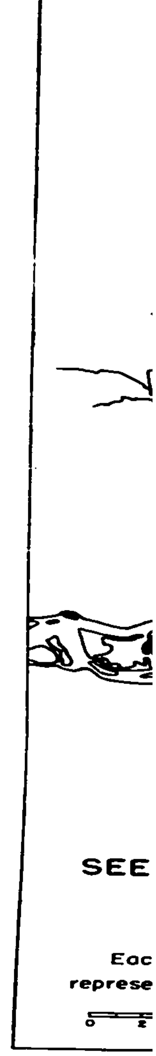


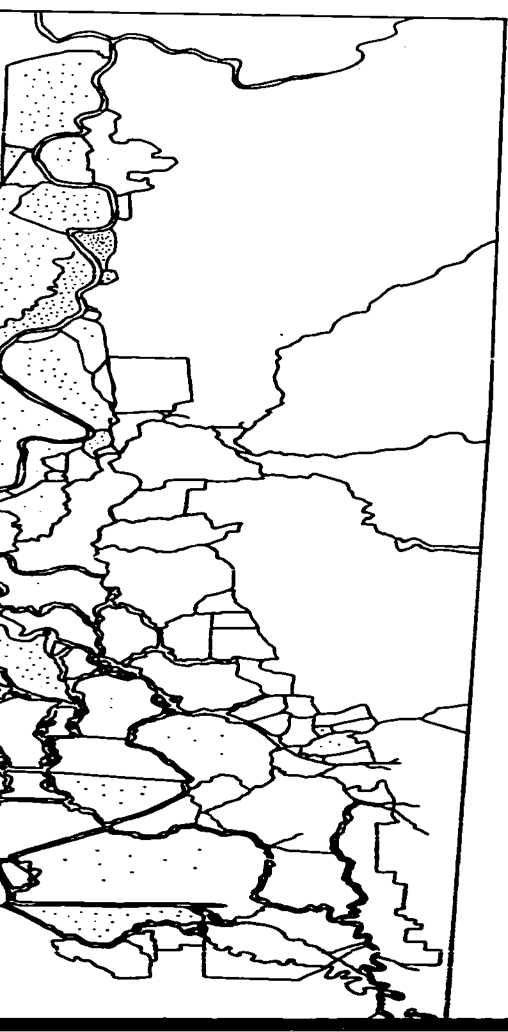

N
SEED CROPS
1924
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

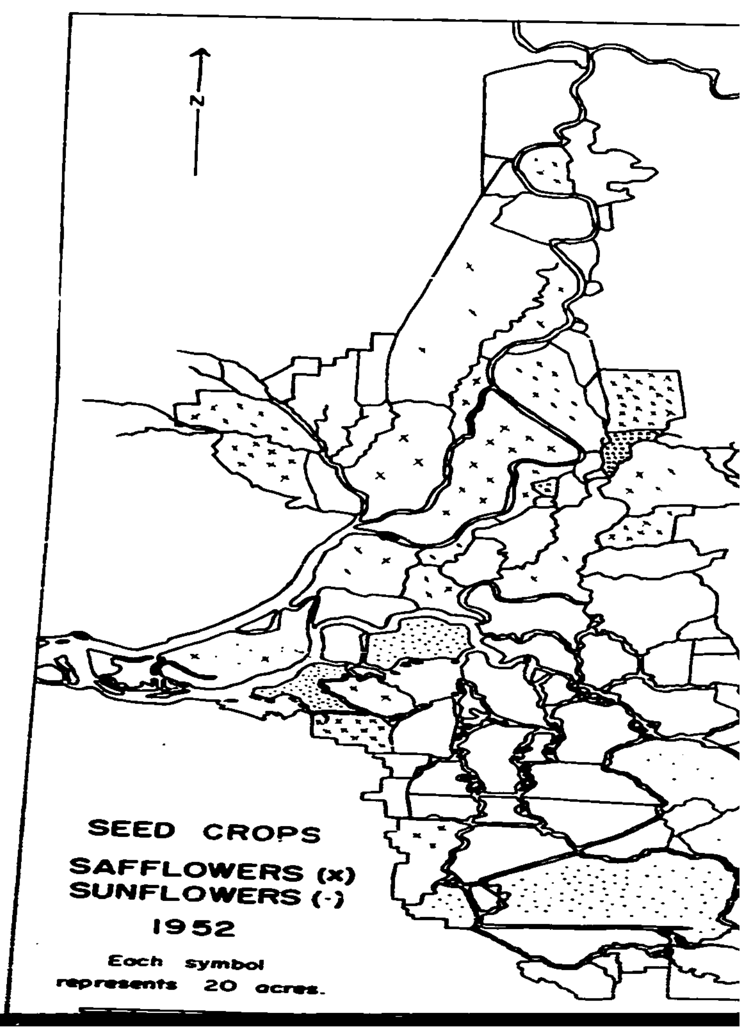

N
SEED CROP
1931
Each dot (·)
represents 20 ac
0 2 4 6
MILES

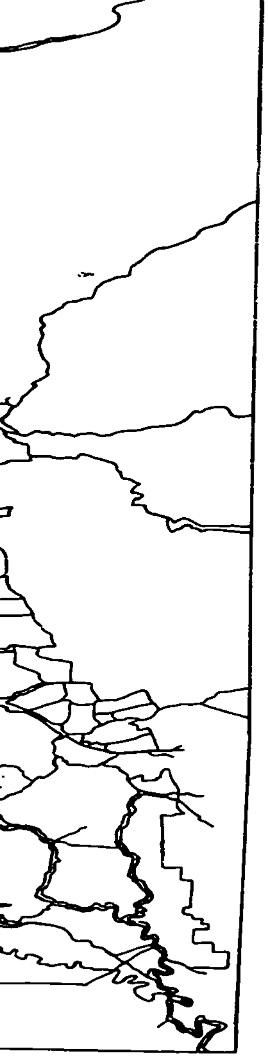

N
SEED CROPS
1945
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

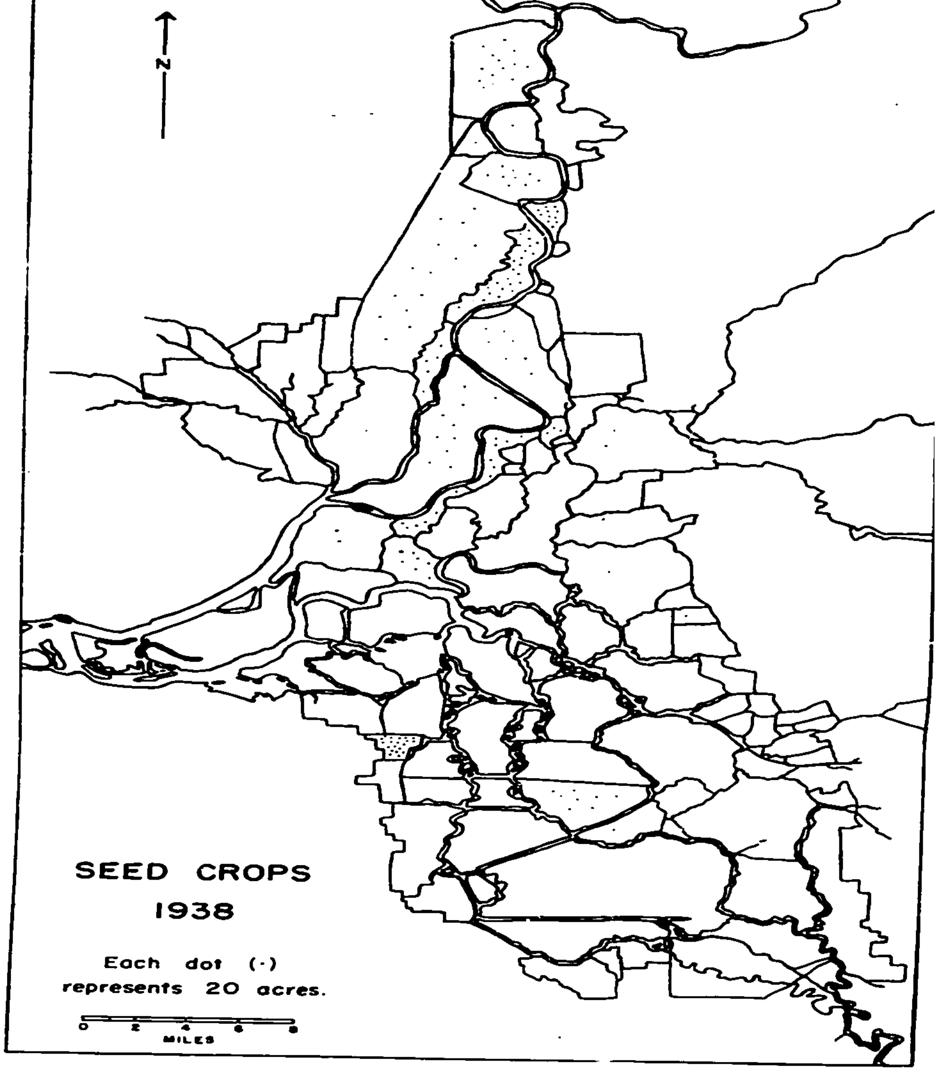

N
SEED CROPS
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

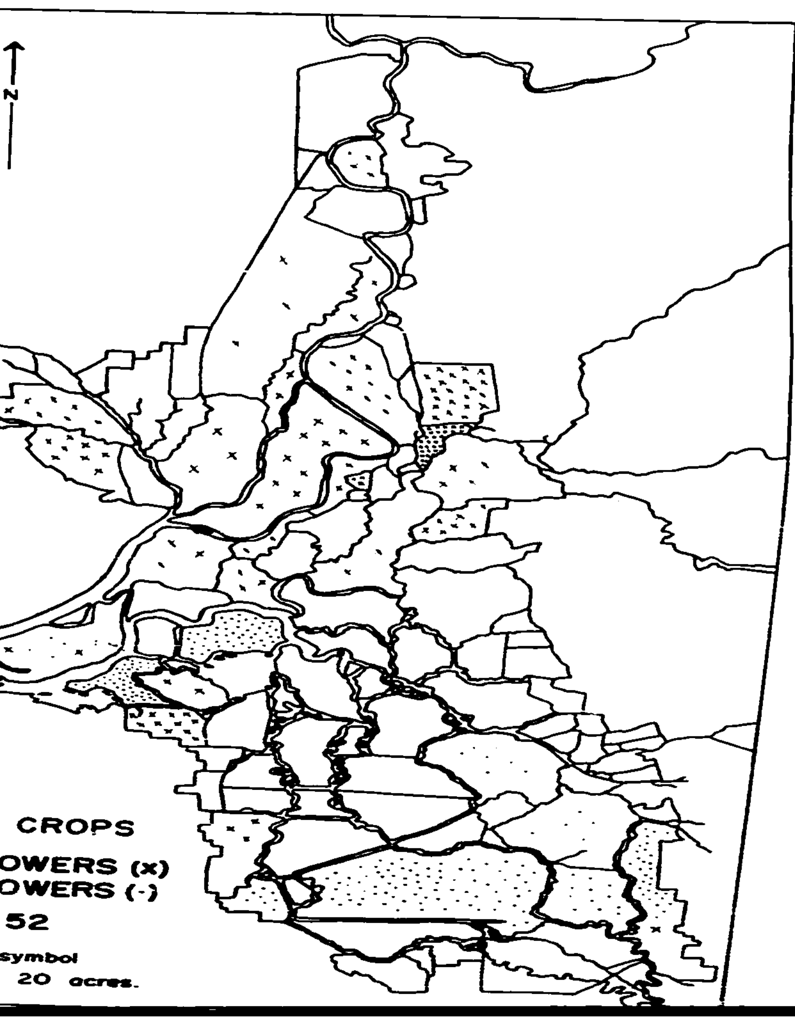


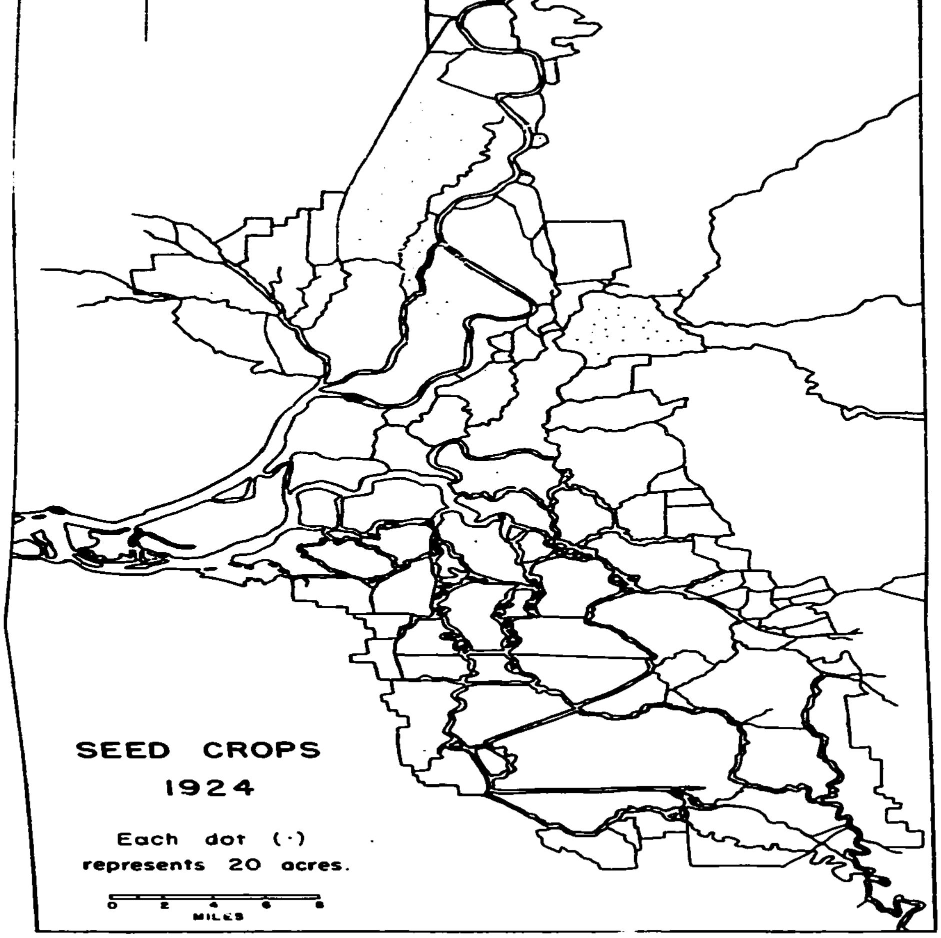


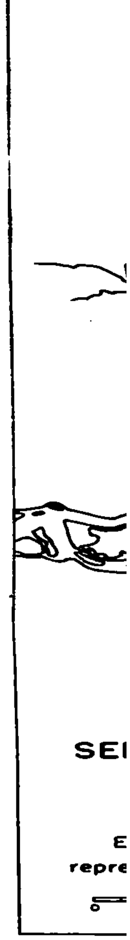

N
SEED CROPS
SAFFLOWERS (x)
SUNFLOWERS (·)
1952
Each symbol
represents 20 acres.

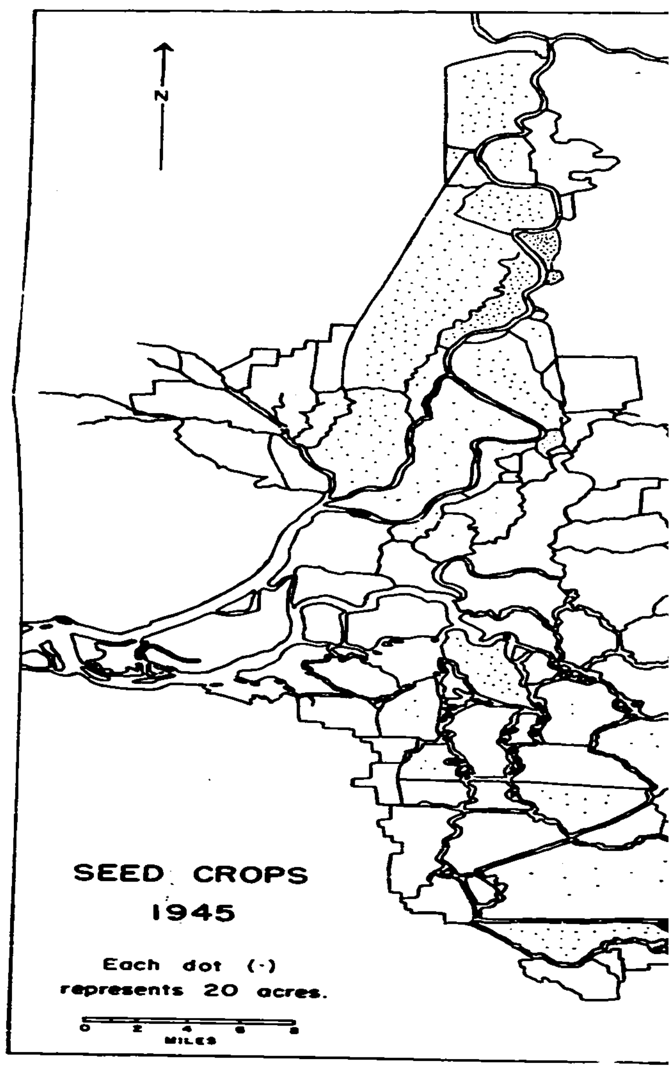


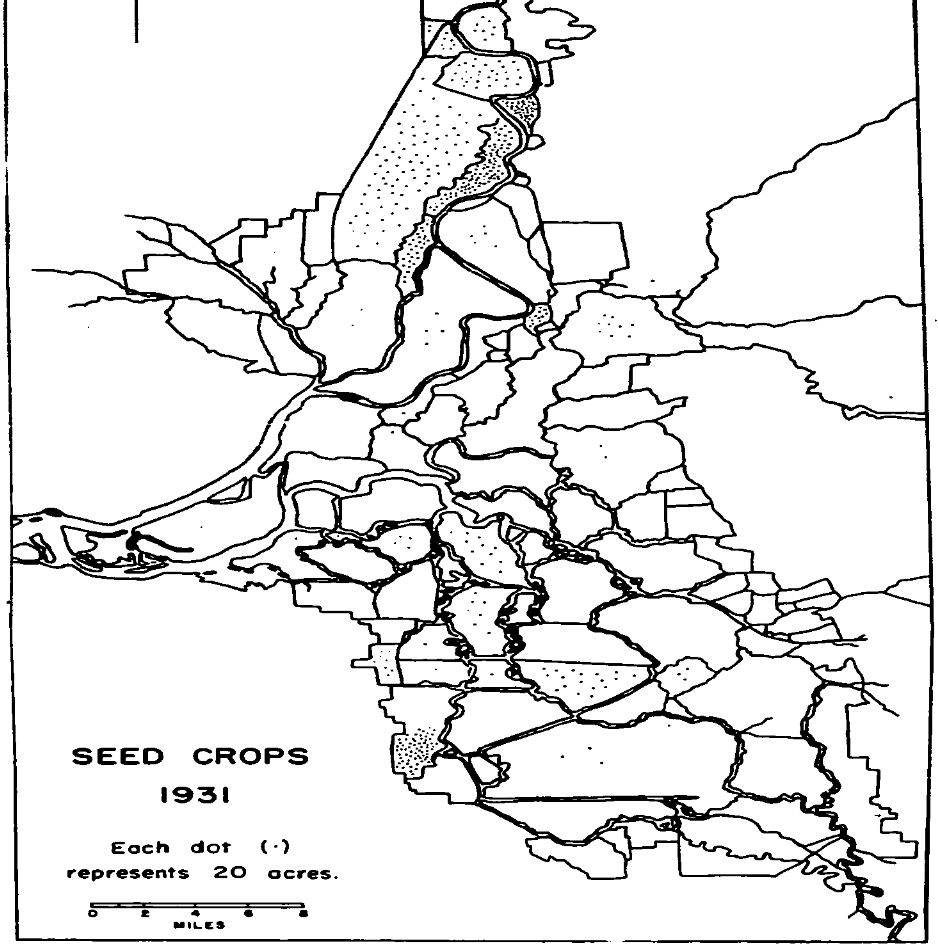

N
SEED CROPS
1938
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES


N
CROPS
OWERS (x)
OWERS (·)
52
symbol
20 acres.

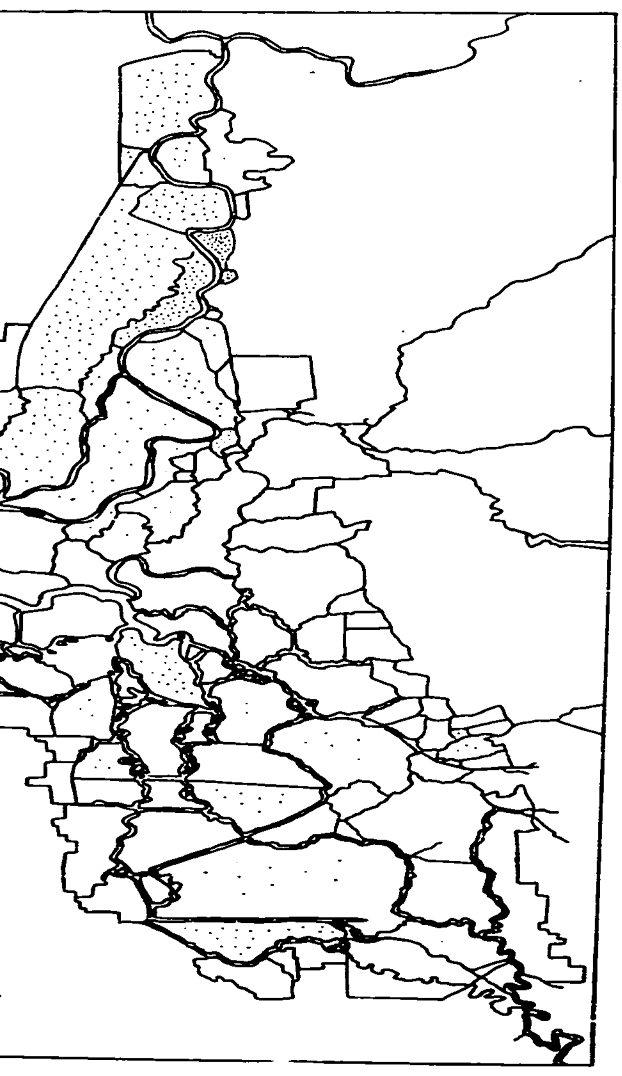

SEED CROPS
1924
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES



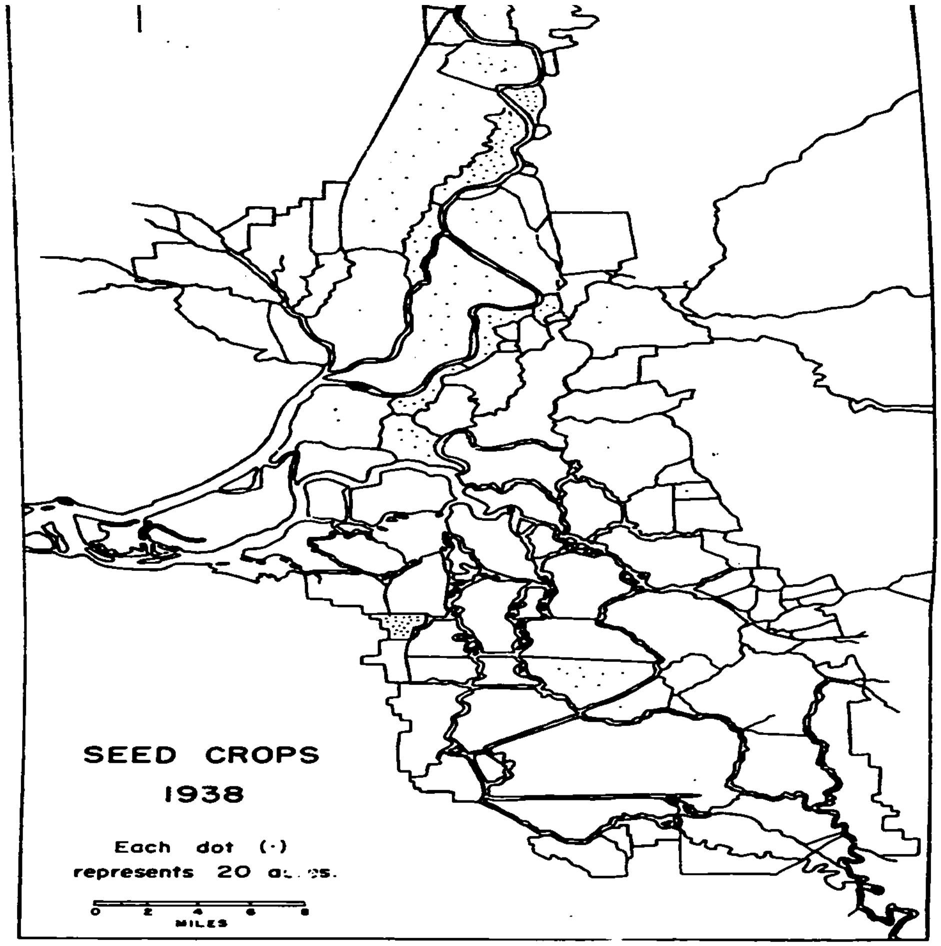

N
SEED CROPS
1945
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

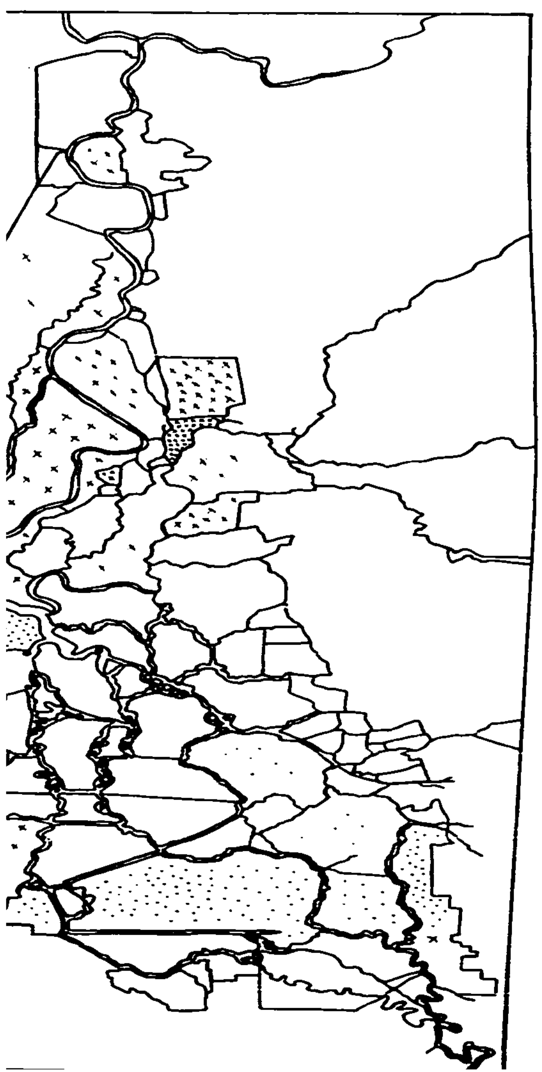


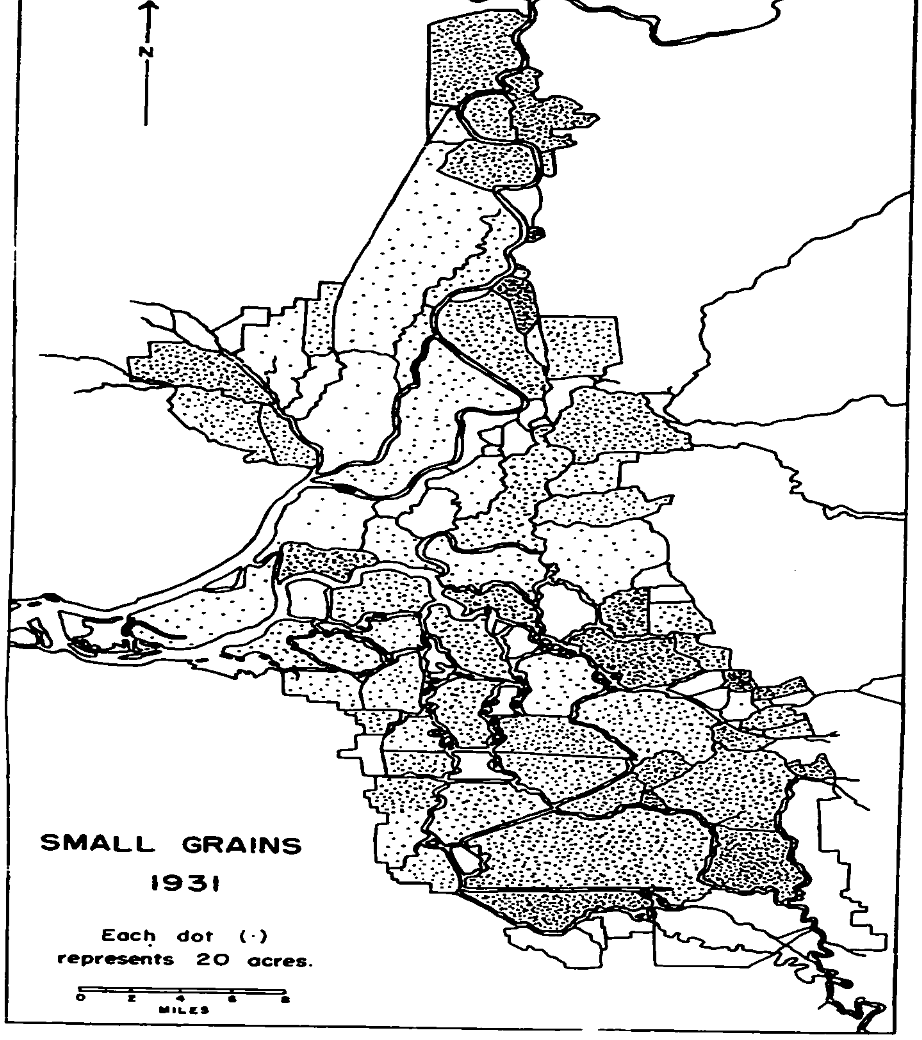
SEED CROPS
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

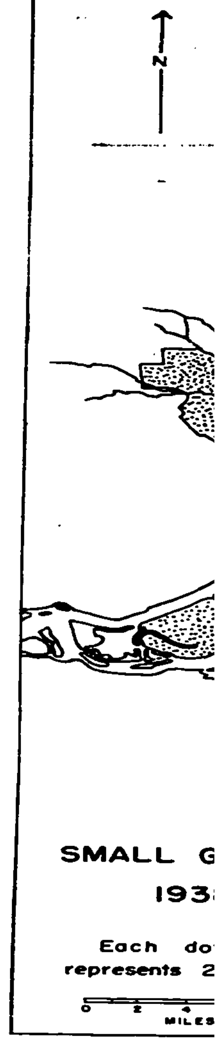


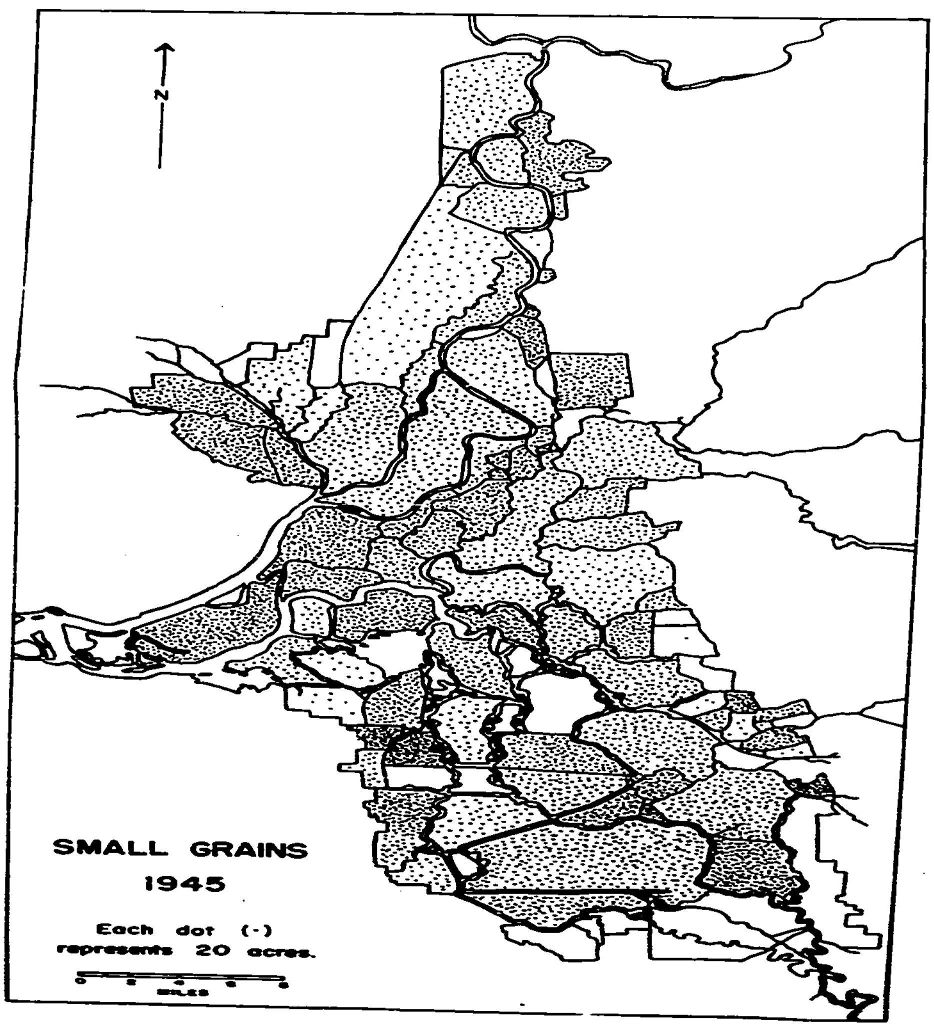
N
SEED CROPS
SAFFLOWERS (x)
SUNFLOWERS (·)
1952
Each symbol
represents 20 acres.
0 2 4 6 8
MILES

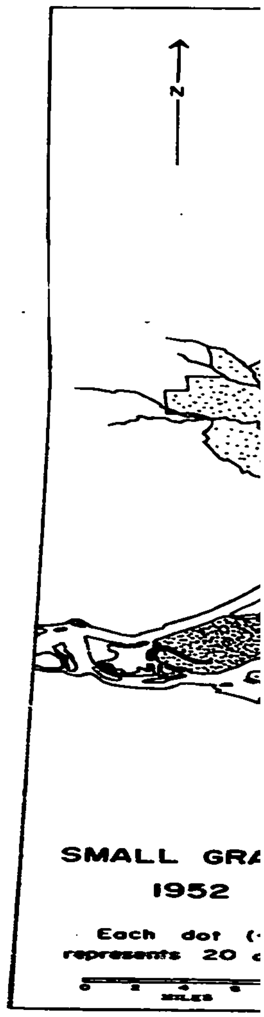

SEED CROPS
1938
Each dot (·)
represents 20 a...s.
0 2 4 6 8
MILES

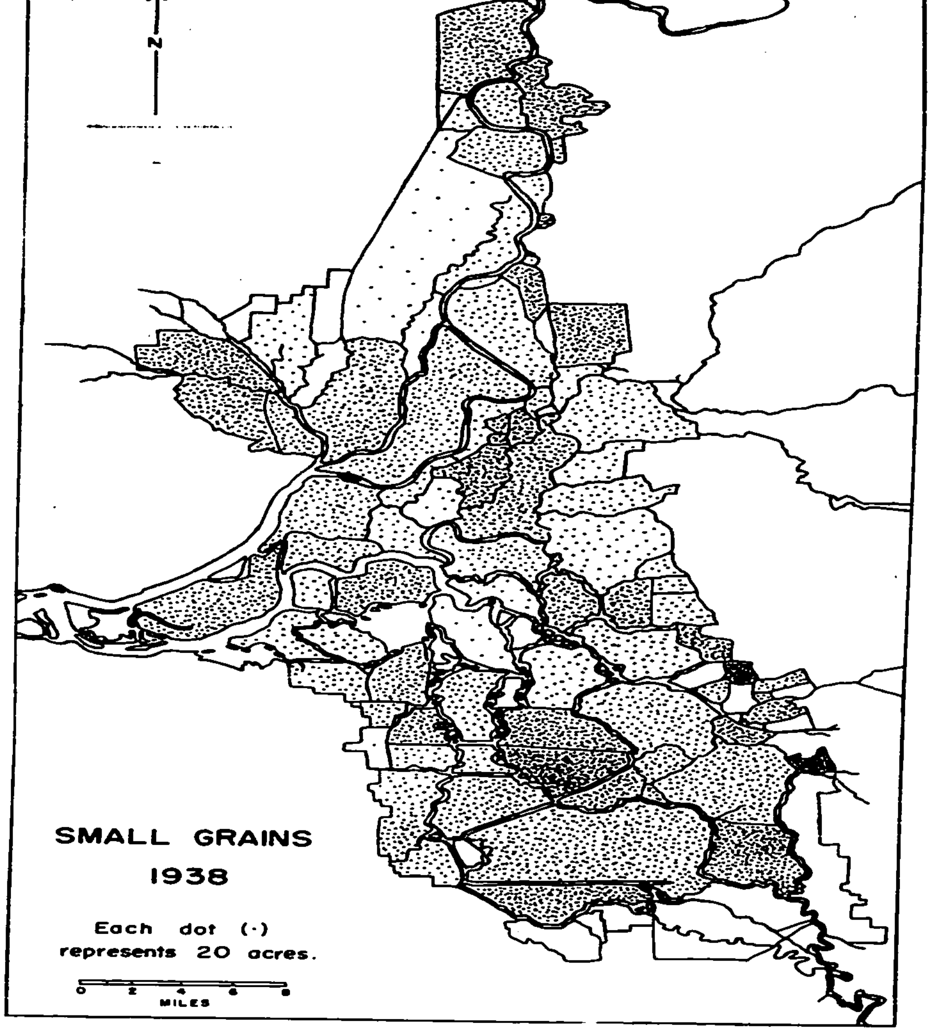


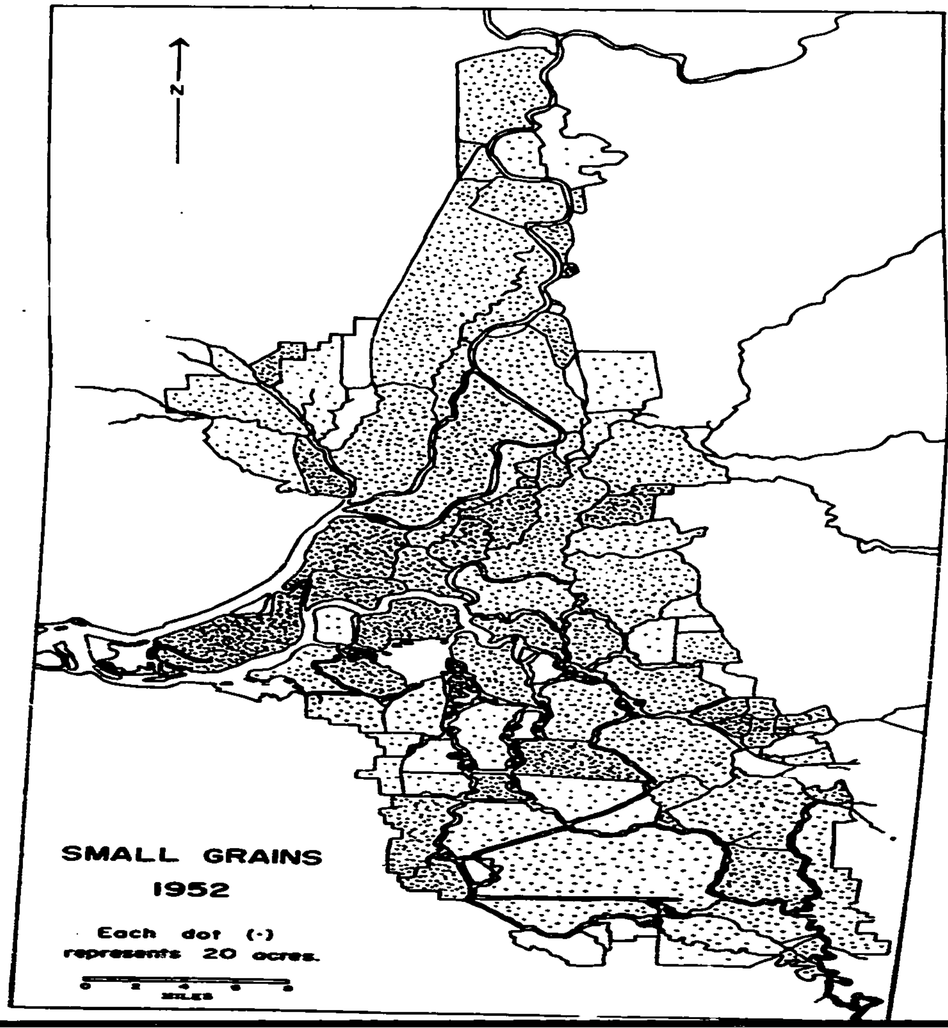

N
SMALL GRAINS
1931
Each dot (·)
represents 20 acres.
MILES

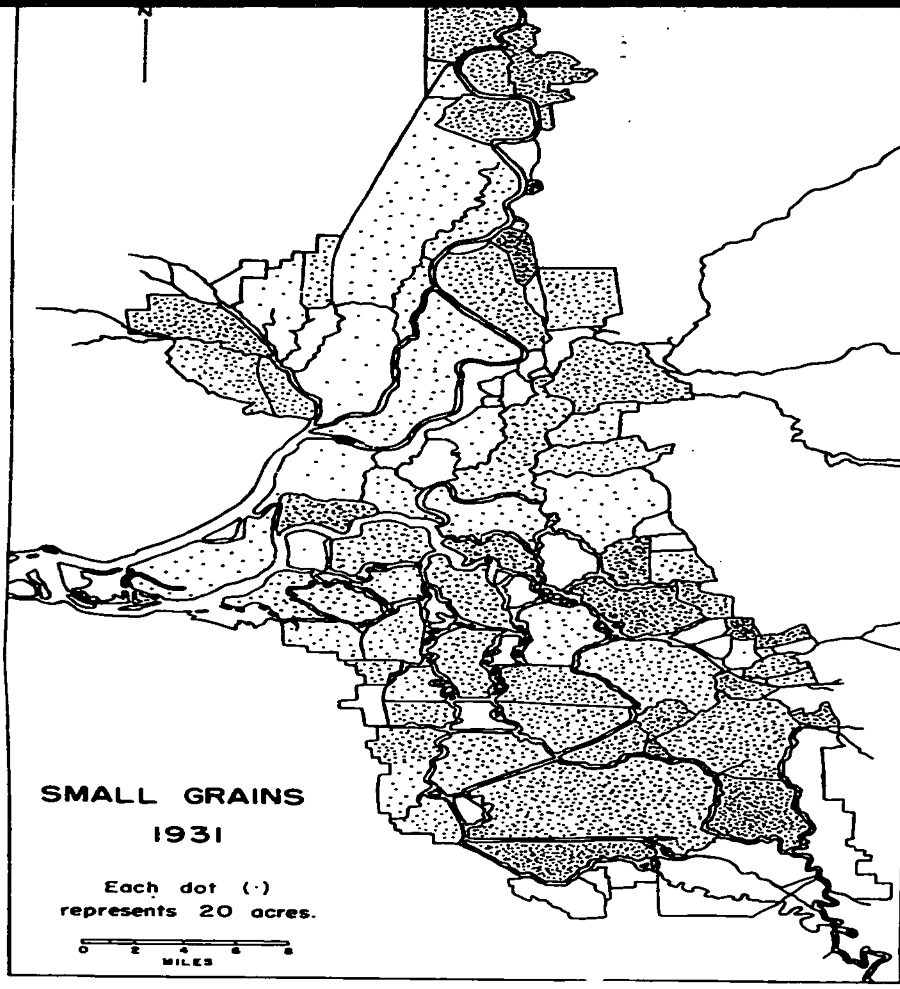

N
SMALL
Each
represents
MILES

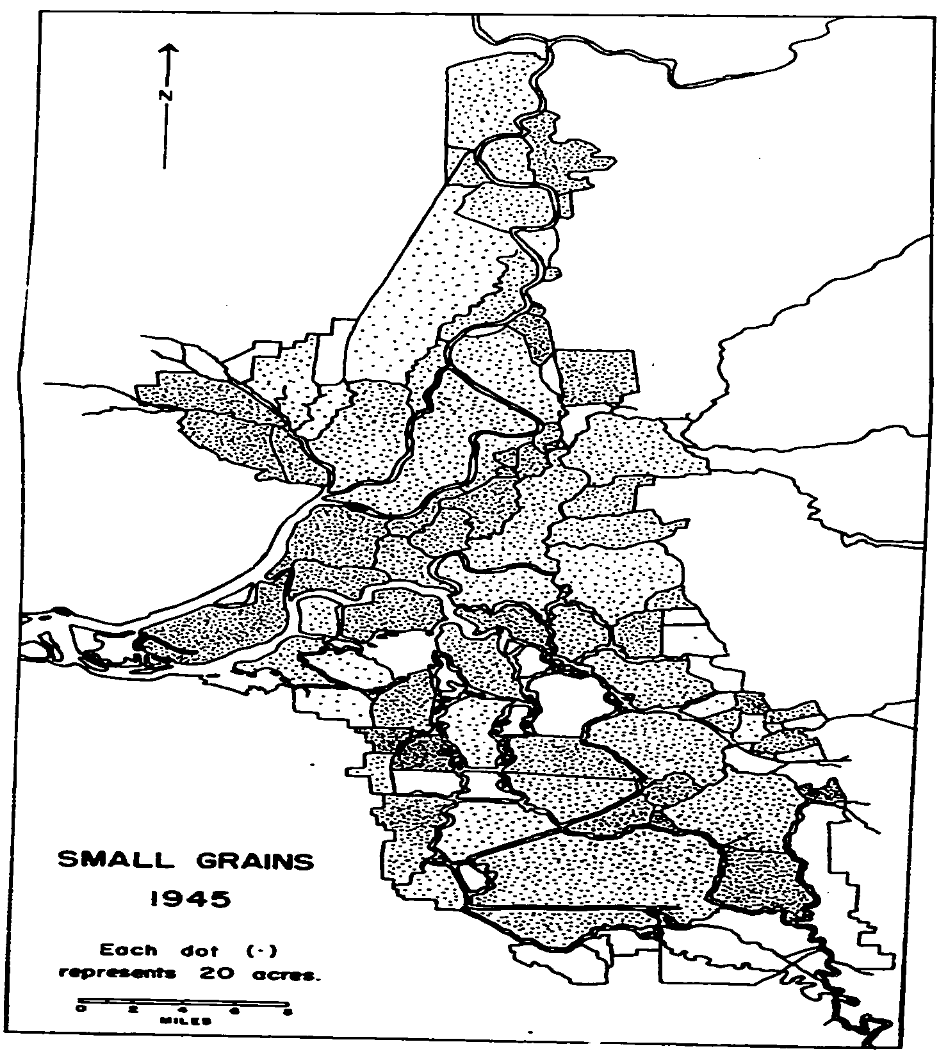

N
SMALL GRAINS
1945
Each dot (·)
represents 20 acres.
MILES

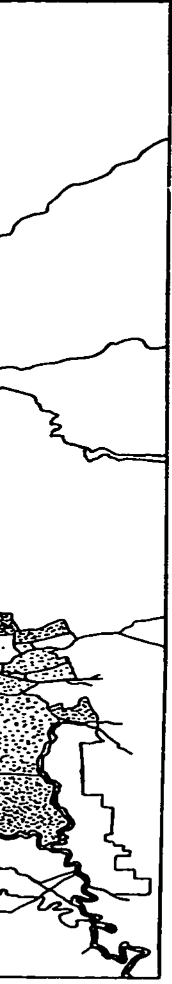

N
SMALL
1952
Each dot
represents 20
MILES

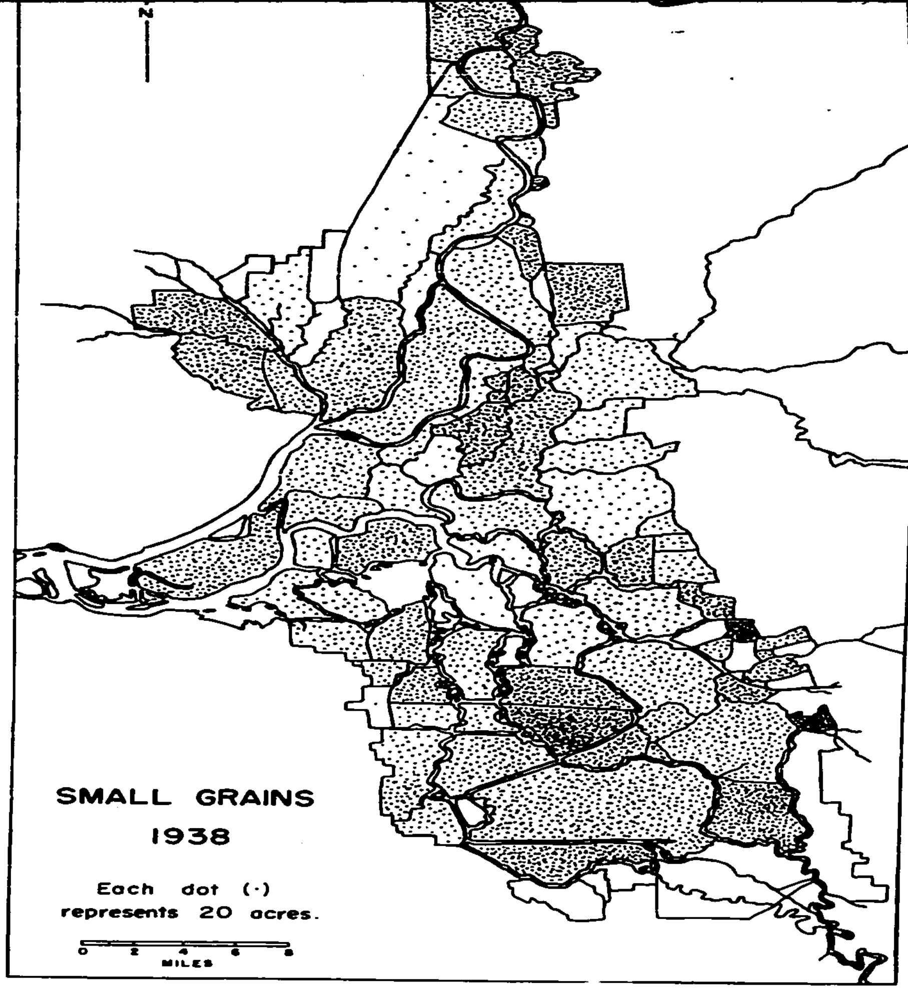

N
SMALL GRAINS
1938
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

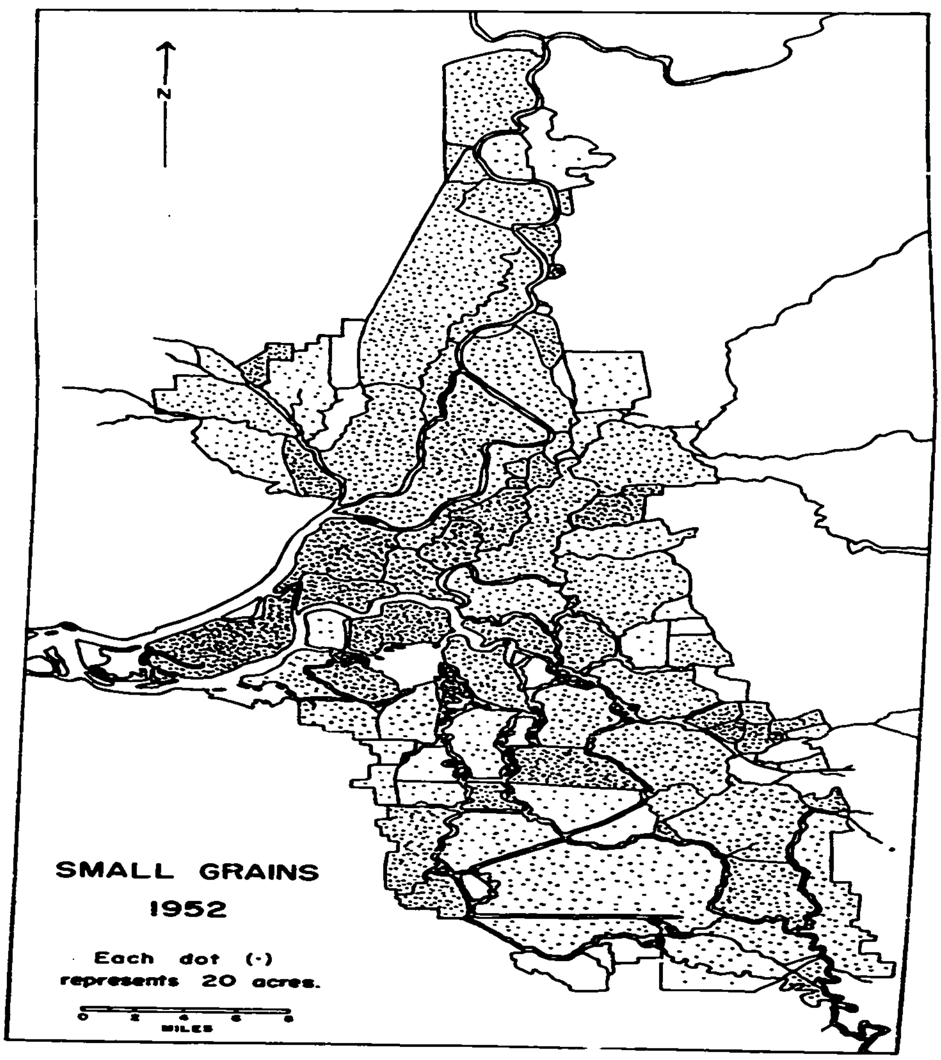

N
SMALL GRAINS
1952
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

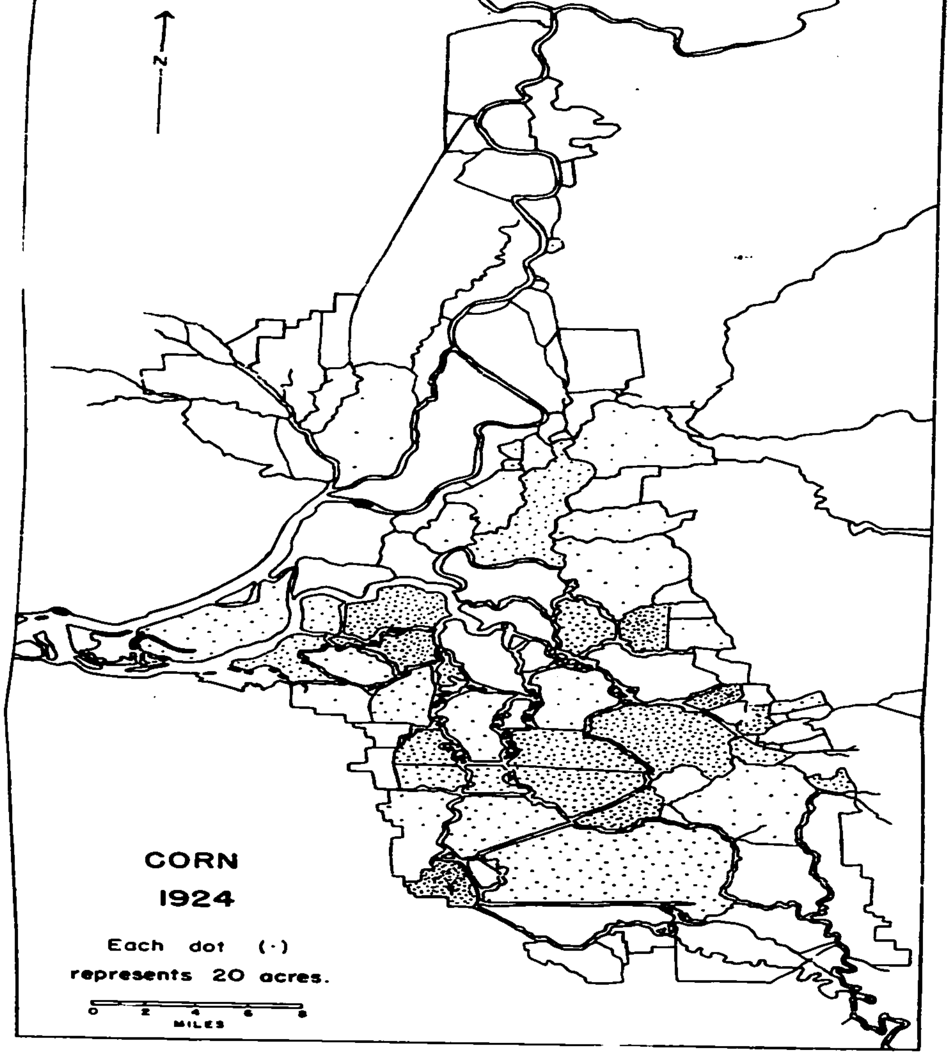

N
SMALL GRAINS
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

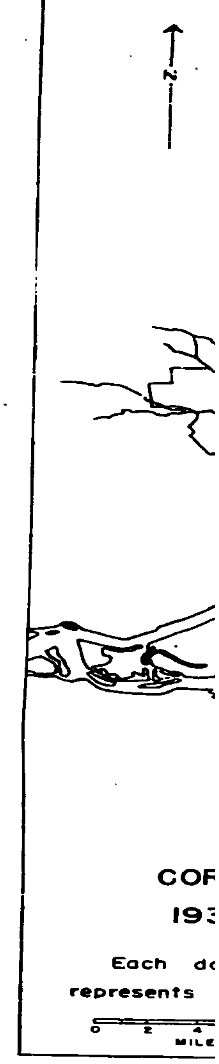

N
SMALL GRAINS
1945
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

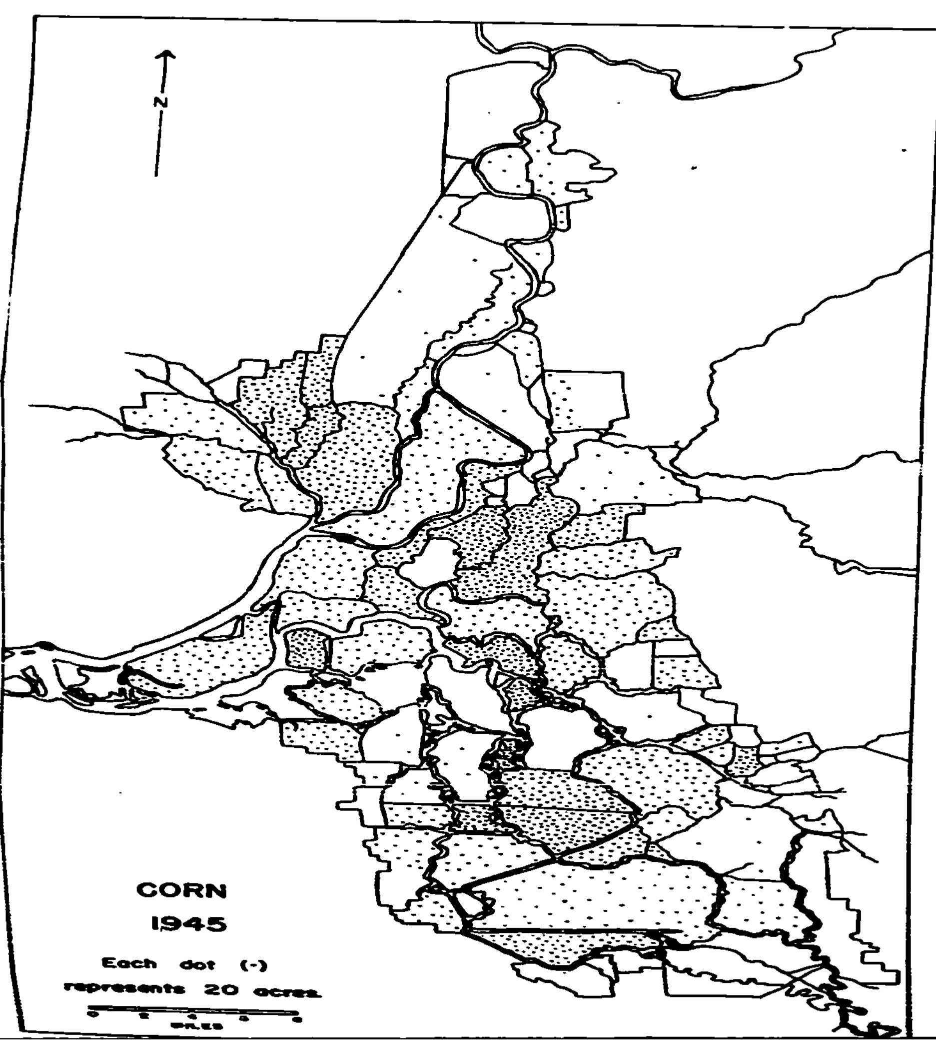


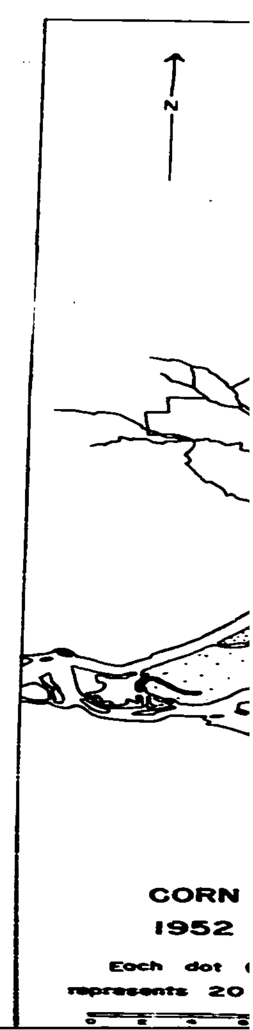

N
SMALL GRAINS
1938
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

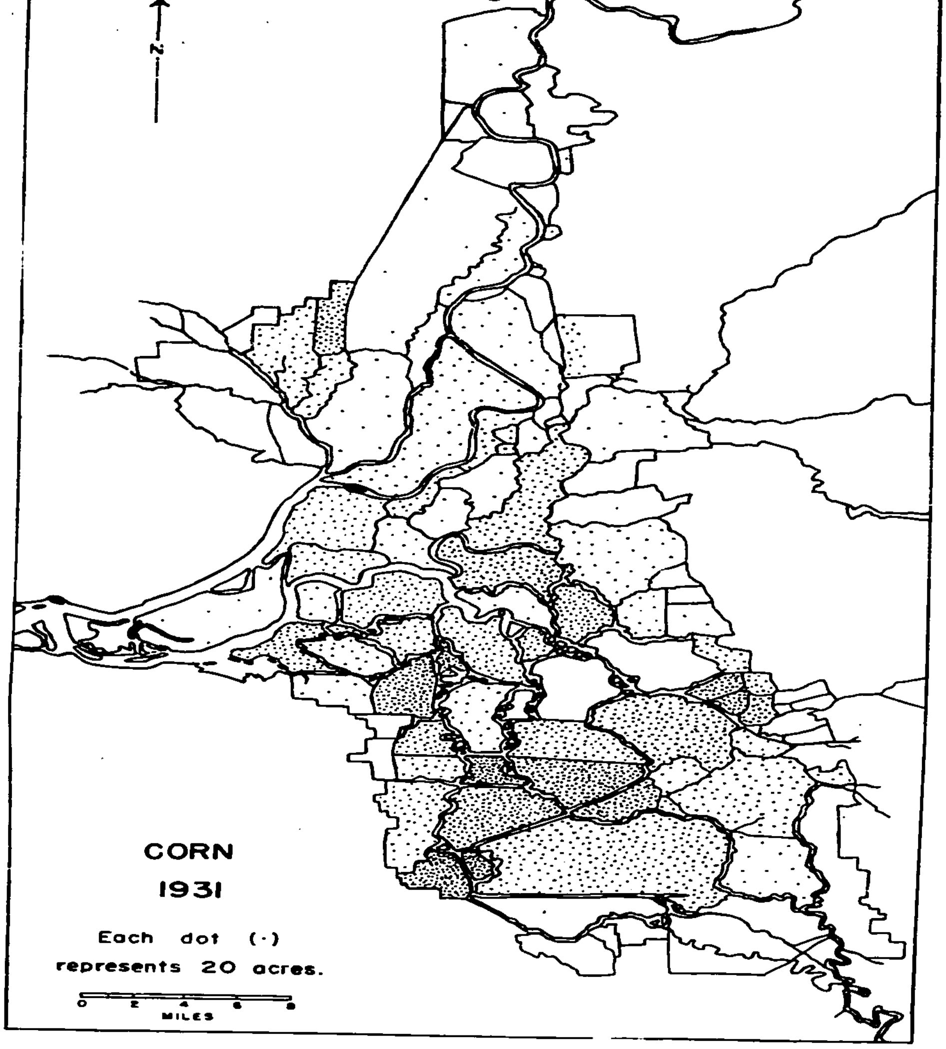

N
SMALL GRAINS
1952
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

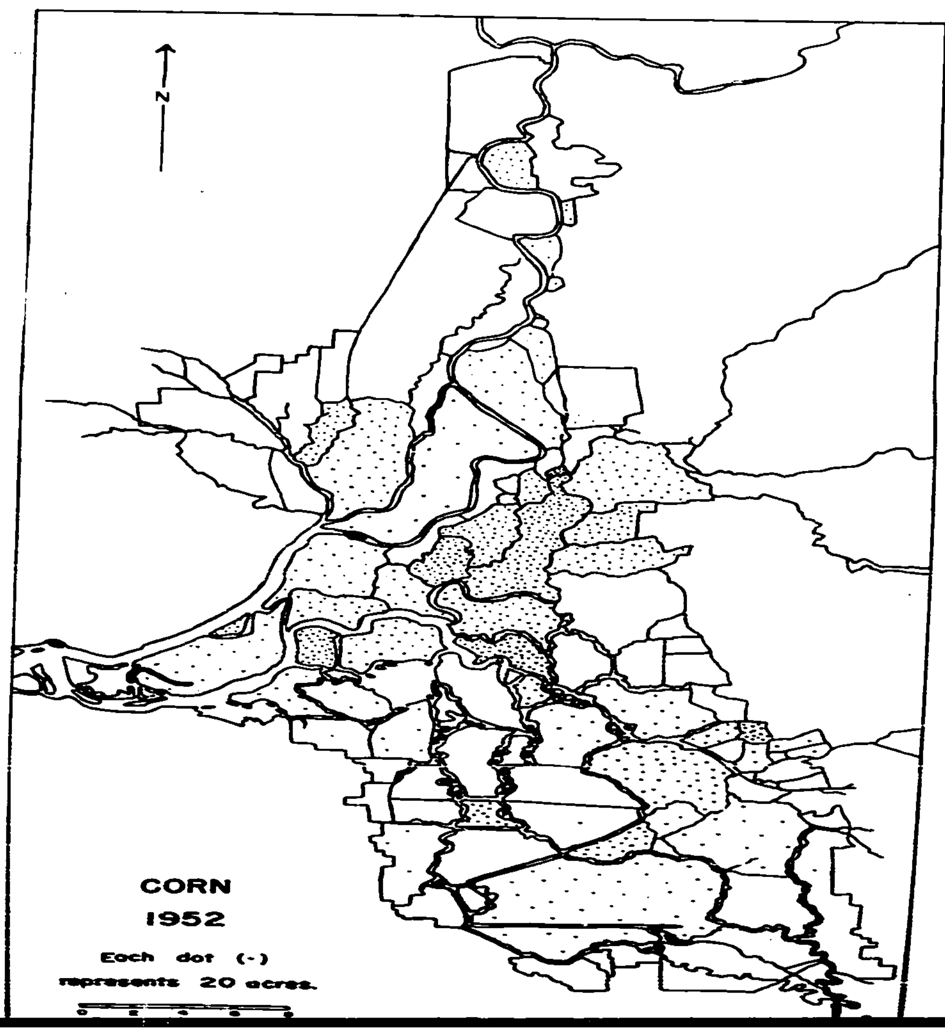

N
CORN
1924
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

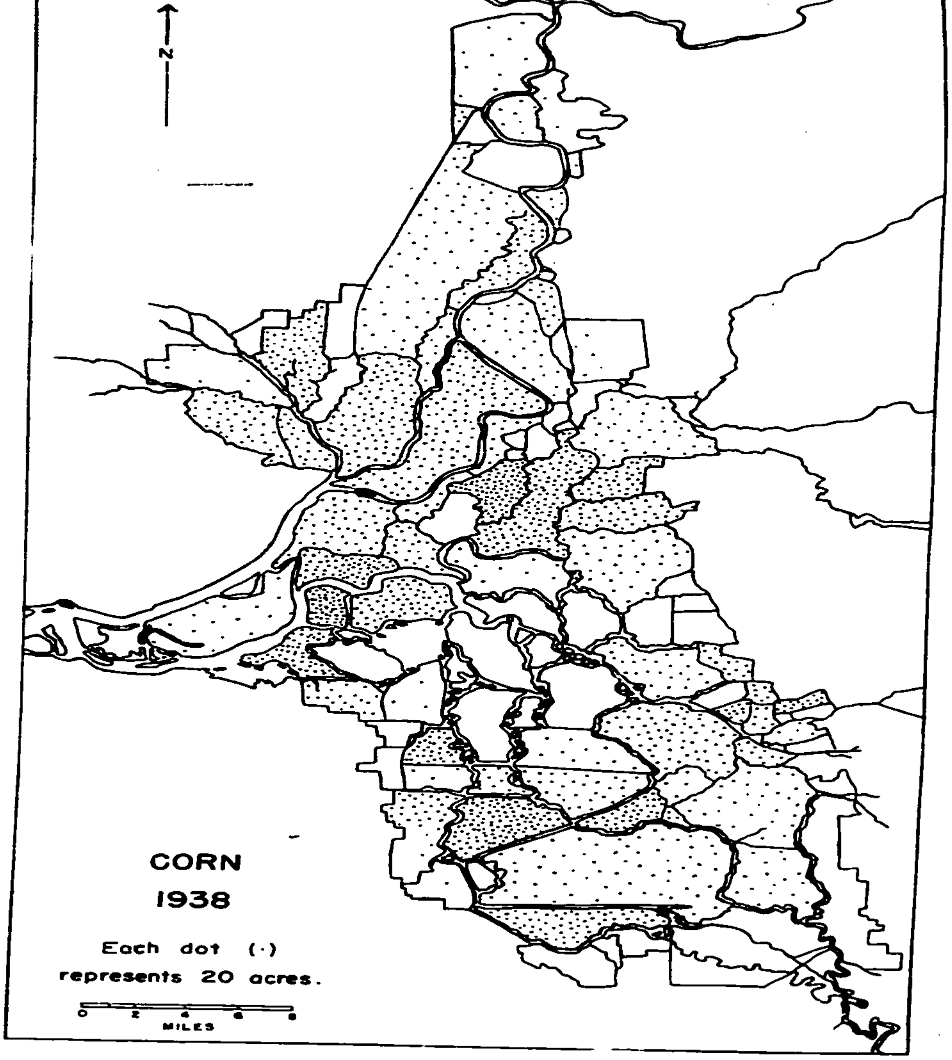

N
represents

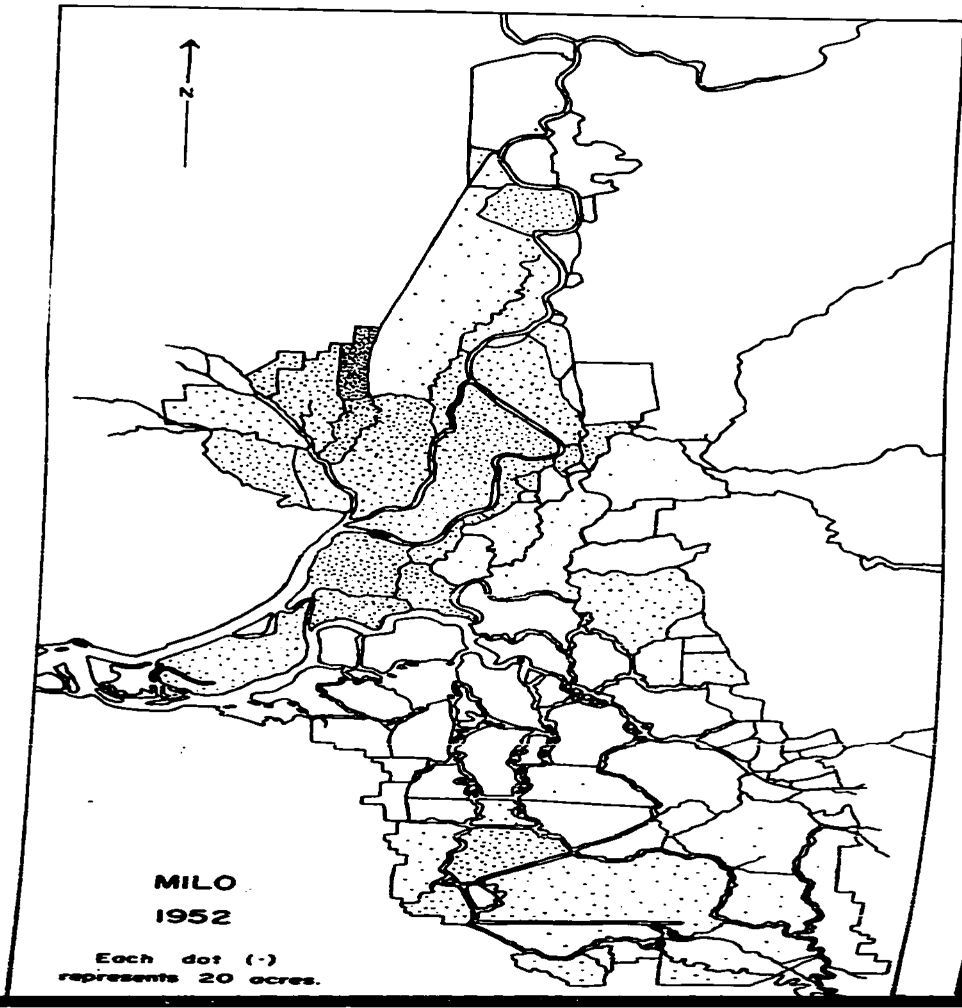

N
CORN
1945
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

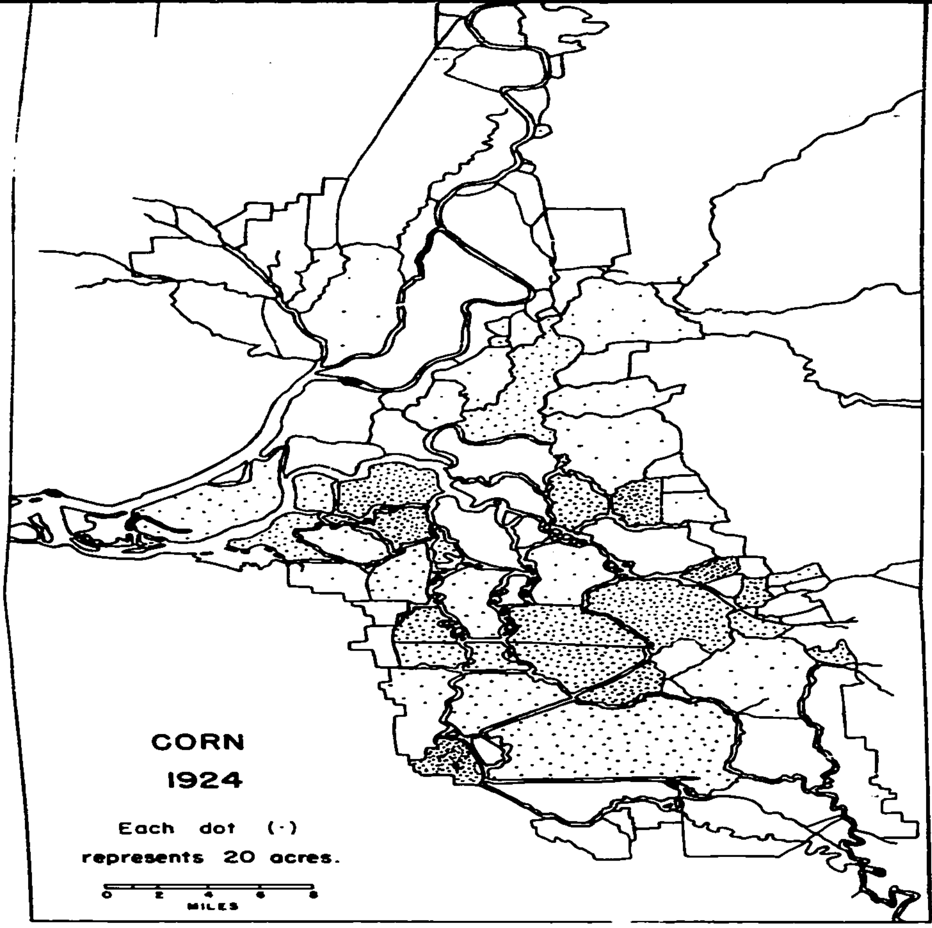

N
CORN
1952
Each dot
represents 20

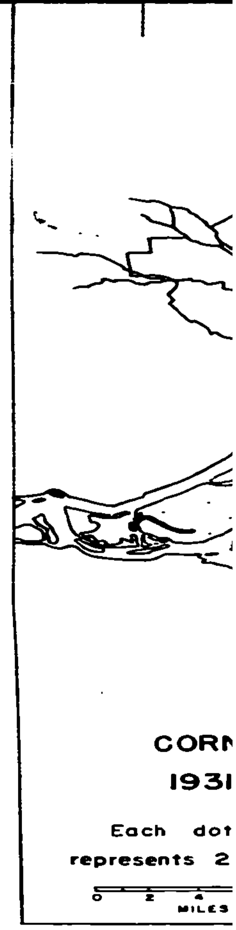

N
CORN
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

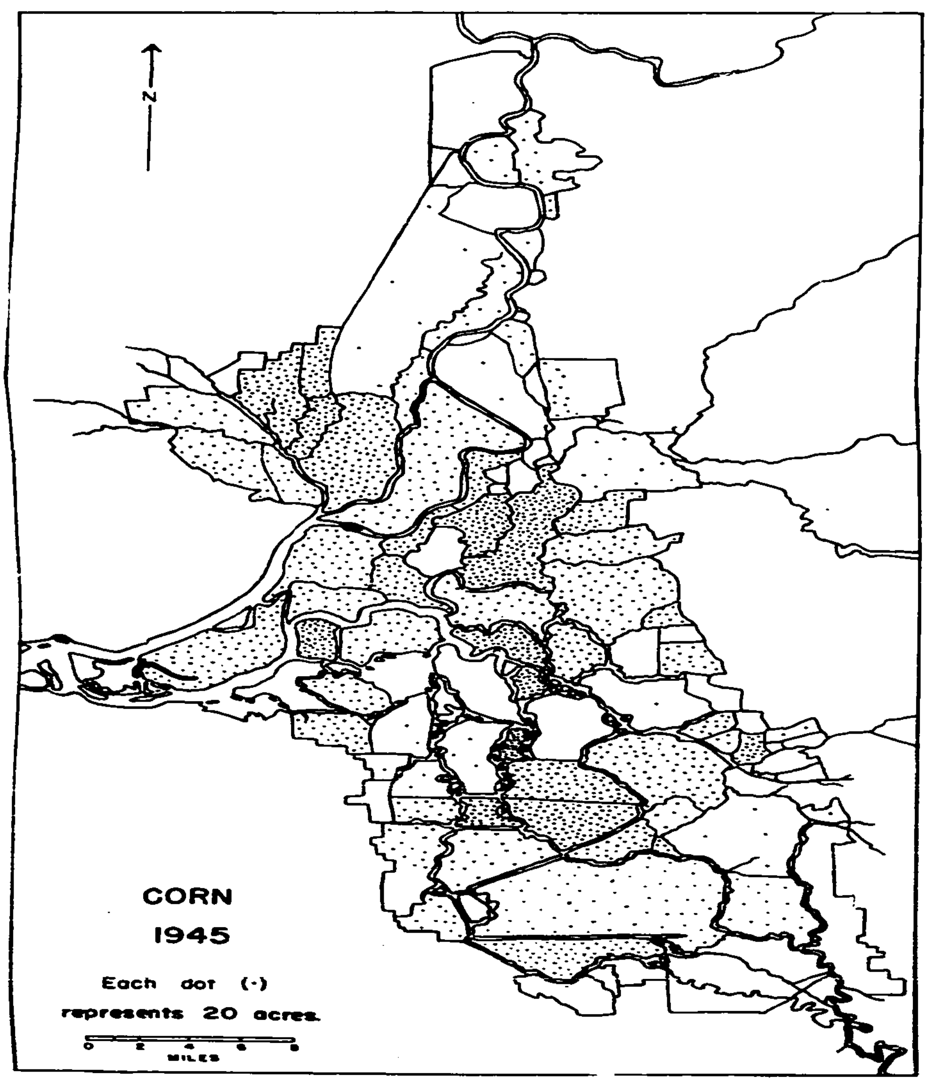

N
CORN
1952
Each dot (·)
represents 20 acres.


N
CORN
1938
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

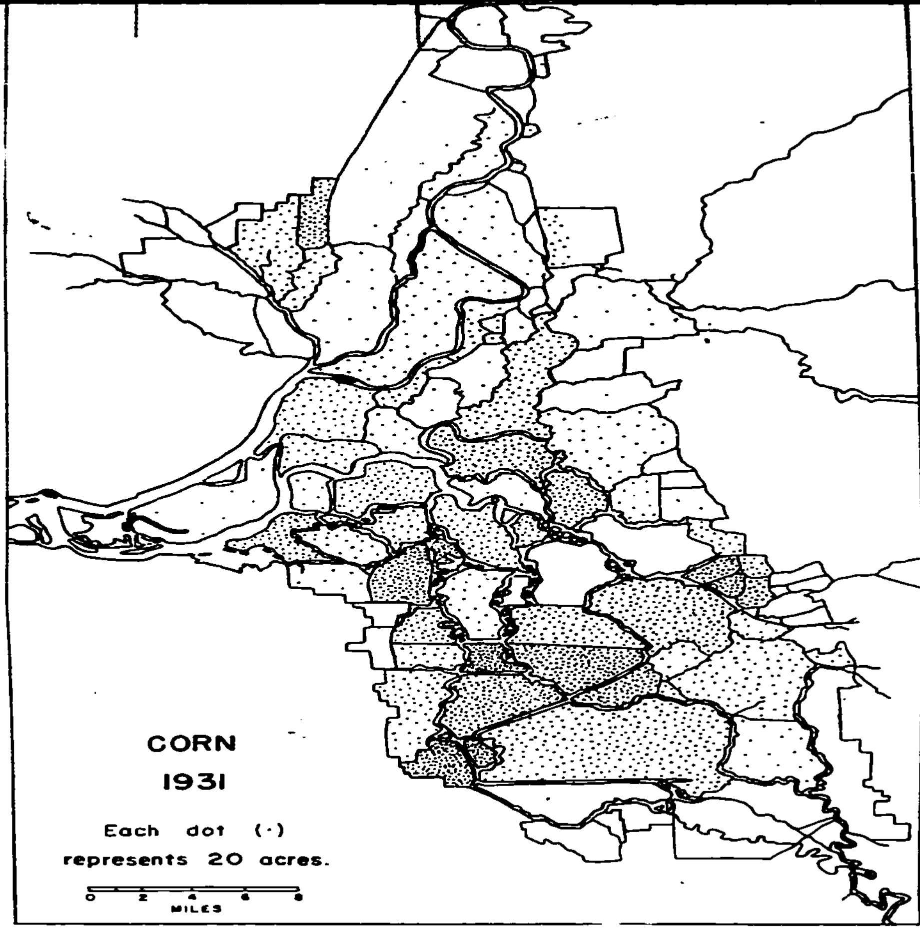

N
MILO
1952
Each dot (·)
represents 20 acres.

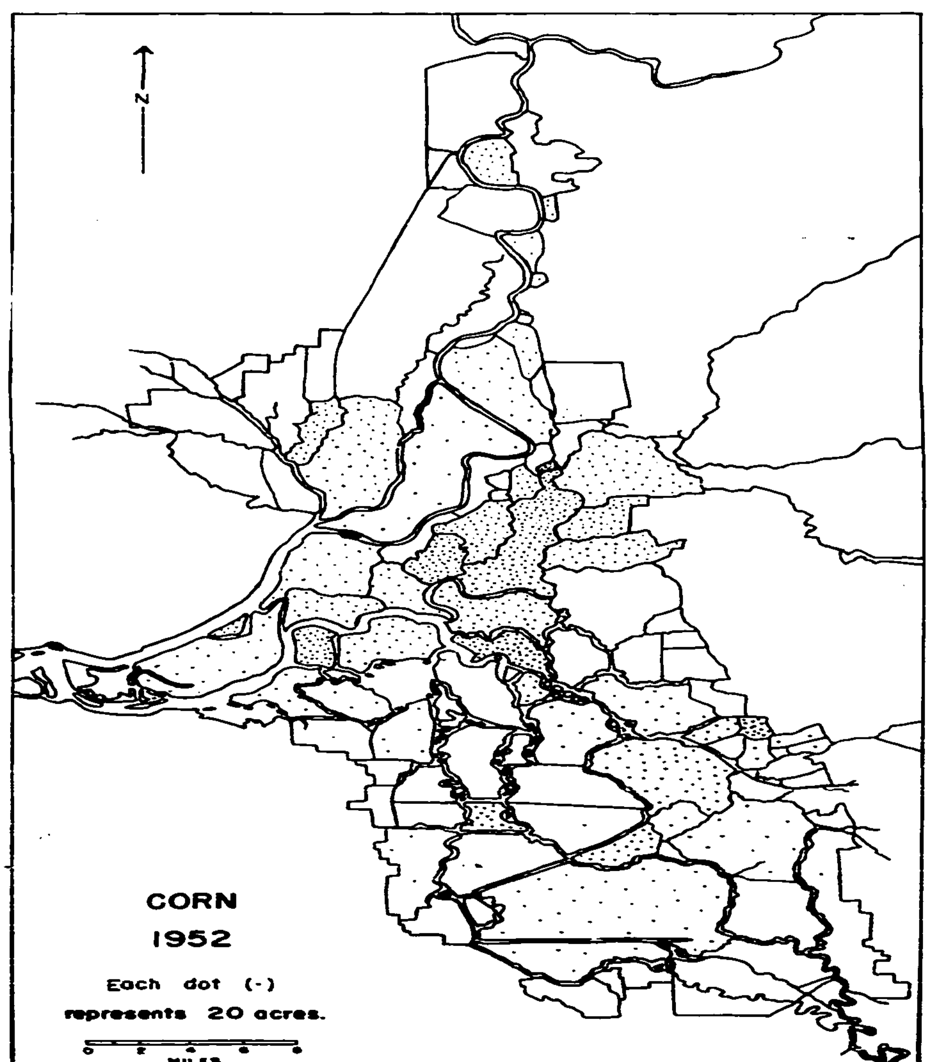

CORN
1924
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

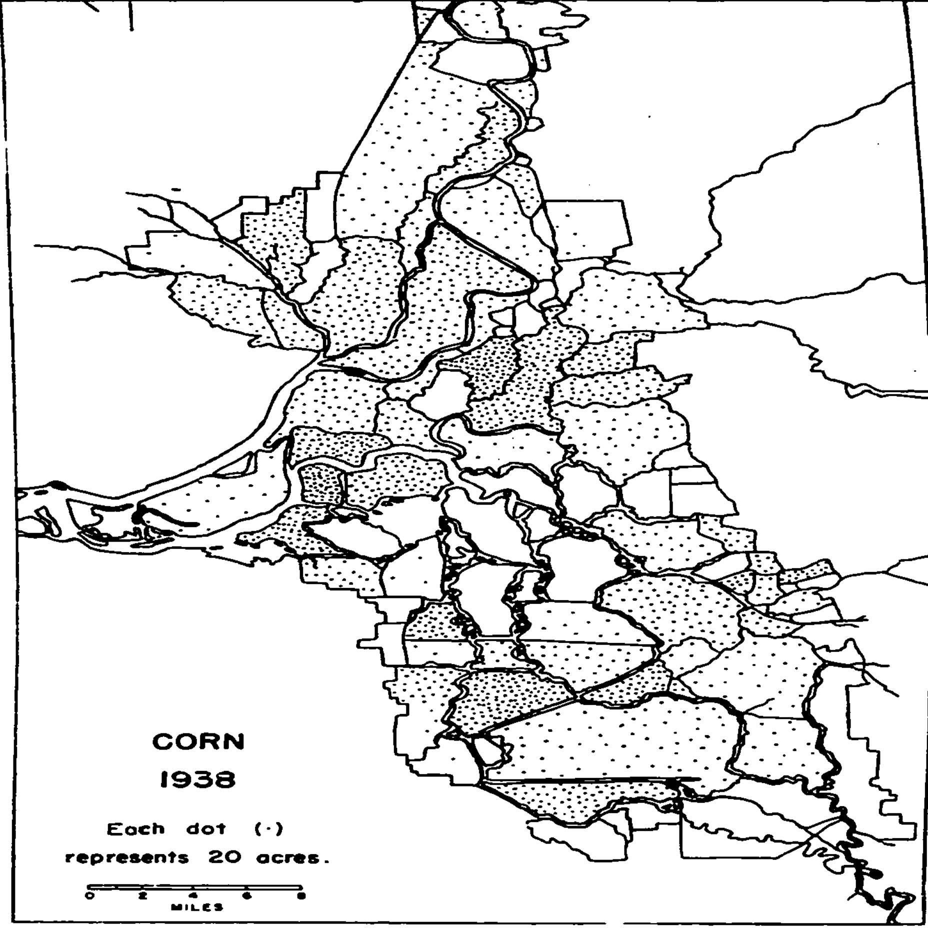

Each dot
0 2 4
MILES

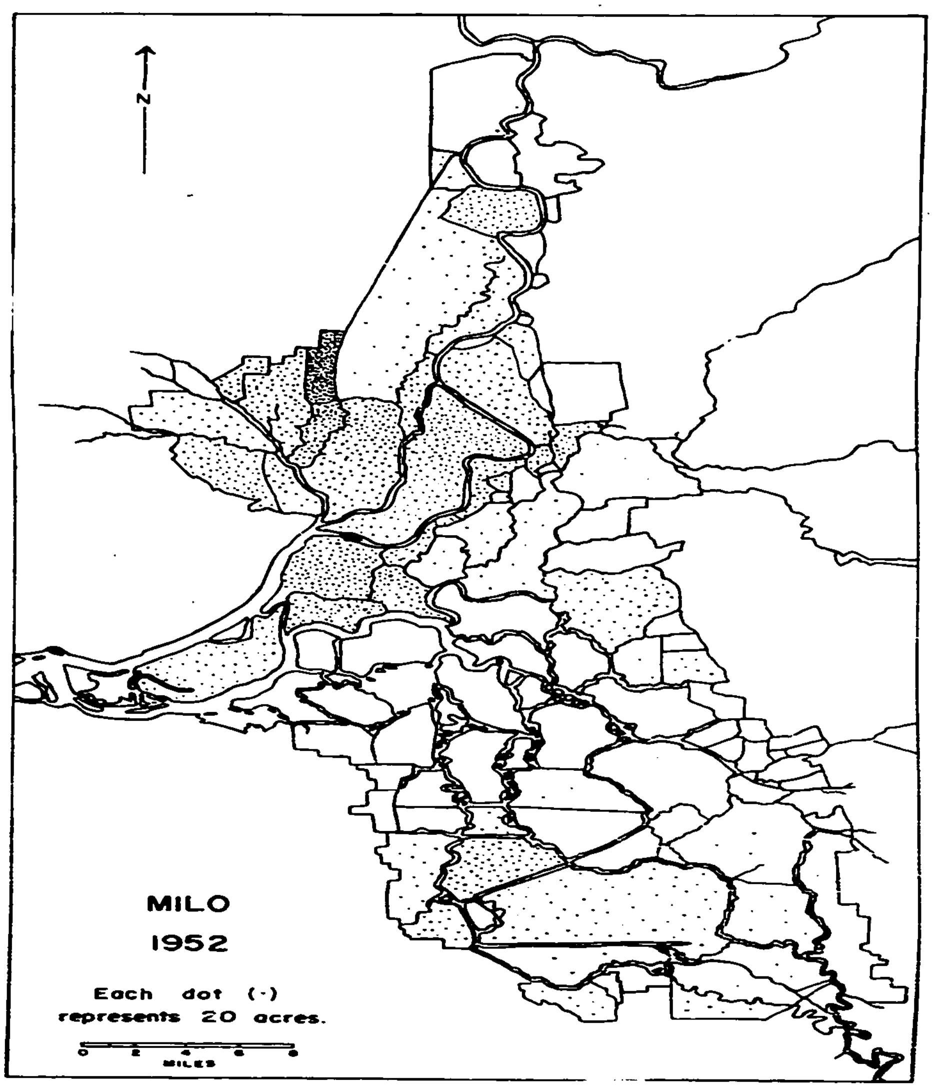

N
CORN
1945
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

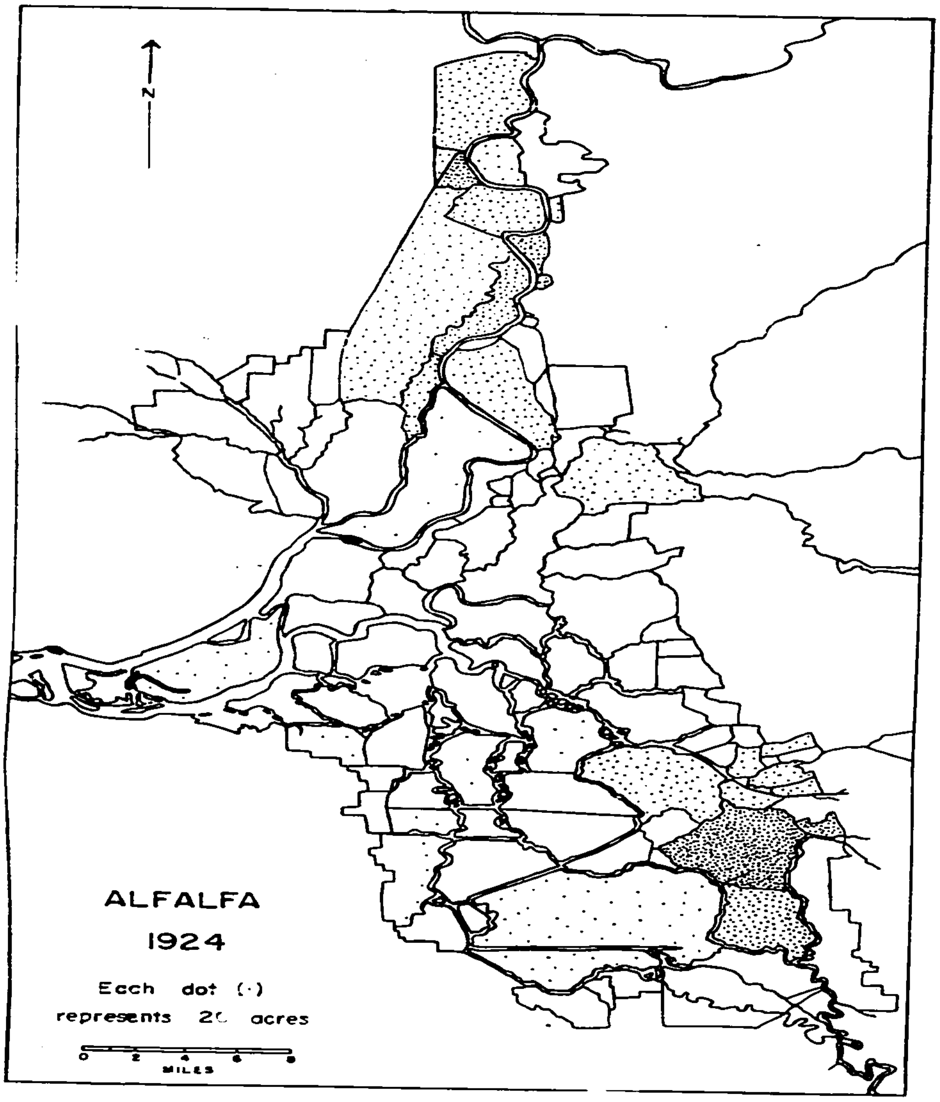

N
1952
Each dot
0 2 4
MILES


CORN
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

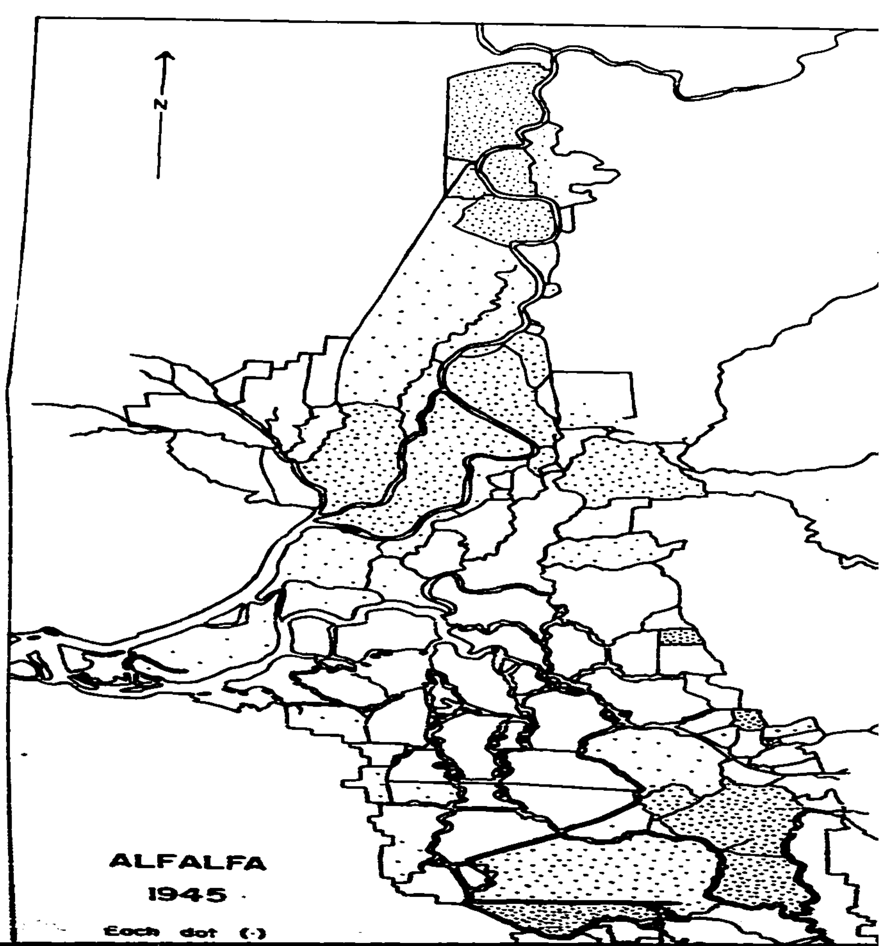

N
CORN
1952
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

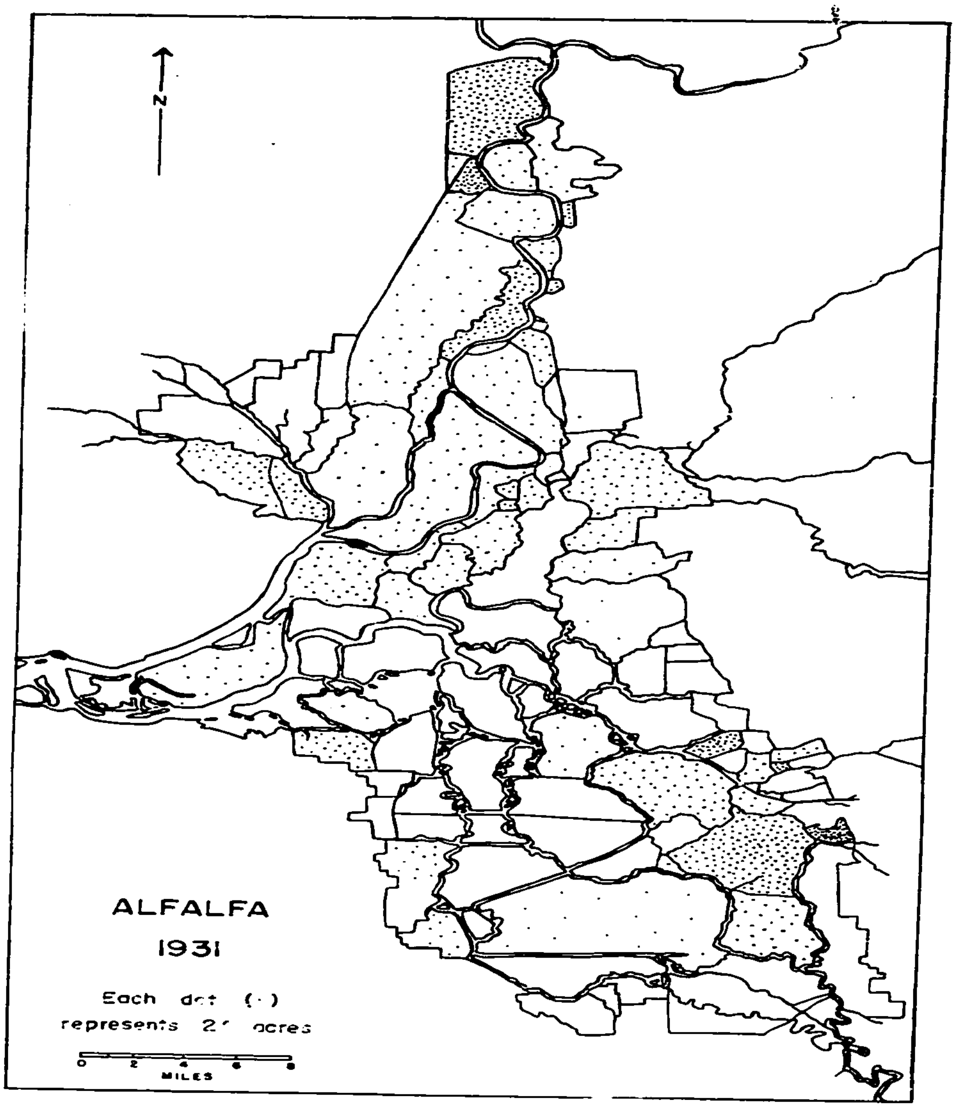

CORN
1938
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

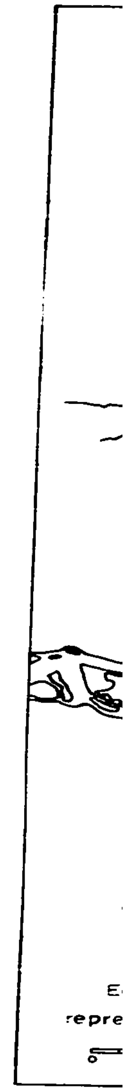

N
MILO
1952
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES

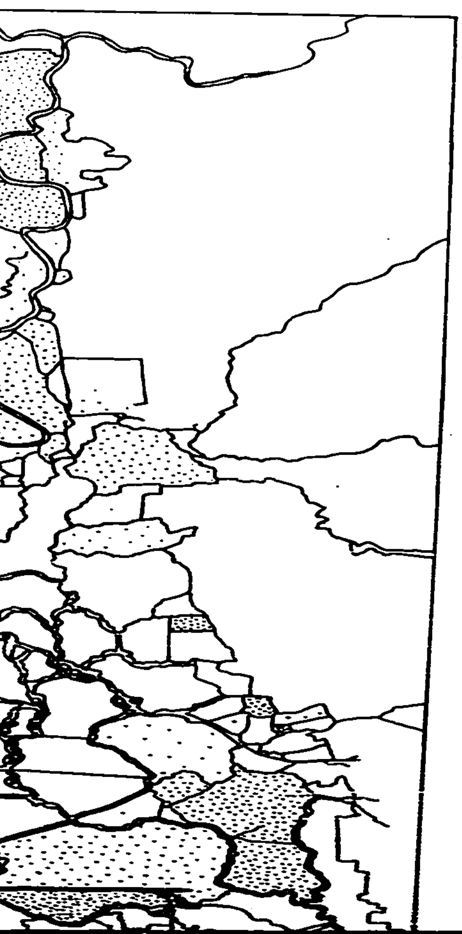

N
ALFALFA
1924
Each dot (·)
represents 2 acres
0 2 4 6 8
MILES

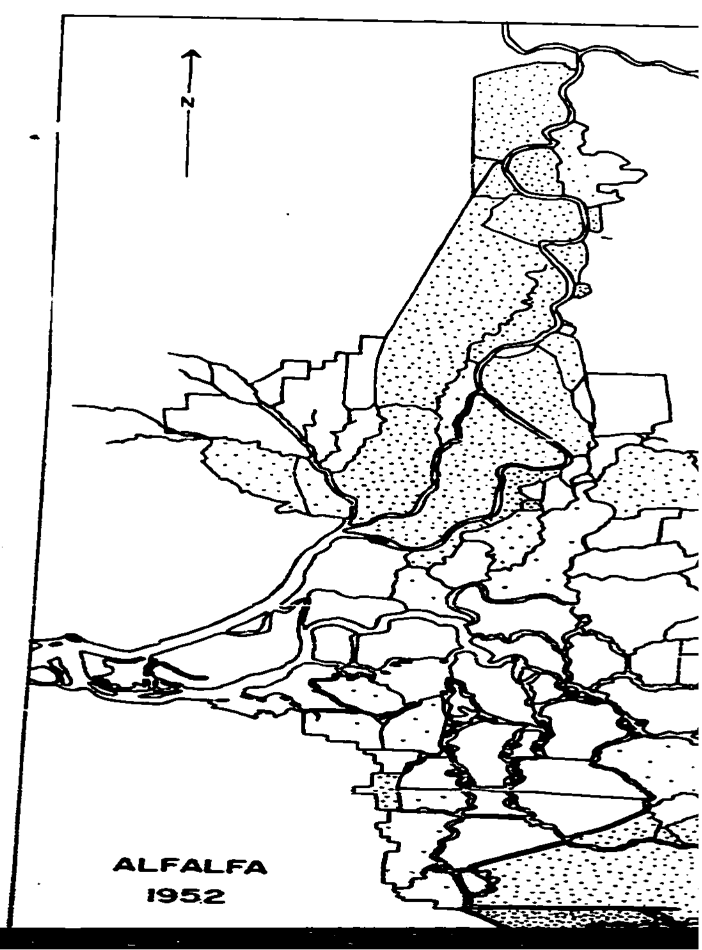

N
ALFALFA
1931
Each dot (·)
represents
MILES

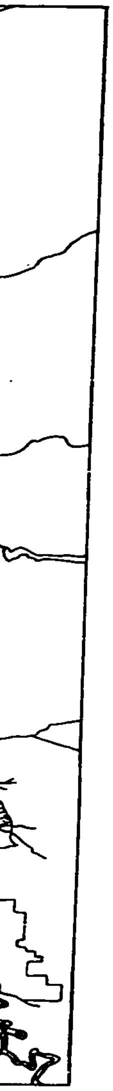

N
ALFALFA
1945
Each dot (·)

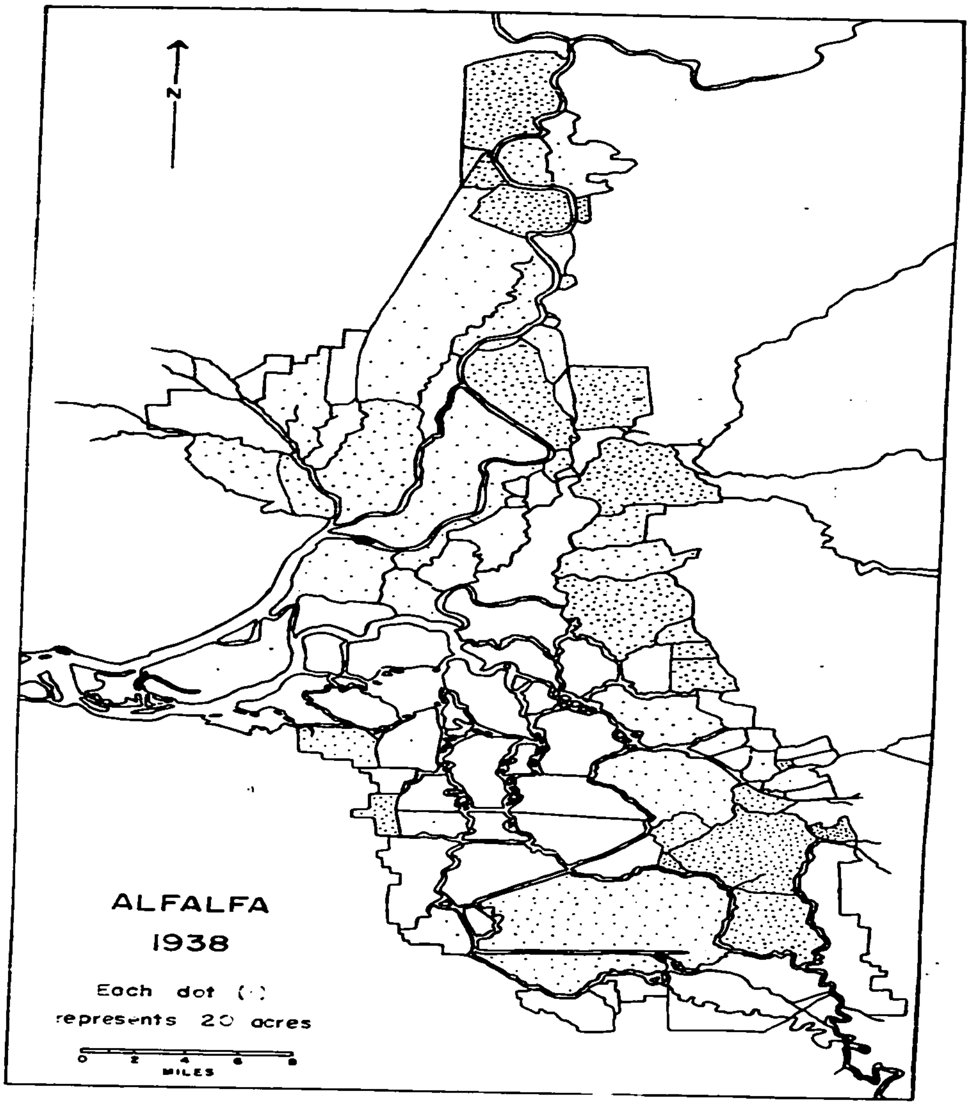

N
ALFALFA
1931
Each dot (·)
represents acres
0 2 4 6 8
MILES

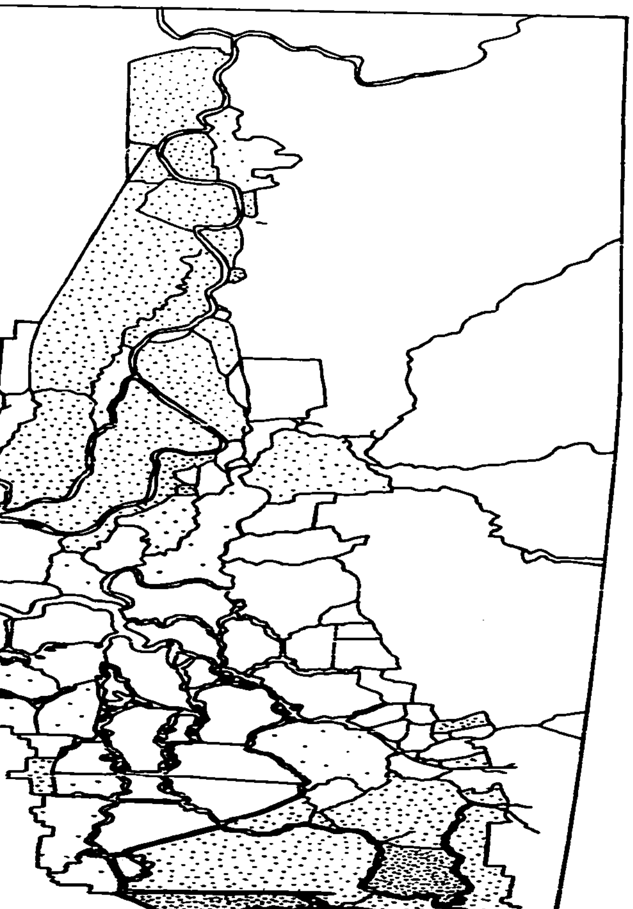


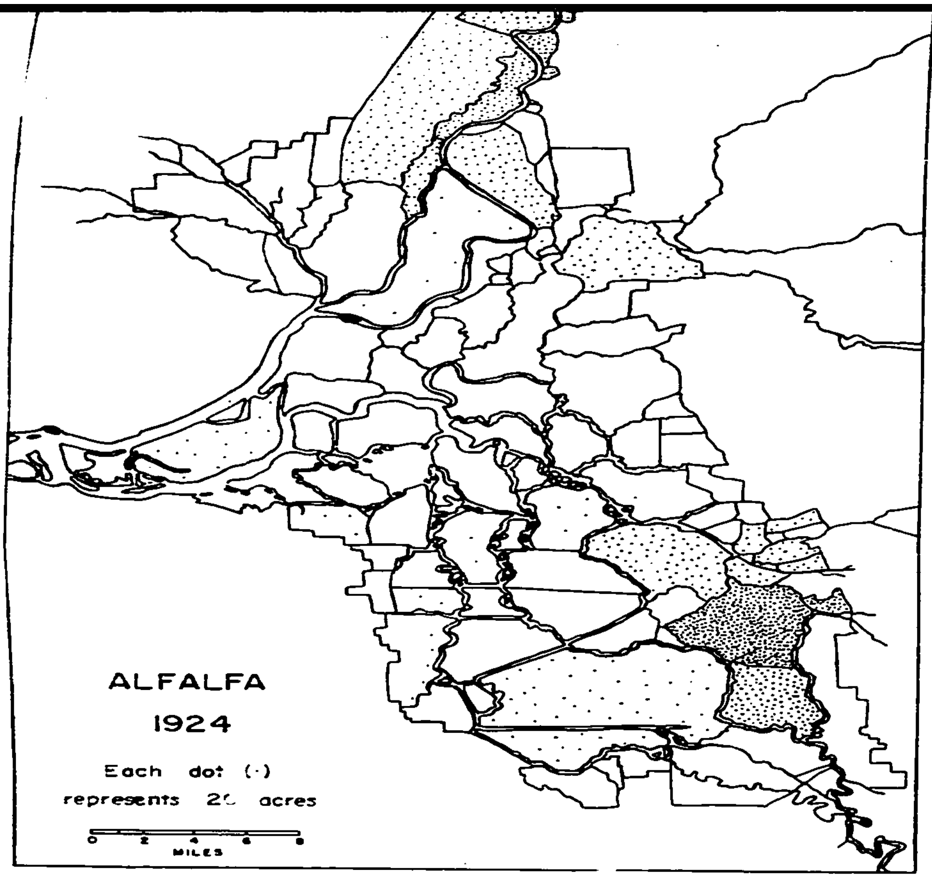


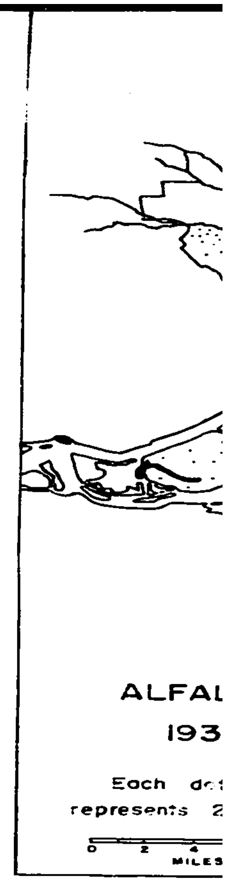

N
ALFALFA
1952

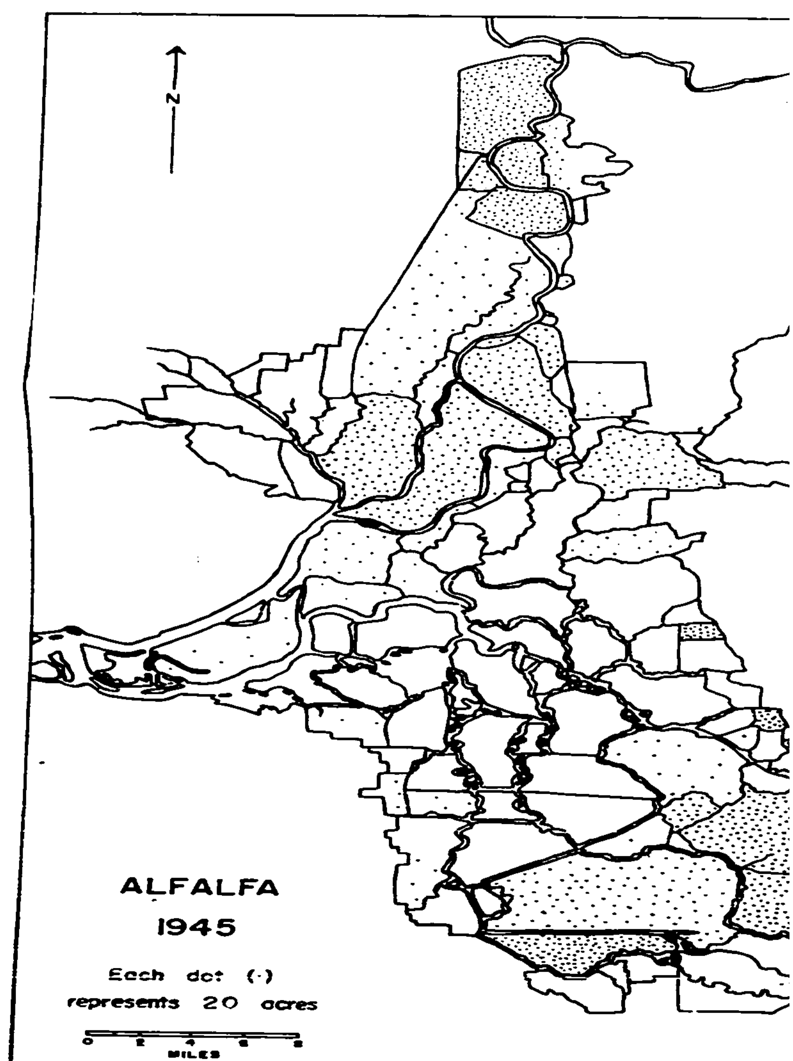


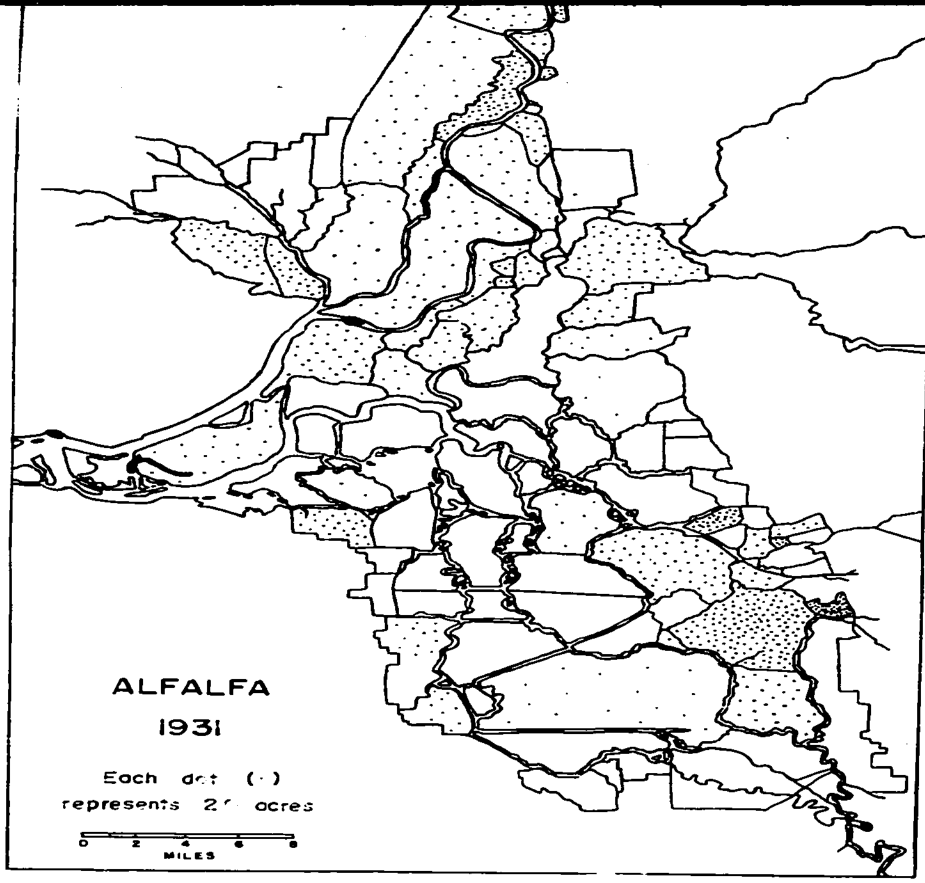

N
ALFALFA
1938
Each dot (·)
represents 20 acres
0 2 4 6 8
MILES

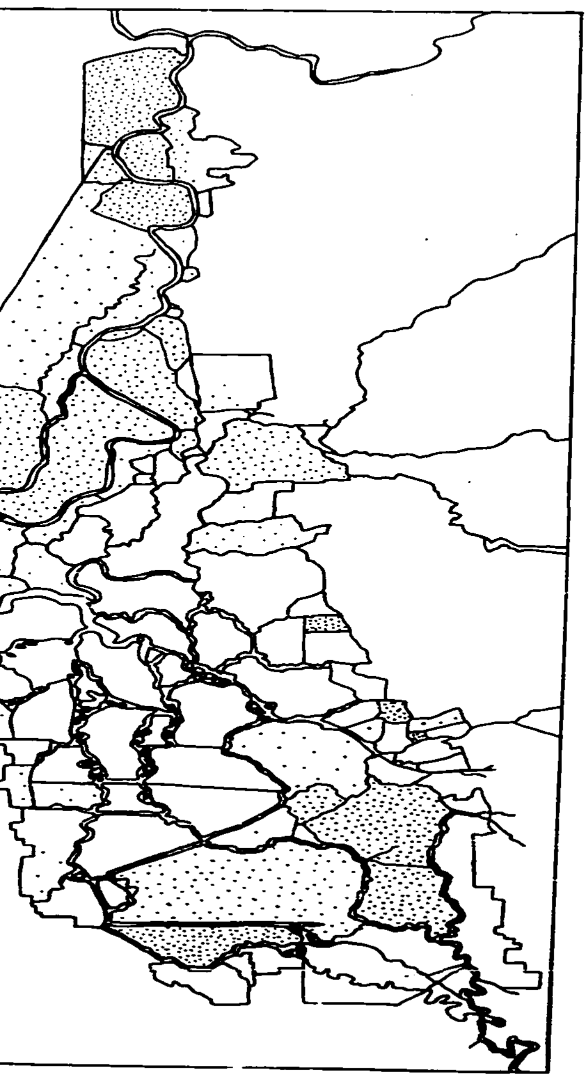


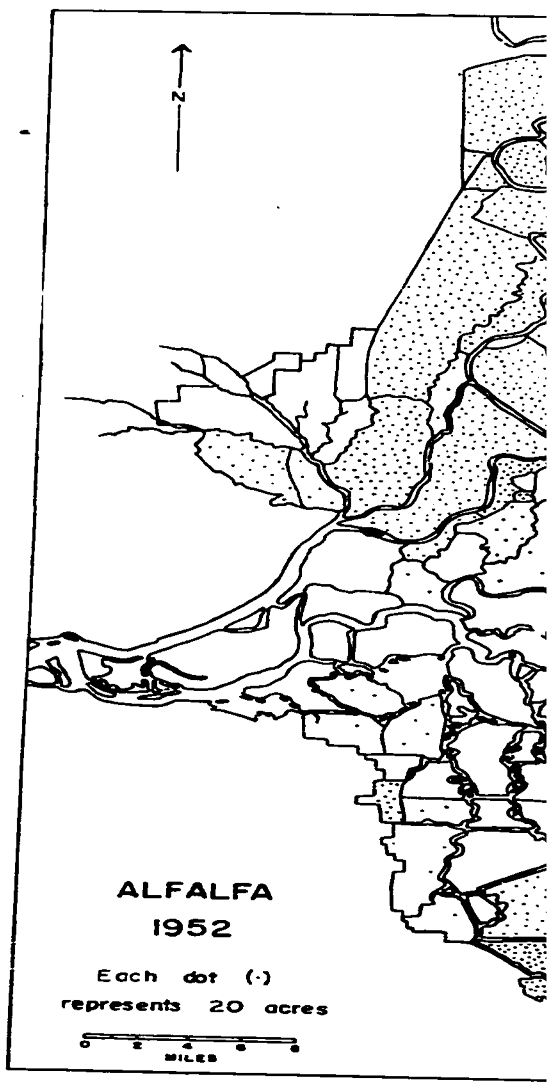

ALFALFA
1924
Each dot (·)
represents 20 acres
MILES

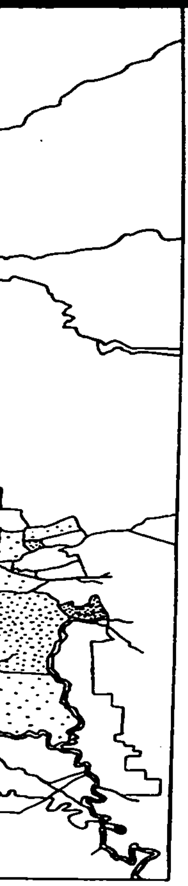

MILES

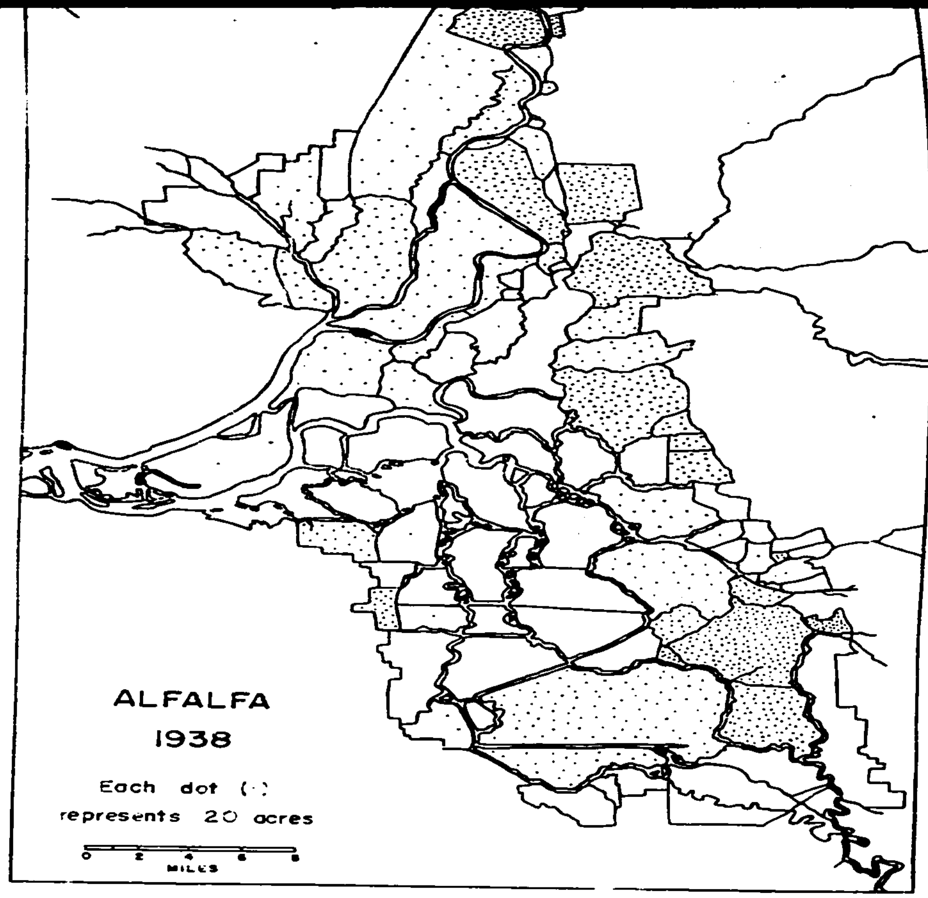

N
ALFALFA
1945
Each dot (·)
represents 20 acres
MILES

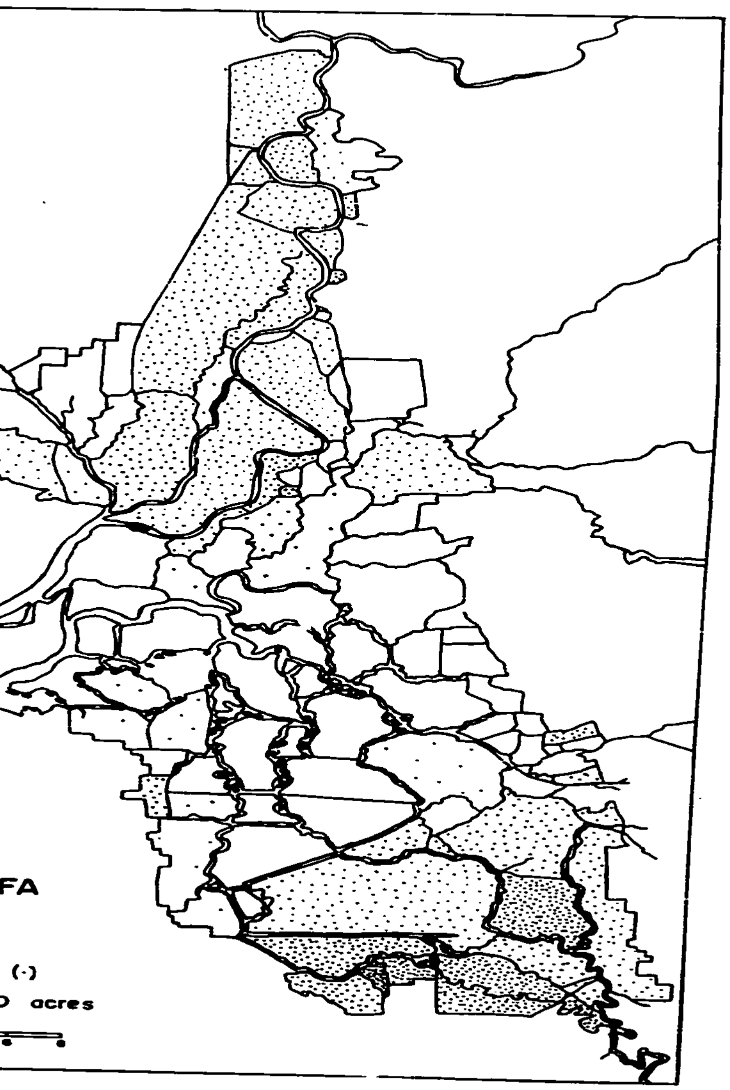

ALFALFA
1931
Each dot (·)
represents acres
0 2 4 6 8
MILES

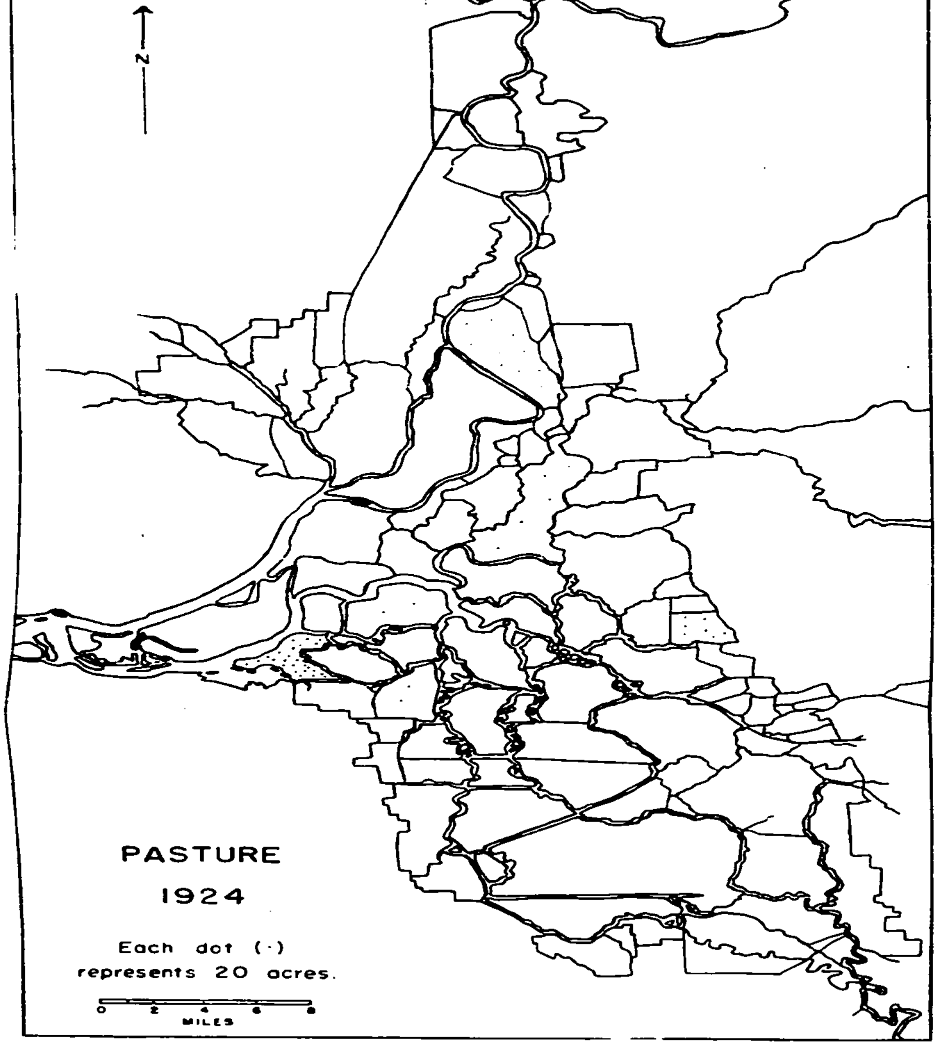



N
ALFALFA
1952
Each dot (·)
represents 20 acres
0 2 4 6 8
MILES

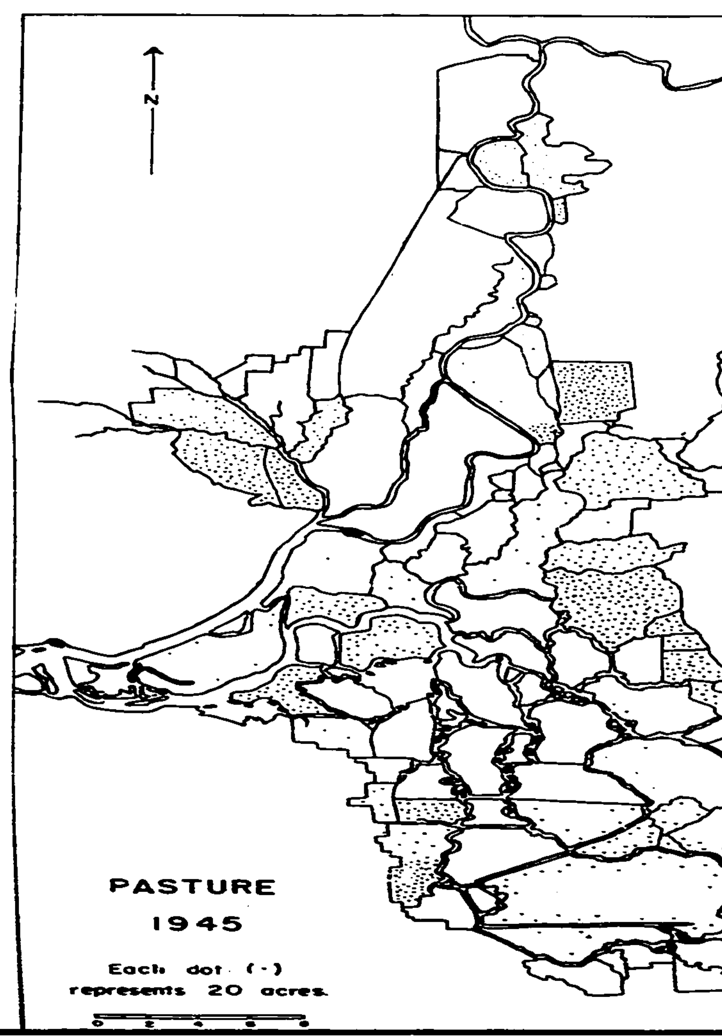


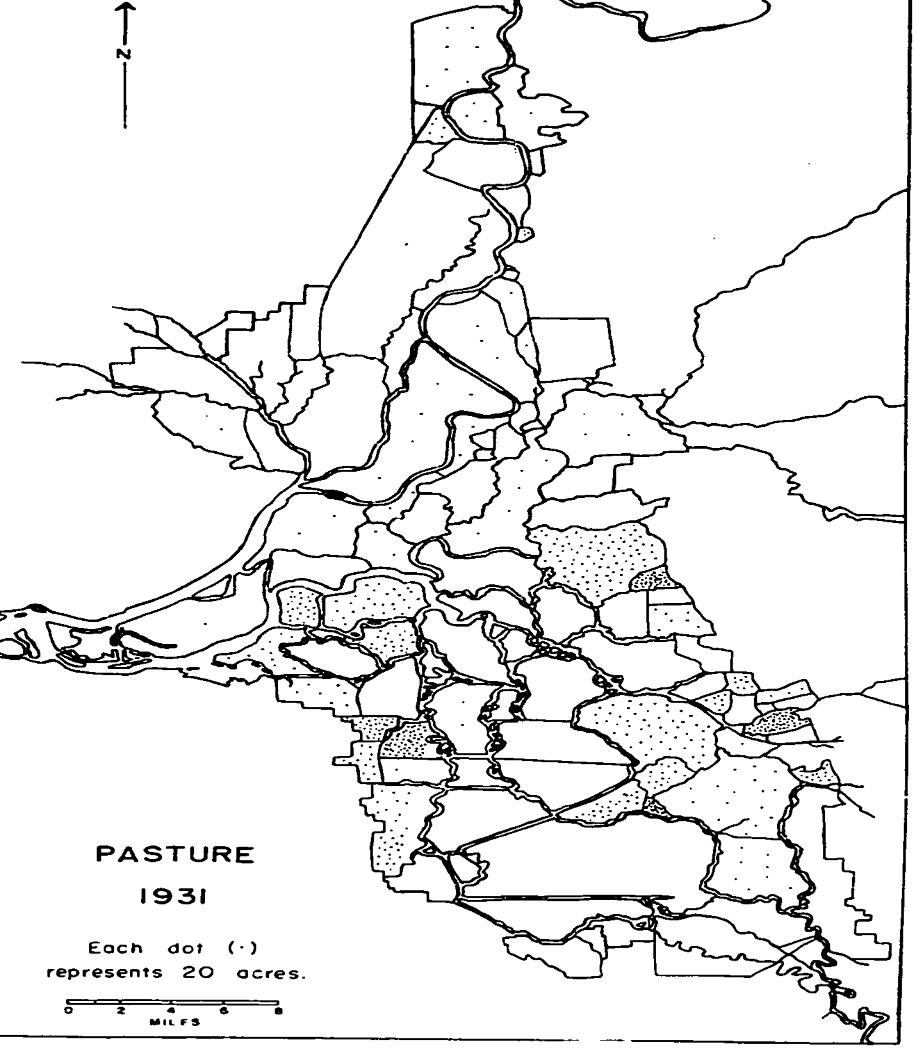

ALFALFA
1938
Each dot (·)
represents 20 acres
MILES

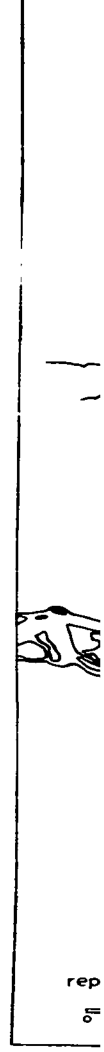

FA
(·)
acres

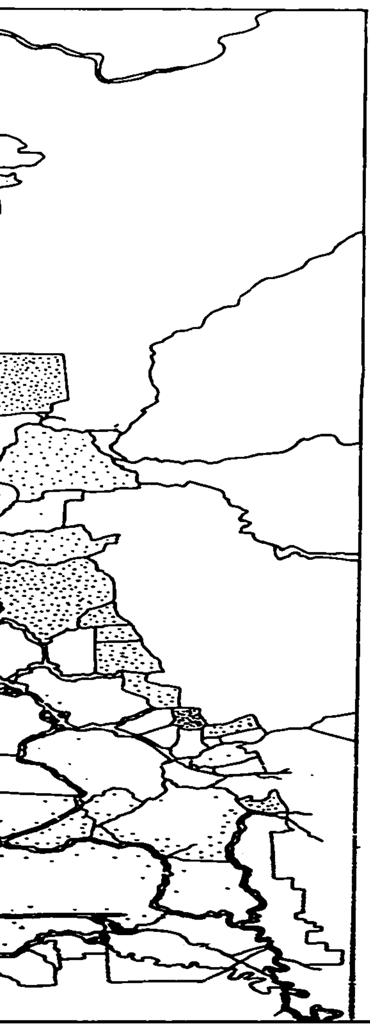

N
PASTURE
1924
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

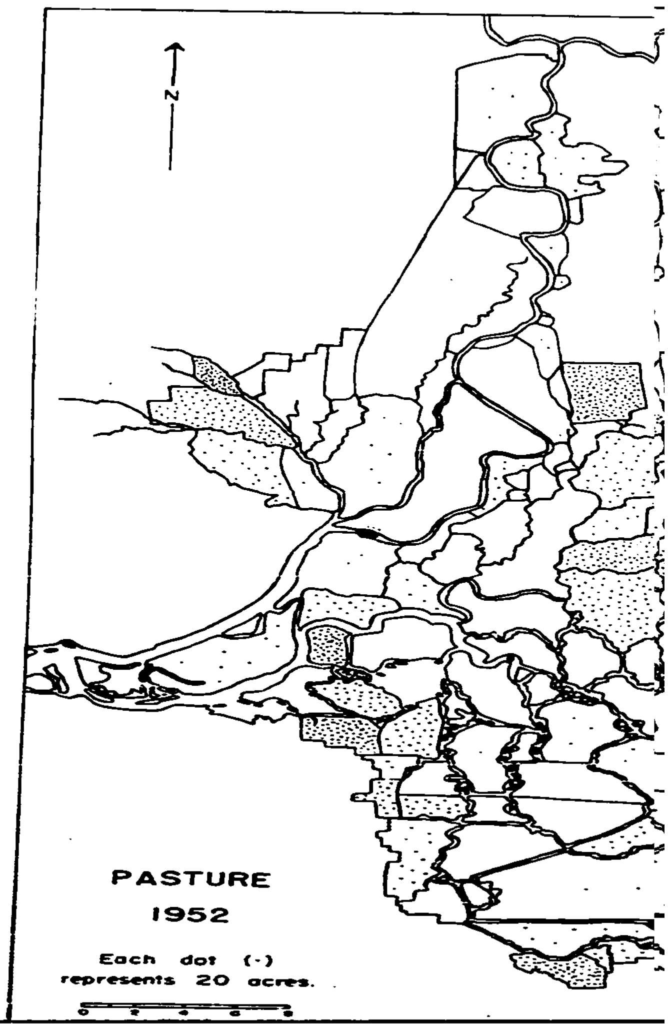

N
PAS
Each
represents

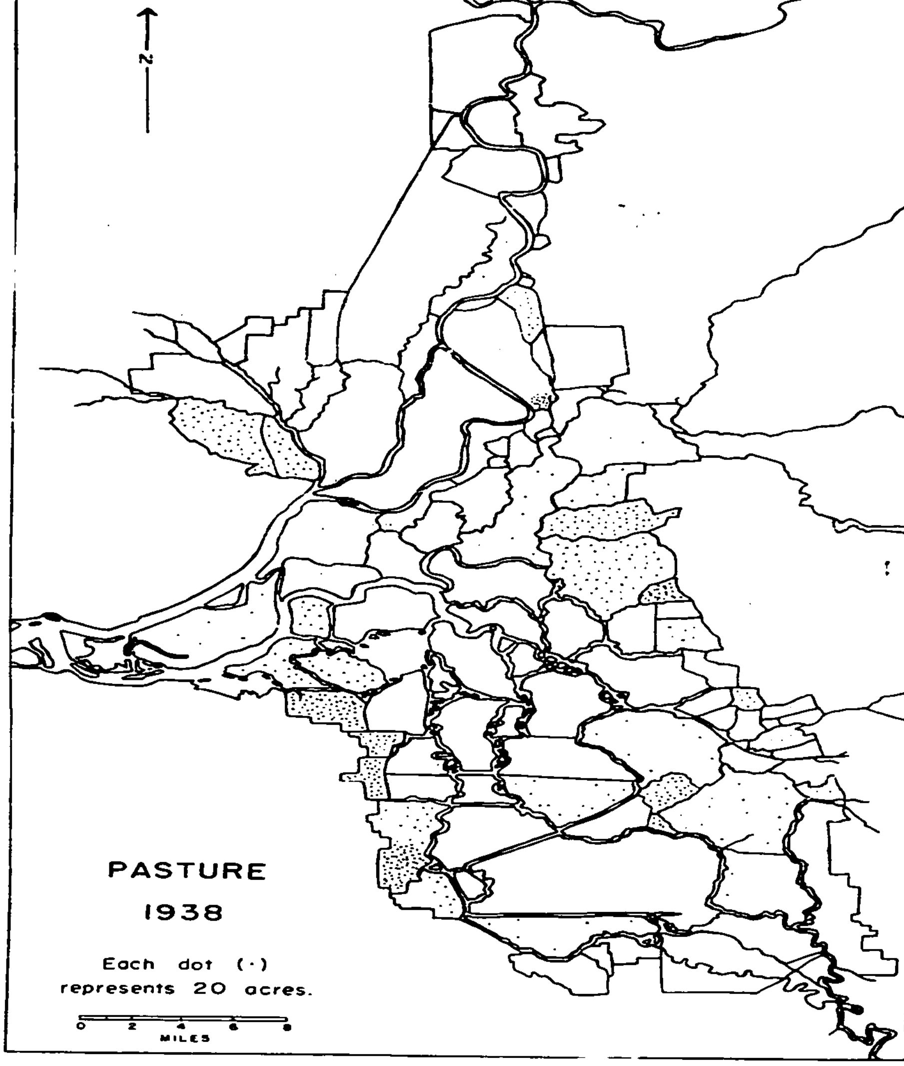

N
PASTURE
1945
Each dot (·)
represents 20 acres.

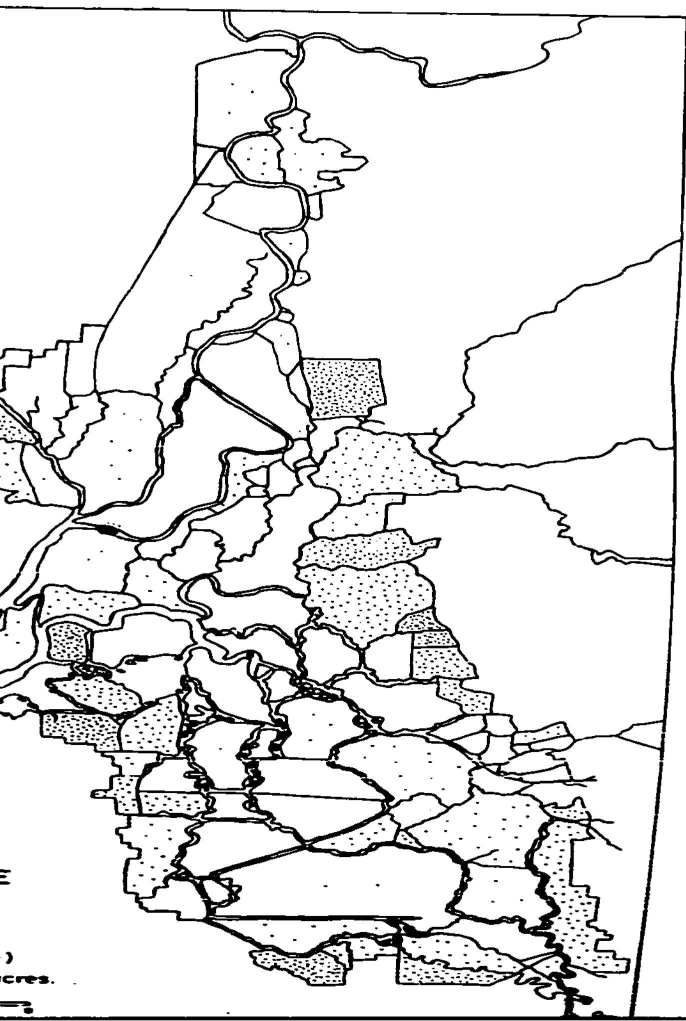

N
PASTURE
1931
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

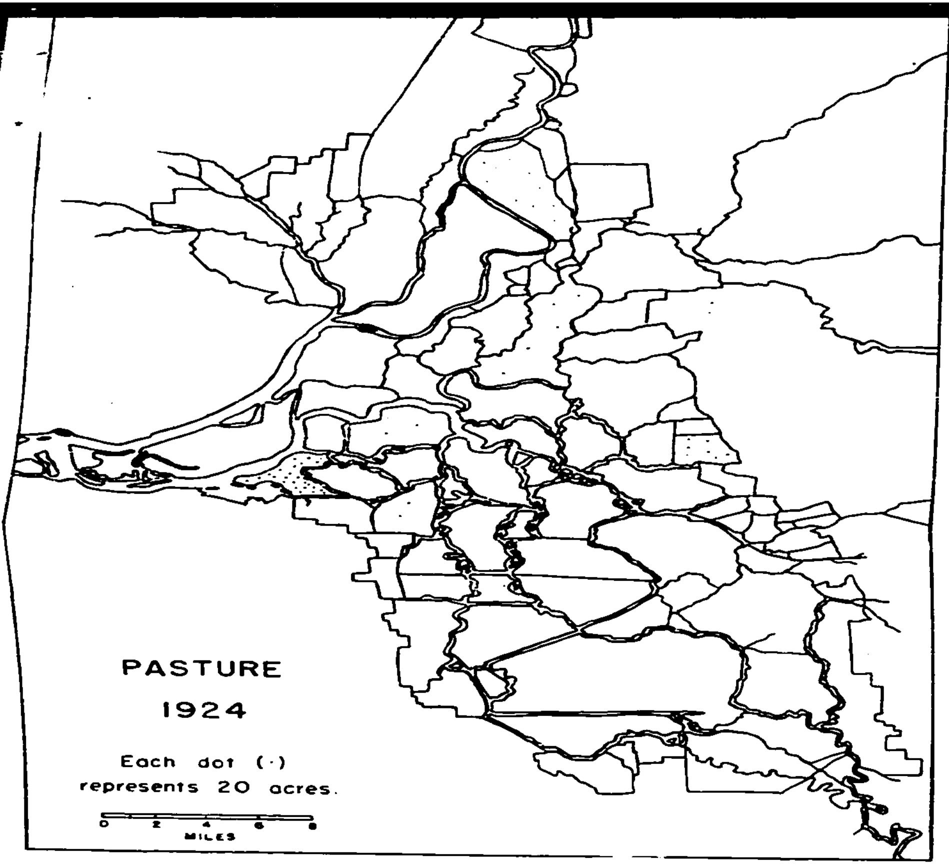

rep

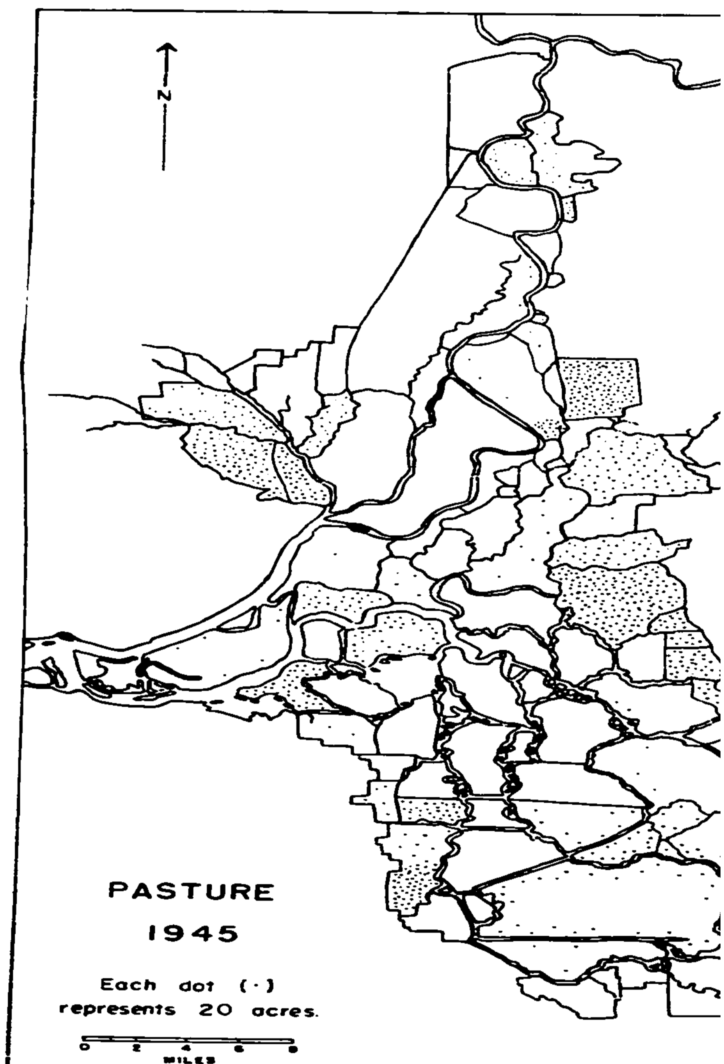


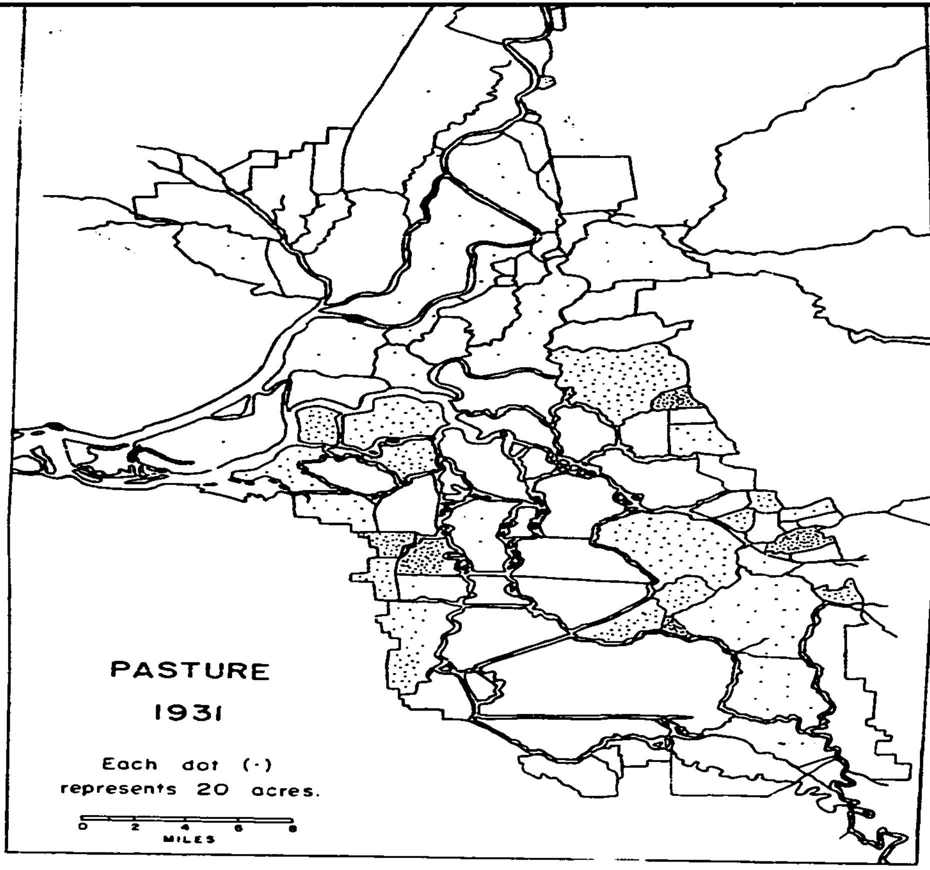

N
PASTURE
1952
Each dot (·)
represents 20 acres.
0 2 4 6 8

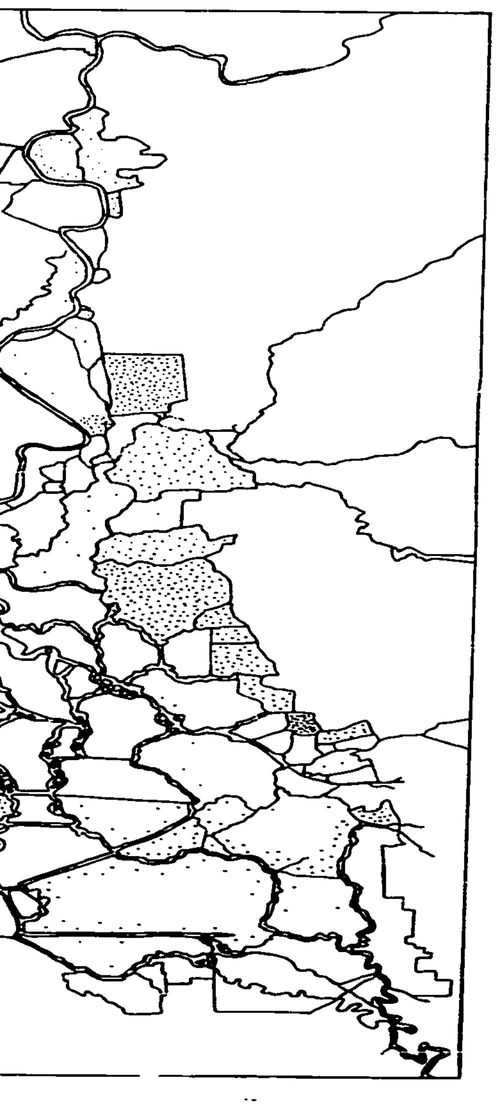

N
PASTURE
1938
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

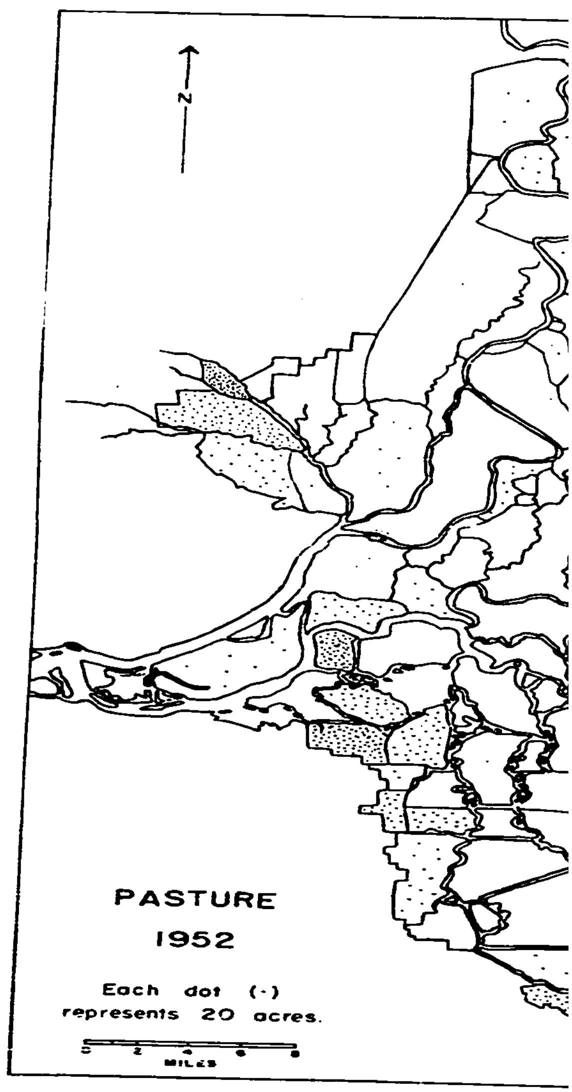


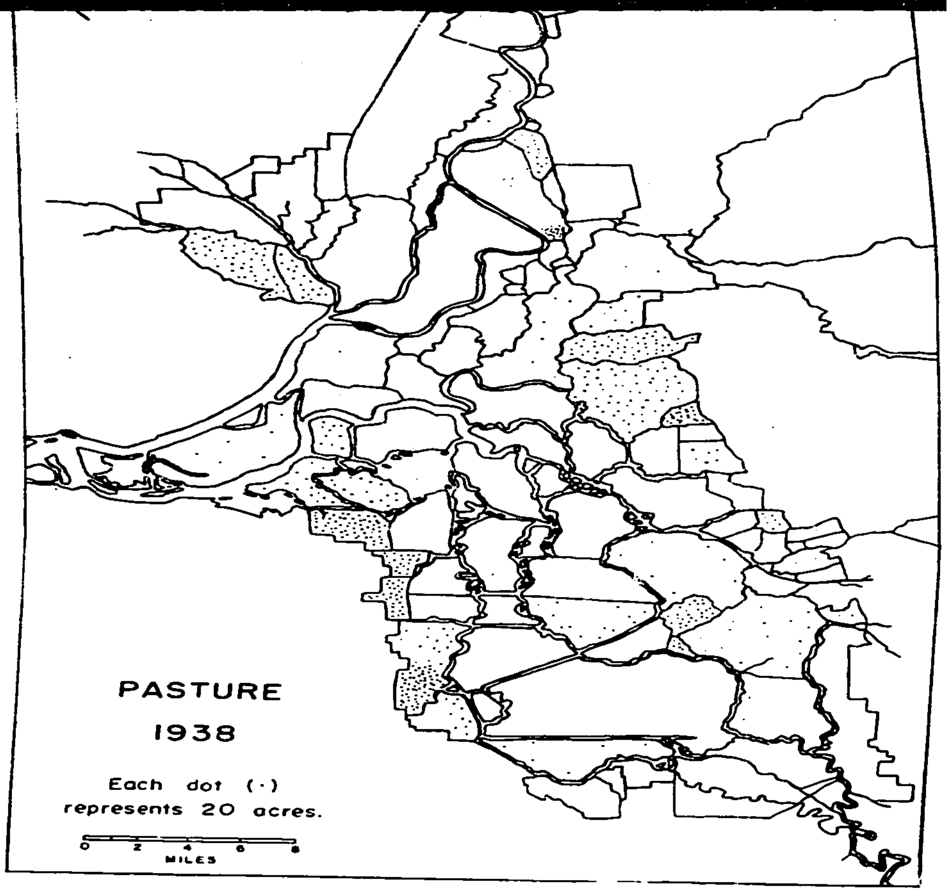

PASTURE
1924
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES

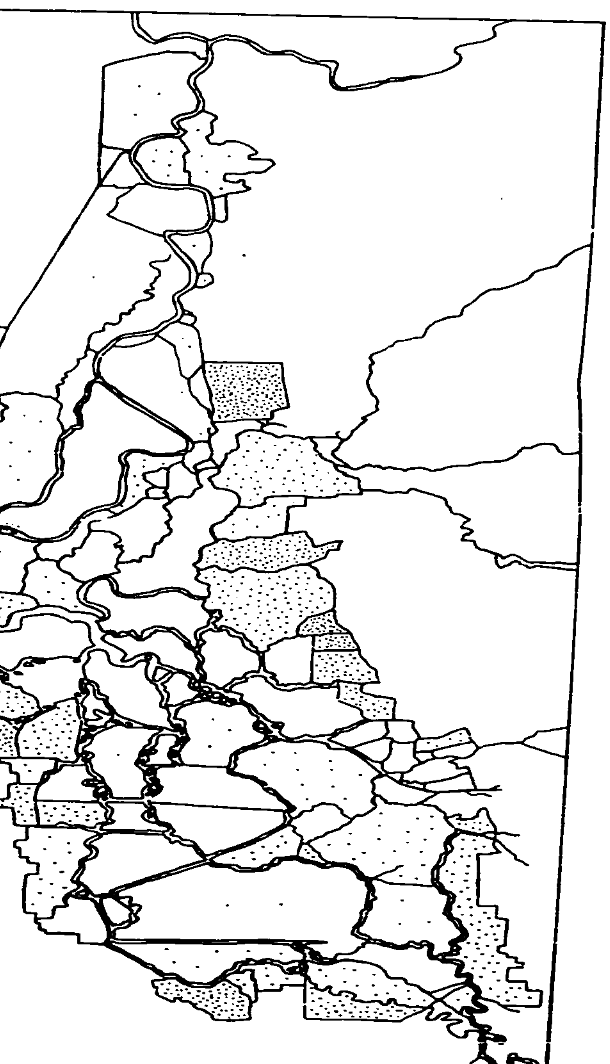

N
PASTURE
1945
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES


PASTURE
1931
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES




N
PASTURE
1952
Each dot (·) represents 20 acres.
0 2 4 6 8
MILES


PASTURE
1938
Each dot (·)
represents 20 acres.
0 2 4 6 8
MILES



MAP PLATE G: **Onions**

Source: County Agricultural Commissioner's Reports

MAP PLATE H: Tree Crops

Source: County Agricultural Commissioner's Reports

MAP PLATE J: Seed Crops

Source: County Agricultural Commissioner's Reports

MAP PLATE K: Small Grains

Source: County Agricultural Commissioner's Reports

MAP PLATE L: Corn and Milo

Source: County Agricultural Commissioner's Reports

MAP PLATE M: Alfalfa

Source: County Agricultural Commissioner's Reports

MAP PLATE N: Pasture

Source: County Agricultural Commissioner's Reports