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A Culture History of Rice With Special Reference to Louisiana.

Chan Lee

Louisiana State University and Agricultural & Mechanical College

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**LEE, Chan. A CULTURE HISTORY OF RICE
WITH SPECIAL REFERENCE TO LOUISIANA.**

Louisiana State University, Ph. D., 1960
Geography

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A CULTURE HISTORY OF RICE
WITH SPECIAL REFERENCE TO LOUISIANA

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Geography
and Anthropology

by
Chan Lee

B.A., Seoul National University, 1951
M.A., Louisiana State University, 1957
June, 1960

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ABSTRACT

This dissertation has two aims: one a study of the origin, diffusion, and evolution of different modes of rice cultivation; the other a consideration of natural and cultural factors affecting rice production, with brief mention of the accompanying cultural landscapes and special reference to Louisiana. Place and mode of origin of domesticated rice are as yet uncertain. However, it is agreed generally that the place of origin is somewhere in southeastern Asia. Maximum botanical variation in both wild and cultivated rice, most-diverse linguistic terms for rice, and a wide range in modes of cultivation are found in southeastern Asia, especially in the area from Bengal to Indo-China. The stimulus for rice domestication may well lead back to an earlier domestication of root crops in the same area. Planters of the latter may have domesticated semi-aquatic plants like rice by the act of transplanting seedlings regarded as weeds to wet alluvial lands, with partial extension of the vegetative planting habit learned earlier with taro. From these possible simple beginnings, modes of rice culture have evolved through time to fit varied natural conditions and to conform to different cultural values.

Natural factors responsible for the world distribution of rice have now been largely supplanted in importance by cultural factors such as the development of new varieties, the improvement of techniques, and the use of special tools and machinery. But, migrations of peoples as a means of spreading culture have likely been the most important factor in explaining the basic distribution of cultivated rice. Before the arrival of Aryans in India and Han Chinese in China, rice spread pri-

marily with archaic Caucasoids into India and South China, probably as far north as the Hwang Ho valley. Malayo-Polynesians were responsible for the dispersal of rice to Indonesia, possibly as far east as New Caledonia, and to Madagascar. Arabs carried rice into Mediterranean areas and eastern Africa. Aryans and Chinese expanded rice production into lowlands with the introduction of the plow from the west. Europeans brought rice and its techniques to the New World with their expeditions.

On the basis of early documents it appears that the first rice seed in Louisiana were brought by French from the West Indies. Since the introduction of rice into Louisiana, modes of rice cultivation have evolved and new methods adopted with the passage of time, accompanying advances in technological level and changes of cultural values. Rice culture in Louisiana may be divided into three types, each first appearing in time sequence but all persisting virtually to the present: Providence rice, or small-scale home-use rice with little or no artificial irrigation; river rice or irrigated rice along the Mississippi River, primarily commercial; and prairie rice, or mechanized large-scale rice culture developed in prairie Louisiana.

Distinct field patterns were developed to fit the three types of rice culture in Louisiana: irregular small patches of Providence-rice fields on the edges of swamps; checkerboard-type fields with the striped French field pattern along the Mississippi; and contour-levee fields in prairie-rice areas.

Consideration of the controlling natural and cultural forces behind the shift of rice production to the prairies shows clearly that the natural factors involved in producing rice must be evaluated in

terms of the level of technology and the value system of the human group practicing it. Decline of the rice areas of South Carolina and the river section of Louisiana, and the rise of prairie-rice culture can be explained more by changing technological level and altered cultural values than by natural factors such as water resources, configuration of terrain, and soil, comparatively constant through time, even though variable in space.

I. Introduction

This dissertation was projected as a study of the origin and diffusion of domesticated rice, and of the origin and spread of the different modes of its cultivation, harvesting, and milling, all with special reference to Louisiana. Natural and cultural factors accounting for the distribution and treatment of rice were to be considered. There was also a limited interest in the settlement patterns accompanying rice cultivation, notably those found along the lower Mississippi River and related streams.

Evidence confirmed the notion that rice is one of the oldest cereal crops of southeastern Asia, even though by some (Sauer, 1952, p. 27) regarded as a relatively new subsistence crop as compared with the antiquity of certain Asiatic root crops, taro, for example. The botanical origin of cultivated rice remains in doubt, as do the place and manner of its domestication. The thread of biologic descent appears to be obscured by a long period of natural mutation and human selection, while the same long, largely unchronicled period reduces the answers as to the when and how of domestication to intelligent guesses.

Evolution and modification of modes of cultivation were required with extension of rice into new natural milieus and cultural environments. With the appearance of new varieties and the advancement of technical level, rice spread gradually from tropical savanna and monsoon areas to temperate monsoon areas, thence to western India where the rainfall season is in winter. Rice reached the New World with the Age of Discovery, in the late 16th or early 17th century.

In Louisiana, rice is as old as European settlement, which came in the early part of the 18th century. It, together with the techniques of cultivation, was introduced by the French, probably from the West Indies. Rice was well adapted to substitution for wheat, which is not suited to Louisiana's natural conditions. The history of rice cultivation in Louisiana may be divided into three distinctive stages: Providence rice along the Mississippi and in the prairies, with primarily subsistence intensity; river rice with a commercial motive; and commercial prairie rice following in-migration of Midwest farmers and an advancement of technological competence. This study proposes to deal primarily with the first two stages of rice culture in Louisiana, with special emphasis on primitive rice cultivation, chiefly because these aspects of rice growing have been so scantily treated. The third stage, prairie rice, needs to be mentioned chiefly to afford comparison with the two earlier stages.

Since this is a study in cultural geography, it was deemed proper to emphasize pertinent material elements such as field patterns, settlements, techniques, and agricultural implements. Non-material traits such as land tenure, social organization, economic and political aspects, and religious factors, no less important but less "earthy" and hence less geographical, were excluded except as they were connected significantly with matters such as diffusion and the composition of cultural landscapes.

An historical approach was necessitated by the nature of the study, that is, a tracing of the origin, diffusion, and natural and cultural modifications of rice cultivation. For areas outside of Louisiana, field experience in Korea, Japan, and Manchuria, and a reading knowledge of the languages involved, complemented and extended normal library research. In Louisiana, field work during the years 1957 through 1959

was supplemented by library and archival research in the Louisiana State University and cooperating libraries. During the three-year period, especially in 1958, year-round field observations and interviews with re-tired and active rice farmers provided the bulk of the local field data.

Comprehensive studies of rice on a world-wide basis have been made chiefly by agronomists and agricultural economists (Copeland, 1924; Musset, 1942-1944; Grist, 1953; Efferson, 1952). Quite naturally, they emphasize agricultural and economic aspects rather than the historic development of rice culture. In Louisiana, Ginn (1930) is the first to deal with rice historically, based on primary materials. Though her work provides an excellent historical background on commercial rice production in Louisiana, it is little concerned with the primitive types of rice growing which were dominant prior to 1850. Slight attention is given material traits such as agricultural implements, field patterns, and the like.

Numerous works are available concerning prairie-rice cultivation in Louisiana (Chambliss, 1920; Jones and others, 1952; Taylor, 1952). But, there has been little concern with primitive rice cultivation and the cultural aspects of commercial rice production along the Mississippi and associated streams. It therefore became a primary function of this dissertation to provide factual and speculative answers to questions concerning the primitive and early commercial developments of rice culture in Louisiana.

II. Nature of the Plant

The most widely distributed of all species of rice, the cultivated Oryza sativa L., is an annual semi-aquatic plant belonging to the same family as wheat, maize, oats, barley, and the millets. It is an annual propagated from seed. The stalks commonly grow 3 to 4 feet high and are topped by spikelets bearing grains. The spikelets form a loose panicle or head similar to that of oats but different from the tight ears of wheat (Fig. 1). Sativa grows in irrigated or naturally flooded fields; it also grows on uplands without irrigation or natural flooding. It does not require high atmospheric humidity if the water supply is sufficient, for it grows in the dry valleys of the Sacramento and Nile with irrigation. The temperature needed for germination of sativa falls between 50°F. - 68°F. During the growing season, it needs 2 to 3 months of mean monthly temperature above 68°F.

Sativa adapts to a wide variety of soils. It can be grown in acid, slightly brackish,¹ and sandy soils. It is more successful on soils which contain a certain amount of clay in the subsoil. Light soils require too much water and lose plant food very quickly through leaching. Silty loams with impermeable subsoils, such as claypan, are ideal. However, well drained sandy and lateritic soils are not suitable for wet rice cultivation, but can be used for upland rice. Sativa is tolerant of rather wide differences in pH which may vary between 3 and 8, but slightly acid soils (pH 5.5 - 6.5) are better suited.

Sativa needs conspicuous dry and wet seasons; a wet season for the vegetative period and a dry season for maturing. Beyond quite general traits in common, sativa exhibits wide varietal diversity in color of

¹This and similar numbers refer to explanatory notes grouped at the end of the text.



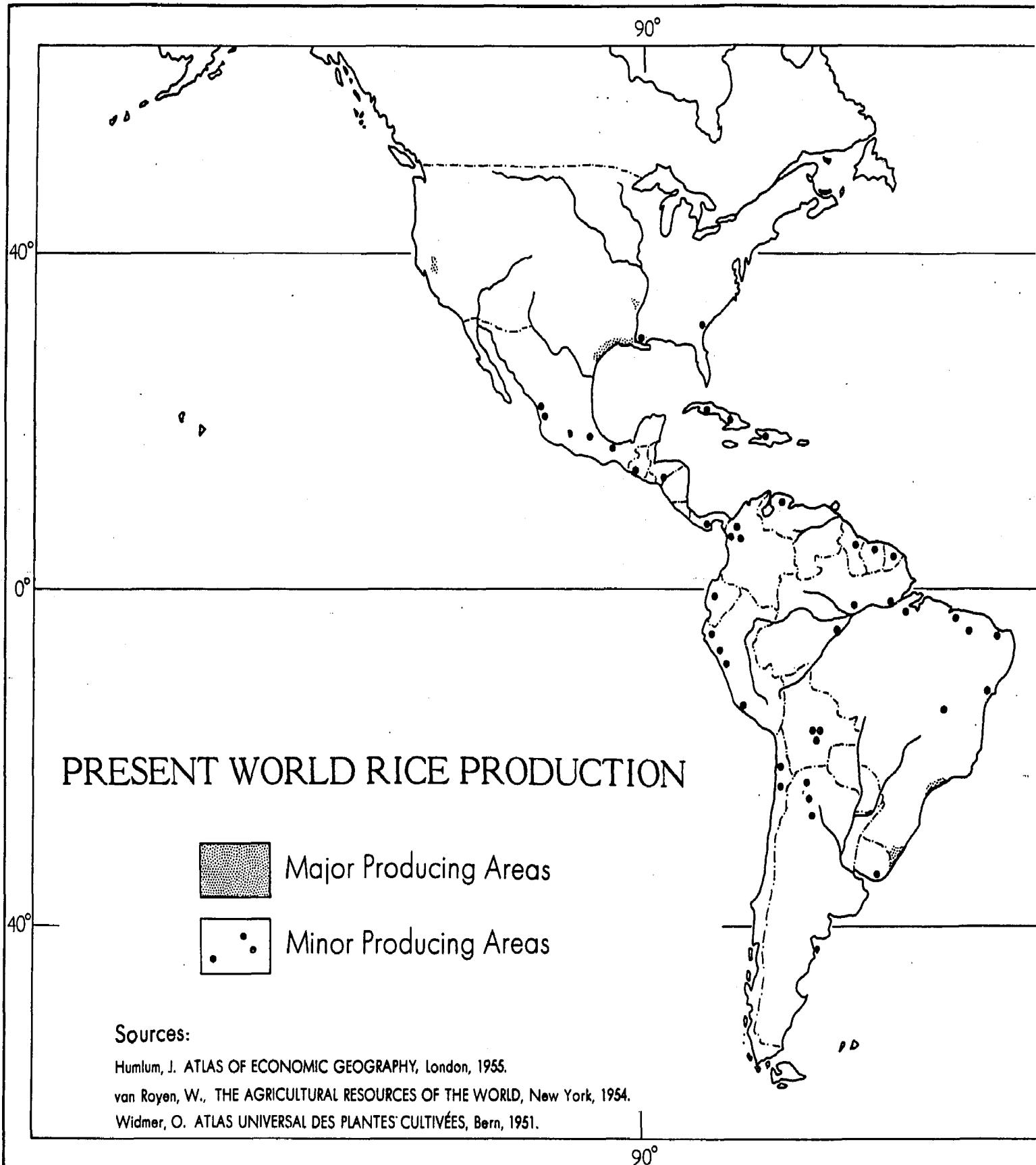
Fig. 1 The rice panicle.

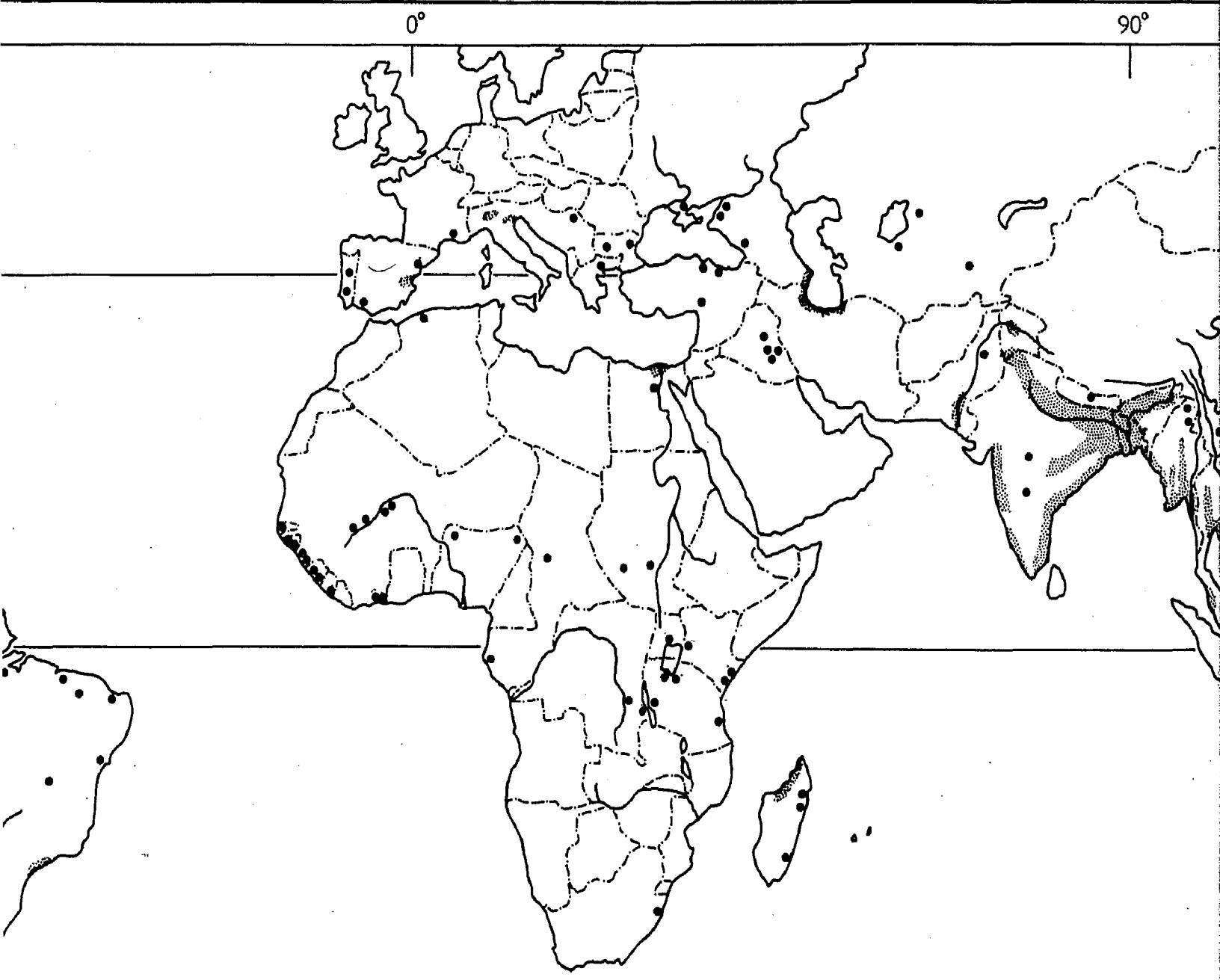
spikelets; form differences, such as short and long grains; early and late varieties; varieties that are, and those that are not, glutinous; varieties that are resistant to aridity, to salinity, or to low temperatures. There are about 6,000 recognized varieties in India and about 4-5 thousand in Japan (Marinaga, 1955, p. 131).

Other cultivated and wild species are not so widely distributed as sativa. O. glaberrima, the one species cultivated other than sativa, grows only in a limited part of West Africa. Recently introduced sativa grows more widely than the native African cultivated glaberrima. The wild form of sativa, O. sativa L. f. spontanea, according to Roschevitz' map (Plate 2), is widely distributed in southeastern Asia, northern Australia, and Africa, and ranges in habitat from swampy areas to the wet mountain slopes of the Himalaya. The other wild rices have a more limited distribution (Roschevitz, 1931, pp. 119-133). Based on its distribution and varietal differences, we may say that sativa has a wider range of adaptability than any other species. However, it is also true that there are considerable differences between the wild and cultivated form of sativa, in addition to the shattering characteristic of wild sativa. Although wild sativa has a wider range of adaptability than other wild species, it has been recorded only in wet tropical and sub-tropical areas. Reports of the occurrence of wild sativa in temperate and dry areas are highly suspect. Based on the above noted differences in distribution, it may be concluded that wild sativa is a less adaptable variety than is cultivated sativa.

Due to the development of a wide range of varieties through time, cultivated sativa can be grown almost everywhere between the latitudes of 40° north and south except in high altitudes and extremely poor soils

(Plate 1). Rice culture is, however, overwhelmingly associated with the monsoon areas of Asia. Its lower distributional limits approximate 40 inches of annual rainfall and a cold-month mean temperature of 32°F. Over 95 per cent of the total yield of rice is in monsoon Asia and it is also consumed there. This most populous area still practices traditional methods of cultivation. At no other place is rice culture so closely identified with modes of life and cultural landscapes. The fields in the stream valleys and on the hill slopes are very small. Plowing, sowing, transplanting, and harvesting are done by hand or with assistance from water buffaloes.



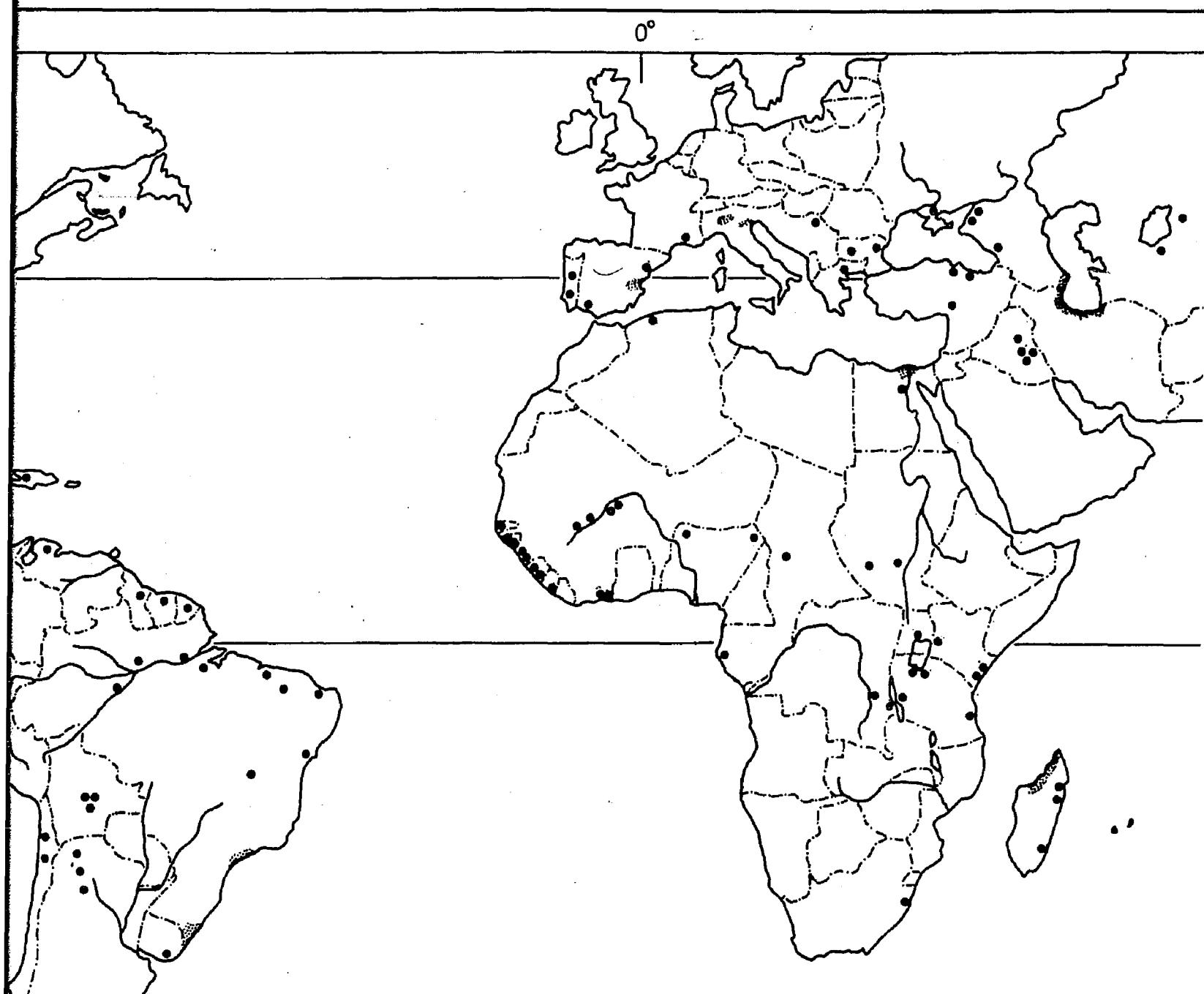


0

MILES ON THE EQUATOR

0°

90°



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MILES

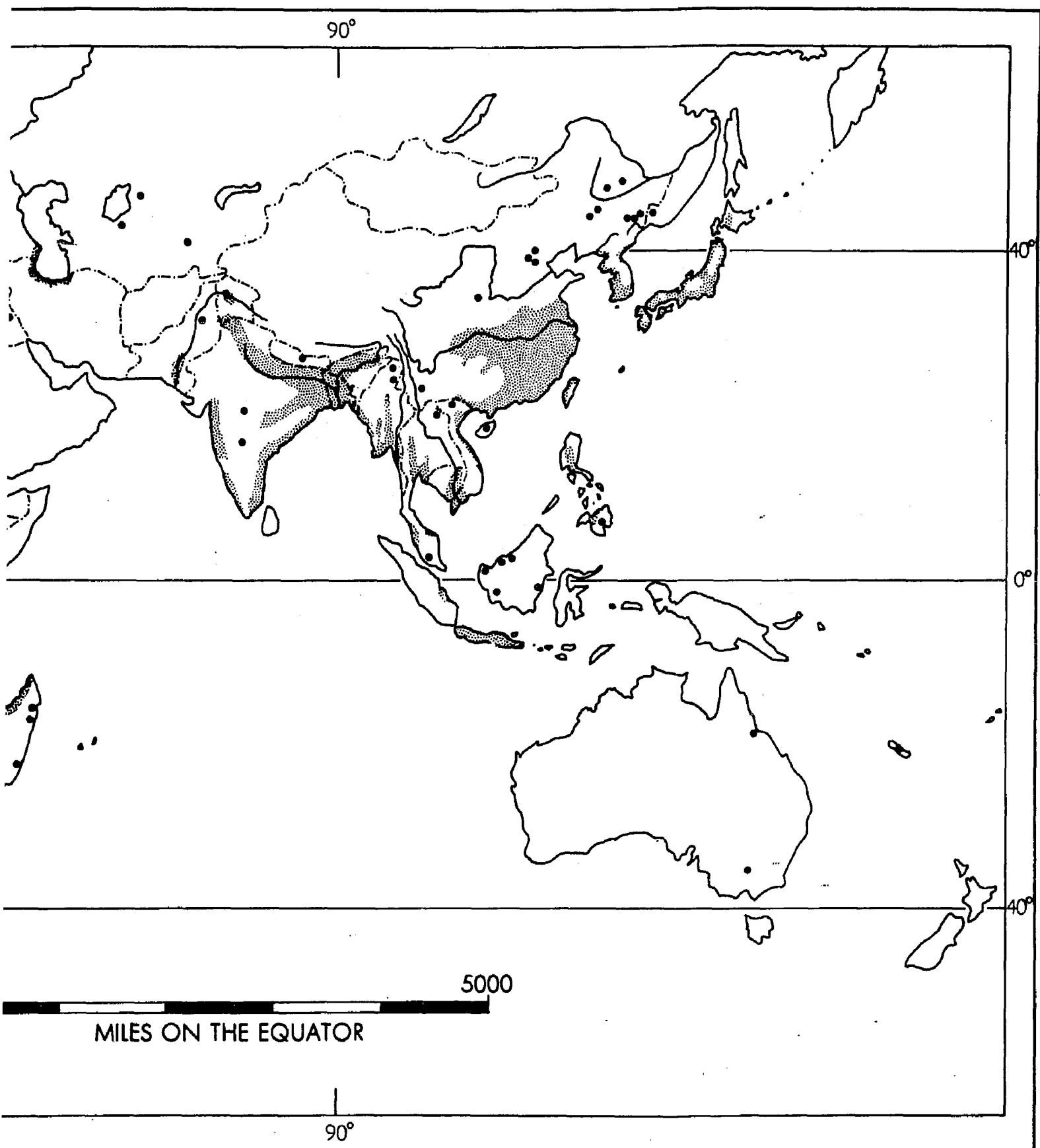


Plate 1

III. Wild Rice¹

The genus Oryza to which cultivated rice belongs, is listed as including a varying number of species, between 19 and 25; Roschevitz (1931, pp. 119-133) listed 19 species, Chatterjee, 23 (1947, pp. 234-237). Jodon (1955, p. 5) says that "the genus Oryza comprises 19 species, give or take three or four. Where a greater number has been listed, it appears that O. sativa has been split on the basis of simple mendelian characters." Among the species only two are cultivated, O. sativa and O. glaberrima. O. sativa is cultivated all over the world, while O. glaberrima is grown only in West Africa. Wild forms of sativa (O. sativa f. spontanea) and glaberrima are found in swampy places and in fields of cultivated rice (Chart 1). Though the wild forms are very similar to cultivated rices in physical character, they are readily distinguished by difference of color and marked tendency to shatter (Roy, 1921, pp. 365-380).

The distribution of wild rice is limited to the humid tropical and subtropical areas; about 8 - 9 species in Southeast Asia including the Philippines, 6 - 7 species in Africa, 5 in Central and South America, and 3 in Australia and New Guinea. On the basis of study of samples collected from all over the world, Roschevitz (1931, pp. 119-123) grouped 19 species of the wild rice into four sections on the basis of similar physical characters (Chart 1). Among the four, the sativa section comprises 12 species (No. 1 through 12 in Chart 1), and is distributed most widely in almost all areas of the distribution of the genus (Plate 2). Eight species of the section are annuals and the others are perennials.

CHART 1

<u>Oryza</u> L.	Annual or Perennial	Height in Meters	Asia	Africa	Australia	Middle & South America	Habitat
1. <u>O. sativa</u> L.	A	1-1.5	X	X	X	X	In swampy places, and in fields of cultivated rice
2. <u>O. australiensis</u> Dom.	A	+ 1			X		On drying river beds
3. <u>O. punctata</u> Kotschy	A	up to 1		X			Growing in water
4. <u>O. stapfii</u> Roshev.	A	0.3-0.8		X			Drying river beds
5. <u>O. breviligulata</u> A. Cheval. et Roehr.	A	0.6-1		X			Swamps
6. <u>O. glaberrima</u> Steud.	A	0.5-1		X			In swampy places
7. <u>O. latifolia</u> Desv.	A	1 - 3			X		On river banks and in swamps
8. <u>O. grandiglumis</u> Prod.	A	1.5-2			X		In swampy places and on river banks
9. <u>O. officinalis</u> Wall.	P	1 - 1.5	X				In low, moist valleys
10. <u>O. Schweinfurthiana</u> Prod.	P	0.75-0.8		X			?

CHART 1 (Cont'd.)

Oryza L.

Habitat

11. <u>O. minuta</u> Presl	P	\pm 0.5-1	X	Near the water on swampy banks
12. <u>O. longistaminata</u> A. Cheval. et Roehr.	P	1 - 1.5	X	In swampy places drying in summer
13. <u>O. granulata</u> Nees	P	up to 0.8	X	In dry forests
14. <u>O. Abromeitiana</u> Prod.	P	0.3-0.4	X	In moist forests
15. <u>O. branchyantha</u> A. Cheval. et Roehr.	A	0.6-0.7	X	?
16. <u>O. Schlechteri</u> Pilger	P	0.3-0.4	X	On mountain slopes
17. <u>O. Ridleyi</u> Hook.	P?	0.6-2	X	In swampy forests
18. <u>O. coarctata</u> Roxb.	P	1.2-1.8	X	On river banks
19. <u>O. subulata</u> Nees.	P	1 - 1.8	X	On river banks
20. <u>O. Dewildemani</u> Vanderyst	?	?	?	?

Modified from Roschevitz, R. J., "A Contribution to the Knowledge of Rice." Bulletin of Applied Botany of Genetics and Plant-Breeding, Vol. XXVII, (1931), chart between pp. 128-129.

Granulata section is found in Southeast Asia. The section includes 2 perennial species, O. granulata Nees and O. abromeitiana Prod. Coarctata section. embraces the area of Southeast Asia and northern Australia, from the Indus through India and Indo-China to New Guinea, but one species, O. branchyantha A. Cheval. et Roehr., is endemic for central Africa. Among the four species (No. 15 through 18 in Chart 1), one is an annual and the others are perennials. Rhynchoryza section occurs only in southeastern South America. O. subulata Nees., which is an annual, belongs to this section.

Habitats of wild rice vary with species as shown in the Roschevitz' chart (Chart 1): in swamps, drying river beds, river banks, moist valleys, dry forests, moist forests, and mountain slopes. The most of the species seem to favor swampy, moist lowlands and rainy mountain slopes, but O. granulata is found only in dry forest. In accordance with difference in habitat, heights of the plants vary from one to nine feet.

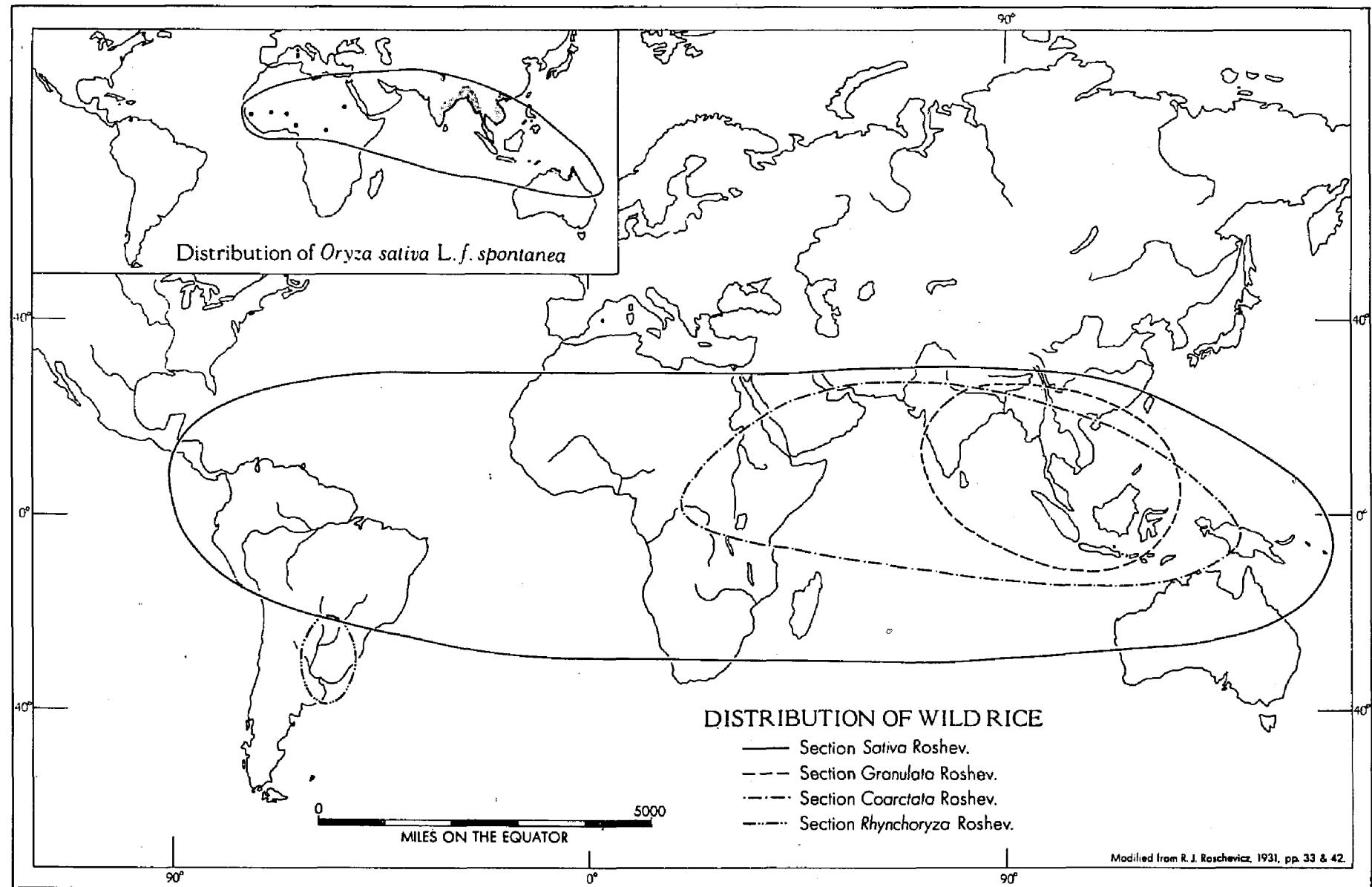


Plate 2

IV. Origin of Cultivated Rice

The botanical origin of cultivated rice has been much debated, but it is still far from being settled. Traditional thought starts with Watt (1891, pp. 498-653) and Roy (1921, pp. 365-380), who consider O. sativa f. spontanea (fatua) to be the progenitor of the cultivated rice, O. sativa. Based on a most extensive comparative study of wild and cultivated rice, Roschevitz (1931, p. 124) concluded that the species nearest to cultivated rice belong to wild rices of the sativa section, comprising 12 species of the genus Oryza. Concerning the sativa section he states:

"Oryza sativa L. f. spontanea is doubtless the species most closely approaching the majority of varieties of cultivated rice, coinciding with the latter almost in all characters and differing from it chiefly by the fact that its spikelets are shed a long time before the ripening of the seeds. O. sativa L. f. spontanea itself indubitably represents a complex of several species, therefore, the number of its characters is very great..." (Roschevitz, 1931, p. 124).

In Africa a separate origin of cultivated rice is proposed by Chevalier and Roehrich (1914, pp. 560-562). They identify O. glaberrima Steud. as a cultivated rice in West Africa, and judge it to have been derived from a native wild-rice species in Africa, O. breviligulata. This notion has been supported by Roschevitz (1931, p. 126), Chatterjee (1951, pp. 18-22), and Grist (1955, p. 1)¹

Recent studies (Sampath and Rao, 1951, pp. 14-17; Sampath and Govindaswami, 1958, pp. 17-20) suggest that the cultivated sativa came from O. perennis rather than from O. sativa f. spontanea. Spontanea is always found with cultivated sativa, from which it may be derived. Sampath and Rao (1951, p. 15) consider that the cultivated O. sativa

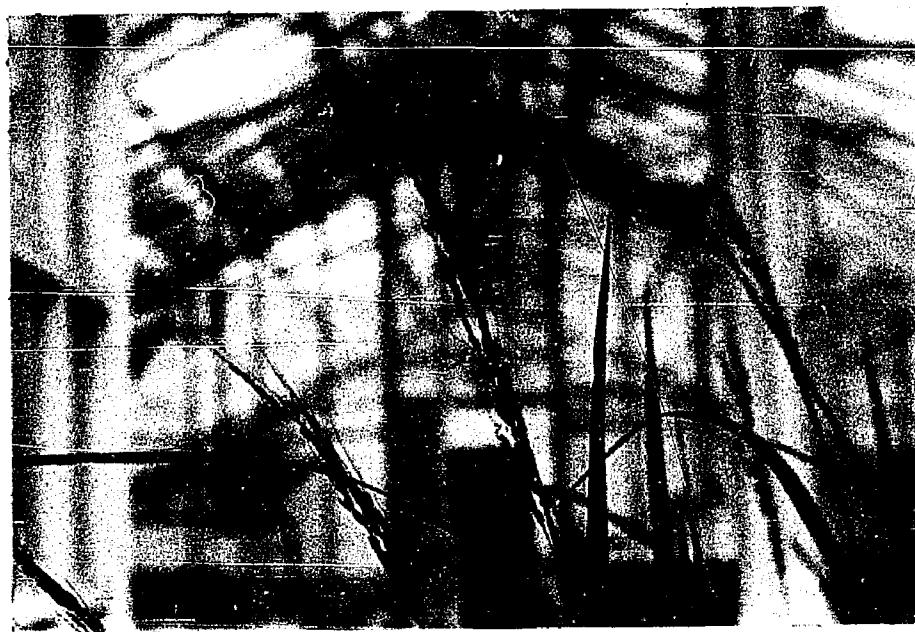
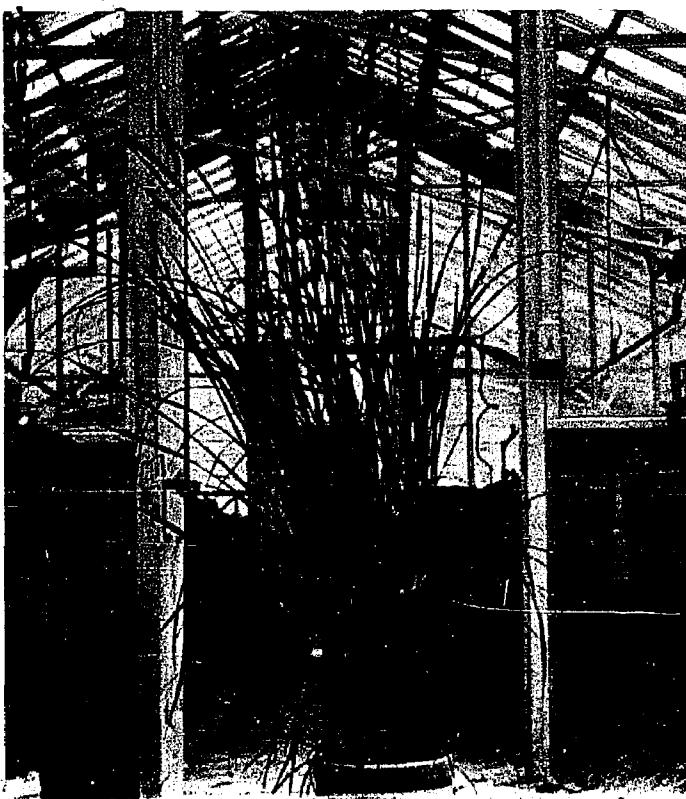


Fig. 2 O. sativa L. f. spontanea. Pictures taken at Louisiana State University Experiment Station, through the courtesy of Dr. M. T. Henderson.

in Asia and O. glaberrima of Africa have probably evolved by human selection from O. perennis (Fig. 3). They state:

"O. perennis has the widest distribution of all Oryza species, occurring in Asia, in Africa (recorded under O. barthii and O. dewildemanni) and in America. It is now known that it is widely distributed in India, in addition to Ceylon from where it has been recorded. The Daung Saba of Burma is probably O. perennis. It occurs in New Guinea also, as inferred from a packet of seeds received at Coimbatore from Fly River area, New Guinea. All other species of Oryza are restricted to one continent or other. O. perennis is 24 chromosomed. It has been hybridized with O. sativa and selfed progeny obtained at Coimbatore. The progeny showed a great range of variation, and significantly, some of the segregants closely resemble "spontanea" paddy."

On the basis of observation in Orissa, India, and experiments, Sampath and Govindaswami (1958, pp. 17-20) state further that spontanea probably has been derived through hybridization between cultivated rice and O. perennis.

Though the two schools differ in identifying the botanical progenitor of cultivated rice, they are generally agreed concerning the place of origin, partly because the areas of distribution of O. sativa f. spontanea and O. perennis are almost identical, except in tropical America.

The center of origin of the sativa section, according to Roschevitz (1931, p. 130), must have been Africa, as is supported by the greatest number of species: 7 species of the sativa section in Africa, and 3 species in Asia. However, the center of varietal diversity of both wild and cultivated rice is located in southeastern Asia. Roschevitz (1931, pp. 130-131) suggests that the botanical origin of cultivated rice was in India and Indo-China and not in Africa, the conclusion advocated by Watt (1891, p. 519).



Fig. 3 O. perennis. Shows its prostrate habit and a panicle with long awns. Photographs taken at L. S. U. Agricultural Experiment Station, through the courtesy of Dr. M. T. Henderson.

Vavilov (1949-50, pp. 14-54), who sought the hearth of cultivated plants by plotting varietal diversity, indicates eight possible areas of domestication. He attributes rice to the second hearth, that is, India, more precisely, Hindustan, including Burma and Assam, excepting north-western India. Recent works by Indian geneticists and rice breeders (Ramiah and Ghose, 1951, pp. 7-13; Chatterjee, 1947, pp. 234-237, and 1951, pp. 18-22), also suggest India and Indo-China, including the southern part of China, as the place of origin.

A word for rice, vrihi, first appearing in the Atharva-Veda, is accepted by many writers as the Sanskrit name for the grain. It is believed to be 3,000 years old, i.e., extending back to 1000 B.C. (Watt, 1891, p. 531). According to Watt, various names for wild and cultivated rice are mentioned in Sanskrit works: nivára for wild rice, and dhánya, vrihi, syáli, jiva-sadhana, tatoun, and shashtika for cultivated rice. He also states that most of these names are traceable to roots which denote life, existence, subsistence. They also reflect rice's use as one of the main offerings to Hindu gods, and ceremonial uses accompanying birth, marriage, and death. Watt (1891, p. 513) states:

"Most of these names are traceable to roots which denote life, existence, subsistence. Thus dhá means to support, conceive; it gave origin to dhátri a founder, a creator; to dháman, a dwelling-place, home; and ultimately to dhána, grain, i.e., rice. So in like manner jiva comes from jiv, to live. It would thus seem that in their origin, the Sanskrit names for rice were associated with the most primitive conceptions of the human mind, and hence it is just possible they may have matured into specific significance at comparatively later periods. At all events, we find even vrihi (which many writers accept as the most direct Sanskrit name for the grain) associated also with other food materials. Thus, for example, we meet with vrihi-kancana (a name synonym for masura) as denoting the pulse Lens esculenta, with vrihi-rajika, the millet Setaria italica, and vrihi-kanga, the millet Panicum milliaceum."

The basic significance of rice indicated above suggests an existence back to oldest antiquity, though words for rice do not appear in the older Vidic literature (Idem). The very diversity of words for rice speaks for its antiquity. Sanskrit terms distinguish three principal classes of rice: sali, that reaped in the cold season; vrihi, that ripening in the rainy season; and shashtika, or that grown in hot weather in lowlands (Ibid., pp. 512-513).

An extensive series of undoubted indigenous names occurs, not only for each form of cultivation, but also for every process in cultivation for all areas of southeastern Asia, India, and Cochin-China. Watt's illuminating chart (1891, p. 515), here reproduced, is a good example (Chart 2).

CHART 2

Parts indicated by names	Maldah*	Rangpur*
The seed.	Bihan	Bij or bichhán
Plants a foot high and ready for transplanting	Phúl	Neochá bichhán
Plants throwing out ears.	Gambhar	Kanch thor
When the ears have appeared . . .	Phulan	Phulan
When the substance, or as it is called, the milk, has formed in the grain	Dudhi-khotan	Dudh bhara
When the grain is ripening. . . .	Dhan	Kálá paká
When ready for reaping.	Pakká Dhán	Purá Paká
Unhusked rice	Dhán	Dhán
Husked rice	Chául	Chául
Husk.	Fus	Fus

CHART 2 (Cont'd)

Parts indicated by name	Maldah	Rangpur
Husked after being boiled.	Ushná chául
Husked after being simply soaked in water	Aroá	. . .
Husked after being ripened in the sun.	Atáp chául
Fragments of rice broken in husking.	Atap chaul
Boiled rice.	Bhát	Bhat
Boiled, then parched in flat pieces	Chirá	Chura
Rice soaked, boiled, dried, and husked; afterwards blown out by cooking in hot sand.	Muri	Muri
Rice husked in heated sand, the husk coming off naturally as the grain expands.	Khai	Khai or Lai
Cakes from rice flour.	Pishtak	Pithá
Spirits from rice.	Dhánimad	Denomad
Rice beer.	Pachwai	Pachwai
Liquor made of rice boiled with milk, sugar, ghi, and spices . . .	Paramanna	. . .
Rice mixed in water and left overnight until it becomes sour	Pantha bhat

*Maldah and Rangpur are both districts of the state of Bengal, India.

Most of the words for rice in India come from Sanskrit. Persian names for rice, brinj or grinj, and the Armenian name, brinj, are believed to have been derived from Sanskrit (Laufer, 1919, p. 373). More-

over, the modern European words for the grain are also traceable to Sanskrit. (Chart 3). However, recent works by Indians (Majundar, 1938, pp. 212-213; Chatterjee, 1951, pp. 20-21) suggest that modern European terms for rice and the Greek term Orysa may have been derived from the Dravidian (Tamil) term for rice, arisi, through ancient trade routes between India and Europe.

Indonesian terms for rice are quite different from those of Sanskrit derivation. They are much simpler than the terms used in India, Indo-China, and China. They are generally separated into two parts, parai or padi, and bras or beras. The former implies un-milled rice or rough rice, and the latter means milled rice. The English word 'paddy' is supposed to be derived from padi. Parai or padi and bras or beras have spread widely through the migrations of Indonesian peoples to most of the East Indies, the Philippines, Formosa, Madagascar, and parts of Indo-China, Tibet (Morinaga, 1957, p. 228); and probably through Spaniards to Mexico. In Indonesia, rice is connected with religious ceremonies, as among the Hindus. In Java, rice is considered to be the offspring of the goddess Dewie Srie (Grist, 1955, pp. 2-3).

In Indo-China and China, there are various terms for rice. The archaeologically oldest known Chinese script for rice, tau or tou (稻) and me (米), appears on the 'divination shell' from the findings at An Yang in northern Honan, the capital of the Shang (Yin) dynasty, 1400 B. C. - 1123 B. C. (Chen, 1953, pp. 2-3). Terms for rice in Korean and Japanese are related to the Chinese names, though the relationships are not clear.

Riso (Italian)

Riz (French)

Oryza or Oruzon - Oryza -
(Greek) (Latin) Rice (English)

vrihi - vrinzi or vrinza - uruzza or arruzza - Reis (German)
(Sanskrit) (Persian) (Aramaic)

Rouza or Oruza - Aroz
(Arabic) (Spanish)

CHART 3

<u>Chinese</u>	<u>Korean</u>	<u>Japanese</u>
me (米)	me or mi	mai or ku-me
nuwin, nwan, nun (暖, 暖, 稲)	ni of na-rak	nni, ini, ni, nei
tau or tou (稻)	dob	tou
sin (禾山)	i	ine or sine
...	pe	bo or ho (oka-bo)
ru (禾魯)
kau (稭)
...	...	uruchi

According to Matsumoto (Morinaga, 1957, p. 117), there are close relationships between the Mon-Khmer and Chinese terms for rice; namely, the initial letters of words in Chinese "D" (dou), "N" (nwin), "S" (sin), "R" (ru) are found similar to the words used by Mon-Khmer groups in Indo-China. Matsumoto further suggests similarities among Chinese, Siamese, and Tibeto-Burmese on his map (Morinaga, 1957, separate map). Some authors also notice a similarity between the Chinese and Sanskrit word for rice (dhan in Sanskrit, and dau or tau in Chinese), and also in Indonesian and Sanskrit (vrihi and bras). It is not certain as to which is the oldest word for rice. The Sanskrit word vrihi has, however, little chance of being oldest because it is believed that rice culture preceded the Aryan invasion (de Candolle, modern ed. 1904, p. 386). Indonesian terms may also not be the oldest, as evidenced by their simplicity as compared with the others. One may postulate one of the diverse mono-syllabic words for rice, one that is widely distributed from Assam to Cambodia, as the oldest, and as the source from which the three main present groups of terms are derived.

The oldest historical and archaeological records are found in China. According to de Candolle (1904, p. 385), to whom all later writers refer, rice played the principal part in the planting ceremony performed by the Emperor Chin-nong, 2800 B.C. The reigning emperor had to sow it himself, whereas the four other grains were sown by the princes of his family. The sativa from Yang Shao Tsun is believed to be the Japanica type or (Ando, 1951, p. 36), which is a later form of rice than Indica (Jodon, 1955, pp. 5-6). This suggests that the history of rice cultivation is older in southeastern Asia than Yang Shao Tsun culture,² at least earlier than 3000 B.C. (Andersson, 1934, p. 382).

In India, the oldest record of rice comes from the Atharva-Veda of about 1000 B.C. A recent archaeological study gives evidence of rice back to about 800 -500 B.C. in the upper Ganges valley (Wheeler, 1959, p. 129). The Old and New Testaments do not mention rice, while several passages in the Talmud relate to rice cultivation (de Candolle, 1904, p. 386). According to de Candolle, rice culture in India is later than in China, but earlier than the Aryan invasion. Possibly the nomadic Aryans got rice culture from Australoid tribes who were extensively distributed in India.

The most extreme diversity in modes of cultivation is found in India, on such varied terrain as the southeastern slopes of the Himalaya, the Ganges delta, and Assam (Gustchin, 1938, pp. 68-71). There are countless modes of cultivation to fit natural condition and cultural backgrounds: the most primitive swamp rice; broadcasting without previous preparation of fields; shifting slash-burn cultivation on mountain slopes and flat lands; floating rice on the deltaic plain; and advanced irrigated field cultivation, with transplanting and fertilization.

In summary, maximum biologic diversity of wild and cultivated rice, the most diverse linguistic forms, and a wide range of modes of cultivation are found in Southeast Asia, although archaeologic and historical records are not in conformity with these lines of evidence. Nevertheless, Southeast Asia, especially from Bengal to Indo-China, has many vast swamps with low, intervening mountains, a typical Asiatic monsoon climate with a year-round growing season, inundation of low areas for a growing period, and an annual dry season for the harvest. Conspicuous valley-and-hill topography provides diversity of plants and soils. It is very possible that the hearth of cultivated rice is one of the small stream valleys of southeastern Asia. Neolithic farmers in northern China knew rice before 3000 B.C.; possibly they were proto-Chinese. The first rice cultivator seems to have been neither Chinese nor Aryan. One of the neolithic Australoid or archaic Caucasoid peoples probably domesticated and cultivated rice along with their previously domesticated root crops. This superior new crop was introduced to Chinese and Aryans, and it was the latter who elaborated its cultivation techniques.

V. Domestication and Modes of Cultivation

Watt (1891, p. 56) believes that wild rice was collected in India as a prized luxury afforded only by the rich or by religious devotees, as early as the Vedic Age. Gathering of rice among aboriginal tribes in the tropics has often been noted. The native tribes of Australia continued gathering rice up to the end of the last century (Watt, 1891, p. 319); Sampath (1951, p. 15) observes that harvesting of wild rice is practiced in India even at present; and a similar account has been given for the eastern coast of Africa and Sudan (Leplae, 1936, pp. 6-7. Dresch, 1949, p. 296).

According to Raman,¹ collecting of wild rice is still carried on in interior, poorly accessible areas of Orissa state, India. In general, two ways of collecting wild rice are noted. In the areas where the stand is limited in extent, tribal peoples collect wild rice by striking the panicles of the plant with sticks, knocking the grains into winnowing baskets. The other method, observed in areas of extensive stands, involves a temporary pathway made in the middle of a thick growth of the wild rice. The harvesters place a long mat on the narrow path, bend the panicles to the ground, and with sticks strike off the grains onto the mat. These practices of collecting grains directly and easily from the wild plant without plucking the heads or harvesting the plant as a whole, as is done with cultivated rice, are both possible and necessary because wild rice shatters and spills its grains so readily.

As mentioned above, it is not known exactly who were the first domesticators of rice. However, it is very certain that the first rice cultivators were neither Chinese nor Aryans. The oldest archaeological

evidence of rice is in Yang Shao, and is believed to be proto-Chinese (Andersson, 1934, p. 382), while the dispersal of rice in India is thought to be earlier than the Aryan invasion. It seems more likely that the original domesticators were widely distributed in India and Southeast Asia. They may be identified with those who still exhibit wild-rice traits in India. It has been suggested by Sauer that the progenitors of rice culture were root-crop, perhaps taro, cultivators. According to his speculation (1952, p. 28), rice was a weed in the taro fields which was transplanted elsewhere during weeding. A grain crop was produced with partial extension of the vegetative planting habit learned earlier with taro.

Transplanting is a very common practice in Asia, especially with aquatic and semi-aquatic plants. Transplanting of vegetables from seed beds or from field thinning is a very common rainy-day occupation. Semi-aquatic plants like rice may have been domesticated by the process of transplanting seedlings to wet places. Rice seedlings acquired from root-crop fields or wild swampy areas, could have been planted on alluvial lands with a simple stick. In the case of inundated swampy areas, primitive peoples may have puddled the alluvial land with their feet, then the seedlings could have been planted without any implements, by thrusting them into soft soils with the fingers.

From such simple beginnings modes of rice culture have evolved through time to fit varied natural conditions and to conform to different cultural values. They may be divided into five major types: (1) swamp rice; (2) slash-burn, shifting cultivation; (3) sedentary rice culture with uncontrolled irrigation; (4) irrigated rice with broadcasting of seed; and (5) irrigated rice with transplanting of

seedlings.

Swamp rice. Man's first rice fields were perhaps swampy alluvial lands along small streams or rainy-season ponds where inundation occurred annually through monsoonal rainfall. Fields were prepared on low alluvial patches, puddling with the feet to clear the small weeds at the beginning of the rainy season. No levees were involved. Quite possibly seedlings were collected from field weeds or from swampy areas before making seed beds. Young plants were then set out with simple sticks, or without any implement, thrusting the seedlings into soft soils.

Dibbling of seeds just before the rainy season and broadcasting germinated seeds directly on the inundated fields without preparation may have extended to suitable habitats. During this stage no weeding and no irrigation were practiced. Needed water was supplied by natural flooding or rains.

Harvesting came in the dry season, a hand process that involved the plucking of rice heads and placing them in a basket. This very primitive method has been described by Camus (1921, p. 22) for the mountainous areas of the Philippines. An alternative method was that of rice heads gathered into bundles, likely possible because of the early selection of rice varieties less given to shattering, that is, ripened grains falling freely from the heads. Harvesting heads of rice rather than the whole plant is still a common practice in Indonesia, parts of Malaya, the Philippines, Madagascar, and Surinam, where there is partial retention of old ways.

Threshing was accomplished by tramping the rice heads on hard surfaces or in log canoes. Similar practices have been noted among Negro rice farmers of coastal Colombia (West, 1958, pp. 149-151). The

mortar and pestle may have been adapted in this stage to the husking and threshing of rice.

Slash-burn, shifting cultivation, the most primitive form of agriculture surviving to the present, is likely the second stage in the developmental sequences. Now the area of rice cultivation has been extended to tropical forest lands, where primitive peoples have easily tilled soils at their disposal. Underbrush is cleared and trees deadened by girdling; then the brush and grasses are burned in the dry season. The preparation of fields is the responsibility of the men; at the beginning of the summer monsoon women and children plant rice among the tree stumps. There is no preliminary preparation of the soil--no plowing, spading, or hoeing. Planting is simply making holes in the ground with pointed sticks - dibbles; three to ten grains of rice are dropped in each hole and covered with dirt by the dragging of the feet of the planter. The unfertilized land is not used more than three years, and is then abandoned to the forest (Camus, 1921, p. 22).

The slash-burn method differs from swamp cultivation in important respects: the clearing and burning of forests; cultivation without inundation; and direct planting of seeds rather than transplanting of seedlings. Dry-land fields are more suited to dibbling seeds than to the setting out of young plants. It is also possible that it was easy to obtain seed due to the development of varieties of rice less subject to shattering. Yields of rice are very uncertain in slash-burn agriculture, due to the fluctuation of precipitation during the growing season; i.e., precipitation is the most critical natural factor in this mode of cultivation. Present slash-burn cultivation and upland types of rice production are still found mainly in evenly distributed

and abundant rainfall areas, i.e., the southern slopes of the Himalaya, the mountain slopes of Indonesia, Madagascar, tropical Africa, and tropical America.

Sedentary rice culture with uncontrolled irrigation, the third stage, might have stemmed from both or either slash-burn and swamp-rice cultivation. The radical departures from previous methods are those brought about by the introduction of the plow from the west and the adoption of draft animals. The plow and animals permitted extension of rice culture into lowland soils. Fields were plowed and harrowed with animals. Fertilizer was used in rice fields in this stage. Levees were constructed to hold water as long as possible.

However, there is no artificial irrigation system in this stage. Direct precipitation, with associated overflow, is the only source of water supply. Rice so produced is often called 'Providence' rice in China, Korea, and Japan, since its culture depends wholly on monsoonal rainfall. An advantage of this method is the easy control of weeds by flooding. Slash-burn cultivation and upland-rice methods eliminate weeds by shifting cultivation. Uncertainty of yield, however, is still true of this third method, because rainfall remains the only means of water supply, as it is in upland rice. Most of the subsistence rice farming of Asia still falls in this stage.

Irrigated rice culture with seed broadcast is an advanced method over Providence rice. Uncertainty of water supply is overcome at this stage by artificial irrigation. Preparation of the field remains the same as with Providence rice. The only difference is the introduction of controlled irrigation. The most primitive form of irrigation may have been gravity flow from small streams with cuts and ditches to carry

water to the fields. Succeeding this is the reservoir method. Two types of reservoirs may be distinguished, seasonal and permanent. A seasonal reservoir is made after the rice harvest, and accumulates water during the non-growing season (Fig. 4). Some peoples conserve snow melt-water in early spring. The seasonal reservoir is opened with the preparation of the field, and, when empty, rice is also planted in the reservoir itself. Well-irrigation techniques and water-lifting devices were also developed or adopted during this stage.

Irrigated rice with transplanting is the most common procedure among the main rice-producing countries in Asia. Transplanting techniques have become a common practice in rice culture in comparatively recent times, although it is possibly the earliest form of cultivation. It seems to have been restricted originally to special habitats such as swampy alluvial lands along streams. Transplanting would become a common practice only as advanced implements, such as plows with iron shares, permitted movement into the plain from small stream valleys or hillsides.

One of the oldest agriculture books in China, Chimin-Yelshu, (about 400 A.D.) suggests that transplanting was practiced to control weeds (Ando, 1951, p. 72). Gustchin (1938, pp. 84-85) also attributes the main cause of transplanting to weed control, with other advantages such as (1) saving quantities of seed; (2) easy control of diseases in nursery beds; (3) start of culture before the rainy season; i.e., extension of the vegetative period. According to him, weeds can be controlled easily by plowing several times before transplanting. Transplanted rice seedlings prevent the maximum invasion of weeds, and



Fig. 4 Air view of seasonal reservoirs (white) for irrigation in Korea. Shows tiny, frozen rice fields (reservoirs) during winter, and upland fields for other grains.

may be planted in rows to aid any necessary weeding. It may be noted also that the transplanting method can utilize fields more effectively for double cropping or winter-crop cultivation. The growing period of winter crops, such as barley, can be extended for about 40 days during the nursery period of rice in Japan. Increase of yield through tillering (proliferation of stems) is also notable with this method.

However, transplanting has been practiced since the beginning of rice culture in Japan, as far as historical records show. Also, historical evidence fails to indicate that transplanting was initiated in Japan to control weeds (Ando, 1951, p. 72). It is believed that transplanting in Japan became popular only after the introduction of iron implements in about 400 A.D., which allowed deep plowing and the use of green manure. In Siam, the choice between transplanting and broadcasting rests on labor density, i.e., transplanting is practiced when labor is abundant, broadcasting when labor is limited (Morinaga, 1955, p. 46). Sauer (1952, p. 28) and Yanagida (Morinaga, 1955, p. 43) opposed the idea that the transplanting method is based entirely on its presumed essential place in rice cultivation. Transplanting is not restricted to rice cultivation. It is very common among cultivated aquatic plants in Asia. Sometimes every vegetable and garden crop is transplanted, crops such as Chinese cabbage, pepper, maize, squash, and eggplant. It has been suggested that transplanting is a partial retention of the traditional root-crop planting habit (Sauer, 1952, p. 28).

Preparation of the nursery bed is a painstaking process. Often the nursery bed has religious significance. In Japan there were formerly permanent nursery beds called Shinden or Misumida, situated on

headwater streams of unpolluted water (Morinaga, 1955, pp. 121-123). A tree often stands in a corner of the permanent nursery bed, a place for worship and offerings to the rice god (Morinaga, 1955, p. 122). With a few exceptions in Tohoku Province, these old-fashioned nursery beds have almost disappeared because of the efforts of the Department of Agriculture and Commerce in Japan for the last 50 years. Formerly no fertilizer was used in the nursery beds; now it is a common practice.

There are countless methods of preparing seed beds, varying from place to place and from culture to culture. However, each falls into one of three major types: wet, dry, and floating nurseries.

The most widely distributed is the wet nursery. Preparation of the nursery starts before the rainy season. Seed beds are located usually near streams or reservoirs in order to assure a water supply. Plowing and harrowing are done with animals; walkways are marked off with straw ropes to prevent tramping on the elongated raised seed beds. Seed is usually soaked—pre-germinated—then broadcast on the strips of the seed bed. No covering is needed. Duration of the nursery period depends on the rainfall season, about 40 days generally. In cold Korea, the young plants are protected from frost by deep nighttime flooding (Efferson, 1952, p. 4).

The dry nursery, or Rab, is used in western India because of water shortages in the early spring season. The seed bed is initially covered with a layer of dry grass, leaves, tree limbs, dried cowdung, and all other flammable materials. A fire is then set to the mass and it burns until converted to ash. The burning is done shortly before the rains are expected. The area is then lightly plowed, cross-plowed, and the seeds are sown. This procedure makes the soil fertile, loose,

and porous, so that the available moisture may be retained and the plants pulled up easily without injuring the roots (Efferson, 1952, p. 192; Copeland, 1924, pp. 271-273). The use of the dry nursery is also common in parts of Malaya, British Guiana, and on the saline soils of Sind (Grist, 1953, p. 116).

The third type of seed bed, a most distinctive one, is the floating nursery of India, Indonesia, and Indo-China. In parts of India, the seed bed is made by constructing a mat of logs and branches covered by a mud surface on which the seed are planted. When heavy monsoon rains come, the water rises from one to three feet a day; the seed beds rise with the water, float, and save the plants from destruction by flooding (Efferson, 1952, p. 4).

The preparation of fields and seed beds is usually the responsibility of men. Transplanting falls to the lot of women and children in most countries of Asia (Grist, 1953, p. 126). The common practice is to pull the seedlings, tie them with rice straw into bundles of convenient size for handling, then rinse the roots in water to remove the soil. Sometimes the tops are cut off a few inches to reduce evaporation and give rigidity to the plants, so that when transplanted the leaves do not bend over into the water. Bundles of seedlings are transported by boats (Fig. 5) through irrigation canals or carried in rattan baskets designed for free-air circulation to prevent overheating before planting. Mud sledges are also used to carry bundles of seedlings. Before transplanting, the field is plowed and puddled with harrows (Fig. 6). In case of a small area, the field is often puddled by humans. A bunch of seedlings is held in the left hand; from three to six are transferred at a time to the right hand and thrust into the

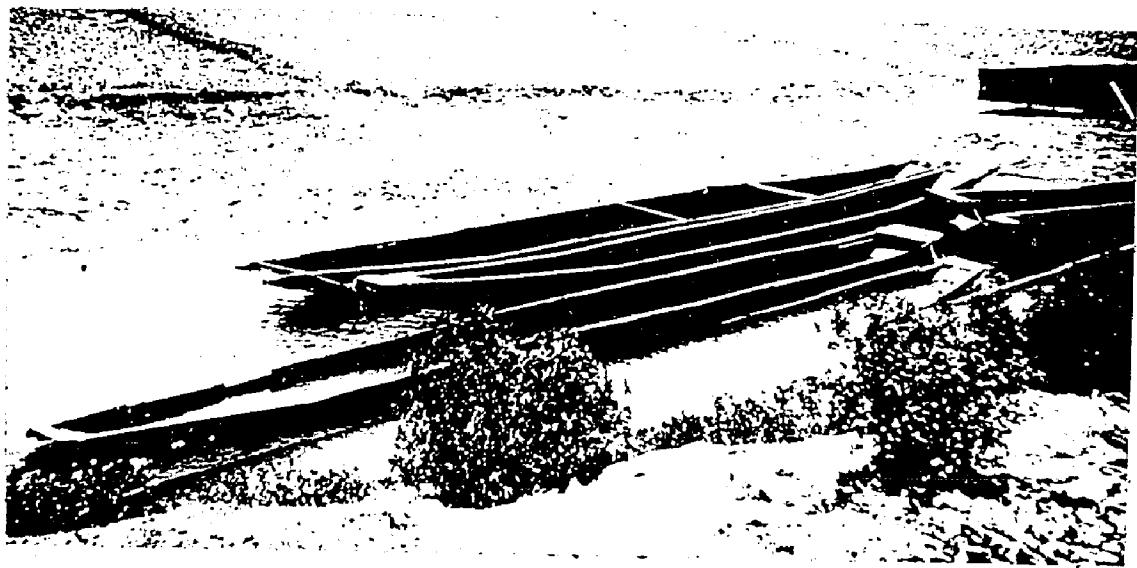


Fig. 5 Flatboats for transporting rice seedlings and harvested rice bundles, East Pakistan. Courtesy of Dr. W. G. McIntire.



Fig. 6 Harrowing rice fields in Ceylon. Photograph from the Rice News Teller, 1958.

mud (Fig. 7). The distance between the 'hills' of plants depends on the variety of rice, local conditions, and custom, usually between 4 and 12 inches (Grist, 1953, p. 126). Transplanting is practiced always while the planter moves backward. During the last 50 years Japanese have adopted the so-called rectangular planting, in which the interval between 'hills' is narrowed. The object is to give denser stands, and is said to be to give the plants sufficient sunlight despite their closeness. (Ibid., p. 127).

Weeding is done by hand or with a hoe. The actual operation varies from place to place. The simplest process is to pull the weeds out by hand, then throw them on the levees or tramp them down in the fields. Another method involves cultivation between hills with a hoe known as 'hom'i' in Korean. In Japan, the long-nailed rotary hand-rake has been adopted recently for weeding, replacing the simple hoe. According to Grist, the crop is usually weeded and the soil cultivated twice in China. This is done either by hand or by means of an implement similar to a miniature harrow, consisting of a flat piece of wood, just wide enough to be worked backwards and forwards between the rows, on which about a dozen curved tines, two to three inches long, are fixed. The board is attached at an angle to a long handle (Grist, 1953, p. 129).

Two principal methods of harvesting are practiced. One is done by removing rice heads with a hand knife and the other is by cutting the rice stalks as a whole. The former is followed mainly in Indonesia, parts of Malaya, and in the Philippines. The most primitive type described by Copeland (1924, pp. 236-237) is the removing of rice heads by the Tagalog² yatab, a knife about six inches long, fastened cross-wise in a short stick. The heads are then put into baskets and threshed



Fig. 7 Transplanting rice in Korea. Note bundles of rice seedlings behind the workers.

by tramping without preliminary curing. This primitive method is practiced only for badly shattering upland rice varieties grown for home use in the Philippines. Similar methods are used with bearded rice in Leyte in the Philippines, most of Indonesia, and parts of Malaya, where rice is harvested by cutting individual stalks about 15 inches below the head with the same yatab, the stalks then tied in bundles ranging in weight between 15 and 30 pounds (Efferson, 1952, p. 231). (Fig. 9).

The other method, cutting rice stalks whole, is a most common practice all over Asia and in parts of the New World (Fig. 8). Various implements are used to cut rice stalks, i.e., the caret, the Tagalog lingcao, and the sickle (Fig. 10). The caret is a small sickle or grass hook. It has various forms and is used for other purposes besides harvesting rice. The lingcao has a knife like that of the caret fastened into the back of a piece of wood bent in the form of a hook. This implement is the chief harvesting tool for the bearded rice of the leading rice-growing provinces of Luzon. The hook draws together a bunch of rice, which is held near the tip with the left hand, while the right turns the tool over and cuts the bunch off, with perhaps a foot of straw adhering (Copeland, 124, p. 237). The most widely distributed harvesting implement is the sickle. The way of cutting rice with a sickle is the same as the above described except that the sickle can cut without being turned over. The cut rice is bound into bundles and cured in stacks until it is brought to the threshing ground.

The threshing method varies also. The most primitive way is by tramping the paddy, by humans or animals, a method widespread in India and southeastern Asia (Figs. 11, 12). Threshing is done also by



Fig. 8 Field scene of harvest with sickle. Note cut rice on the stubble, Bihar, India. Courtesy of D. H. Grist.



Fig. 9 Indonesian girl in rice harvest. Note plucked rice heads in her left hand. Photograph from the Rice News Teller, 1958.

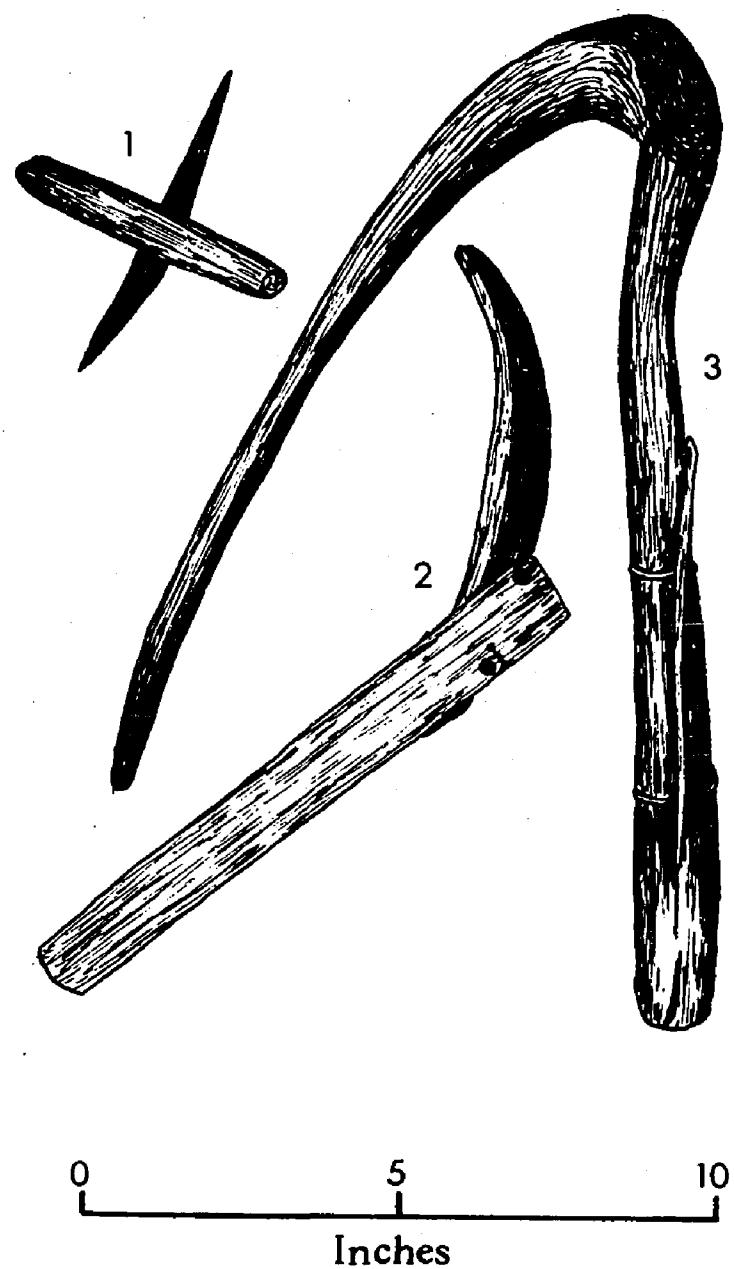


Fig. 10 Harvesting implements in Southeast Asia, 1. Yatab,
2. Caret, 3. Lingcao. Modified from Camus, 1921, p. 35.



Fig. 11 Threshing rice with feet, Kerala, India. Photograph from the Rice News Teller, 1959.



Fig. 12 Animal treading for threshing rice, Bihar, India.
Courtesy of D. H. Grist.

beating the paddy on a round log, and by beating it with sticks and flails (Fig. 13). Mortar and pestle are common implements in areas where rice is harvested by removing the heads of the plant alone.

Winnowing is done usually by tossing the paddy in the air or gently shaking it off the winnowing tray against the wind (Fig. 14). The seeds fall on the mat; husk and the chaff are carried away by the wind.

Universally in Asia, the crop retained for home consumption is in the form of paddy or rough rice, owing to the inferior conserving quality of milled rice and the nature of native husking implements. The common and widespread implements are mortar and pestle made of wood or sometimes a stone pestle with a wooden handle. Mortar and pestle are worked by hand, foot, or water power. The milling is practiced usually by women daily, or as they need rice for food. In the hand-worked type, the pestles are about 4- to 6-feet long and usually made of dense hardwood. Often, two or three women work together at the same time, each with a pestle, pounding alternately. When worked by foot the pestle is on a fulcrum. The pestle is about a foot long and is fixed on the underside of a beam of wood. The fulcrum is located about two-thirds along the beam, away from the pestle. Sometimes a large stone or a heavy piece of wood may be tied on the beam above the pestle, to give added weight to the pounding of the paddy. The worker presses the end of the beam down with his foot, thus raising the pestle. On releasing the foot the pestle falls on the paddy in the mortar. This process is repeated until the husk is removed, leaving the rice. Winnowing follows, the baskets for the purpose having various shapes. This practice is widely spread all over Asia and partially in America. Water power is sometimes harnessed



Fig. 13 Threshing rice by beating with a simple stick, Ceylon.
Photograph from the Rice News Teller, 1958.



Fig. 14 Winnowing rice in breeze, India. Photograph from
the Rice News Teller, 1958.

to work a pestle.

Another type of husking employs a rotary pit-mill, consisting of two portions of the trunk of a tree, superimposed vertically. The superimposed surface of upper and lower portions of the wooden trunk have serrated surfaces so that paddy may be hulled by the rotary action of the upper portion against the fixed position of the lower. The upper contains a receptacle for the paddy, through the bottom of which is a hole leading to the juncture of the upper and lower "stones." Paddy is placed in the receptacle at the top. The worker then pushes and pulls alternately a handle a foot or more in length, or handles, which are fixed on the side of the upper "stone." The rotary mill is widely distributed in Asia, though it is not so common as the mortar and pestle. The rotary mill has a higher efficiency in husking rice than does the mortar and pestle, but polishing of rice is always done with the latter.

VI. Diffusion

Both natural and cultural factors are responsible for the diffusion of rice. Evaluation of the individual factors is difficult to make. Natural conditions, such as flatness of terrain and claypan soils, are the controlling elements in the prairies of Louisiana and the Texas coast, where highly mechanized cultivation is practiced, whereas they are not significant in oriental countries such as Japan and south China. These specific natural factors were not at all significant in rice cultivation even in the Louisiana of about sixty years ago. The distribution of marais, shallow depressions, was the fundamental natural factor in rice cultivation in the prairies of Louisiana before the coming of northern wheat farmers. Natural conditions responsible for the world distribution of rice have now been largely supplanted by cultural factors such as the development of new varieties, the improvement of techniques, and the use of new tools.

Migration of peoples as a means of spreading culture is, therefore, the most important process in explaining the present distribution of cultivated rice. As has been seen, before the arrival of Aryans, rice spread primarily through archaic Caucasoids into India and south China. Malayo-Polynesians are responsible for the dispersal of rice to Indonesia, possibly as far east as New Caledonia, and to Madagascar. The Arabs carried rice into Mediterranean areas and eastern Africa. Aryans and Chinese expanded rice production into lowlands with the introduction of the plow from the west, and elaborated the techniques of its culture.

Natural factors may vary in space, but are relatively stable in time, while cultural factors vary with both space and time. The chief

groups of natural conditions responsible for the distribution of rice are:

1. Availability of water—fresh-water swamps, local rainfall, surface and underground water resources.
2. Length of growing season.
3. High temperature during growing season.
4. Soils and relief.

Availability of water is one of the most important elements in rice cultivation, though the water requirement of rice is less than one usually thinks. According to Sturgis (1957, p. 658), rice does not naturally need the flooding, which usually amounts to a depth of 3 to 9 inches during most of the growing season. Flooding of fields insures the needed moisture, but is primarily to control weeds. The amount of water required to produce rice varies with the rate of evaporation, soils, and irrigation techniques: about 30 inches in Arkansas, 48 inches in Louisiana and Texas, and about 46 to 96 inches in California, which must be provided by either rainfall at the proper season or irrigation (Sturgis, 1957, p. 658; Adair and Engler, 1955, p. 390). In southern China, according to Tang (1957, p. 145), about 25 inches of water are required to grow rice.

Prior to the adoption of irrigation techniques, fresh-water swamps and local rainfall were the only available water resources for the crop. Swamp-rice, which was probably the most primitive stage of rice culture, depended wholly upon the fluctuation of water level of swamps. Local rainfall is still one of the most important natural factors in rice cultivation in areas of slash-burn agriculture in tropical Asia, Africa, and America, as well as in Providence-rice areas of Asia. Distribution of upland rice in Japan is also closely associated with foothills of Pacific coastal plains where abundant rain falls during the

growing season (Morinaga, 1955, p. 17).

Invention of irrigation techniques has changed the value of water resources for rice cultivation. The adoption of permanent or seasonal reservoirs and use of surface streams for irrigation expanded the areas suitable for rice cultivation. Tiny stream valleys were suitable for rice fields with simple irrigation techniques. However, availability of water supply effects sharp distinction in land use between rice and upland crops: lowlands for rice and uplands for other crops (Figs. 15, 16). Further, due to the development of well irrigation techniques, underground water resources are added to surface-water resources for rice cultivation. Recent developments of rice culture in Arkansas and the prairies of southwestern Louisiana are good examples.¹

The development of early and resistant varieties for cold climates reduced the importance of length of growing season. However, length of growing season is still one of the most important factors in rice cultivation in the higher latitudes. In Hokkaido, one of the earliest varieties in Japan, Norin-11, needs a growing season of from 100 to 110 days² (Morinaga, 1957, pp. 46-47). It is said that Norin-11 was once grown as far north as 55 degrees in Manchuria (Idem). According to Brjezitsky (1933, p. 179), rice grows as far north as 49 degrees in eastern Siberia since the introduction of an early Japanese variety between 1816 and 1819. He (Ibid., p. 180) mentions further that if varieties requiring a 60-to-75-day growing period are developed, rice will grow as far north as 55 degrees in central Asia. However, in general most rice is grown in areas of over 150 days growing season.

High temperatures during the growing season are most desirable. Optimum temperatures of the growing season are from 22°C. to 30°C.



Fig. 15 Aerial view of rice terraces in Korea. Note sharp distinction between rice fields and upland fields.



Fig. 16 Rice terraces and upland fields in Korea. Note inundated rice fields along the valley where water supply is readily available from streams or by making seasonal reservoirs. Upland fields are shown on slopes of hills.

(about 72 - 91°F.). During the growing season, most varieties of rice need an accumulated temperature of from 3,500°C. to 4,500°C. (about 6,332-8,132°F.). In general, important rice-growing areas in higher latitudes are marked by high summer temperatures: Asahigawa Basin in Hokkaido, Manchuria, and central Asia.

Soils and relief are less important as limiting factors of rice cultivation than are the above mentioned. However, soils and relief play a very significant role in commercial cultivation in the United States and other areas of large-scale cultivation.

The cultural factors responsible for the diffusion and distribution of rice may be placed under several headings:

1. Migrations of peoples who have a rice complex.
2. Technological competence, including availability of power and tools.
3. Special techniques for rice cultivation, such as terracing, levee making, irrigation, sowing, transplanting, threshing, and milling.
4. Selection or breeding of new varieties fitted to different conditions.

For convenience, the progressive diffusion of rice may be divided into four stages: 1) tropical savanna and monsoon areas; 2) temperate monsoon and part of western India; 3) the Near East and the Mediterranean; 4) Africa.

Tropical savanna and monsoon areas

Rice culture originated in small stream valleys and on the hill-sides of Southeast Asia. Rice spread first through the migration of peoples and the diffusion of ideas to areas of similar natural conditions: annual rainfall about forty inches, hot growing season all year round, and sandy to silty soils, except for the heavy soils of lowlands. At

this stage no irrigation techniques had been developed except that of utilizing natural flooding. No varieties had been developed suitable to a long-day, short growing season. The controlling natural factors persisted for centuries, or until the advancement of the cultural level to the development of new varieties for temperate climates and the introduction of irrigation techniques.

Rice culture was carried to southern China by archaic Caucasoid tribes before the arrival of the Han Chinese people. It is thought that rice culture spread to the Philippines through immigrants from southern China around the second millennium B.C., before the arrival of the Malays. The present rice cultivators of the Philippines, thought to be descendants of the original immigrants from China, continue to cultivate rice by a most primitive method.

From the mainland of Southeast Asia, rice culture spread toward the south and east through the Malay archipelago with the flow of human culture. It is believed that rice culture was introduced into Indonesia by immigrants from the mainland about 1500 B.C. (Grist, 1955, p. 3). At an early date, rice possibly diffused east of Indonesia through migration of Malayo-Polynesians as far east as New Caledonia. But in the eastern part of Indonesia, eastward from Borneo, sago rather than rice remains the staple food. It seems that rice had spread as a basic food only to the west of New Guinea prior to European arrival. Rice was introduced or re-introduced to New Guinea by Germans, and to New Caledonia by the French during the 19th century (Grist, 1955, p. 4). In the Hawaiian Islands rice growing began only with the first importation of Chinese labor for sugar plantations in 1852 (Coulter and Chun, 1937, pp. 9-13).

Rice spread from Bengal westward and toward the southwest along the Coromandel Coast. It then spread westward, possibly before the Aryan invasion. In Ceylon, rice has been grown since prehistoric times, before 543 B.C. The earliest references to tanks for irrigation in Ceylon are for about 420 B.C. (Grist, 1955, p. 3).

It is thought that, with the aid of the equatorial winds and currents, Malayo-Polynesians had frequent contact with Madagascar (Ratzel, 1896, vol. 1, p. 456; and Britannica, 1959, v. 14, pp. 600-605). They are possibly the first ones who, about 1000 B.C., brought rice to Madagascar. The Hova, later immigrants from Malaya, are cultivators of rice in the central plateau. Shifting, slash-burn culture and sowing on small ponds without cultivation are common techniques used by the Hova in mountain areas. The Hova's technique of harvesting is more like that of Malays than that of India, i.e., plucking heads of rice rather than cutting rice stalks as a whole (Leroy, 1926, pp. 69-87).

To summarize, rice was carried at an early date from Southeast Asia to southern China and the Philippines by proto-Chinese such as the Miao and the Lolo. Westward dispersal of rice to eastern India, coastal western India, and Ceylon came before the Aryan invasion of India, and by the archaic Caucasoids. Malayo-Polynesians spread rice to Indonesia and possibly as far east as New Caledonia, though the evidence is not clear. It was also Malayo-Polynesians who first brought rice to Madagascar in prehistoric times.

Temperate monsoon area: China, Korea, and Japan.

Development of techniques for conserving water for longer periods by making levees and terraces, the introduction of artificial irrigation, and the development of new varieties for the long-day, short growing

season were necessary to extend rice culture gradually into the temperate zone of Asia and the dry areas of western India.

Rice culture did not spread from southeastern Asia to China through the Han Chinese. The earliest archaeological evidence of rice has been found at Yang Shao, Honan Province, China; imprints of a rice plant on a fragment of a painted jar from Yang Shao have been identified by the Swedish botanists, G. Edman and E. Soderberg, as husks of cultivated rice, Oryza sativa (Andersson, 1934, pp. 335-336). According to Andersson (p. 382), Yang Shao culture represents the close of the latest Stone Age and perhaps even the beginning of the Metal Age, about 3000 B.C. It is believed that Yang Shao culture is that of proto-Chinese, quite different from the culture of An Yang (1400-1123 B.C.), the capital of the small kingdom which shows the main characteristics of the historic Chinese. It is not clear, however, who were the originators of Yang Shao culture, and how rice reached Yang Shao in the Hwang Ho valley.

There are two possible routes by which rice may have entered northern China; the Miao may have brought rice to northern China from South China through river routes which were the main historical links between north and south.³ The other possibility is the coastal route used by the Mon-Khmer, who were once widely spread in the coastal area of China (Ando, pp. 30-31).

Rice culture, however, has never played a significant role north of the Tsinling divide, a most significant cultural and natural boundary in China. Millet, wheat, and sorghum are staple foods in northern China, as is rice south of the Tsingling. Natural factors alone fail to explain the absence of rice on the northern coast of China. It may be explained by the resistance to a new culture and only partly by climate disadvantages.

Proportions of rice acreage in the total cultivated land are only 2 per cent north of the Yangtze Kiang, and 42 per cent south of the Yangtze (Chen, 1953, p. 1).

The history of rice between the Yang Shao and An Yang cultures is not known. The first evidence of the Chinese written character for rice and paddy appeared in the findings of An Yang. It is believed that the people of An Yang (Yin) and Chu cultivated rice and spread it to the west coast of Korea, around Pyong Yang, the old Han colony (108 B.C. - 300 A.D.) (Morinaga, 1957, p. 191).

During recent years, especially after World War II, the Japanese have sought out the ancient culture history of rice in Japan in order to interpret Japanese history, especially the routes of migration. To summarize the studies, there are three possible avenues of introduction of rice into Japan: 1) the northern route from northern China to Japan through Korea; 2) from Southeast Asia to Japan, with human migration controlled by ocean currents or the presence of islands; 3) from central China, south of the Yangtze, to northern Kyushu and southern Korea via the sea.

The northern route through Korea is the orthodox one. Traditionally, historians have assumed culture streams from northern China to Korea and Japan. Hamada (1935, pp. 1641-1652, 1863-1872), a proponent of the northern route for rice introduction into Japan, advocates this route on the following grounds: 1) The remains of rice hulls found on pottery, as well as ancient carbonized rice, are very similar to the cultivated rice of today in Japan. Botanically, while present-day rice in Japan, Korea, and northern and central China is similar, southern China has more of the type Indica than of the type Japonica to which

present Japanese rice belongs. 2) Linguistically, the name of rice in Miao, tsuo, and the Chinese term, tao, may have come from a common word. Hamada also points out the relationship between the Indian term for rice, dhan, and the ancient Chinese term, dau, as well as similarities between pe in Korean and the suffixes of the Japanese oka-bo and mizu-fo. However, he accepts some southern Chinese influence, as revealed by linguistic evidence, such as sin in Cantonese and ini in the Ryukyu Islands as the words for rice. 3) Historically, he selected the areas of ancient rice culture in China and plotted them on a map (Hamada, 1835, p. 1648). He assumed from the map two main routes of rice introduction from India and southeastern Asia into China: 1) the Burma - Yunnan - Szechwan and Kweichow route; and 2) French Indo-China - Canton - Fukien and Formosa - Yangtze valley - Hwang Ho valley. He suggests dispersal from northern China to northern Korea by sea: Shantung peninsula - Liaotung - Korea, and a land route: northern China to northern Korea through southern Manchuria, during the Han dynasty.

The Japanese invasion of southern Korea at the time of the Empress Jingō (200 A.D.) may have been significant for rice introduction from southern Korea to Japan. Based on this evidence, Hamada concluded that one of the most important routes of rice introduction was from northern China to Japan through Korea.

Ando (1951, pp. 14-17) questioned the northern route of introduction, listing two points: 1) Rice was not a staple crop in northern China; and 2) there is no linguistic relationship between terms for rice in northern China and the northern part of Korea.

One of the proponents of the southern route, Suga, (1944, pp. 395-400, 485-588), based his assumption on the following facts: 1) possi-

bilities of drifting from Southeast Asia to Japan with the ocean current, Kuroshio; 2) archaeologically, the pottery of the Yayoi-shiki culture shows characteristics of the southeastern Asiatic culture, especially in the pointed-bottom pot with a small hole in the bottom for steaming rice. He believes that Indonesians and the Miao may have landed first in the southern part of Kyushu with their pottery and rice seeds.

This southern route has been questioned because southern China grows mostly Indica-type rice and not the Japonica-type (Ando, 1951, p. 37). Another possible route, from Formosa to Japan through the islands, has also been disproved through the negative linguistic evidence as between Formosa and the Ryukyu Islands (Ando, 1951, pp. 38-40).

The third route, from the coast south of the Yangtze to northern Kyushu with the Tsushima current, or to southern Korea, is proposed by Ando (Ando, 1951, pp. 40-52) on the following bases: 1) The route is a very easy seaway from central and southern China to Japan.⁴ 2) The region south of the Yangtze Kiang has been an area of Japonica-type rice (about 65 per cent of the total product) for a long time. The remnants of rough rice on pottery of the Yayoi-shiki culture (200 - 300 B.C.) show the same type of rice as in the South China region mentioned above. 3) Early migrants from an area south of Japan are believed to have come from the coast south of the Yangtze according to archaeologists Torii (cited from Suga and Ono) and Nishimura (cited from A Dictionary of Japan, Vol. 1).

Another interesting view is expressed by the Japanese folklorist, Yanagita (Morinaga, 1955, pp. 79-149). He bases his hypothesis mainly on ancient supply routes of cowries, customs, religious beliefs and practices, and cultivation techniques of rice culture. According to

him, the earliest rice in Japan was red rice, which is still cultivated in isolated places like Tanega-shima and Tsushima (Tsu Islands) as an offering to the gods. The routes of migration, according to Yanagita, are closely connected with the ancient supply routes of cowrie, which had been used widely in China as money, ornaments, and amulets since pre-historic times. The southern islands of the Ryukyu were the nearest cowrie-producing area (Jackson, 1917, p. 24) to China proper. According to Yanagita, the precious cowrie caused casual drifters to return to the islands with their families, taking with them seeds such as rice. Place names meaning rice in the old Japanese language, kumi, komi, are also noted on the west coast of the Ryukyu Islands and Kyushu. Elaborate rituals for the rice gods are found in this area also. Basing his opinion on the above facts, Yanagita thinks rice first arrived from southern China in the southern parts of the Ryukyu, the Yahe-shima, then gradually spread north in order to make use of better growing areas.

As mentioned above, the dispersal routes from China to Korea and Japan are still disputed. It seems that the above three possible routes are not contradictory but are supplementary. It has not been proved which route was the earliest, nor which was the main route of rice introduction into Korea and Japan. Recent studies favor two routes of introduction into Korea: one, from northern China to northern Korea; and the other from central China to southern Korea, separately, but at about the same time, around 200-300 B.C..

In the case of Japan, dispersal routes of rice seem to be more complicated than in the case of Korea. Possibly from southern Korea or directly from central China, the first rice complex arrived in the northern part of Kyushu about the time of Yayoi-shiki culture, around

200-300 B.C. The types were the short-grain or the so-called Japonica rice, and the round-type rice (Morinaga, 1957, p. 172). The former type has become gradually more popular and has spread toward the east along the Pacific coast. About the 4th or 5th century A.D. rice reached the Nara basin, central Japan, and around the 7th century A.D. it reached Fukushima in northern Japan. Japanese penetration since the 19th century has extended rice culture into Hokkaido, except for the northeastern section of the island.

Irrigated-rice culture was brought to Manchuria with the penetration of Koreans along the Duman (Tyumen) tributaries of the country's southeastern border in the early part of the 18th century. Koreans brought rice into the maritime sections of Siberia in the early part of the 19th century, and extended it farther north with the introduction of early Japanese varieties of rice (Brjezitsky, 1933, pp. 177-181; Morinaga, 1957, p. 47).

Western Part of India

Rice seems to have been diffused toward the west from Bengal in two ways: 1) along the southern slopes of the Himalaya; and 2) along the west coast of the Bay of Bengal toward the south. The earliest diffusion of rice may have included the eastern half of India and the elongated southern slopes of the Himalaya. Although direct archaeological and historical evidences are lacking, it is thought that rice culture spread west of India prior to the Aryan invasion, about 1500 B.C. (de Condolle, 1904, p. 386).

The Arabic scholar, Lyall, quoted by Watt (1891, p. 518), states that the Persians did not borrow the cultivation of rice from India, but that rice cultivation existed in the tract where the two races dwelt

together before the Indo-Aryans descended to the plains of the Panjab.

He bases this conclusion on linguistic evidence:

"The Aramaic form in use in Babylonia was uruzza or aruzza, evidently the original of the Greek oryza. It was here, and not in Bactriana, that the Greeks first became acquainted with the grain and the name. The Aramaic name was evidently borrowed from the Persian. I am not aware of any example in old Persian virinj; but the Arabo-Aramaic forms clearly point to vrinzi or vrinza as this origin. This is confirmed by the Armenian brinz, the Pushtu wrizha, and the Khowar grinji (g initial pointing to an older w).

Now vrinzi is exactly the equivalent we should expect of the Sanskrit vrihi. H in Sanskrit regularly appears as z in old Persian (sahasra = hazanra; hima = zima; hridaya = zereda, etc.). But Persian words containing z corresponding to Sanskrit h are not loan-words from Sanskrit, but sister words. They point to the time when the two branches of the Aryan race dwelt together and respectively developed their phonetic peculiarities from a pre-existing original tongue common to both. It is certain, therefore, from a comparison of virinzi and vrihi, that the Persians did not borrow the cultivation of rice from India, but that that cultivation existed in the tract where the two races dwelt together, before the Indo-Aryans descended to the plains of the Panjab or the Perso-Aryans occupied Airyana or Bran. If this tract was Bactriana, which Strabo mentions as a great rice country, the name may have originated there . . ." (Watt, 1891, p. 518).

Lyall suggests further that Bactriana, the area about Samarkand, which Strabo mentioned as a great rice country, may be the place from which the Persians and Indians separated. If the above argument of Lyall is taken as true, rice cultivation existed in Bactriana prior to 1000 B.C., possibly 2000 - 3000 B.C. The climatic conditions of Bactriana, hot and with summer rainfall, favor the practice of rice culture, which may have reached there along the southern slopes of the Himalaya. The main objection to this hypothesis is the fact that rice is not mentioned in the earliest Vedas. But it may be possible that a pastoral people like the early Aryan invaders did not appreciate its importance until they became localized and began agricultural pursuits (Watt, 1891, p. 519).

Near East and Mediterranean Areas

Rice did not reach west of the Indus until comparatively late, due partly to the climatic barrier and the already-established wheat culture.

According to Grist (1953, p. 4), Theophrastus, born about 375 B.C., refers to the cultivation of rice in Egypt, and Diodore of Sicily, a contemporary of Augustus, describes the rice plant and its cultivation according to information from Aristobulus, who took part in the expedition of Alexander to the Indus circa 344-324 B.C. Aristobulus states that rice grew in Bactriana, Babylonia, and Susiana (Laufer, 1919, p. 372).

Rice was therefore known to ancient Greeks and Romans after Alexander's expedition to India about the 4th century B.C. Historical records do not mention how and when rice reached Bactriana, the Indus valley, and Babylonia. It seems that rice reached Bactriana at a comparatively early date, possibly before the Aryan invasion of India. Spread of rice culture into the Indus and Babylonia dates before Alexander's expedition, possibly between 500 and 1000 B.C. If Lyall's conjecture is accepted, the Persians learned rice culture from Bactriana, and the Greeks and the Arabs learned rice culture from Babylonia (Watt, 1891, p. 518).

There were possibly two early diffusion routes of rice to the Middle East: 1) along the southern slope of the Himalaya to Bactriana, thence to Armenia via the southern coast of the Caspian Sea; 2) southwestern India to the Indus valley by sea, then along the southern coast of Iran to Mesopotamia. Rice culture, however, was not common in Persia and Babylonia before the Arabic period (Laufer, 1919, pp. 372-373).

Rice spread to Syria around the beginning of the Christian Era

(de Candolle, 1904, p. 386). The Arabs re-introduced rice into Egypt in the 7th century, and the Moors brought it to Spain about the beginning of the 8th (Grist, 1955, p. 4; Crist, 1957, p. 66). The Moors developed rice culture on the lowlands of Valencia, in the "huertas,"⁵ which were drained and irrigated under a high standard of agricultural practice. Valencia, while it was an unimportant area during the Roman regime, developed rapidly as a great agricultural center with the introduction of rice culture (Crist, 1957, pp. 66-74).

The Spaniards brought rice to Italy in the 15th century. The first authentic mention of its cultivation there is for Milan in 1475 (Grist, 1953, p. 4). It was closely connected with the construction of irrigation canals in Lombardia and Piemonte (Efferson, 1952, p. 258).

It is believed that rice was brought by Arabs into southern France about the 15th century. However, its successful introduction was not made until 1884 in fresh-water areas of the Camargue in the Rhone delta (Lami, 1928, pp. 25-26). Rice reached Portugal at the beginning of the 14th century, possibly by Arab introduction. There it has been grown with hand labor since its introduction on the irrigated fields of three river valleys (Benoliel, 1928, pp. 137-160). According to Benoliel, most rice is of the red varieties because the Portuguese prefer their flavor. Techniques of rice culture are very similar to those of southeastern Asia: hand sown from a boat; small fields plowed with wooden plows; moldboard wooden plow with front wheels also used; harvested with sickles; threshed by tramping with horses.

Africa

Rice, was possibly first brought to East Africa by Arabs, Baluchistane, or Indians, all of whom frequented East Africa after the 11th century

(Leplae, 1936, p. 4). Slash-burn, shifting cultivation has been a main type of rice culture, though irrigated lowland rice has also been produced along the stream valleys (Ibid., p. 7). The technique of harvesting rice heads rather than whole stalks is the same as that of Madagascar and Indonesia.

Rice was grown only along the coast of East Africa until penetration of the interior by Arabic merchants at the beginning of the 19th century. According to Leplae (Ibid., pp. 4-6), the Arabs brought rice to Ujiji, on the eastern shore of Lake Tanganyika, about 1840, then to Luenda near Lake Mweru about 1846. Livingston found rice cultivation around Maniem, at the northern end of Lake Tanganyika, in 1870. It was not until the beginning of the 20th century that the Kasai area and upper reaches of the Congo River knew rice culture.

The Portuguesees introduced rice to Angola from East Africa and possibly brought rice to the Belgian Congo about the beginning of this century. Rice culture in West Africa is more important than one may generally think. Rice is a principal native food in the valley of the Niger from the Guinea plateau to the Territory of Nigeria, and in the coastal areas from Senegal to Sierra Leone (Dresch, 1949, p. 295).

Slash-burn, shifting cultivation is a common technique of rice culture in the highlands of the tropical rainforest (Fig. 17). North of the 40-inch annual isohyet, dry rice culture is impossible. Rice culture in the interior delta or the bend of the Niger is limited to the swamp areas along the river, and to rainy-season ponds (Ibid., p. 296). Seeds are broadcast on the bottom or slopes of the ponds, depending on the duration of inundation. Seeds are sown on the bottom or center where inundation is seasonal only, or on the slopes if stagnant water is present



Fig. 17 Slash-burn rice field in Sierra Leone. Note young rice plants among the shrub stumps. Courtesy of Dr. R. C. West.

all year round. Seasons of sowing and harvesting vary according to the flood season; in the upper Niger valley, rice is sown at the end of June and harvested between November and December (Ibid., p. 299).

Along the coastal areas from Gambia to Sierra Leone, special techniques of rice culture in the brackish marshes have been developed. Rice fields are found in the swampy land near the estuaries of small streams. Brackish-water invasions of fields are prevented by dikes. Water gates in the dikes are open at low tide to drain excess fresh water, and are closed at high tide to prevent salt-water invasion. The fields are divided by small canals following contour lines and irrigated by small canals from the stream.

In all cases of brackish soils, there is transplanting to furrows which are made by a special native implement called kayondo, a large wooden spade about six feet long with an iron tip and provided with a long handle. Preparation of the field, especially use of the kayondo, is a responsibility of the men. Making seed beds and transplanting are done by women. Transplanting is primarily limited to the brackish-soil areas. Use of fertilizer, such as refuse from the village and ashes, has been noted (Paulme, 1957, pp. 257-298; Dresch, 1949, p. 301).

Rice is closely integrated with native social and religious customs; it is a symbol of wealth, as is the ownership of cattle. In the initiation ceremony, a circumcised youth is thrown into the rice field. The rice field is a carefully delimited family property protected by fetish sticks (Dresch, 1949, p. 310).

The basic similarity of techniques of growing rice among various African tribes and its religious importance suggest an early diffusion from Asia. Rice culture and the advanced techniques seem to have been

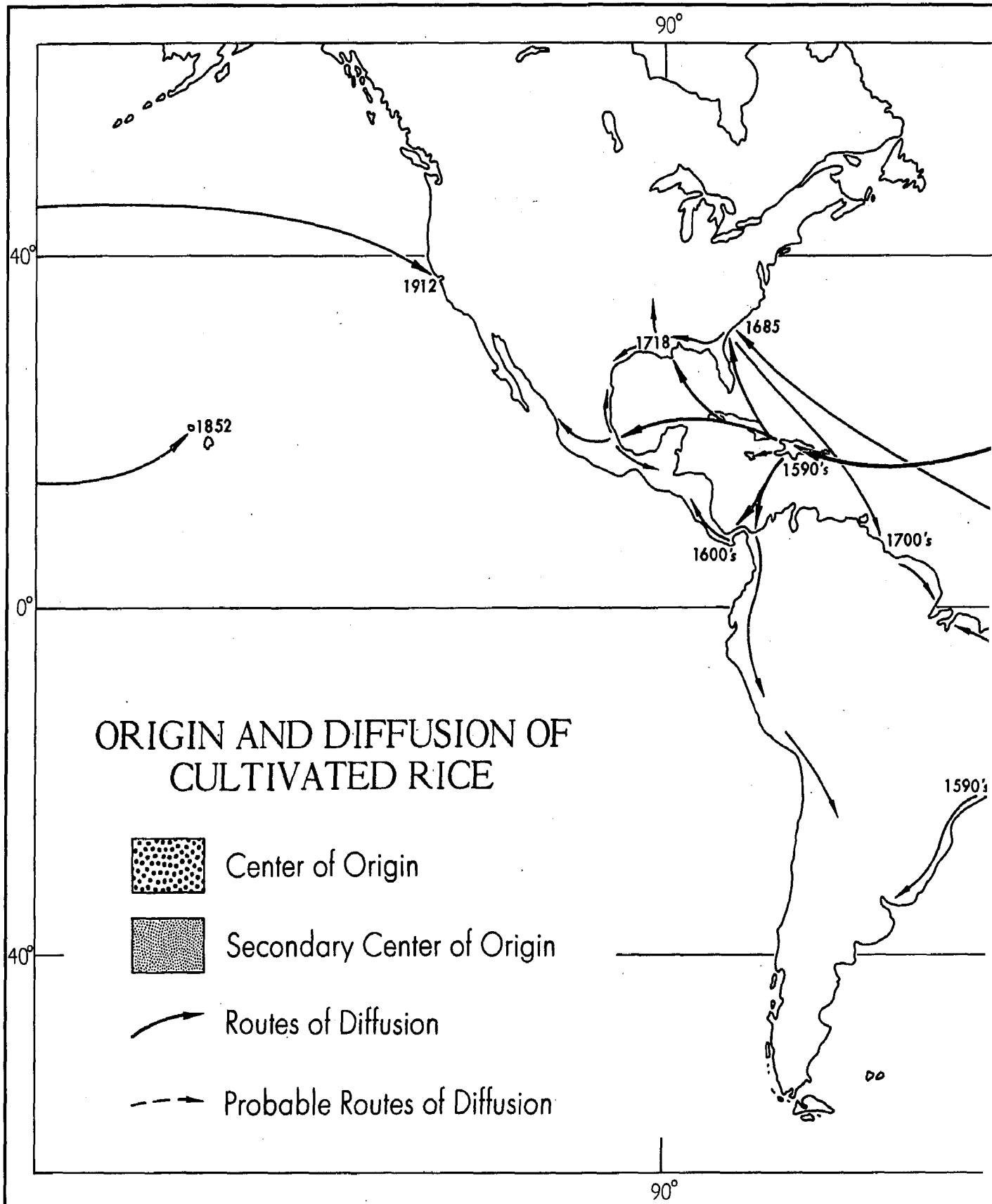
developed before European arrival, though evidence of this is not conclusive (Dresch, 1949, p. 312).

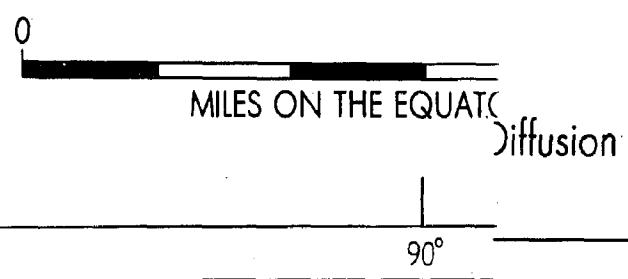
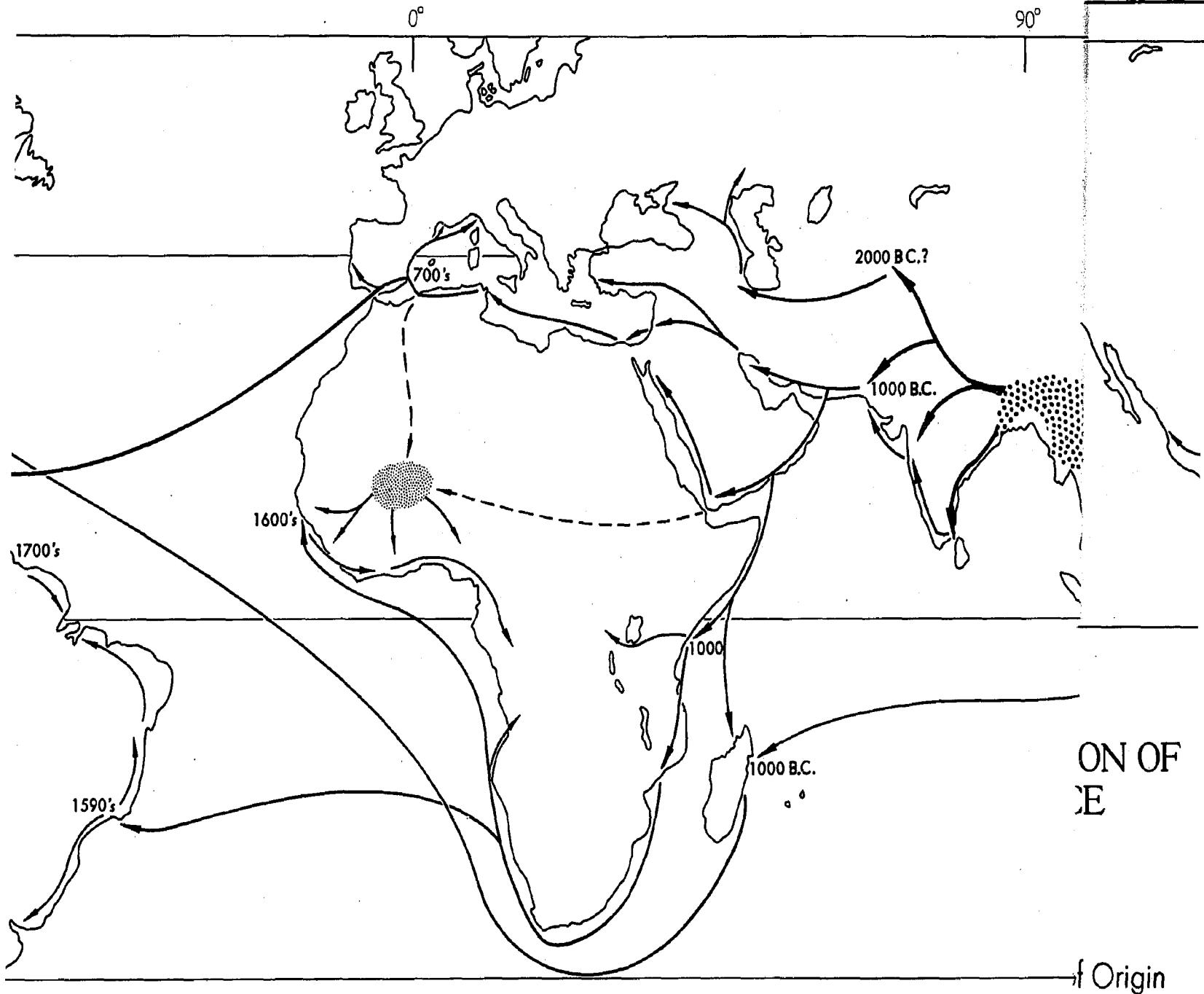
The question has been posed often as to where the rice and its techniques of West Africa came from. Native varieties of rice have been named O. glaberrima instead of O. sativa, the most common cultivated rice. It is also believed by some that O. glaberrima was developed from the African wild rice, O. breviligulata, mentioned previously. According to Portères (1957, pp. 68-99) and Dresch (1949, pp. 295-312), the cultivated rice in Africa, O. glaberrima, was probably spread by Sudanese immigrants from the interior delta of the Niger to the areas of the Senegambia and the Guinea plateau during the period of the great empire of Mali (probably during the 13th and 14th centuries). A minor diffusion of O. glaberrima is noted from the Niger bend to Lake Chad, thence to the south. However, it has not crossed the Berune River. The principal areas of rice culture, that is, within a fan-shaped area extending from the Niger bend to the Senegal and Sierra Leone, have not been much changed since European arrival.

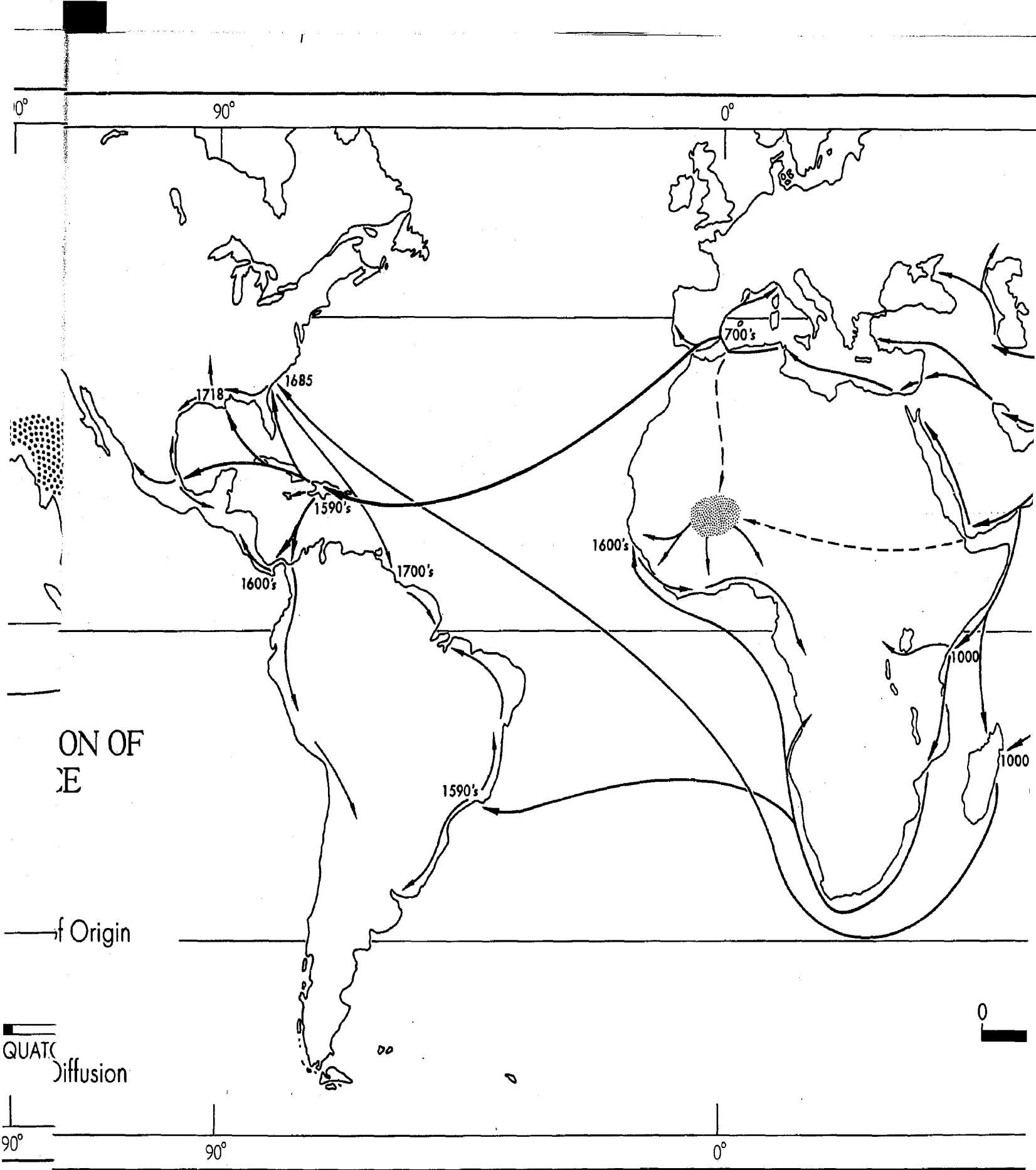
It is not known whether rice in West Africa was developed independently or diffused from Asia. Similar religious significance and prestige value of rice are found in almost all the rice-growing countries. Ceremonial importance of red-rice has been noted in West Africa.⁶ This red-rice complex is widely spread among the rice-growing countries of Asia (Morinaga, 1955, pp. 149-251). Techniques of transplanting and irrigation are also similar to those of Asia, though there are minor differences to fit natural conditions. Dresch (1949, p. 297) suggests that the West African name for rice is of Arabic origin.⁷

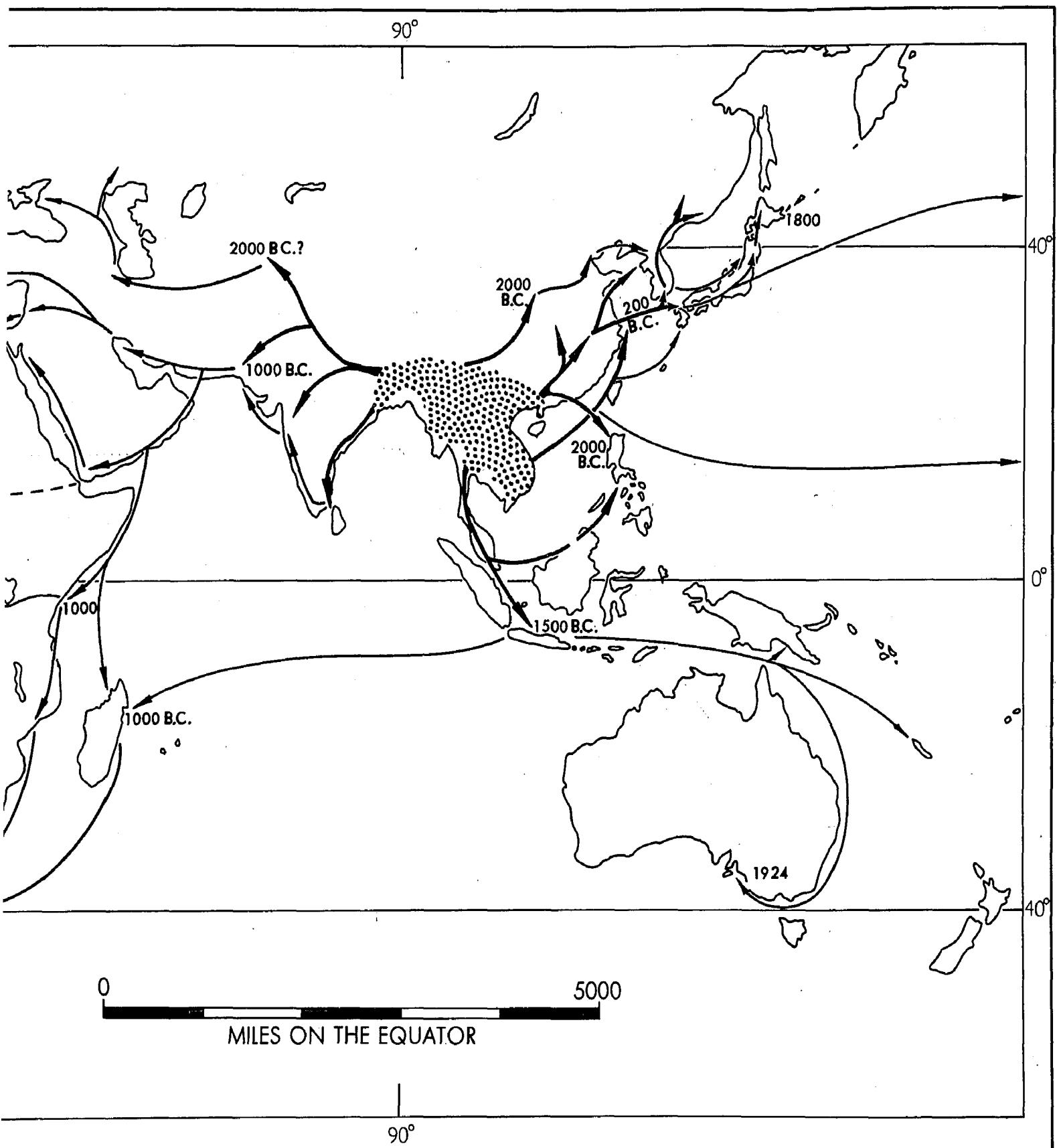
Considering the above similarities, such as ideas, techniques, and possibly linguistic terms, the rice-culture complex may well have been diffused from Asia in antiquity, even if not applied to the common O. sativa. It is quite possible that diffusion brought only the idea and its techniques without bringing the plant itself. There was then local adaptation to a different species, one very similar to O. sativa, from among the wild species native to West Africa.

Asiatic rice, O. sativa, was brought to West Africa from India by the Portuguese about the 15th century. Later, American varieties were introduced into Sierra Leone by missionaries. Superior introduced varieties have gradually replaced native varieties except in remote places.









VII. Rice in Latin America

Wild rice has been reported in Middle and South America (Plate 2). No records are available pertaining to the gathering of the true wild rice for dietary or medicinal purposes. There are, of course, numerous accounts of collecting so-called "wild rice" or "wild oats," which does not belong to the genus Oryza.

Rice is an Old World crop. Europeans brought rice and its techniques to the New World with their expeditions. The time and routes of introduction are, therefore, closely associated with the European expeditions: The Spaniards brought rice to the West Indies, Central America, and north and western South America; Portuguese brought it to Brazil; British colonists introduced rice to South Carolina; and the French brought it to the Mississippi valley from the West Indies.

In Middle America and Colombia, the history of rice is possibly as old as the arrival of the Spaniards. De Espinosa (modern translation, 1942), who traveled widely in the New World, noted rice culture in Jamaica, Panama, Colombia, and Guatemala in the first quarter of the 17th century. Rice culture is recorded in Panama as early as 1605 (Fuson, 1958, p. 305). Based on this evidence, rice culture diffused to the West Indies, Central America, and the alluvial valleys of Colombia in the last part of the 16th or the early part of the 17th century.

In Brazil, rice was introduced during the colonial period (Peixoto, 1925, pp. 255-268). Time and place from whence rice was first brought are not known. Judging from the primitive modes of cultivation and rice's position as one of the important basic sub-

sistence crops. (Efferson, 1952, pp. 299-302), it was introduced probably at the time of Portuguese arrival in the middle part of the 16th century.

There are several natural factors which assured a successful introduction of rice in the above-mentioned areas. The tropical high temperature, abundant rainfall with marked wet and dry seasons for planting and harvesting, and year-round growing season except in the highlands, are very like the climatic conditions of southeastern Asia. Swampy lowlands along streams are suitable for swamp rice, while the rainy hill slopes are good for shifting, slash-burn cultivation. In addition to the natural advantages there were several cultural factors favorable to the successful introduction of rice.

Because of the hot, humid climate wheat can not grow successfully in the tropical lowlands. In colonial times, Spaniards imported wheat flour to make bread. The need for the substitution of a starchy food for wheat was an important factor in the introduction of rice. The substitution of rice for wheat is easily understood, since the Spaniards had grown rice for centuries and had developed their distinctive rice dishes before they came to the New World.

Even today, a subsistence economy is the dominant form of rice production in Latin America. The modes of cultivation are very primitive, giving rise to one of the most elemental rice-culture areas in the world. One of the most primitive types of cultivation is the shifting, slash-burn culture on hill slopes. In Panama, preparation of the fields begins with clearing the undergrowth at the beginning of the dry season. Large trees are killed by girdling or occasionally felled with axes. The most common tool for the preparation of fields

is a machete or field knife, which was introduced by the Spaniards. The preparation of fields is a man's job. A cooperative communal work, the Junta system, has been adopted for preparation of the fields. Clearing the fields of woody trash and downed trees by burning is done at the end of the dry season. Planting seeds is the task of women or of the whole family, including children. The planting tool is a simple pointed stick. Weeding with a machete is done two or three times during the season, depending upon the condition of the fields. Fields are seldom used for more than two years because of weed invasion and exhaustion of soil fertility. Harvesting is accomplished by plucking the heads of rice with a simple knife or with the unaided fingers. On occasion, rice is harvested by cutting the rice stalks with a machete, gathering them into bundles, and then stacking for several days for curing. Threshing and milling methods for home use are the same as the primitive ways of Southeast Asia; i.e., threshing by beating with sticks and milling with mortar and pestle (Fuson, 1957, pp. 187-199; pp. 207-211).

A number of Spanish elements are found in the shifting, slash-burn culture in Panama: 1) the term for shifting field, roza, and the communal labor system, junta, are both of Spanish rather than Indian origin; 2) a most important implement, the machete, was brought by Spaniards (Ibid., p. 197). The plow has never been successfully introduced into tropical America. Only the introduction of the machete has changed the landscape considerably. Before its appearance Indian agriculture in Panama was simply fire farming rather than slash-burn agriculture (Idem).

In limited areas of the Pacific lowlands of Colombia, the wet-rice

culture method with uncontrolled irrigation has been adopted. The seeds are broadcast on cleared backslope swamps without further cultivation. Negro farmers of the Atrato delta transplant rice seedlings to prepared fields. A peculiar type of seed bed, a platform garden, is noted by West (1957, pp. 143-146). He describes two types of raised platforms; the more common is a rectangular frame of palm-wood slats; the other is nothing more than a discarded, half-rotten canoe perched on two poles. The planting surface is made by putting a mixture of macerated termite nests and clay loam on the platform constructed primarily for the vegetables and medicinal plants rather than rice.

Due to the large number of recent immigrants from southeastern Asia, mainly from India and Indonesia, quite different modes of rice culture are seen in British Guiana and Surinam. Rice is grown in small irrigated fields. Transplanting is commonly done as it is in the home countries. Use of the plow, methods of harvesting and threshing, and the preparation of parboiled rice are all of Asiatic origin. Threshed rice is commonly dried on an open platform or on a flat earth surface (Efferson, 1952, pp. 314-322).

In the state of Morelos, Mexico, a preparation of very tiny fields and transplanting (Fig. 18) is described by Marin (1927, pp. 323-324). The techniques of making the tiny fields and transplanting may have been introduced from the Philippines, as its name indicates; the Mexican term¹ for wet rice, aross palay, may have derived from the Philippine term for paddy or rough rice, palai. In another type of cultivation rice is planted between the rows of young coffee trees in the highlands of Brazil (Platt, 1935, pp. 238-239).

Commercial production of irrigated rice with the use of the

plow is of recent importance in Latin America. The important growth of commercial production came after World War I, though it dates back to the 1890's (Marin, 1927, pp. 326-334; Peixoto, 1925, pp. 255-267). The essential techniques of cultivation and the varieties of rice are mostly of North American origin.

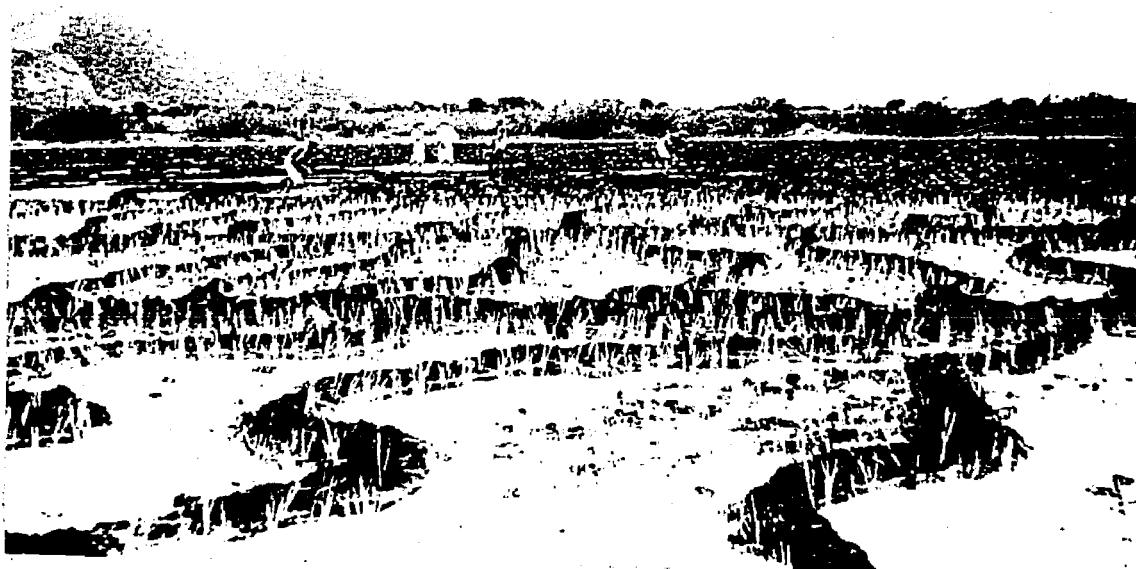


Fig. 18 Tiny transplanted rice-fields, Morelos, Mexico.
Courtesy of Dr. R. C. West.

VIII. Rice in Anglo-America

It is not known exactly how and when rice growing was first successfully introduced into Anglo-America. The first attempt to grow rice in the British colonies was made in Virginia by Sir William Berkeley in 1647, without success (Surface, 1911, p. 500).

The successful introduction was made a little later in South Carolina, possibly during the middle part of the 17th century.¹ The traditional accounts date the beginning of rice culture in South Carolina, however, to 1694, when a ship captain sailing from Madagascar was forced to touch at Charleston. Here he met Landgrave Thomas, who received from the captain a bag of rice. Several years later, Du Bois, treasurer of the East India Company, sent a bag of rice to South Carolina. From these two events presumably there arose the distinction between the Carolina Gold and Carolina White (Gray, 1933, p. 277). However, rice culture existed before the arrival of rice seed from Madagascar in 1694 as demonstrated by Salley in his authoritative study (1919, pp. 1-23). Horne's pamphlet, published in 1666, and a petition recorded for 1691 establish this fact. The petition requested that the settlers be allowed to pay their rents with the products of their lands. The pertinent passage reads:

". . . this we are the most confident of because we are encouraged wth. several new rich comodityes as Silk, Rice & Indigo, wth. are naturally produced here." (Salley, 1919, p. 4).

Subsistence rice, then, was not initiated in South Carolina by seed from Madagascar. However, seed from Madagascar was superior to that used previously; it was a medium long-grain type, called Gold

because of the deep-orange color of the hull. (Efferson, 1952, p. 408). Beginning about 1700, Carolina varieties were introduced into many of the Latin American countries. Most of the so-called native types now grown in Central and South America are quite possibly derived from the original Carolina varieties² (Efferson, 1952, p. 409). Efferson (Idem) further states that Honduras rice, brought to New Orleans from Central America around 1900, possibly originated from the seeds of the Carolina variety cultivated in tropical America. The Carolina variety was also introduced into Sierra Leone by American missionaries, displacing the native varieties of West Africa (Haudricourt, 1943, p. 82).

In summary, the time and route of the introduction of rice into South Carolina are still disputed. It is, however, very probable that rice first arrived in South Carolina from the West Indies with the importation of slaves, and was cultivated first on high land and in little spots of low ground (Allston, Vol. 1, 1846, p. 330). In the early days in South Carolina, rice culture was considered a practice peculiar to Negroes.

About 50 years after the first introduction of rice into South Carolina, the French in 1718 brought it to the Mississippi valley. Until the beginning of the 20th century rice culture was concentrated in South and North Carolina, Georgia, and Louisiana, with a small amount of upland rice in other southern states. Rice culture in Arkansas and California awaited the adoption of new machinery and irrigation systems at the beginning of this century.

The modes of rice culture as developed initially in Carolina may be divided into three types: 1) subsistence rice; 2) inland-swamp

rice; and 3) irrigated tidal-swamp rice.

Subsistence rice likely stemmed from the West Indian seed. According to Allston (1847, Vol. 1, p. 330), rice was first cultivated both in the uplands and on the occasional areas of low ground. The low ground being found to grow better rice, the fresh-water swamps were cleared for the purpose of extending the culture. Owing to the invasion of grass older fields were abandoned and new ones cleared, as in the case of shifting, slash-burn cultivation in tropical America.

Contemporary writers (Glen, 1761, pp. 6-8; Catesby, 1771, p. xvii) mention that the best land for rice was a wet, clayey swamp which was inundated during the growing season.³

A most primitive method of cultivation is described by Catesby (1771, p. xvii):

"In March and April it is sown in shallow trenches made by the hough [hoe]; and good crops have been made without any further culture than dropping the seeds on the bare ground, and covering it with earth or in little holes made to receive it without further management." (Catesby, 1771, p. xvii).

According to the above descriptions, it appears that the early modes of rice culture in South Carolina were almost the same as the primitive methods practiced in tropical America; i.e., shifting, slash-burn cultivation, and swamp rice without controlled irrigation. Before the rainy season, seeds were planted in the furrows made with a hoe, or were dropped in holes made with a stick, as in planting maize. Fields which were located in swampy areas were inundated during the growing season by normal rainfall. For home-use, small-scale production, rice culture of a primitive type was continued by slaves in their gardens and on the margins of the large-scale fields, even after the rise of commercial tidal-swamp rice. Reference to small rice fields on

large plantations appears in Doar (1936, p. 32). After the decline of plantation rice in Carolina, rice continued to be grown in small patches for domestic consumption by Negroes who had lived in the rice areas of Carolina and Georgia (De Bow, Vol. 16, 1854, p. 592).

About 2,600 acres of upland rice were cultivated in the southern states in 1939: Alabama, Florida, Georgia, Mississippi, Missouri, and South Carolina (Jones, 1943, p. 1). A small amount of upland rice was also cultivated in the hill areas of Louisiana and in the Tensas Basin (Phillips, 1953, p. 130). Rice was cultivated like maize, without flooding. Fields were hand weeded several times and harvested with sickles. Methods of threshing and milling remained the same as those of ancient Asia.

Upland rice culture was introduced to the American Indians, namely the Creeks and Cherokees. Swanton (1946, pp. 286-287) says that rice was planted in hills on high, dry ground in the gardens. Possibly seed and methods of culture came from South Carolina.

Inland-swamp rice on a commercial scale was possibly based on the seed imported from Madagascar about 1685.⁴ The various descriptions of the early writers mention the suitability of natural conditions for rice in South Carolina. The fresh inland swamps were considered the best lands for rice, especially the cypress swamps (Glen, 1761, pp. 6-8; Catesby, 1771, p. xvii). Abundant rainfall, not suited to wheat cultivation, was ideal for rice. Early planters who had a knowledge of rice were attracted by any natural conditions favorable to its cultivation. Soils of the choice spots were not too heavy to work with the hoe.

Until the close of the colonial period in 1776, inland-swamp methods were dominant, though tide-water swamp rice was introduced in

1758 (Gray, 1933, p. 279). Before the adoption of irrigation, commercial inland-swamp rice was cultivated in the same manner as subsistence rice. The employment of irrigation is said to have begun around 1724. The inland rice swamps were irrigated by water from springs or dammed storage ponds. Excess water was drained by canals into the rivers. Early irrigation was, however, employed for the purpose of supplying sufficient moisture to the plant, rather than a systematic control of weeds, as was the case in the later period (Gray, 1933, p. 297).

During the inland-swamp period, rice production was a hoe culture (Fig. 20) conducted by slaves. Use of plows and draft animals came after the Revolution when a shift to tidal swamps took place. Fields in inland swamps were prepared with the hoe, constructing furrows for seeding and ditches for irrigation and drainage. Weeding was required several times, using both hoe and bare hands. Rice was harvested with the sickle (Fig. 20) in mid-September, then placed in stacks until threshed with flails or trodden-out by horses or cattle. Milling of rice was done with the hand-mill, then finished with mortar and pestle by Negro slaves (Catesby, 1771, p. xvii). Besides the common mortar and pestle, so-called 'wood-pecker' rice mills (Fig. 19) were used among the slaves for their home milling (Evans, 1921, No. 2, p. 29). This method involving mortar and pestle worked with a foot instead of by hand is widely distributed in Asia. It was probably introduced from India during colonial times. According to Gray (1933, Vol. 1, pp. 282-283), the horse-powered mortar-and-pestle mill was invented in 1768 by Veitch. The description of the mill by Phillips (1929, p. 116) and a picture (Drayton, 1802, p. 122) suggest the type noted for Louisiana (Fig. 47).



Fig. 19 A 'wood-pecker' rice mill. Picture from Evans, "The Evolution of Rice Milling," The Rice Journal, Vol. 24, No. 2, (1921), p. 29.

The great shift from inland-swamp rice to tidal-swamp rice came after the Revolutionary War, from about 1790 to 1800. The chief causes of the shifting were the incessant struggle with grass in inland swamps and the advantage of irrigation and plow culture possible with tidal-swamp rice.

Winyah Bay is said to have provided the first experiment in the production of tidal-swamp rice, as early as 1758 (Gray, 1933, p. 280). The lower parts of streams flowing into the bay had vast tidal fresh swamps. A combination of from 2 to 4 feet of tidal range and a favorable shape of estuaries gave the surface water level of rivers a considerable range between ebb and flow. Without levees along the rivers the inundation covered vast areas of swampy lands at the time of flow, and large lowlands were exposed at ebb.

Tidal rice fields came only with the control of the river and systematic use of water. While inland-swamp methods were somewhat an extension of upland crop farming, tidal-swamp rice was quite distinctive. Tidal lands have always been considered good for rice only.

The clearing of tidal swamps and the preparation of fields were quite different than with inland swamps. The length and breadth of required land was measured, then the trees were cut to make a road thirty feet or more wide through the swamp. The next step was to make 4- or 5-foot ditches through the clearing, using the mud thus obtained to make enclosing banks, leaving a margin of 15 or 20 feet between ditch and bank. After the land was entirely enclosed, hollow-tree pipes (trunks) were put in the bank and the land drained. Trees were felled, piled, burnt, and the stumps removed. The year following clearing, small ditches running lengthwise of the field were made, 2-feet wide, 3-feet deep, and 50 to 70 feet apart, for better drainage. These were

called 'quarter divides' because originally they were a quarter of an acre apart.

The large banks or levees along the rivers and canals were kept 1 or 2 feet above the highest spring tide in order to prevent overflow. The cross banks separating fields were placed according to slopes, in order to keep the irrigation water as level as possible (Doar, 1936, pp. 7-13).

Floodgates of wood were placed in the main canals to control the water level. In the bank along the open canals wooden tree trunks were inserted to make possible flooding and draining. Very often, little trunks known as plug trunks⁵ were set into the small banks in order to pass water through the fields (Ibid., p. 12).

On the sandy subsoils, trunks were often washed out or sank almost out of sight. In these places, a half-moon bank running outside the margin of the original break was built, the old break was then filled in as a supporting margin on the inside. Doar (1936, pp. 12-13) says that this idea of a half-moon bank came from a Dutch engineer, Van Hassel, who taught the planters how to overcome the quick-sand breaks in olden times. There are still many of these half-moons on the Santee River and the Negroes always speak of them as 'Ban Horsal.'

The fields were plowed with mules or oxen; usually the latter were used for lower fields. Very often, in order that the mules might work better on soft lands, boots (Fig. 21) were put on their hind feet. The mule boots were made of square pieces of rawhide, with holes all around the edge. A wad of straw was put in the middle of the square, the mule's foot set upon it, and then a hide string was run through the holes, drawn up around the fetlock, and tied tightly (Doar, 1936,



Fig. 20 Rice hoes and sickle in South Carolina. Courtesy of the Charleston Museum.



Fig. 21 Mule boots in South Carolina. Courtesy of the Charleston Museum.

p. 13).

The plowing was done as soon after the harvest as the fields could be gleaned, and the scattered rice was left on the surface to sprout. (De Bow, Vol. 16, 1854, pp. 604-608). In March, fields were prepared for planting with three-cornered home-made harrows. At the time of seeding, trenches were made with a 4-inch trenching hoe, 13 inches from center to center. Seeds, at a rate of from 2.5 to 3 bushels per acre, were sown carefully by hand or with horse-drawn drills (Doar, 1936, p. 14; Ravenel, 1936, pp. 43-50).

The first flooding of fields, known as 'sprout water,' was done just after sowing, and withdrawn when rice seeds began to fork, about 3 to 6 days later. About 20 days after sowing, fields were hoed with a 6-inch hoe and flooded deeply, the water known as 'point flow' over-topping the plants for 2 or 3 days. This was done in order to destroy the young grass just springing up among the plants, and also the insects that may have infested the young plants (De Bow, Vol. 16, 1854, pp. 607-608; Doar, 1936, pp. 13-15). It seems that the flooding and hoeing were repeated several times, depending upon the amount of weeds. During the tidal-swamp period, weeds were controlled more effectively by flooding than in the time of the inland-swamp cultivation, when flooding was only for supplying enough soil moisture for the plants. Following the several point flows, the 'long water' was on until the crop was ready to harvest.

Manuring was little known until the middle of the 19th century. Fertility of the fields was maintained by alluvial deposits from river overflow and tide-deposited silts from the bays or estuaries. (De Bow, Vol. 16, 1854, p. 613). The rice stubble also helped to fertilize the soils.

Harvesting rice with the sickle remained unchanged throughout the inland-swamp and tidal-swamp periods. Rice was laid on the stubble to dry a day or two after cutting, then tied in bundles and stacked upright in the fields until threshed. Small rice stacks were often transferred to larger stacks, 12 to 16 feet in diameter, after the harvest for safekeeping (Doar, 1936, p. 17). Dried rice was transported to the threshing grounds by flats and two-wheeled carts instead of on the heads of slaves, as previously.

Threshing with flails and animal treading continued until the success of the threshing machine around 1830. In 1830, a thresher constructed at New York was tested in the Santee River rice area. The machinery was driven by an apparatus similar to that employed for driving the cotton gin. The test was not very successful, but it laid the groundwork for later successes (Elliot, Vol. II, 1851, p. 306).

Milling by mortar and pestle, hand mill, and partly by the horse-powered mill, described for the inland-swamp rice culture, were the principal means of milling until the beginning of the 19th century, when Lucas built the first steam-operated rice mill (Heyward, 1937, pp. 22-25). In 1780, Lucas first constructed a mill driven by tidal power, which operated iron-shod pestles in cast-iron mortars, each holding five bushels of rough rice (Butterworth, 1892, p. 26). Lucas then succeeded in operating a steam rice mill in 1801. This mill was soon diffused to England; later it was adopted among the commercial rice areas of Asia.

In 1849, South Carolina, North Carolina, and Georgia produced 90 per cent of the total rice crop in the United States, of which 60 per cent was grown in South Carolina (Jones, 1936, p. 415). After the

zenith between 1850 and 1860, the old rice area, which led production in the United States for 200 years, declined gradually. The causes for the decline were various: untimely storms and freshets; decline in the price of rice; and migration of labor to other industries. An even greater cause of decline was the introduction of rice into the prairie section of Louisiana in the latter part of the 19th century and the beginning of the 20th, with the use of modern machinery and new irrigation systems (Doar, 1936, pp. 41-42). The value of land for rice fields in the older area has declined since the adoption of newer methods in more-favored areas. The tidal swamps, the best rice lands for a long time, were not suited to competition with the newly developed rice areas. The comparatively small patches of rice swamps were unable to adopt the new machinery and methods.

With the development of commercial inland-swamp rice in the early colonial period, the colonists made considerable changes in the cultural landscape. Wealthy rice planters built large homes along the rivers. A short distance away, near the rice fields, double or single houses were built for slaves. Houses were invariably on piles to save them from inundation.

Inland swamps were cleared and drained. The small reservoirs, ditches, and levees for irrigation and drainage were constructed in irregular shapes. During the colonial period most of the cultural landscapes were made by slave labor with axes and hoes, with little animal power and few wheeled vehicles. Techniques and the resultant landscapes were semi-Asiatic: small irregular fields, depending primarily upon rain water; modes of field preparation, threshing, and milling. The large colonial-style dwellings were not a part of this

pseudo-Asiatic complex.

The adoption and evolution of irrigation techniques after the Revolutionary War brought fundamental landscape changes to the tidal swamps. The extensive forests which once covered tidal swamps disappeared as far inland as the tidewater flowed (Fig. 23). The swamps were drained, and the tide was shut out, subjected to regulation, and rendered tributary to the designs of the planters (De Bow, Vol. 6, 1854, p. 605). Levees were built along the streams following the form of the river meanders. Fields were divided by small, straight levees or banks; various sized canals and ditches were dug along the levees. Numerous water gates and pipes of various sizes were put in canals and banks. A rice plantation, one rice planter said, is a huge hydraulic machine, maintained by constant fighting against the rivers (Doar, 1936, p. 8).

On higher spots along the rivers, large plantation dwellings were built. Often levees surrounded the plantation houses to protect them from inundation. Oak trees were planted for shade around the houses. These trees remain even after the destruction of the old houses.

Slave quarters in rows with streets between were a little distance from the planter's dwelling. Negro houses were usually wooden double houses with a chimney in the center (Fig. 22). In each half of the house were two sleeping rooms and one living room and each house was occupied by two families. Houses were raised on piers made of logs or bricks to protect them from inundation (Doar, 1936, pp. 31-32). On the lower part of the Santee River, planters built so-called storm towers to save slaves in case of dangerous floods. These were of brick, round, windowed, with conical roofs, and were 20 or 30 feet in diameter and 20 feet high. About 10 feet from the ground was an entrance to the floor

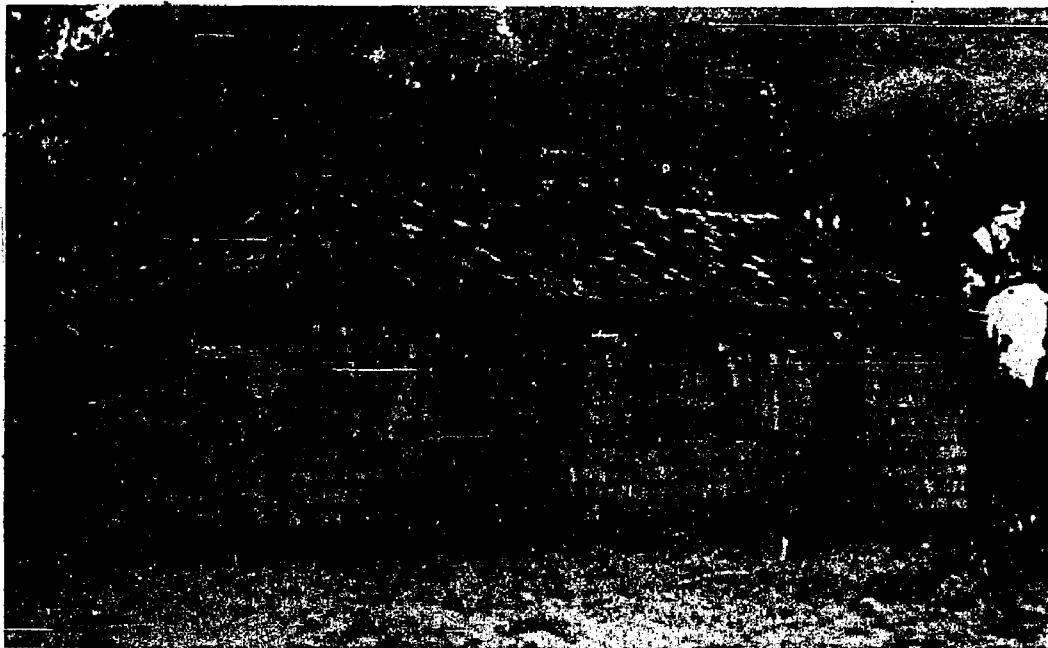


Fig. 22 A Negro house in South Carolina. Courtesy of the Charleston Museum.



Fig. 23 Abandoned rice fields along the Black River, South Carolina. Courtesy of Mr. Philip Larimore.

at this height, fitted with a heavy door. These towers were observable until the middle of the 19th century (Doar, 1936, pp. 22-23).

A hundred years from the zenith of Carolina rice, the cultural landscape is still the heritage of the past: field patterns (Fig. 23), old settlement sites covered with oak trees, thousands of miles of levees and ditches, mill ponds, old abandoned plantation houses under trees, relics of slave quarters in rows, remnants of water gates and trunks in the silent fields.

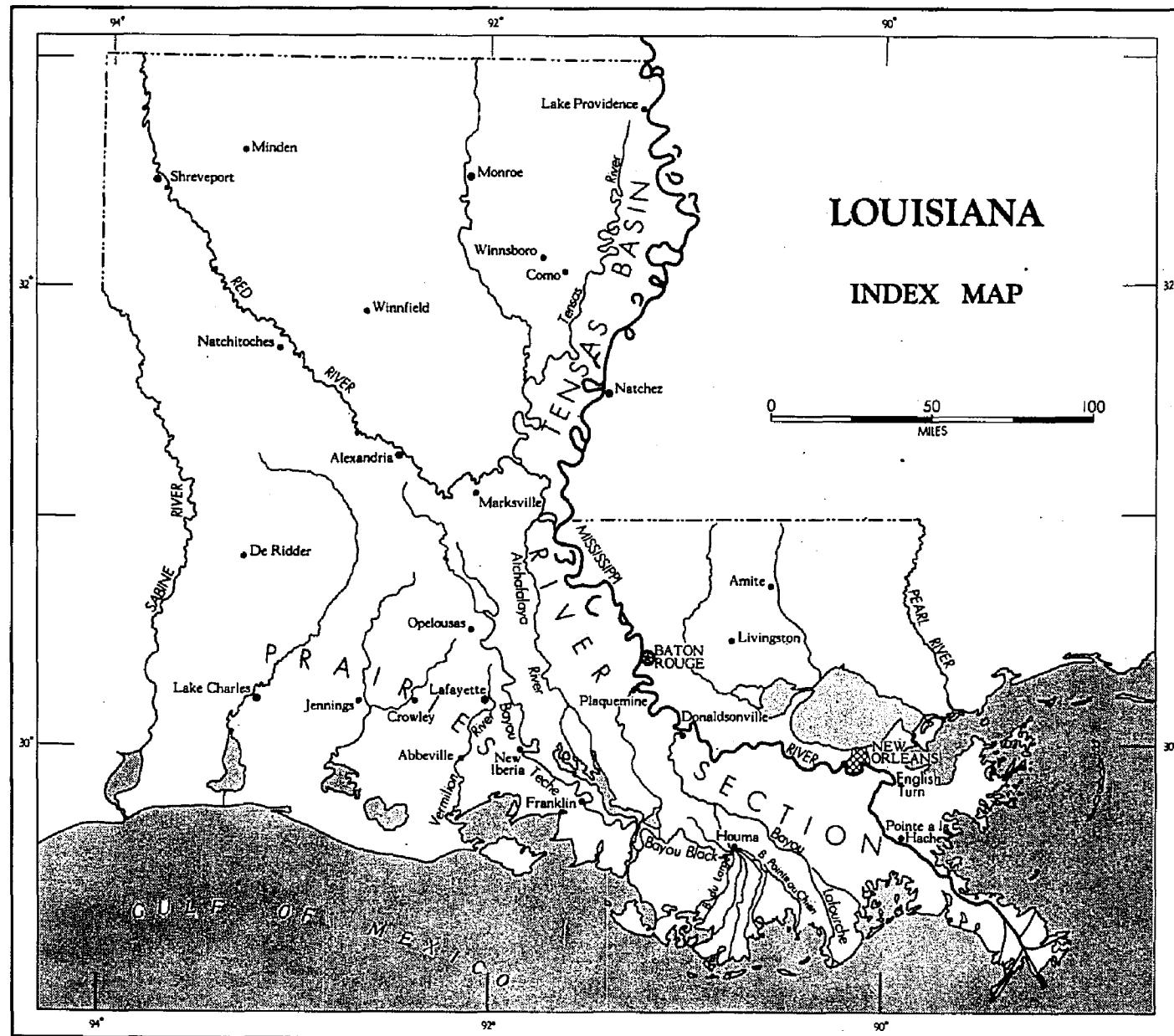
IX. Providence Rice in Louisiana

'Providence' rice is an expression long used by the French farmers of prairie Louisiana (Plate 4). It means rice growing with little or no controlled irrigation and without any other special care; that is, simply rain on suitable soils and the resultant harvest. Fields with or without levees are flooded during the growing season, but the source, amount, and time of inundation are not controlled. Rainfall rather than irrigation supplies most of the needed water (Roy, C. A., and Engler, K., 1955, p. 389). The term is adopted here, then, to stand in contrast to rice culture employing controlled irrigation.

The literature nowhere makes clear the origin of the term Providence in connection with rice growing. It seems likely to be of French origin, as suggested by the fact that the word is given a French pronunciation among all rice farmers even today. It is also interesting to note that a term synonymous with Providence rice is commonly used in China, Korea, and Japan.

Providence rice was widely distributed in the early days of the Mississippi delta and flood-plain areas and in the prairies of southwestern Louisiana. This was the principal type of rice cultivation in Louisiana prior to 1850, when large-scale river-rice production started. Providence rice has declined gradually; however, it has continued almost to the present.¹ Providence rice was grown mainly for home use, produced on relatively small individual fields. The method of cultivation was simple, without fertilizer and machinery, and the rice was sown by hand and harvested with a sickle.

LOUISIANA INDEX MAP



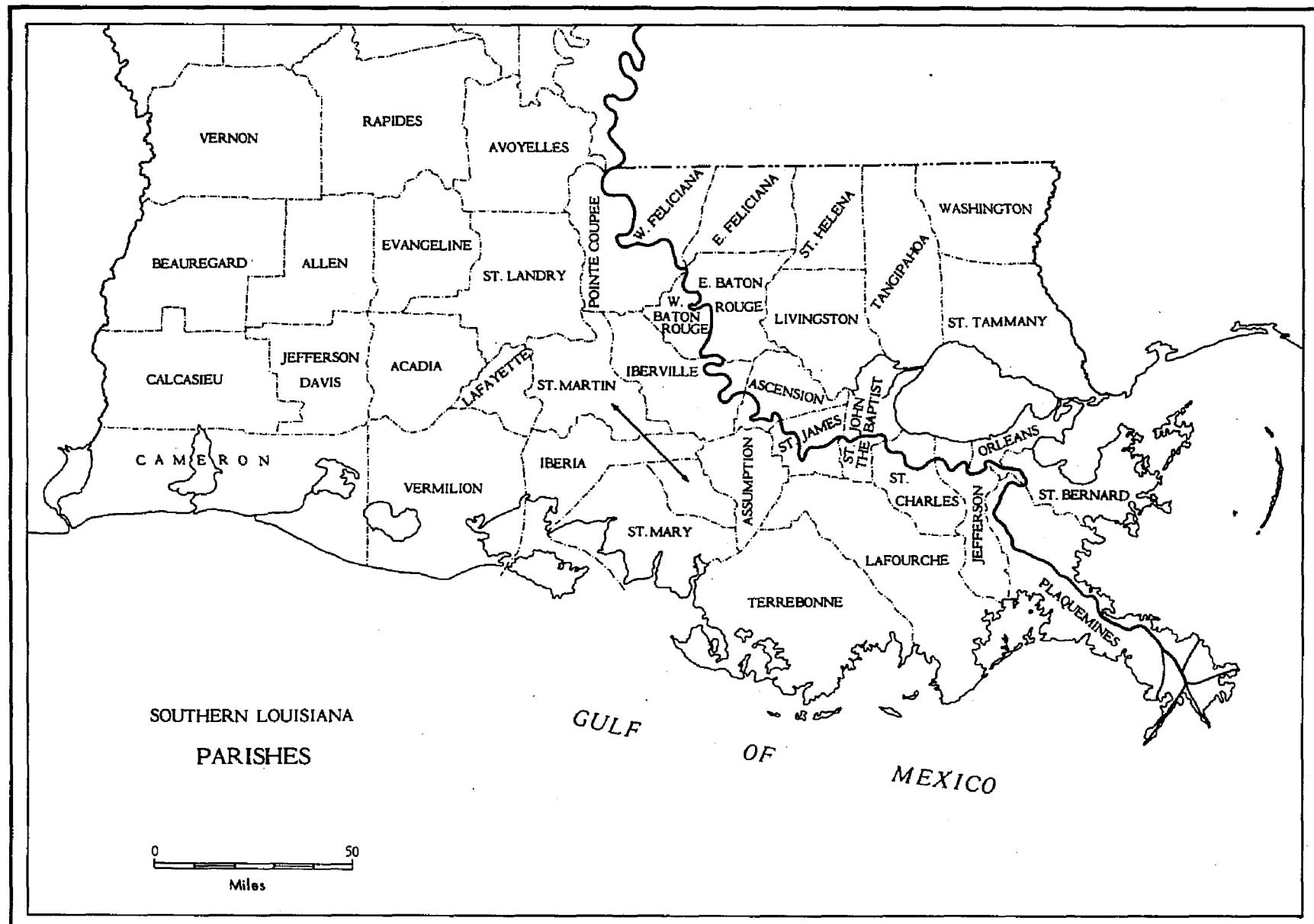


Plate 5

Small amounts of upland rice have also long been grown in the sections of Louisiana here mentioned and in hill Louisiana (Plate 6). Upland rice was grown also for home use and cultivated and harvested wholly by hand methods. The chief difference between Providence rice and upland rice is that the former is inundated by natural means, while the latter is grown with only direct rainfall, like wheat or maize (Roy and Engler, 1955, pp. 389-394; Jones, 1943, pp. 1-6).

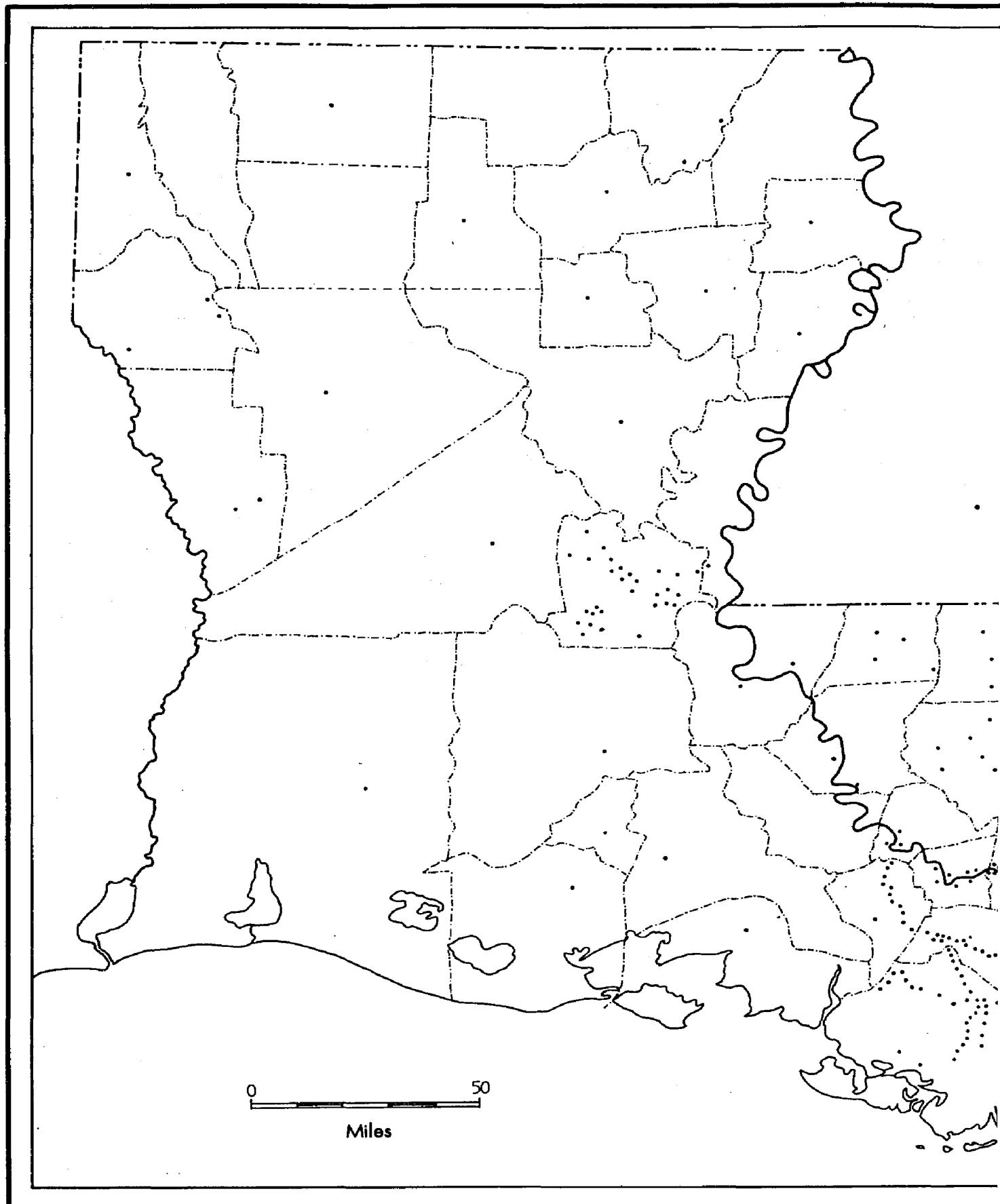
Introduction of Rice in Louisiana

The earliest mention of rice in the literature on Louisiana appears to be a statement of D'Artaguette in a memoir to Pontchartrain in 1710 (MPA II p. 59, June 20, 1710). He states that ". . .the Indians are not growing any rice for lacking seeds. I am asking for some at Vera Cruz. I think it will grow well here." In 1712, he states further that

".... the Indians grow their Indian corn on fields that are inundated by the overflowing waters; these are the only places that are productive. I think that rice will grow well there. I have several times asked for some from Vera Cruz in order to plant it. I have not been able to obtain any except some that was suitable for eating. The inhabitants of Vera Cruz, of Havana of the Indies regarded this establishment with great jealousy." (MPA II p. 63, May, 1712).

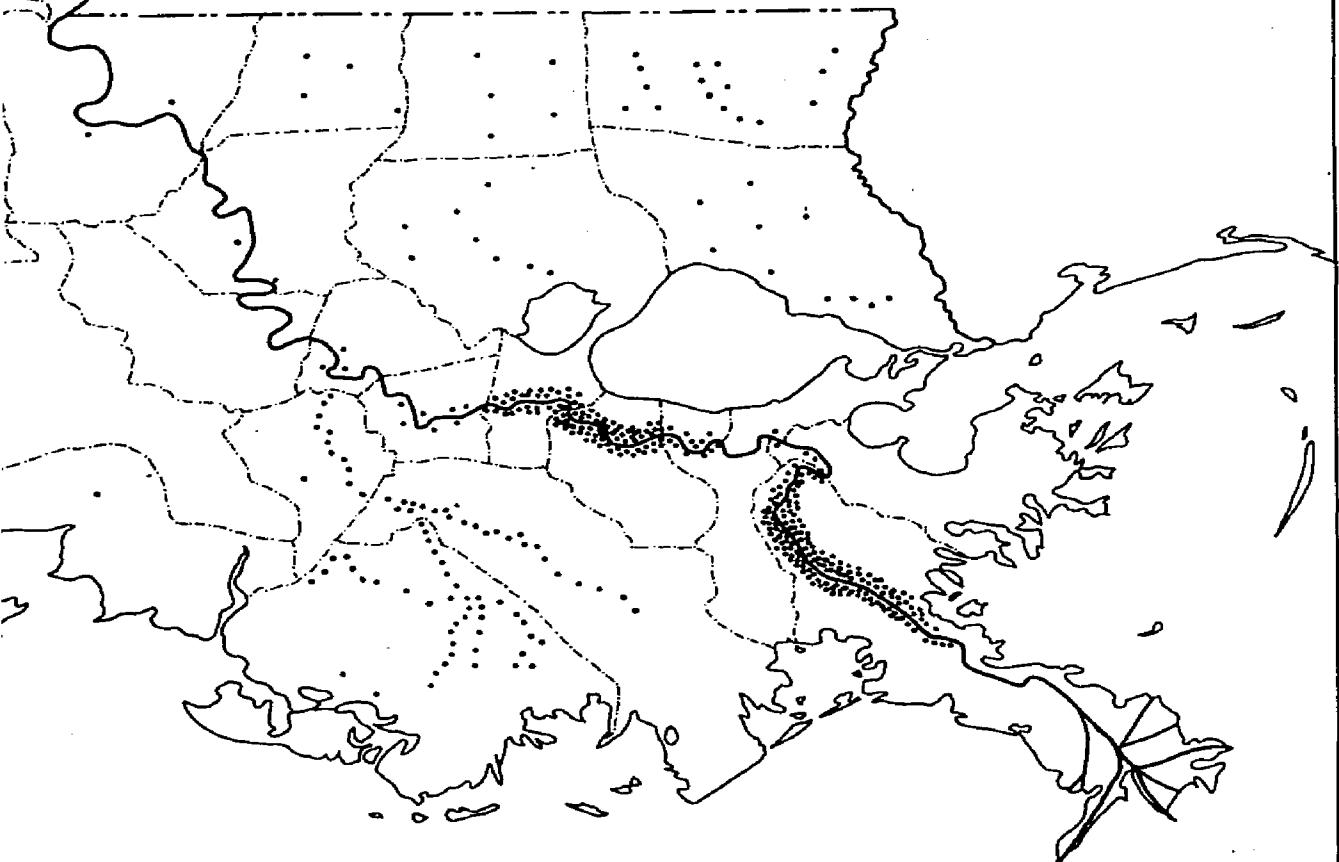
Rice could have been introduced earlier into Louisiana. Early settlers were not interested in agriculture partly because of sandy, infertile, coastal soils, and perhaps more because of their dislike of agriculture. Hubert, who came to Louisiana as the Commissary General with Governor L'Epinay in 1716 (MPA II p. 232), wrote in his memoir to the Council that

"... the colonists of the present time will never be satisfied with the infallible resource, accustomed as they are to the trade with the Indians the easy profit from which supports them, giving them what they need



RICE PRODUCTION
IN
LOUISIANA 1849

• Clean Rice 10,000 Pounds or Less.



day by day like the Indians who find their happiness in an idle and lazy life, who have no taste except for an animal life."

During the last part of the economic monopoly of Crozat, in 1716, the first rice seed, two barrels, were introduced from Saint-Dominique to Dauphine Island, an entry port of Mobile, the capital of the colony (Giraud, 1958, p. 131). However, it is not known whether or not rice was successfully cultivated from that seed.

Dart (1931, pp. 163-177) reveals pertinent information from a paper titled "The First Cargo of African Slaves for Louisiana, 1718." In this document, two captains were instructed by the Western Company to go to the coast of Guinea to carry on the trade in Negroes there and to transport the Negroes to Louisiana. One of the captains, Captain Herpin of the Aurore, was particularly instructed

"... to trade for a few who know how to cultivate rice. He will also trade for three or four hogsheads of rice suitable for planting, which he will deliver to the directors of the Company on his arrival in the colony." (Dart, 1931, p. 163).

The document does not, however, mention whether he brought Negroes and rice seed. Dart (1931, p. 164) presumes that Martin's account of two ships which brought 500 Negroes from the coast of Africa in 1719 (Martin, 1827, Chap. IX, pp. 198-235) must refer to the two ships in question, the Aurore and the St. Louis.

Le Page du Pratz, who lived for the 16 years between 1718 and 1734 in Louisiana, says that

"the rice which is cultivated in that country was brought from Carolina. It succeeds surprisingly well, and experience has there proved, contrary to the common notion, that it does not want to have its foot always in the water." (Le Page du Pratz, modern ed. 1947, pp. 203-204).

The earliest rice cultivation in Louisiana seems to have been in 1718 or 1719, according to a proclamation issued by the India Company early in 1720, which said that rice would be purchased from local growers at the price of 20 livres for one barrel (Gayarre, 1919, pp. 286-291). One of the earliest references to actual cultivation of rice is found in the census report of 1724 (Deiler, 1909, pp. 50-51). The report mentions two older German villages, founded in 1719, ten lieues (about 30 miles) above New Orleans on the right bank. It says that in September, 1721, the peoples of the two villages were drowned out by the high water of a hurricane. The hurricane is reported to have destroyed over 8,000 French quarts (130 pounds each) of rice which was ready for the harvest, though the amount seems excessive.

In the minutes of the Superior Council of Louisiana dated July 20, 1723, it is stated that

"Since the Council has no flour or meat at all to send to the Belize for the subsistence of the troops and workmen, having only unhulled rice which would make it impossible for them to work because of the long time required for shelling it and the difficulty of so doing, because of the lack of a mill. . ." (MPA III p. 354).

The above sources indicate that rice was first brought into Louisiana between 1716 and 1720. There are three possible routes of introduction: 1) from the West Indies through Dauphine Island, between 1716 and 1718; 2) carried by slaves from the Guinea coast around 1719; and 3) from Carolina sometime in the early part of the 18th century.

In summary, historical records are not available to indicate positively the first introduction of rice into Louisiana. However, it appears that the first rice seed were brought from the West Indies to Louisiana by way of Dauphine Island. As mentioned above, colonists had tried to

introduce rice culture into Louisiana since 1710. Six years after the earliest mention of rice, rice seed arrived in Dauphine Island (Giraud, 1958, p. 131). The first rice cultivation appears to have occurred about 1718, or not later than 1719, judging from the proclamation issued by the India Company early in 1720. It is reasonable to suppose that the first rice may have been cultivated from the West Indies seed by the first French agricultural settlers of Bayou St. Jean, north of New Orleans, in 1718 (Giraud, 1958, p. 132); and that, although these settlers had rice seed, the India Company issued instructions in 1718 to obtain more seed rice and Negroes who knew rice culture in Guinea.

Botanical evidence also suggests that the first rice seed in Louisiana did not arrive from South Carolina. The "Gold Seed," a long-grain South Carolina variety, became popular in Louisiana after 1850 (De Bow, Vol. 21, 1856, p. 290) when the river-rice method of cultivation spread along the Mississippi River. Before the gold seed, so-called "Creole" rice was the most common variety in Louisiana. It was a short or medium length and fat grain. Often it was known as "Bull" rice or "Bull" head because of its fat kernel.² The creole rice which was closely connected with Providence rice may have been derived from the variety which was introduced from the West Indies.

The German villagers, previously mentioned from the census report of 1724, could have obtained rice seed from the first French agricultural settlers or in the West Indies on the way to Louisiana.

There are several natural factors which made for a successful introduction of rice: the well distributed rainfall during the growing season (April to September); warm temperature; dark-brown clayey soils

on the backslopes of natural levees; and comparatively flat terrain. The semi-aquatic character of rice favored the use of wet and heavy clay soils which were inundated seasonally. In the extensive areas of seasonal inundation where rice grows best, crops such as sugar cane would not have thrived.

Besides these natural advantages, the need for a substitute for wheat was an important factor in the successful introduction of rice in Louisiana. In early colonial days, maize was one of the most important staple foods, though European settlers much preferred wheat flour. Due chiefly to the damp climate, early settlers failed to produce wheat. In the memoir from D'Artaguette to Pontchartrain dated June 20, 1710, appears a passage:

"I have never seen finer wheat than that that was at Biloxi on the lower part of the Mississippi. Ten days before it was mature some fogs came up that made it completely wither away in such a way that it will be all that one can do to gather six minots [an old French measure; about 1.11 bushels] where there was prospect of gathering more than one hundred. Six settlers have informed me that this accident happened to them two years ago [1708]. They have shown me the impossibility of growing any so near to America [The meaning seems to be that it was thought impossible to grow wheat so far south] and have asked me for concessions at the Natchez, and Indian village sixty leagues from the settlement of Biloxi." (MPA II p. 59).

On May 12, 1733, about two decades after the first mention of rice, Bienville states the following in his reply to the king's memoir:

"... the quality of the soil and the climate are perfectly adapted to rice. It grows here very abundantly and without much work. Three-fourths of the inhabitants live on it and have forgotten wheat bread. This last grain has not been successful at all in the lower part of the colony. The fogs that are caused by the forests and the lakes of these quarters make it rust as soon as it is in the head ..." (MPA III p. 600).

Meanwhile the settlers learned to prefer rice over maize and to substitute rice for wheat. The French once used bread chiefly to crumble into soup or milk. This eating habit made them try to make a kind of bread from maize or rice. However, neither was found suitable for soaking in soup of any kind.³ (Le Page du Pratz, modern ed. 1947, pp. 165-166). It seems a substitute was soon found for bread in the form of simple boiled rice, for rice too was a starch which could be added to soup, gumbo, or milk. Actually, in southern and southwestern Louisiana of today rice is eaten always with gravy and beans. This practice is common in areas where rice is used at almost every meal and sometimes without bread.

Additionally, rice was an easy crop to grow. The seed were broadcast, nature provided the water, and there was little or no cultivation. This applied to Providence rice, produced largely for home consumption.

Modes of Cultivation

For convenience, rice culture in Louisiana may be divided into three types: Providence rice or small-scale home-use rice with little or no artificial irrigation; river rice, or irrigated rice along the Mississippi River, primarily commercial; and prairie rice, or mechanized large-scale rice culture developed in prairie Louisiana.

There are several types of Providence rice to fit different natural conditions, though the basic principles of production remain the same; with respect to the former, Providence rice may be divided into three main types: row-rice, including upland rice; swamp-rice; and marais-rice.

Row-rice

The term 'row-rice' is here adopted from the expression used

among rice farmers along the Mississippi and its distributaries. As its name indicates, row-rice was planted always in rows rather than by broadcasting. According to historical records, row-rice appears to be the oldest form of rice cultivation in Louisiana. Le Page du Pratz, who lived in Louisiana between 1718 and 1734, describes the method of cultivation:

"... rice is sown in a soil well laboured, either by the plough or hoe, and in winter, that it may be sowed before the time of the inundation. It is sown in furrows of the breadth of a hoe." (Le Page du Pratz, modern ed. 1947, p. 165).

Du Pratz' statement suggests that the preparation of fields and sowing was done before the annual flood, that is, before the fields were inundated during the growing season.

Row-rice fields were located on the outer edge of the natural levee where wet clay soils were not suited to maize and sugar cane. The boundary between upper-levee fields and row-rice fields may be divided approximately by the line of inundation during the flood or high-water season (Fig. 24). Clearing of the forested natural levee, if new ground, and preparation of fields for seeding were done during the low-river stage when the land was dry enough to plow or turn over with the hoe. Furrows were made with the hoe approximately to its own width, or by plowing as with other upland crops, the furrows about two and one-half feet apart from center to center. Seed were dibbled in or broadcast on the furrows and covered with hoe or wooden harrow (Fig. 26).

The size of the field was usually one or two acres, depending upon the amount of family labor available. Fields were cultivated for one or two years and then abandoned because of weed invasion in favor of fallow lands. Often fields were surrounded by post-and-rail



Fig. 24 View from an abandoned row-rice field toward the natural-levee crest, where line settlements are developed. The dotted line shows a rough boundary between row-rice field and upper-levee field. An old fence serves to keep cattle out. Picture was taken in January, 1958, after a little shower, Terrebonne Parish.



Fig. 25 One of the typical abandoned row-rice fields. Picture taken near the above.

fences (French pieu) to keep out animals (Figs. 24 and 25).

Growing rice was left without special care except for occasional hand weeding. Row-rice ripened in September, when the water level of the swamp had dropped. Its readiness for the harvest was indicated when the head became yellow and bent under the weight of the ripened grains. The farmers chose a clear day for harvesting. They cut the rice with a sickle (Fig. 27) and dropped it on the stubble, to lie there drying for a day. The dry rice was then tied with rice straw in bundles. The bundles were in turn stacked on higher ground safe from inundation in case of rain and rising water levels. This latter consideration means that the stack was near the house, since all the houses were located on the crests of natural levees, the highest places along the river. If the bundles were to remain in the stack for some time, they might be covered with a palmetto thatch in order to protect the rice from rain.

Upland rice, involving different methods of cultivation, was grown on the higher parts of natural levees, flat hill lands, and older alluvial cones, all lacking inundation during the growing season. Planting was in furrows as with row-rice. The only difference between row-rice and upland rice was the latter's lack of growing-season flooding.

Upland rice is traceable to the first part of the colonial period. According to Le Page du Pratz, for the period between 1718 and 1734:

"It has been sown in the flat country without being flooded, and the grain that [was] reaped was full grown, and of a very delicate taste." (modern ed., 1947, pp. 203-204).

Du Pratz' statement suggests that upland-rice production may have been derived from row-rice methods. Phillips (1953, p. 130) says that prior

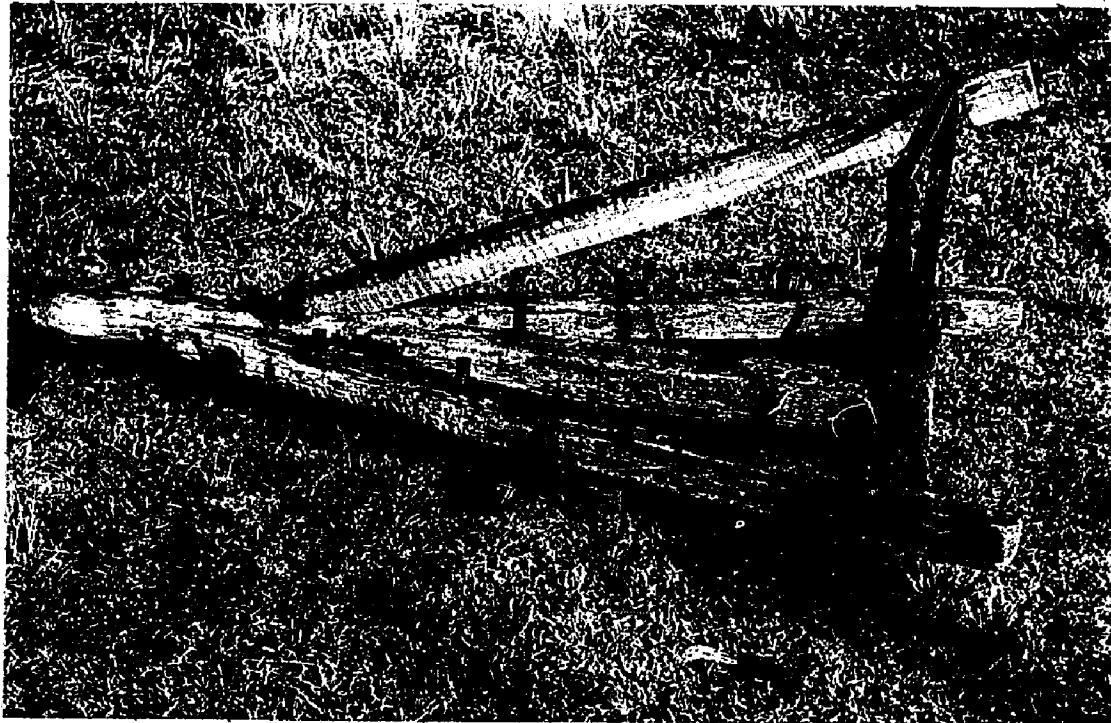


Fig. 26 A wooden spike-harrow used for row-rice cultivation, lower part of Bayou du Large, Terrebonne Parish.

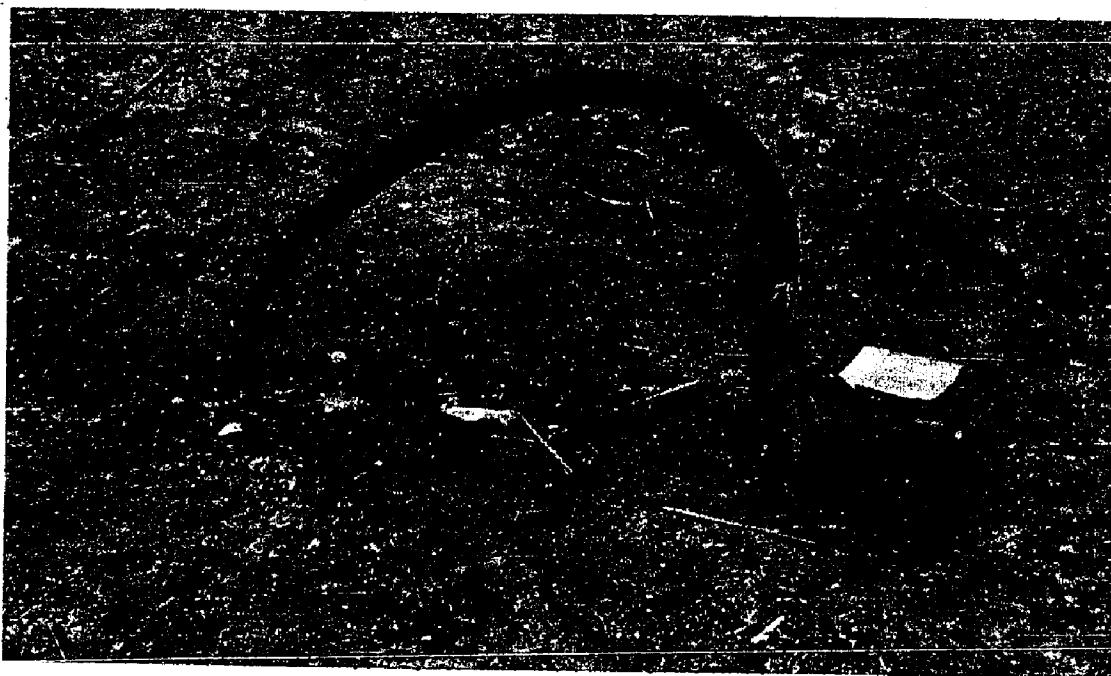


Fig. 27 A sickle or rice-hook, Diamond, Plaquemines Parish.

to the Civil War rice was planted in small patches for home consumption in the Tensas Basin and was called "dry rice" since it was neither irrigated nor necessarily planted in shallow water. After the Civil War this practice was continued on a very small scale, principally by Negroes. Phillips observed one of the last vestiges of this small-scale upland-rice culture near Como, Franklin Parish, in 1950.⁴

Rice for home use was also often planted between rows of maize. It was weeded and cultivated several times with the hoe as were other upland crops. This variant of upland-rice cultivation was practiced along Bayou Teche and Bayou Black until the early part of this century.

Recent experiment (Gray, J., 1937, pp. 41-42) confirms the ready feasibility of upland-rice cultivation in Louisiana. Six varieties of rice were grown on well-drained upland soils without irrigation. In this experiment the rice was planted in rows, as was done with row-rice on the backslopes of natural levees. At the same time, the same varieties were planted in prairie Louisiana, using the wet method. This experiment, carried out in the years 1932 to 1934, demonstrated that the yield and quality of upland row-rice were the equal of those produced by the wet method.

Swamp-rice

The most primitive, but not necessarily the oldest, method of rice growing in Louisiana was swamp-rice. Germinated seeds were broadcast directly on inundated swamps. No covering of the seed was required; until harvesting there was no special care, except that some farmers weeded by hand. This was a common practice until about 50 years ago in the bayou countries and has continued in some places almost to the present⁵ (Figs. 28, 29).



Fig. 28 One of the abandoned swamp-rice fields on lower Bayou du Large, Terrebonne Parish.



Fig. 29 Transition between swamp-rice (left) and row-rice fields. Picture taken near the site of the above view.

Martin's History of Louisiana, published in 1827, mentions an interesting sidelight in connection with a most destructive hurricane of September 11, 1723:

"... the colonists were in some degree relieved by the appearance of an unexpected crop of rice. The grain scattered by the hurricane had taken root, and promised a comparative abundance." (Martin, vol. 1. 1827, pp. 253-254).

The account suggests that the early settlers may have learned the method of swamp-rice cultivation, that is, broadcasting seed directly in the swamp without preparation of fields, from this natural lesson.

In the memoir on Louisiana of Bienville, written probably in 1725 (MPA III, pp. 499-528), the following observation was recorded:

"This last year when the water from the river maintained on the land a very long time people took the risk of planting the rice in the water itself. No sooner had the water run off than it grew with such vigor that most of those who thus ran a risk with it will have made an abundant crop." (MPA III, p. 519).

All swamp-rice fields were located at the edge of fresh-water swamps or marshes, lower lying than row-rice fields (Plate 6). Salinity was one of the main controlling factors of swamp rice and salinity was closely associated with fresh-water flow and discharge of the Mississippi through distributary bayous. After the Mississippi River flow into Bayou Lafourche was restricted by the construction of a dam in 1901-1902, there was a decline of rice cultivation in the lower bayou sections. The increasing salinity of marsh and swamp water made rice production impossible.

Swamp-rice fields were most commonly situated on the small undulating depressions between old natural levees and crevasses at the edge of swamps. The swamp areas, like the row-rice fields of the

levees, were originally forested; thus clearing of the forest was the first step in preparing the swamp-rice fields. Before felling, the trees were killed by girdling. Swamp soils are usually very fine clay, rich in humus. This fine clay soil, the so-called 'buckshot' clay, is impermeable. This impermeability is important for rice culture, since it holds water for a long period. The swamp-rice fields were not continuous, but were rather small undulating patches of depressions, one or two acres in size, along the edges of swamps (Plate 7).

Another sub-type of swamp-rice cultivation was found on the slopes of newly developed crevasses in the marsh area. Since the crevasse slopes were open marsh grassland, there was no need for clearing. Row-rice and the most-common swamp-rice fields had no levees to hold water. However, crevasse-slope rice fields were usually surrounded by levees, with the necessary water supplied by rain. According to one informant, who once lived in the abandoned settlement on the lower part of Bayou Pointe au Chien,⁶ the only irrigation consisted of the temporary use of a portable flume with water coming from the crevasse canal or from the backswamp. Planting was in rows or by broadcasting without preliminary furrows. This subtype of swamp-rice appears to be a transitional type between row-rice and swamp-rice. Further, it was likely a beginning of simple irrigation practice.

Swamp-rice was harvested in September after the water level of the swamp had dropped. The rice was cut with a sickle and dried on the stubble for one or two days. Tying of bundles and stacking them near houses were the same as with row-rice.

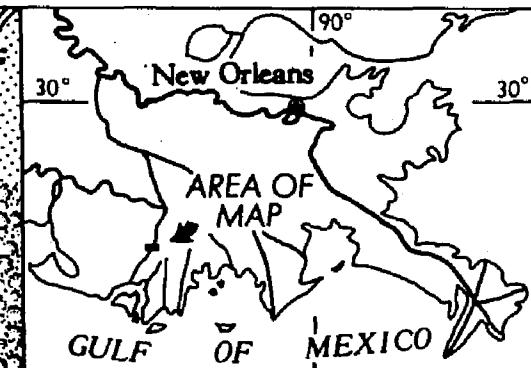
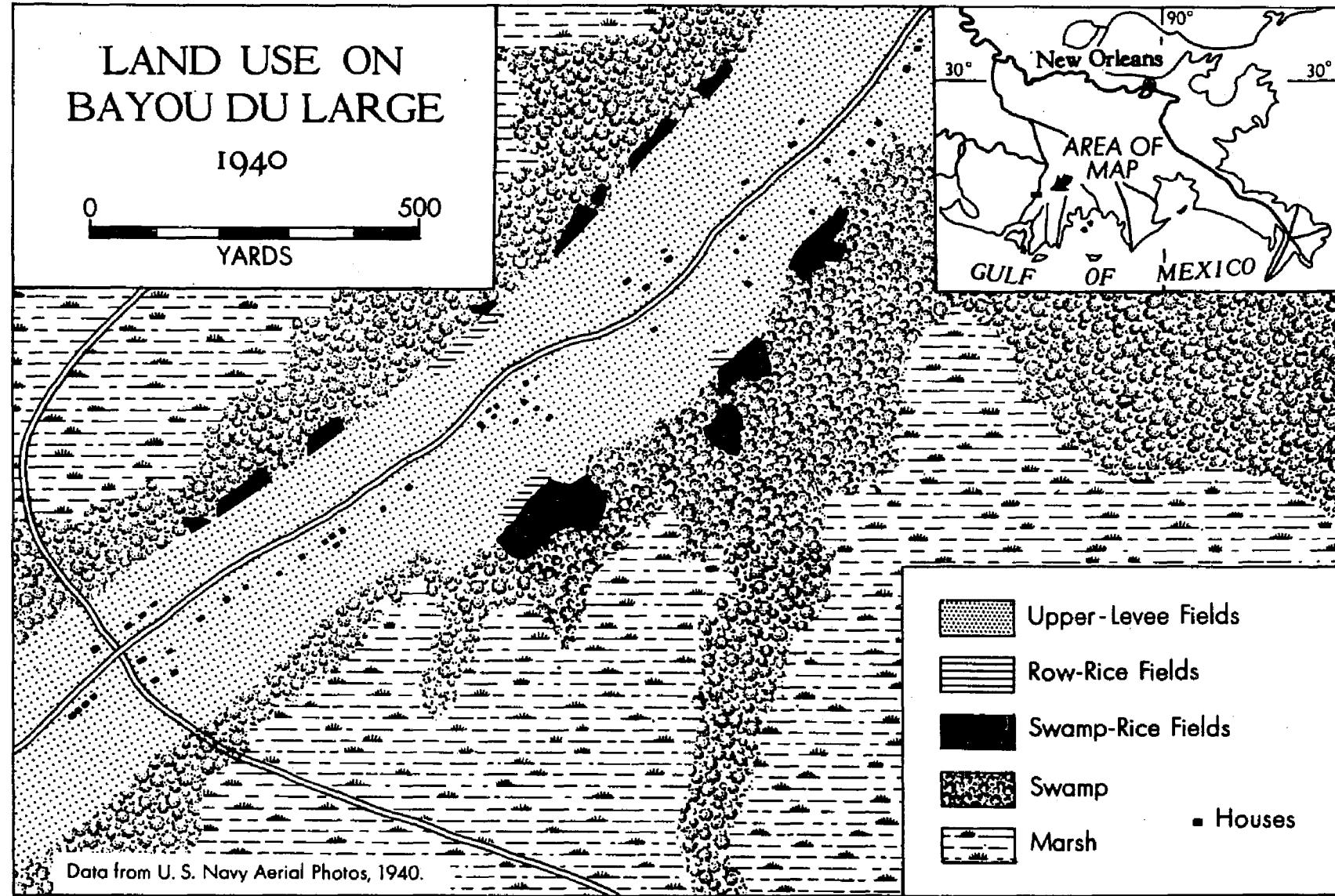
Marais-rice

The marais of prairie Louisiana is a small, round or irregular

LAND USE ON BAYOU DU LARGE

1940

0 500
YARDS



depression or rainy-season pond, 40 to 50 yards in diameter; depth of the marais is quite uniform at one to two feet. These ponds have no inlet or outlet but depend on precipitation for their water supply, and on the claypan that underlies them to hold it. Thousands of marais spotted the prairies, especially in the eastern section along the Vermilion River.

The origin of the marais is still uncertain. One student points out two main factors in their distribution: claypan and cattle. Post (1940, pp. 575-576) states:

"The best-developed ponds were generally on high ground, a location which suggests that during times of flood milling buffaloes or cattle trampled them out of what may have been but slightest depressions capable of holding water."

In Ditchy's Les Acadiens Louisianais et leur Parler, published in 1901, marais appears as trou de taureau (hole of bull) and is defined as "hollows which one encounters frequently in the grand prairies of Attacapas and which one supposes were made by angry bulls." [translation] (Ditchy, 1901, p. 209).

It is also very possible that the shallow ponds are unfilled remnants of abandoned Pleistocene channels. Aerial photographic study by Taylor (1956, pp. 20-24) reveals an arrangement of marais in relation to old channel scars which strongly suggests this origin.

In the early days of the prairies these ponds were prized for livestock, for ducks, and for the raising of rice (Post, 1940, p. 576). The early French settlers broadcast pre-germinated rice seed in the ponds without any special preparation of the field, and harvested a fair yield. The term Providence rice was derived originally from this marais-rice cultivation. Concentric levees were occasionally made in

marais to hold the water, and the pond was fenced to keep cattle out. The yield of rice depended wholly on the nature of the weather; that is, comparatively abundant rainfall during the growing season assured a good harvest. Rice was harvested with a sickle and dried on the stubble for one or two days, as with other Providence rice. Rice stacks were made near the house, where they remained until threshing.

The chief implements used in preparation of the fields were the hoe, plow, and harrow. Except for crevasse-slope rice in marshes, all swamp-rice fields were prepared with the hoe because neither the mold-board plow nor the common upland plow was suitable for working heavy, wet, swamp soils, not to mention the difficulty of plowing around the girdled trunks of trees left on the plots. On the other hand, the comparatively coarse materials on new crevasse slopes were easily worked with the moldboard plow. The most primitive type of marais-rice was sown without any preparation of the field; some farmers broke up the top soil with hoe or plow before planting. Row-rice fields were usually plowed like any other fields, and the implements were the same as those used with corn or any other row crop.

Providence rice was threshed by members of the family as it was needed. Several methods of varying complexity were known. The most simple method practiced until recent years by a swamp-rice farmer on the lower part of Bayou du Large was to beat the cut and dried rice with ordinary sticks. Some grasped the rice bundle and beat it on a log, a barrel, or some similar object, until most of the grain was removed from the straw. The bundles were then beaten with sticks to remove the remaining grains. Finally, the rice was winnowed with Indian basketry trays made of cane (Fig. 31) when there was breeze sufficient

to blow the chaff away. Besides these simple techniques were animal treading and the use of true flails.

Milling of rice is a quite different process than pounding the grain to meal, as with corn. While milling corn is a process of breaking grains, milling rice is a process of husking or shelling the outer hull of the rice kernel and polishing off a part of the inner seed coat. Most rice is eaten in the whole grain, whereas other small grains are used as a flour in most cases. Milling of rice was probably the most laborious and tedious job in connection with rice production, and it was done from time to time as family need dictated. It is said that early French farmers of the prairies milled rice only on Saturday afternoons and only for Sunday dinner, because marais rice provided enough for the big Sunday dinner, but not sufficient for daily consumption. Though there were early attempts to introduce an efficient rice mill,⁷ the wooden mortar and pestle remained the main implements. The wooden mortar and pestle adopted from the Indians were found throughout the Providence-rice culture area. One can still find old mortars and pestles, though they are no longer in use (Fig. 30). Milling of rice by this primitive means was done primarily by women, and only occasionally by male members of the family. Occasionally milling was the combined work of two or three persons, alternating strokes with individual pestles. This practice is still carried on in some parts of Asia and among some American Indians.

A more advanced implement for husking rice was a wooden rotary pit-mill (Figs. 32, 33), which consists of two slabs of wood, about two feet in diameter, revolving one on the other. The surfaces of these slabs are serrated, with channels diverging from the center



Fig. 30 A wooden mortar and pestle, lower part of Bayou du Large, Terrebonne Parish.

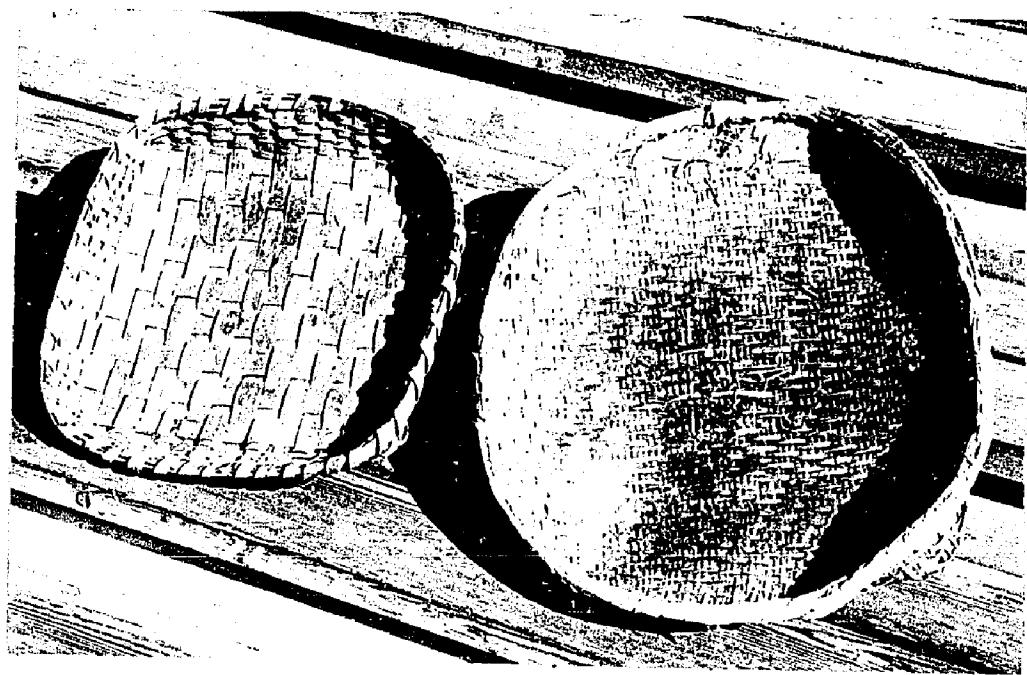


Fig. 31 Winnowing baskets used by Indian swamp-rice farmers near Dulac, Terrebonne Parish.

(Fig. 33). The outer skin of the rice was husked between the serrated surfaces with the rotary action of the upper on the bottom slab. However, removing the thin inside skin of rice was accomplished always with mortar and pestle. Whenever the rotary pit-mill was used, it was used in conjunction with the mortar and pestle; but the latter was used both with or without the rotary pit-mill. It seems that the rotary pit-mill was distributed along the Mississippi River south of Baton Rouge and in the bayou country, but not in the prairies.

The origin of the pit-mill in Louisiana is not known. In Carolina, according to Catesby (1771, Vol. 1, p. xii), writing probably around the close of the fourth decade of the 18th century, the colonists used "hand-mills" to get off the grains' outer coat or husk, then removed the inner film with large wooden mortars and pestles. It is believed that by the middle of the 18th century wooden hand mills were generally employed to remove the outer husk (Gray, 1933, p. 282). The hand mill's use and appearance, as described by Catesby and Gray, are identical with those of the rotary pit-mill described above for Louisiana. It is very possible that the pit-mill so widely used along the Mississippi River and in the bayou country was introduced from South Carolina during the colonial period, although no historical record bearing on the matter was discovered.

In summary, the development of Providence rice has been closely related to the French and their settlements in Louisiana. The known areas of Providence-rice culture are found in French-settled sections, roughly within a triangular area connecting New Orleans, Point Coupee, and Lake Charles. Field investigation indicated that all of the former Providence-rice farmers encountered are of French descent.

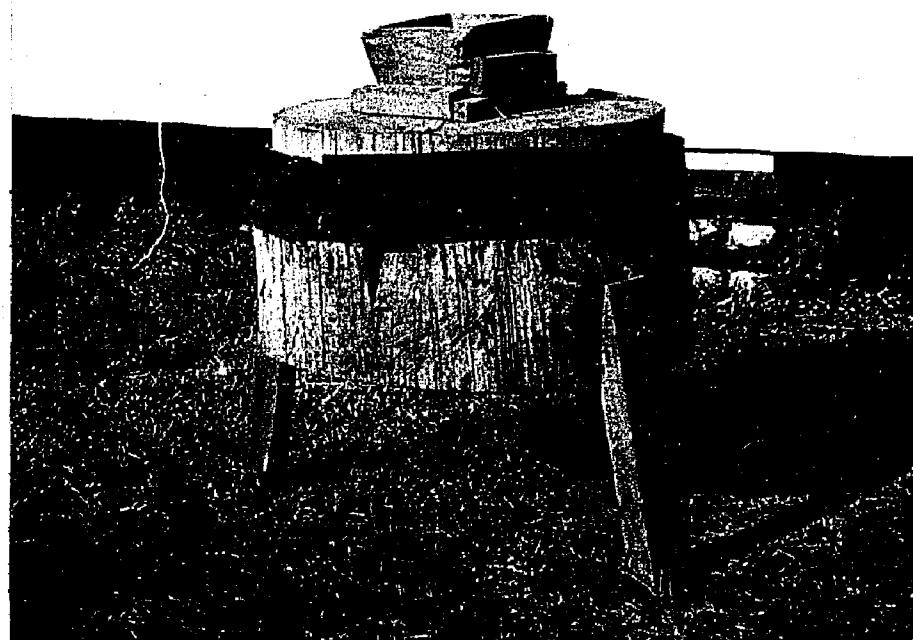


Fig. 32 A side view of rotary pit-mill made of cypress,
lower Bayou du Large, Terrebonne Parish.

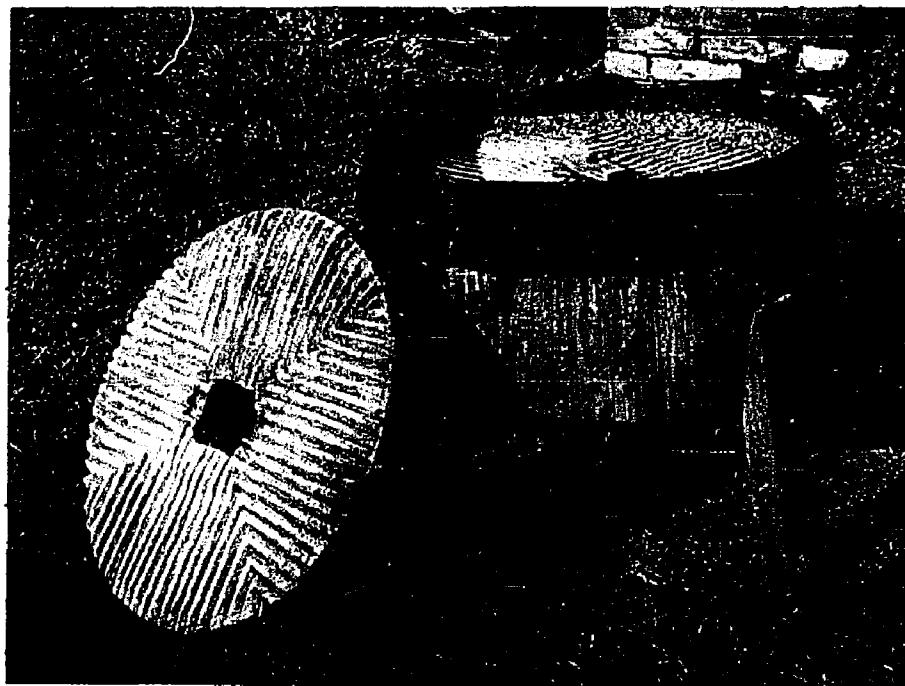


Fig. 33 A wooden rotary pit-mill showing serrated surface for
hulling rice, Terrebonne Parish.

On the basis of one of the earliest descriptions of rice culture by du Pratz (modern ed. 1947, p. 165) and Bienville's memoir on Louisiana (MPA III p. 519), written possibly in 1725, the earliest form of rice culture in Louisiana seems to have been Providence rice, which likely originated with the first French agricultural settlement on Bayou St. Jean, north of New Orleans, about 1718. Rice culture then spread with the migration of French settlers. Around 1725, Providence-rice culture had diffused throughout the colony from New Orleans to Natchez, especially in swampy areas (MPA III p. 520). Then rice culture spread down Bayou Lafourche and jumped across the Atchafalaya swamp into the Teche country. Finally, about 1760, rice reached the prairies. It moved from north of New Orleans to the south of English Turn on the Mississippi River, probably around the last part of 18th century.

With respect to time, place, and technology, row-rice was the first form of Providence rice in Louisiana; then came swamp-rice and marais-rice. Swamp-rice was the most primitive form of rice culture, but not necessarily the oldest in Louisiana. The technique used with the first introduction of rice from the West Indies appears to have been row-rice.

Upland-rice culture was a subtype derived from row-rice, an adaptation to higher-standing lands lacking inundation during the growing season. The wide adaptability of the rice plant is indicated by the readiness with which lowland varieties were grown in upland areas; that is, the same varieties of rice which grew on wet rice fields grew in dry upland environments. Soon after the introduction of rice, colonists accidentally discovered the swamp-rice method of utilizing

swampy lowlands. The method spread rapidly, especially to the lower bayou country, owing to its simplicity and fair yields.

The primitive type of maraïs-rice is technically almost the same as swamp-rice, but it could not be an earlier form because the prairies were settled some forty to fifty years later than the Mississippi River and Bayou Lafourche areas. Maraïs-rice was likely a swamp-rice technique adapted to the maraïs, which provided a similar natural condition. Among the several swamp-rice techniques, swamp-rice proper seems likely the first because of its greater technical simplicity. Crevasse-slope rice was an advanced form of swamp-rice using artificial field levees, occasional simple irrigation, and advanced threshing and milling implements such as the true flail and pit-mill. This subtype of swamp-rice was possibly a transition between Providence rice and a beginning of simple irrigation practice.

Cultural Landscape

With Providence rice culture, French colonists transformed the landscape along the Mississippi and bayous to a considerable extent. During early colonial times, swamps bordering small crevasses and bayous were cleared for rice cultivation. After the building of artificial levees along the Mississippi, lands were cleared and drainage channels were dug an arpent (about 193 feet) apart and perpendicular from natural-levee crest to backswamp. It is probable that in all newly cleared lands rice was sown, because new lands were usually wet lowlands, not suitable for upland crops. After several years of rice culture, lands were sufficiently improved in drainage so that upland crops such as corn could be cultivated. Still newer lands were then

cleared for rice. New lands were usually free from weeds. Moreover, Providence-rice cultivation required little labor as compared with upland crops. This practice of growing Providence rice was continued in part even during the river-rice period by Negro farmers. The latter commonly cleared one or two acres a year, and planted rice on the new lands for several years. The fields were then turned over to a commercial crop and new land was cleared for rice cultivation.

The Providence-rice fields typically appeared as small irregular patches. These irregular patches on the edge of backswamps, now abandoned and partly covered by woods, are still distinguishable on aerial photographs. Oil-company surveyors in the swamps may encounter such tall-canegrass-covered patches surrounded by woods (Fig. 34), possibly lacking levees, but often showing large tree stumps relict from clearing, and abandoned wooden fences which were built to protect the crops from cattle. In the marshes one may encounter old levees and abandoned flumes on relict crevasse-levee slopes.

On the prairies, French settlers soon discovered the utility of the seasonal ponds or marais. On them rice was broadcast in the manner of swamp-rice. First, marais were used as waterholes for cattle, and later became of special interest for the growing of Providence rice. Though marais needed little improvement to become rice fields, they were often protected against cattle with the familiar post-and-rail fence. With the newer development of mechanical production of rice in the area, the marais are no longer in use for rice. Heavy machinery has often obscured the sites of former marais. Others have returned to their original use as waterholes for cattle. They are still numerous and conspicuous features of the prairies. Without



Fig. 34 An abandoned rice field covered with tall canegrass and young trees. The small canal was made by oil-company surveyors. In foreground is a dugout pirogue; lower Bayou du Large, Terrebonne Parish, 1958.

knowing the culture history of the prairies, it is impossible to recognize in these ponds once most important natural factors in controlling the distribution of rice growing. (Fig. 35).

Providence rice was a development of Louisiana French settlers, hence was an integral part of the rural French cultural landscape. With it went the creole house (Fig. 36), modified from the European prototype in the form of porches to withstand a semitropical climate and piers to raise the structure above the threats of inundation and reptiles. It is assumed that the creole barn (Blume, 1956, p. 57) was developed during the French period.

The form of settlement followed the traditional French colonial linear pattern along river and bayous. Houses were set facing and close to the river and paralleling road (Fig. 37). Distance between houses varied in accordance with the width of individual land holdings, determined by size of original grant and extent to which the French system of inheritance had divided it.

The construction of artificial levees began early in the 18th century. As the threat of flooding increased, so were the levees made higher. It was legally mandatory that each land owner build and maintain levees. During the early French period levees were built to a height of at least two feet, with a width of six feet. The levee top provided a foot and bridle path (Surrey, 1916, p. 92). In the later Spanish period the required height of levees was increased to six feet, and they were reinforced by a wooden revetment or an increase in bulk of the structure (Blume, 1956, p. 94).

Early in the French period, rivers were the only means of travel between towns and farms. Each settler was obliged to set in the stream



Fig. 35 A marais, formerly used for Providence-rice culture. The marais in this picture has been slightly enlarged for cattle and duck raising. A French barn is seen across the marais. Near Abbeville, Vermilion Parish.



Fig. 36 A side view of French creole house, lower Bayou du Large, Terrebonne Parish.



Fig. 37 A former slave quarter, showing creole-type houses along a river road, Iberville Parish.

bank a twelve-foot green oak or cypress post, at least eight feet of it in the ground and the part above ground not less than four feet in circumference. These posts were for the convenience of vessels that might make landings. Along the levees, roads were made. As early as 1732, an order was issued providing for a wagon road forty-eight feet in width on the landward side of the levee. The colonists were responsible for the good condition of the public road and of the culverts crossing the drainage ditches (Surrey, 1916, p. 92). By the end of the French period there was a good wagon road along the river, some fifty miles in length, eighteen miles of which were below New Orleans (Surrey, 1916, p. 93).

The seasonal rhythm of Providence rice followed closely the flood and low-water stages of the Mississippi and associated floodplain bayous; on the prairies the agricultural calendar followed the rainy and dry seasons. Clearing and preparation of fields were done during winter and spring, when the river stage was low. Just before or after the high-river stage seed were sown on the dry or previously inundated fields. Dark-grayish fields were soon covered with green rice. Needed water was supplied from small bayous and crevasses by natural flooding or with simple levee cuts. On the prairies, rain was the only supplier of water.

Fields turned golden yellow in August when the rice was ripe. Then it was necessary for children and old people to protect the ripened rice from feeding birds. Crude scarecrows and bird-watching wooden stands were to be seen in the fields. Golden fields of a solid stand of rice were gradually transformed into the gray-yellow of small stacks or shocks of harvested grain.

Near the dwellings, grain yards received bundles of rice transported on human backs or in two-wheeled carts. Pole-less large stacks were often covered by palmetto leaves. Here they remained until need dictated their threshing. Threshing with ordinary sticks or standard flails preceded winnowing with Indian basketry trays. The final step in processing rice was a crude milling. As needed, rice was milled mainly by female members of the family with a wooden mortar and pestle, less often with the rotary pit-mill.

X. River Rice before 1885 in Louisiana

River rice is a term used during the last sixty years among rice millers and farmers along the Mississippi and its flood-plain bayous in contrast to rice produced in the prairies of southwestern Louisiana. River rice is always irrigated from the active Mississippi, bayous, or abandoned channels. Artificial levee-cuts or flumes and irrigation ditches have served to flood fields during the growing season, whereas Providence—whether prairies or river—rice uses primarily natural flooding. Source and time of irrigation were not controlled prior to 1885, when a crude steam-powered device for lifting water from streams was devised for use in the prairie section of Louisiana, and was subsequently transferred to the Mississippi River area. In general, before 1885, the fields were artificially flooded, only when the river rose to a stage sufficiently high to permit controlled divergence to fields. Controlled irrigation through pumping and the accompanying rise of prairie rice make 1885 a significant break.

Compared with Providence rice, river rice was grown on a larger scale, primarily for commercial purposes. Fields were located usually on both lower-levee slopes of the Mississippi and related bayous. Upper slopes were used for other crops, such as sugar cane, cotton, and vegetables, which were not suited to the heavier soils of the lower slopes.

Prior to 1850, rice culture in Louisiana was primarily in the form of Providence rice, though to a limited extent river rice was grown along the lower Mississippi River, especially in Plaquemines

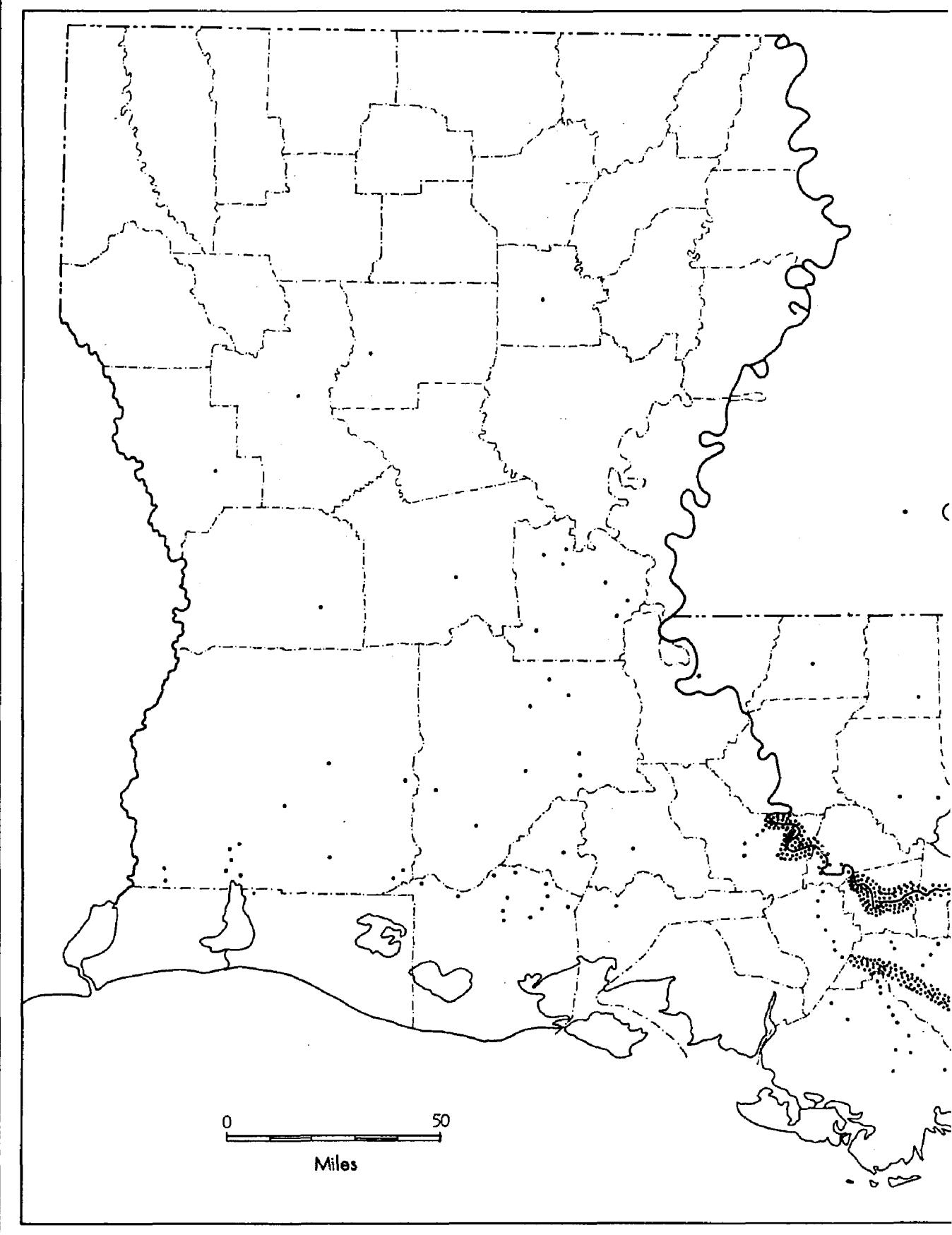
Parish. Between 1850 and 1885, river rice had its heyday in the period before the appearance of prairie rice in Louisiana. It was distributed widely in the areas south of Natchez along the Mississippi River and related bayous (Plates 8, 9). After the development of prairie rice in southwestern Louisiana, river rice declined gradually. However, it continues to the present, with a modification of methods introduced from the prairies.

For convenience, the account of river rice may be divided into two periods: before, and after, 1885. About 1885, the first steam pump for lifting water from the bayou was devised in southwestern Louisiana; this invention introduced a new era in the methods of cultivation. Of the earlier period, one of the primary descriptions of irrigated rice in Louisiana appears in Du Pratz' The History of Louisiana:

"[When the rice reaches] three or four inches high, they let water into the furrows, but in a small quantity, in proportion as it grows, and then give water in greater plenty." (modern ed. 1947, p. 165).

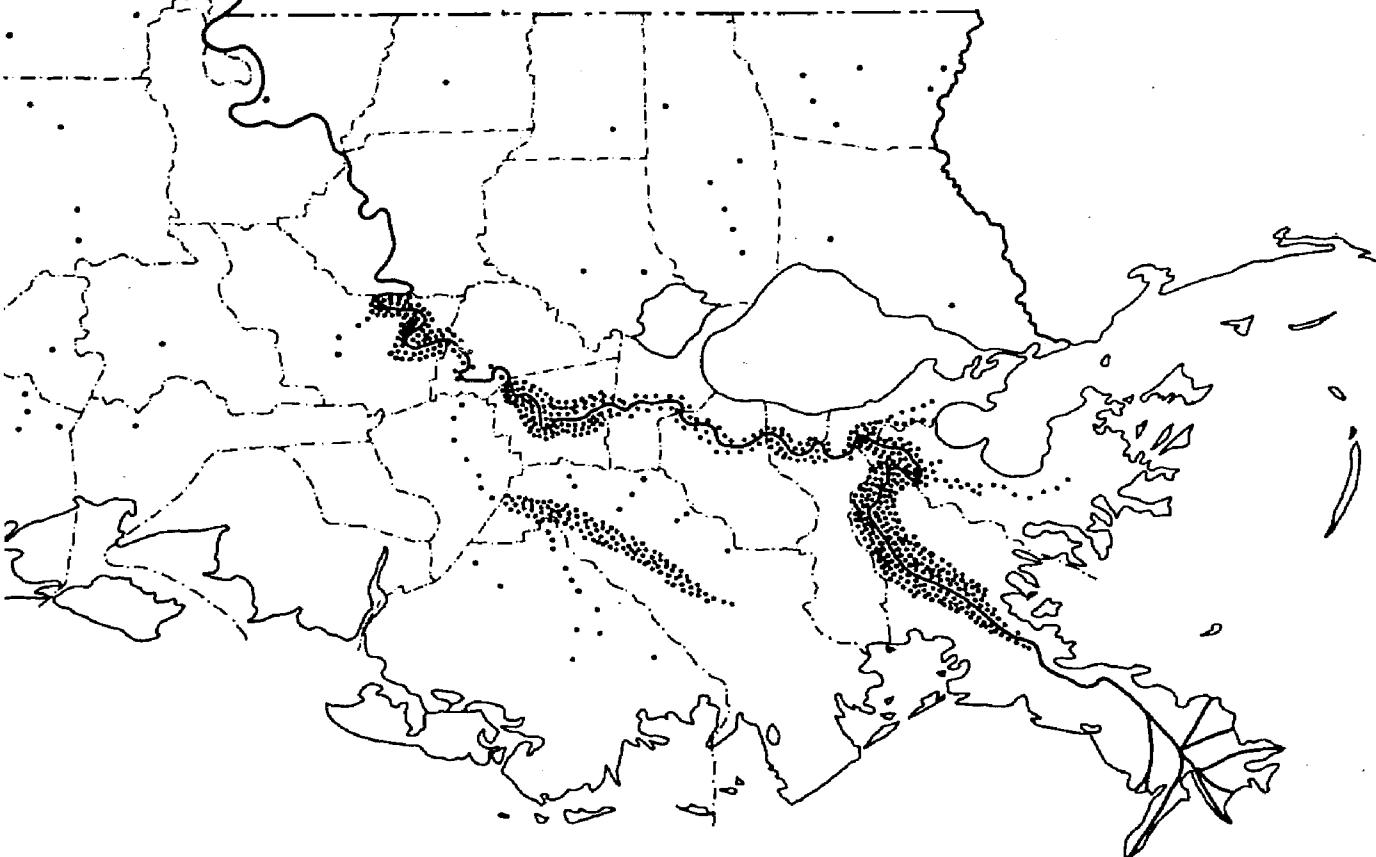
Du Pratz' description does not mention the artificial irrigation ditches which are such characteristic features of river rice. Probably he is describing a type of Providence rice on a crevasse slope.

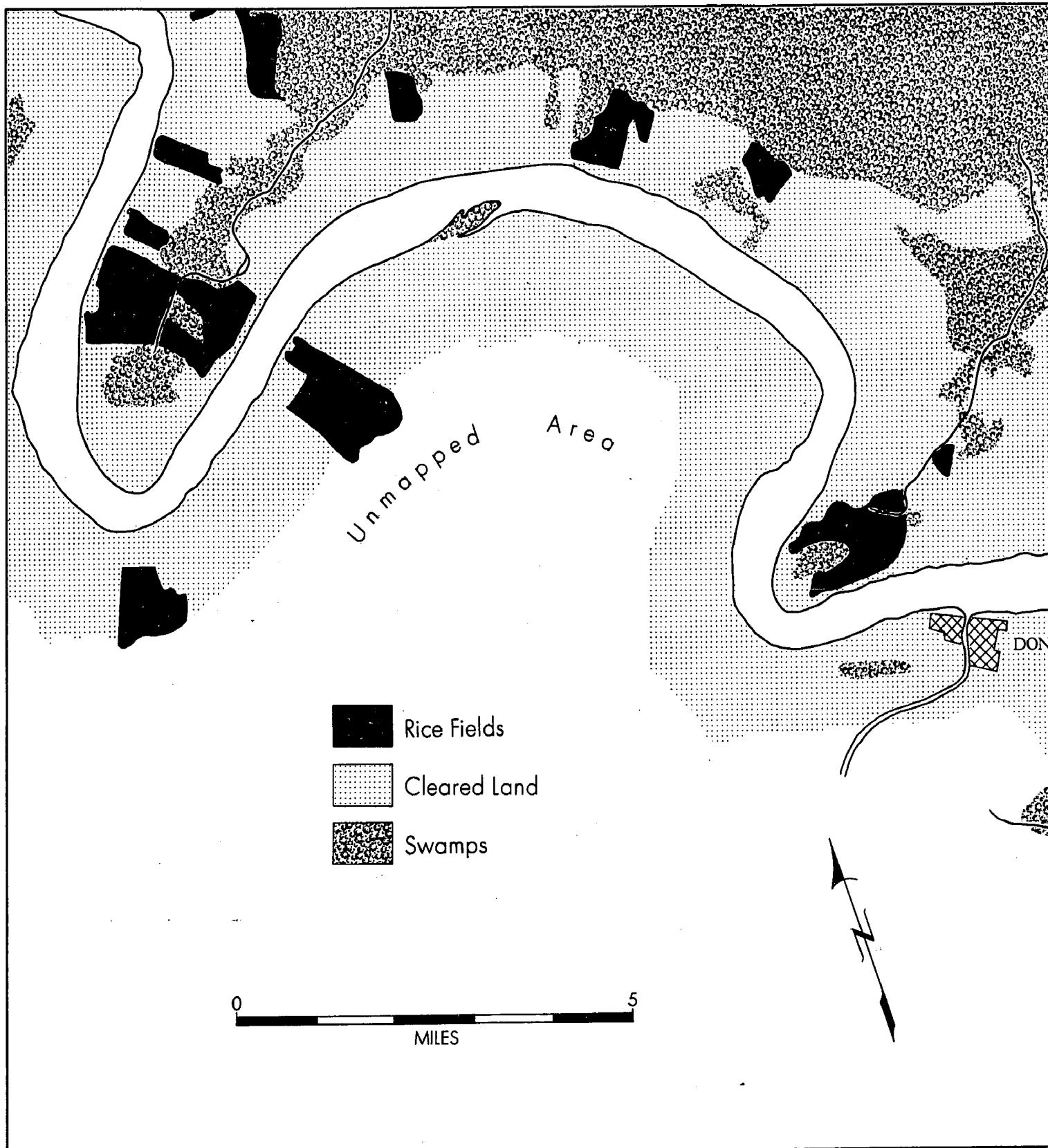
For 1833, Flint (1833, Vol. 1, p. 244), an extensive traveler and writer, describes rice culture in Louisiana. He mentions the great area of land favorable for upland-rice cultivation and the immense extent of swamps suitable for swamp rice. However, he describes only small-scale rice production for home consumption without referring to any irrigation system. This suggests that the river-rice method was not common practice even in the 1830's. One of the earliest mentions of river-rice cultivation with artificial irrigation by means of ditches appears in De Bow's Review (Wilkinson, 1848, pp. 53-57). According



RICE PRODUCTION
IN
LOUISIANA 1879

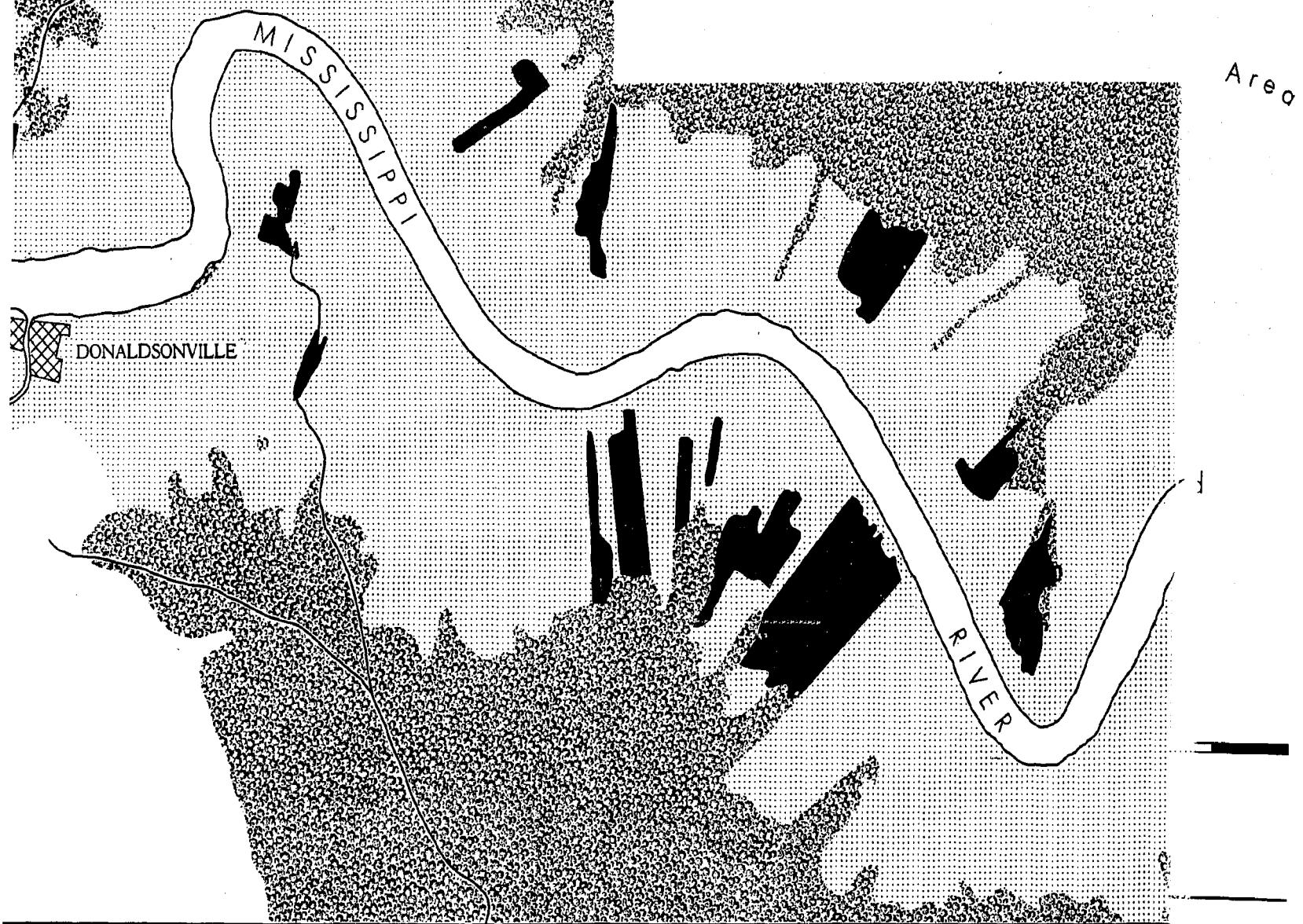
- Clean Rice 30,000 Pounds or less.

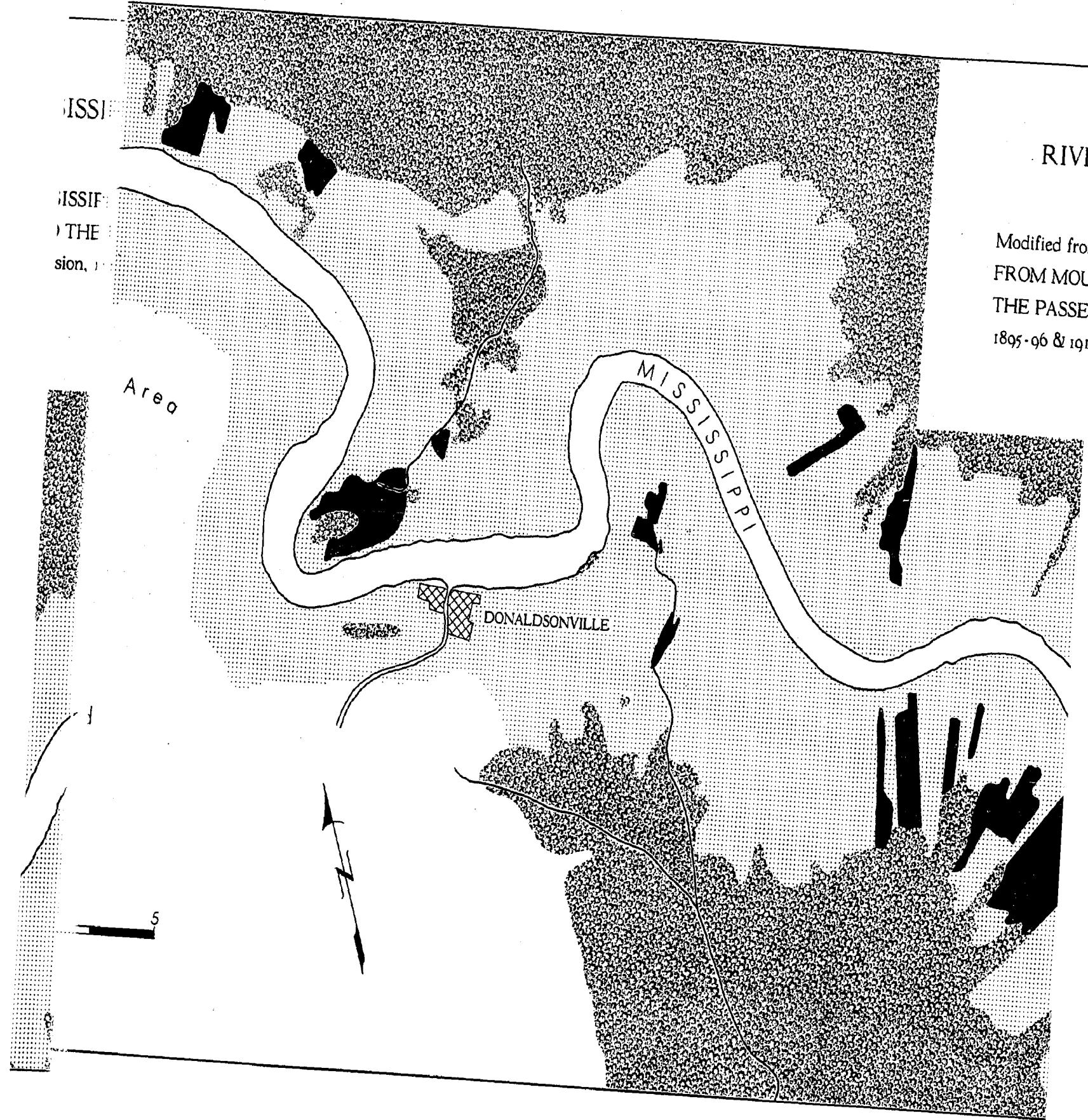




RIVER RICE ON THE MISSISSIPI
1884-1896

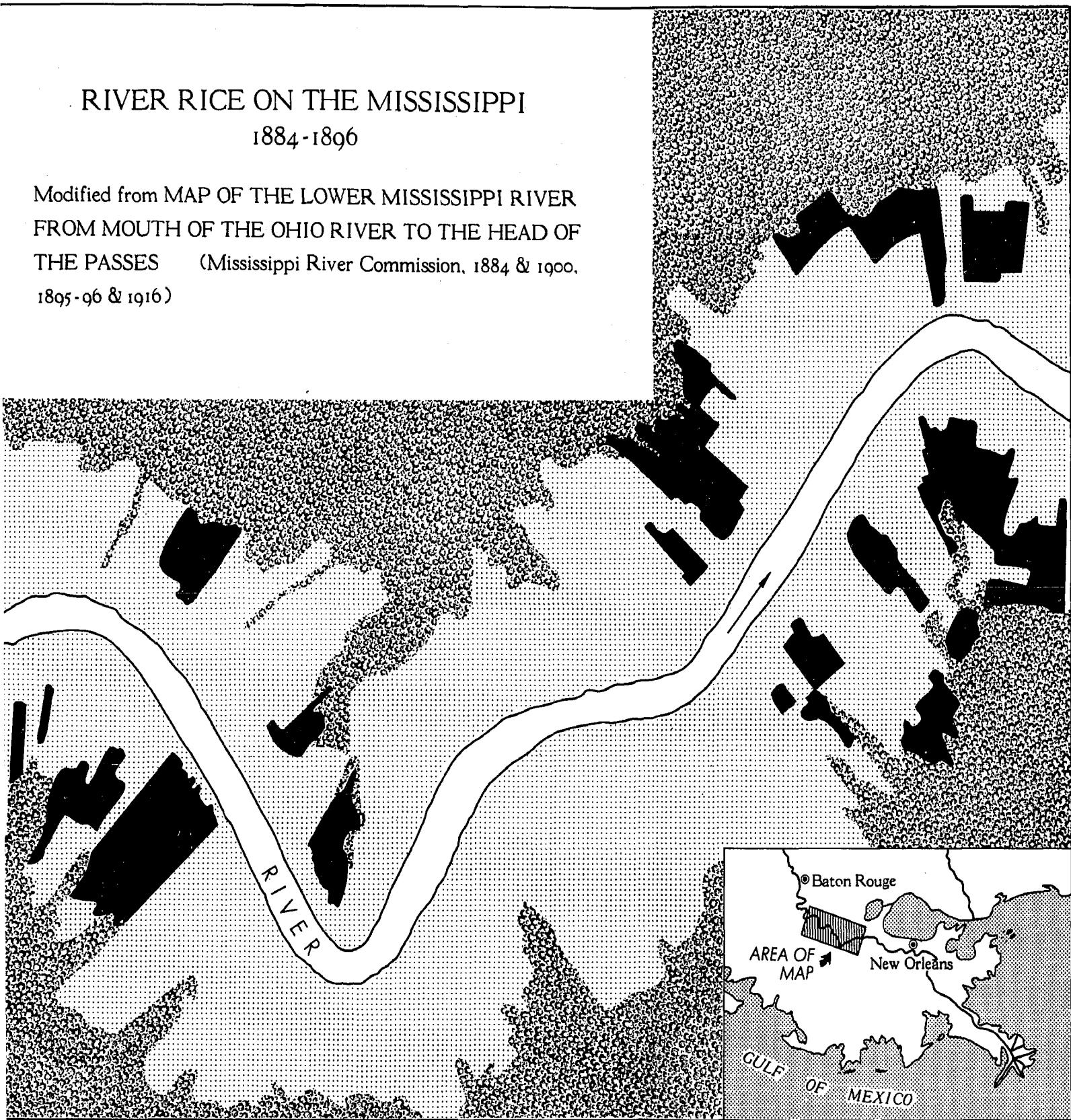
Modified from MAP OF THE LOWER MISSISSIPPI
FROM MOUTH OF THE OHIO RIVER TO THE
THE PASSES (Mississippi River Commission,
1895-96 & 1916)





RIVER RICE ON THE MISSISSIPPI
1884-1896

Modified from MAP OF THE LOWER MISSISSIPPI RIVER
FROM MOUTH OF THE OHIO RIVER TO THE HEAD OF
THE PASSES (Mississippi River Commission, 1884 & 1900,
1895-96 & 1916)



to Wilkinson, the author of the statement, in about 1855 a large number of planters imported rice seed from South Carolina to provide a substitute crop for sugar cane since the latter was in decline due to an unfavorable tariff. Subsequently the native "Creole" rice was gradually replaced by "Carolina Gold" and "Carolina White," which were the principal varieties in Louisiana until about 1890, when a new variety, "Honduras," was introduced from Central America (Jones, 1936, pp. 428-429). The planters were mostly small-scale growers; no one had more than two-hundred acres for rice, many less than fifty. Especially in Plaquemines Parish, a considerable acreage of sugar-cane fields was replaced by rice fields in the middle 1850's (Bouchereau, 1873, p. vii).

Rapid increase in rice production came after the Civil War. Due to the loss of labor and capital, production of sugar dropped abruptly, not reaching its pre-war level until 1885-1890 (Fig. 38). During the Reconstruction period rice cultivation was extended rapidly by small-scale farmers and sugar planters, because rice culture needed less capital and labor than sugar cane. Unlike sugar's decline, rice production in 1869 was almost triple that of 1859, and continued its growth throughout this period.

Modes of Cultivation of River Rice

Preparation of fields began before the high-river stage, usually in February. The first task was to dig or clean out irrigation ditches to fit the configuration of the land, but the principle was the same. In general, in a farm of four-acres frontage on the river, a flume-ditch, four feet or more wide, four to five feet deep, running from the river to the swamp, was dug. Flume-ditches were connected to the

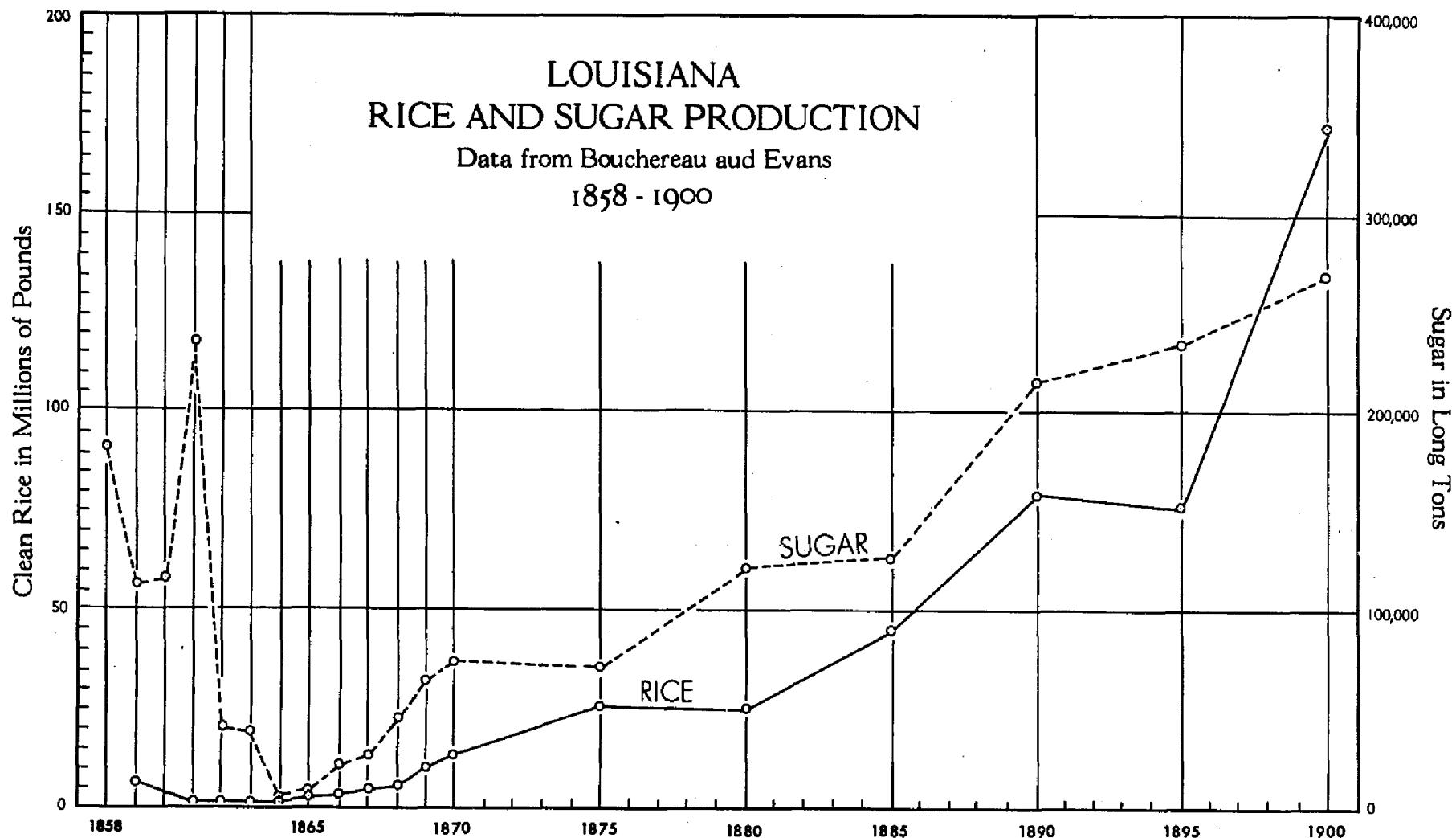


Fig. 38

river in different ways, such as a simple levee-cut or flume. One or several cross ditches, depending upon the configuration of the levee slope, were made at right angles to the flume-ditch or -ditches (Fig. 39). Fields were further divided by cross-levees to fit the natural-levee slope, first with the plow, then completed with hoe or shovel. Cross-levees blocked the old arpant-system drainage ditches with either plank gate or earth dam. Check- or length-levees were added where flume-ditches were far apart.

In Plaquemines Parish, according to Wilkinson (1848, pp. 54-55), cross-ditches rather than the later-developed cross-levees were made every half-acre apart. The cross-ditches were two-feet wide, with a bank behind them to hold the water about a foot or more high. At the back of the field was a ditch four-feet wide running parallel with the river. It had a levee somewhat higher than the field-levee on the down-slope side to complete the enclosure of the cultivated area. In the back-levee was a floodgate opening to admit or expel water. This irrigation system described by Wilkinson has a striking similarity to the South Carolina tidal-swamp irrigation system except for the use of high-water stage instead of tidal range of rivers. It is very possible that early rice farmers got their ideas from South Carolina, but gradually modified them to suit local conditions, such as the slopes of the natural levees and the seasonal fluctuation of river stage.

Two methods of preparing the field for sowing were practiced. They were known as the "dry" and the "wet" methods. The former was used on the upper part of the levee slope where the land was dry and the soils comparatively sandy; the latter was practiced on the lower

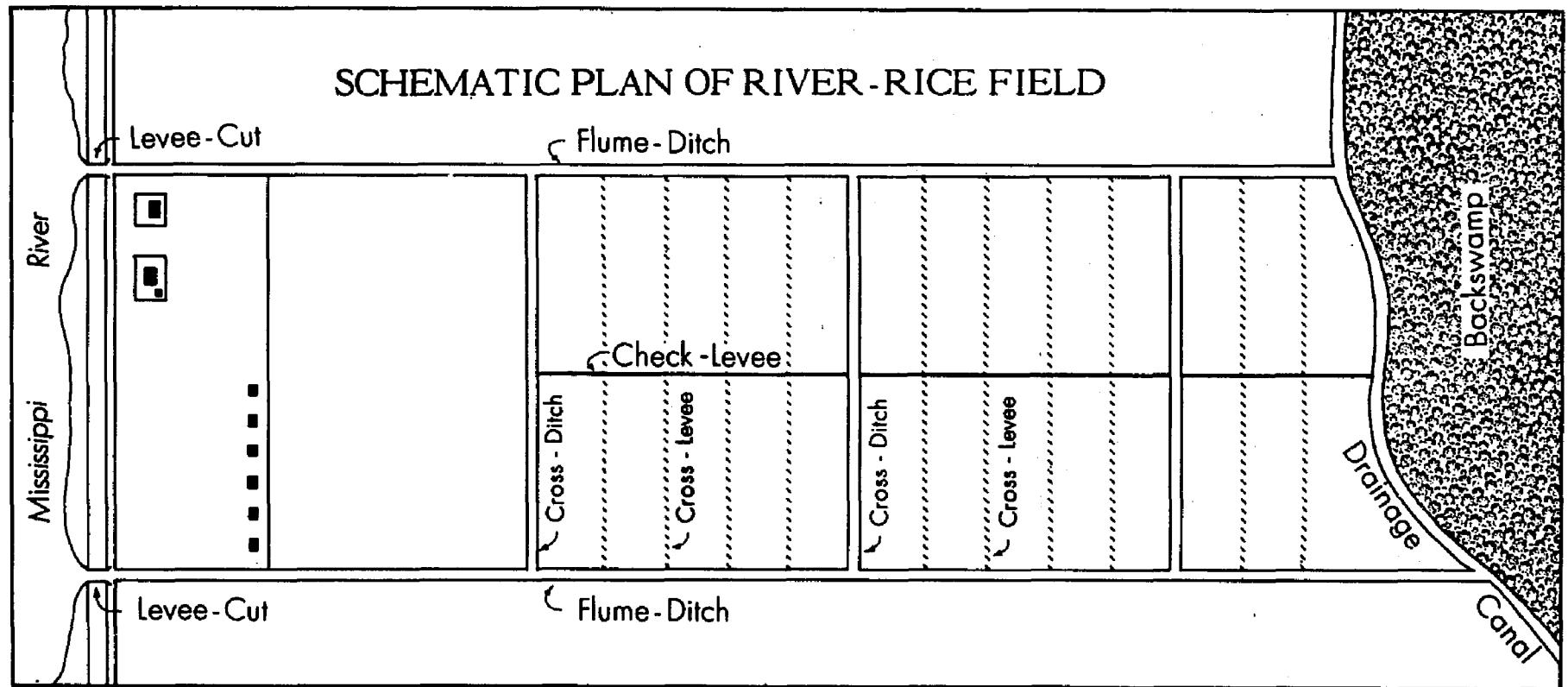
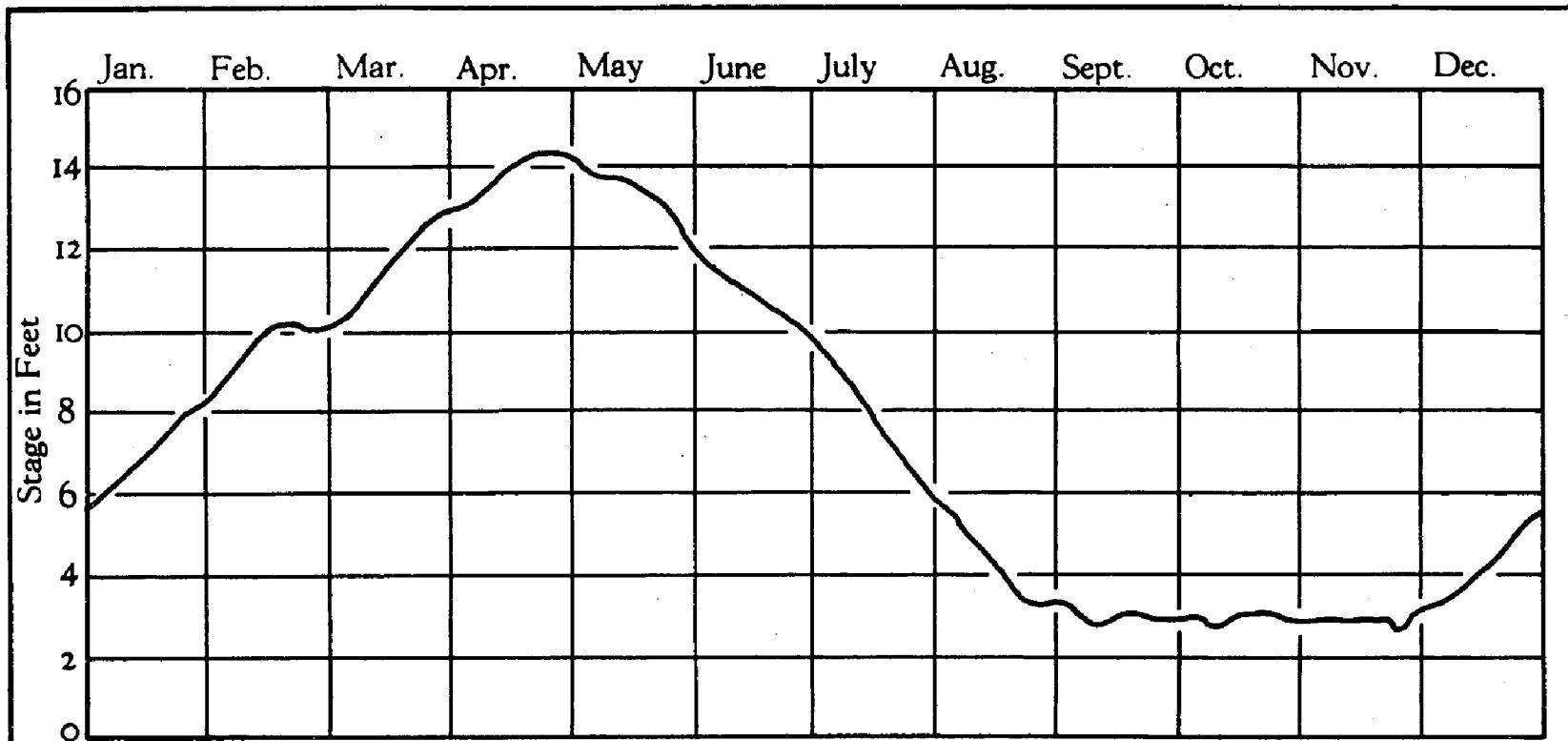


Fig. 39

levee slope where soils were heavy clay and acid.

In the preparing of fields by the dry method, land was plowed in the fall and winter, and thoroughly harrowed prior to inundation. Seed were broadcast or drilled and covered with the harrow, a process similar to the planting of oats or wheat (Stubbs, 1904, p. 373). The period of sowing was usually during the last of March or in early April. When the rice grew to some three inches in height, corresponding in time to the highest river stage (Fig. 40), fields were flooded to give sufficient moisture and prevent weeds. With the wet method, plowing was usually done in April, with or without inundation. However, plowing after inundation was often practiced on the heavy clay soils, since they are not easy to plow dry. Seed were pre-germinated and then broadcast on the flooded fields. After sowing, fields were drained until the rice reached six inches in height, and then they were inundated again.

Implements used in preparation of the fields were the moldboard plow and hoe or shovel. The comparatively sandy upper slope was plowed with a common moldboard plow, in a manner similar to the preparation of fields for corn or wheat, with motive power consisting of either one or two oxen or a mule team. Down-slope fields with heavy clay soils were plowed with a special wheeled wooden moldboard plow pulled by a six-ox team, employing two drivers and a third hand to guide the plow (Wilkinson, 1848, p. 55). The plow is known by various names: lowland plow, French sock plow, and creole plow. The lowland plow with two front wheels was well adapted to the section below New Orleans, where heavy soils were extensively used for rice cultivation. In the area north of New Orleans and on the bayous, lowland plows must have



STAGE HYDROGRAPH

Carrollton Gauge, New Orleans

Average Hydrograph for period 1901-1929

Data from C. of E. U. S. Army

Fig. 40

been uncommon, as no evidence of their use can be found outside the lower reach of the Mississippi south of New Orleans. In one instance, a lowland plow was used by a tenant rice farmer until about 1950, when he discontinued rice culture because of salt-water intrusion from the Gulf. (Figs. 41, 42). The lowland wheeled plow is the same as the type commonly used after the 11th century in northern Europe (Jope, 1956, pp. 88-94). Likely it was introduced into Louisiana during the French colonial period from northern France, specifically to overcome heavy lowland soils.

Weed plants were controlled by flooding and hand weeding. In the early 1840's, rice farmers checked weeds by deep flooding, leaving only the heads out, and known as "point flow." The water was kept about six inches deep until the rice was ready for harvesting; at this time or a little before all the water was drained off. Weeds were also pulled out by hand, since all were not controlled by flooding. The hands weeded about one-quarter to one-third of an acre per day. Systematic flooding to control weeds was not so much practiced as in the later period of river rice and Carolina tidal-swamp rice. This was because the time of availability of water could not be controlled, but rather was a natural phenomenon. During this period the weed problem was one of the important factors preventing more extensive rice cultivation. Frequently farmers lost a considerable quantity of their crop and found its quality lowered because of excessive weed invasion, due generally to the failure of the river to rise sufficiently when needed to flood fields. Yields of rice were therefore dependent upon the height of the river and upon rainfall during the growing season, especially at the time of sowing and during the youthful stage of

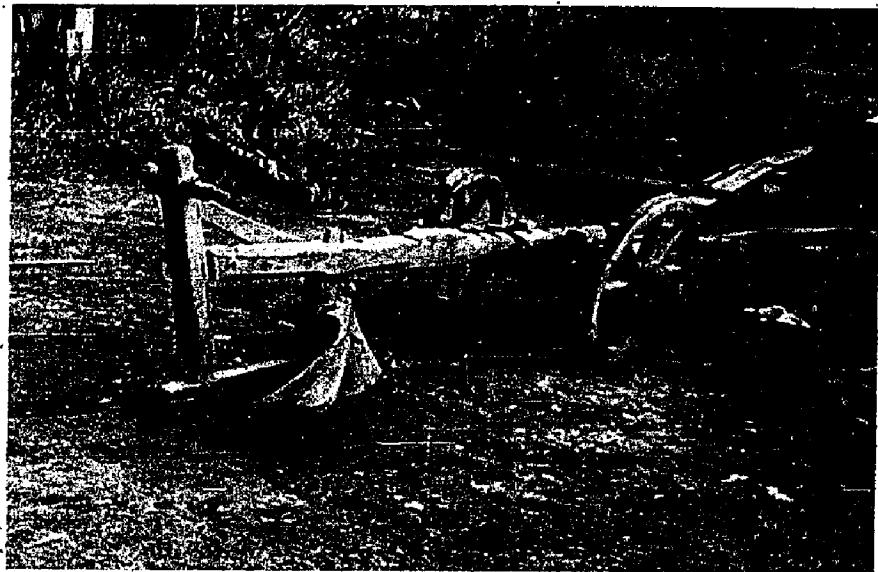


Fig. 41 A lowland or creole plow with two front wheels.
Lower Mississippi River, Plaquemines Parish.

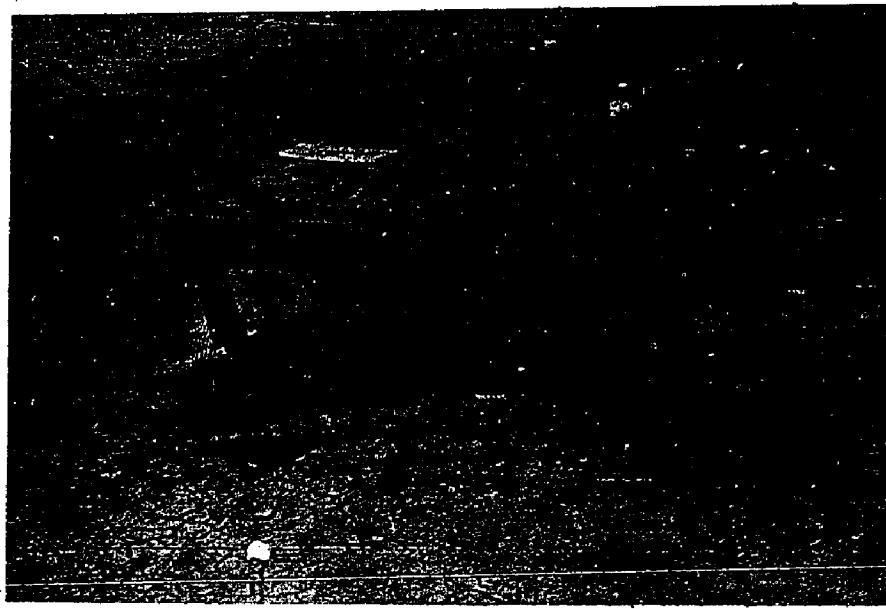


Fig. 42 A side view of lowland plow, with false handles
simulating the originals. Lower Mississippi River,
Plaquemines Parish.

the rice plants. Bouchereau (1873, vii) mentions this fact:

"The falling-off this crop [rice] for the last year or two [1871 & 1872] must be attributed to the fact, that the rivers and bayous, on which we depended for this irrigation, were too low to furnish it in the months of May and June, when this irrigation is most necessary."

Wilkinson (1854, p. 537), a gentleman planter of Plaquemines Parish, recommended "a small water wheel," six or eight feet in diameter, which can be propelled by two horses or mules, to overcome low river stages during the irrigation period.¹ This water wheel was probably a type of 'Persian wheel' which was introduced into Louisiana for draining sugar-cane fields in case of inundation through crevasses. Research shows that as late as about 1880 a horse-powered water wheel was used for draining over-inundated rice-fields. It was, however, never generally used for irrigation purposes.

One of the earliest mentions of steam engine used for lifting water for rice-fields appears in 1856 (De Bow, Vol. 21, 1856, p. 290):

". . . when the river is lowest, they may be effectually flooded by machines [steam engines], such as are in use on most all of the large sugar estates."

According to an old Teche rice farmer, his father planted rice at Reserve, St. John the Baptist Parish, in 1861 and 1862. In 1862, his father irrigated with a steam pump rented from a sugar planter. The engine had a hardwood piston, and thus could be used only about 5 to 6 hours before being stopped for a while to cool the piston. Records and field investigation clearly show that there were water-lifting devices which were used primarily by nearby sugar-cane planters. Such devices for rice culture were not in common use as late as 1885.

Fields turned golden yellow in August when the rice was ready for harvesting. It was sometimes necessary to protect the ripened grain

from feeding birds, as with Providence rice; birds were often scared off by cracking a whip from the bird-watching stand in the field (Figs. 43, 44).

Rice was harvested with the sickle in August. About one-half to three-quarters of an acre was cut in a day, depending upon the condition of the fields. Cut rice was laid on the stubble for one or two days to dry, then tied in bundles with rice straw or latania strips. Bundles were piled in small stacks or shocks in the field in positions convenient to the cutters. When all the rice was cut and piled in several small field stacks without benefit of poles, it was hauled with a two-wheeled cart (Figs. 45, 46) to the grain yards near the house, the first cut being hauled first, and so on until all was in large stacks. These large stacks, each containing about twenty barrels of clean rice, were built on wooden blocks rising about three feet above the ground. The stacks were well pointed, without center poles, and topped with latania (Wilkinson, 1848, p. 55).

Old threshing methods such as flailing and animal treading continued almost throughout this period. After the Civil War rice-threshing machines developed in South Carolina were probably brought to Louisiana by migrating South Carolina rice planters. However, it is remembered among the old rice farmers that simple threshing machines from Wisconsin were in use in St. John the Baptist Parish, probably in the 1870's. Their use is recorded first for the area south of New Orleans, around the mid-1880's.² This early machine had a simple spiked cylinder and "concave" turned by a steam engine. It had neither self-feeder nor straw blower as the later model had. Animal treading remained a common method of threshing rice in 1850. Wilkinson (1848,



Fig. 43 An abandoned bird-watching stand in a former rice field, Plaquemines Parish.

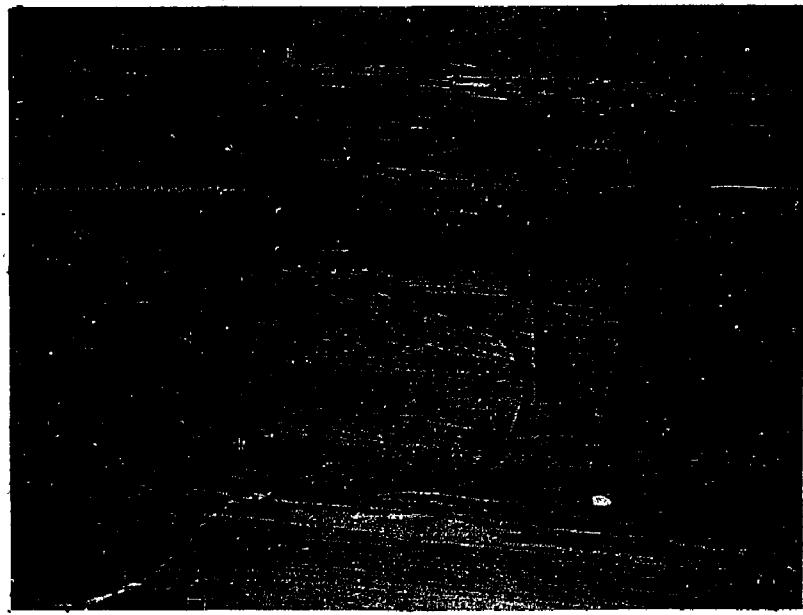


Fig. 44 A whip used for scaring birds from the rice field, Plaquemines Parish.



Fig. 45 An abandoned two-wheeled cart formerly used for hauling rice bundles from the field to threshing ground, Iberville Parish.

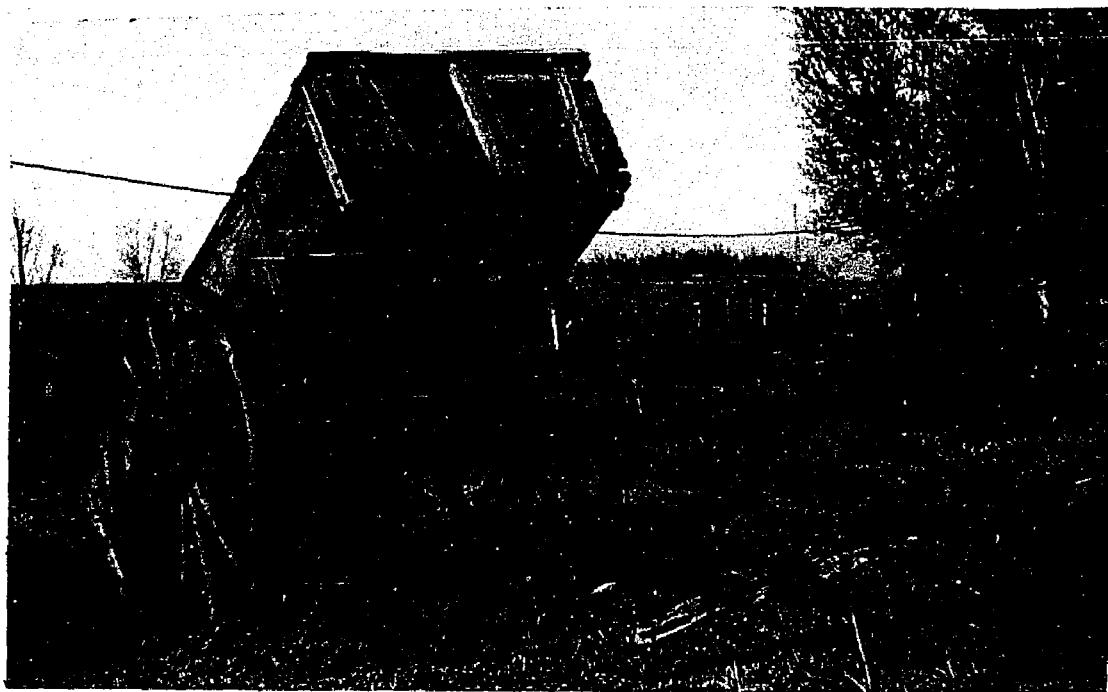


Fig. 46 A dumping device on the above-pictured two-wheeled cart.

p. 56) describes it in detail:

"... eight or ten tackeys, or small horses, are tied one to another to a post; the rice is placed on the ground about three feet deep, the heads up, and the animals are made to trot around, occasionally shaking up the rice. In this way about twenty barrels per day are usually trodden out."

Prior to 1860, river rice was milled with the wooden mortar and pestle. The wooden rotary pit-mill was also used for hulling rice before polishing it with mortar and pestle. Combining the pit-mill with mortar and pestle, about seven or eight barrels at most were cleaned on an average day (Wilkinson, 1848, p. 56). A small steam-powered mill was introduced in Plaquemines Parish around 1840. It had a milling capacity of 20 barrels a day. However, it was soon abandoned because of the prejudice of farmers against this mode of cleaning (Idem). Before the end of Civil War, 1865, the crude milling techniques, mortar and pestle with pit-mill, were probably the most common modes of milling, even though horse- or steam-powered mills may have been in use at the same time.

With a rapid increase of production and its alteration to a commercial nature after the Civil War, the crude hand-pounding mortar and pestle were gradually replaced by horse- or steam-powered mills (Bouchereau, Vols. 1868-1883; Wise, 1916, No. 3, pp. 24-25).

Bouchereau's Statement of the Sugar and Rice Crops in Louisiana gives the number of the "horse-powered rice mills" by parishes (Fig. 48). According to an informant who was a boy in St. John the Baptist Parish in the last quarter of the 19th century, there was a horse-driven wooden mortar-and-pestle mill in the parish at that time. The mill was a type of wooden mortar-and-pestle mill. It had several

wooden pestles, and mortars which were made by excavating holes in a long cypress log. (Fig. 47). A similar type of horse-powered rice mill in South Carolina was invented in 1768 by Veitch. This mill had several pestles moving up and down, powered by moving animals (Gray, 1933, Vol. 1, pp. 282-283). It is very possible that horse-powered rice mills came from South Carolina, the source to which the river-rice methods in Louisiana owe so much.

Distribution of the horse-powered rice mill coincided roughly with the areas of rice production: mainly in the parishes of Lafourche, St. Charles, Plaquemines, and St. John the Baptist. Horse-powered mills gradually decreased as the number of steam-powered mills increased, and they were completely replaced by around 1885 (Fig. 48). It seems that horse-powered rice mills were used for a comparatively short period and likely did not play a very important role in milling because of the rapid spread of steam-powered mills. Thus, an authentic description of milling methods of rice in South Carolina and Louisiana by Wise (1916, No. 3, pp. 24-25) and Evans (1921, No. 1, pp. 24-26) does not even mention the horse-powered mill in Louisiana.

A small-scale steam-powered rice mill was introduced from South Carolina soon after the Civil War. The steam-powered mill retained the mortar-and-pestle principle. The only difference was the use of steam power instead of horses and enlarged and iron-covered mortars and pestles (Wise, 1916, No. 3, p. 25). These small-scale rice mills were distributed throughout the areas of rice production, as with the previous horse-powered mills. Large-scale rice mills appeared around 1870 (Perkins, 1926, p. 46), and subsequently small-scale mills were gradually abandoned. Large-scale commercial mills

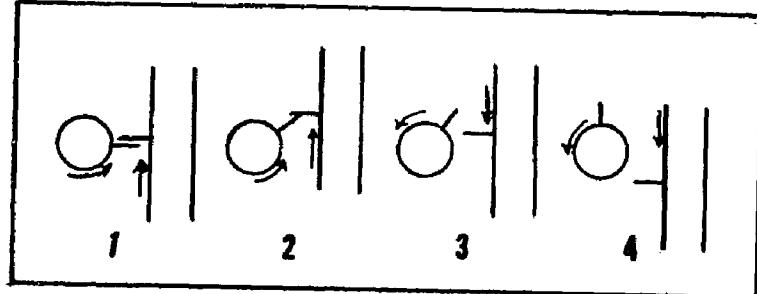
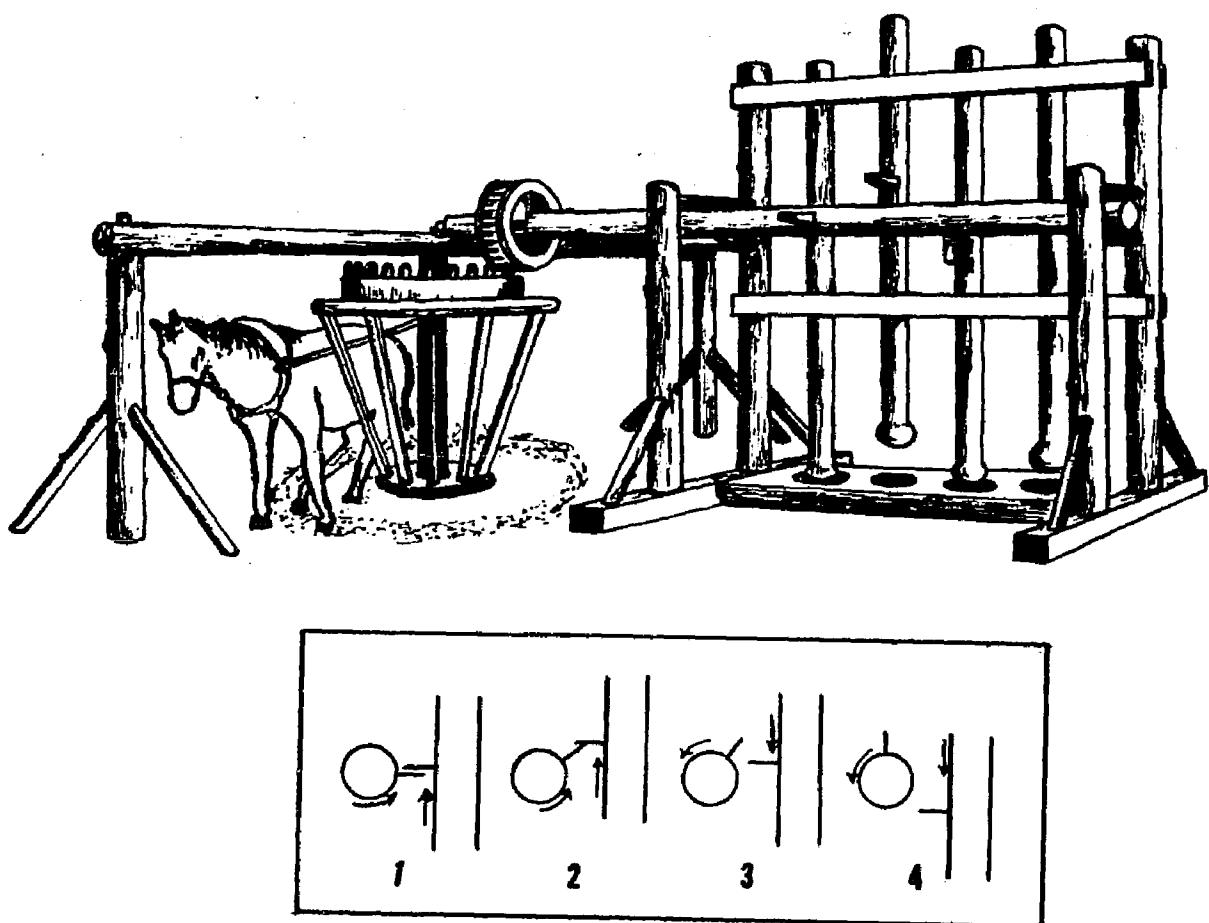


Fig. 47 Horse-powered rice mill in Louisiana. Picture was made from description by an observer. The same type rice mill appears in John Drayton's A View of South Carolina, 1802, p. 122.

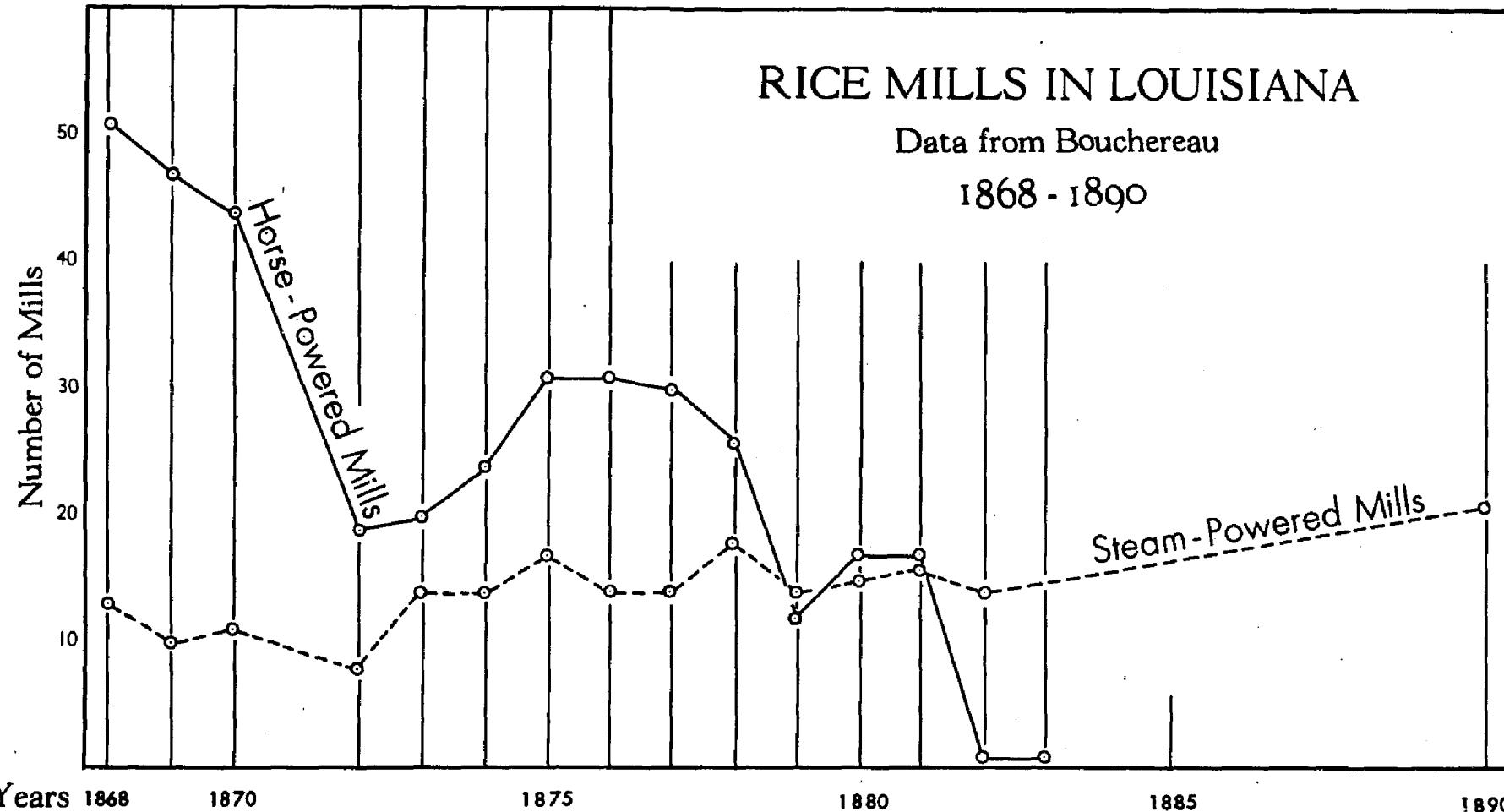


Fig. 48

spread from New Orleans along the Mississippi and down Bayou Lafourche. However, about two-thirds of the rice mills were located in New Orleans at the end of the period, 1885 (Bouchereau, Vols. 1868-1883). The pattern of distribution of rice mills indicates that until 1870 rice was milled in the producing areas, while after 1870, rice was milled largely in New Orleans by large-scale commercial mills which were copied (Wise, 1929, No. 5, p. 19) from those in South Carolina.

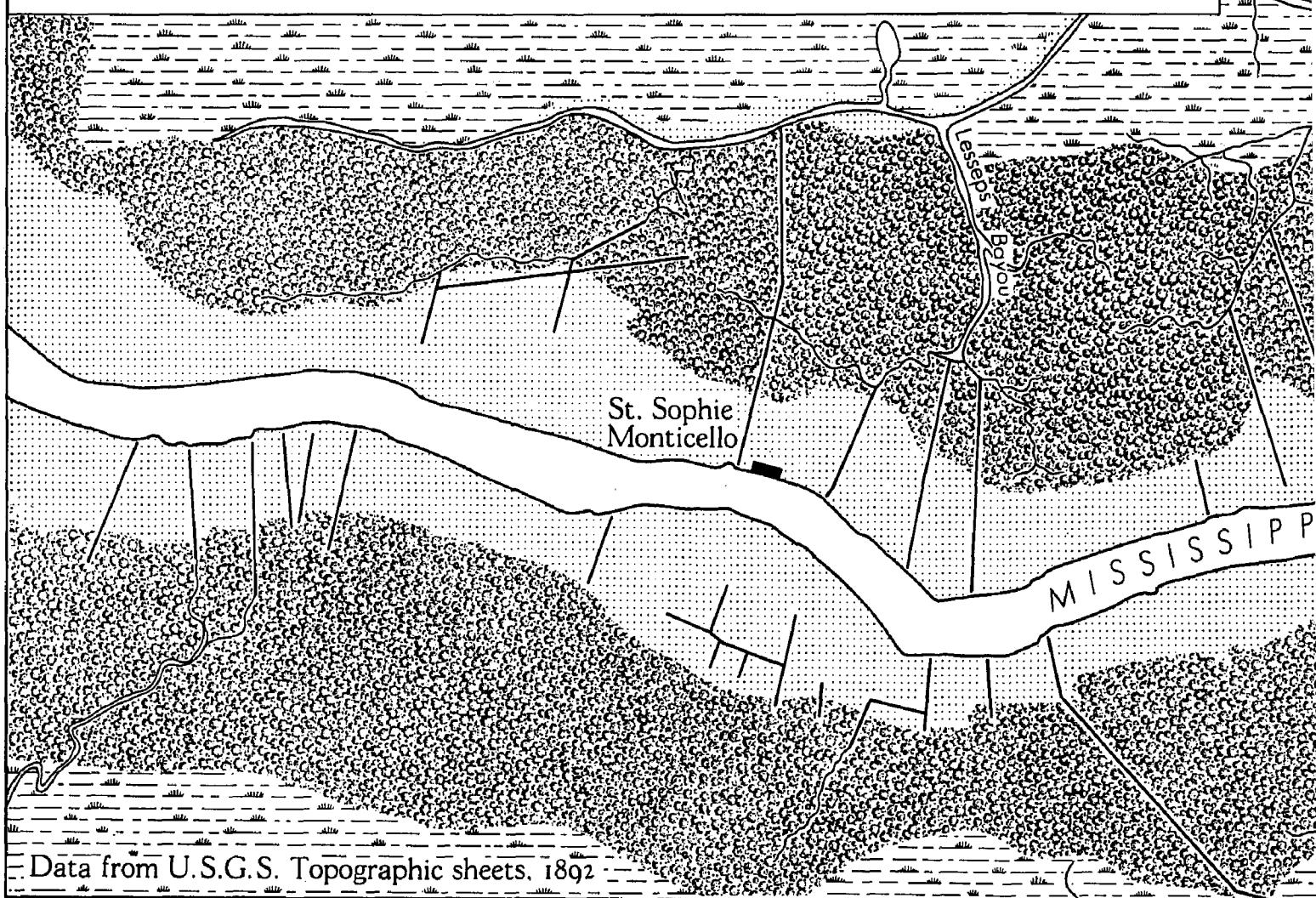
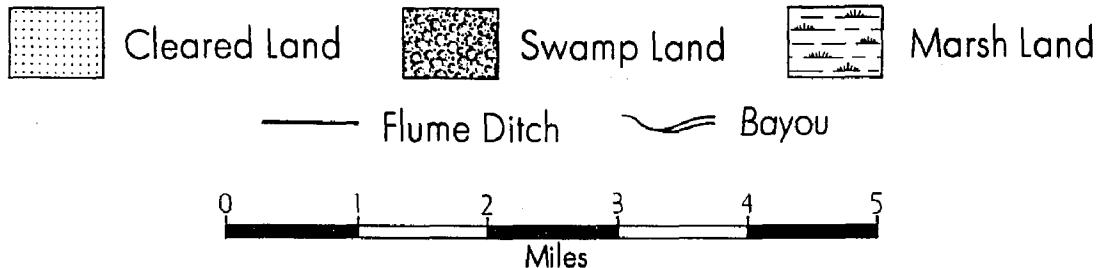
Cultural Landscape

The introduction of new techniques and implements, and the alteration from subsistence to commercial production of river rice, brought fundamental changes in the pattern of the cultivated field. Irregular small patches were no longer suitable for large-scale commercial production. The new patterns of fields were developed in two directions. One was on newly cleared swamp lands, and the other was a modification of former sugar-cane fields.

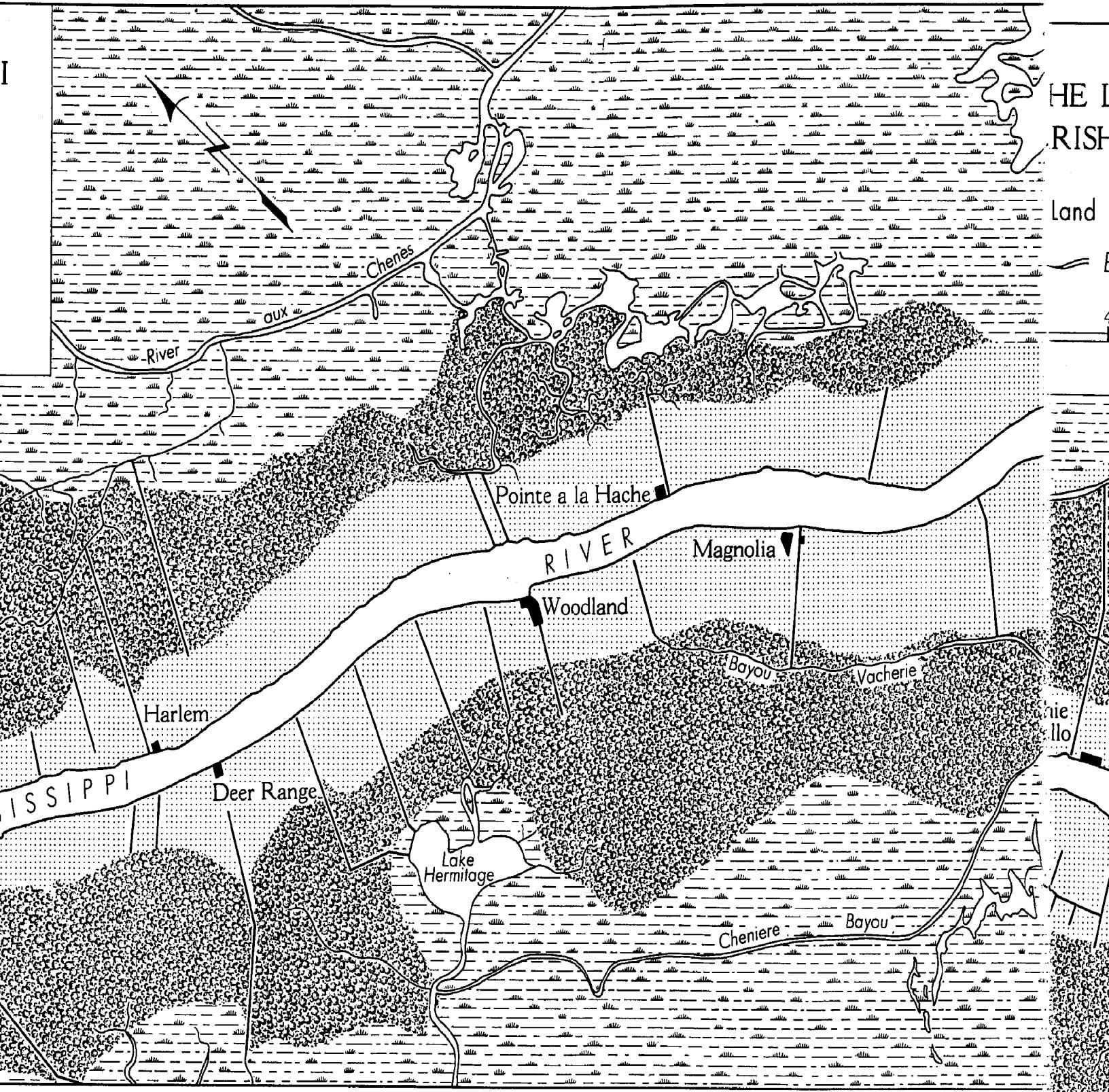
Most-active clearing of swamps occurred along the lower Mississippi River in Plaquemines Parish. Ditches serving both irrigation and drainage purposes were constructed perpendicular to the natural levee, from crest to backswamp. The main ditches (Plate 10) ran usually from the levee crest to a small bayou or lake, open to the Gulf, for better drainage (De Bow, 1856, Vol. 21, p. 290). As previously mentioned, cross-ditches were dug at right angles to the flume-ditches. The resulting pattern on the newly cleared swamps approached a regular checkerboard, exhibiting a little denser ditch system than on the former sugar-cane fields.

The field pattern developed on former sugar-cane lands was no

FLUME DITCH PATTERN ON THE LOWER MISSISSIPPI PLAQUEMINES PARISH, 1892



Data from U.S.G.S. Topographic sheets, 1892



THE LOWER MISSISSIPPI RISH, 1892

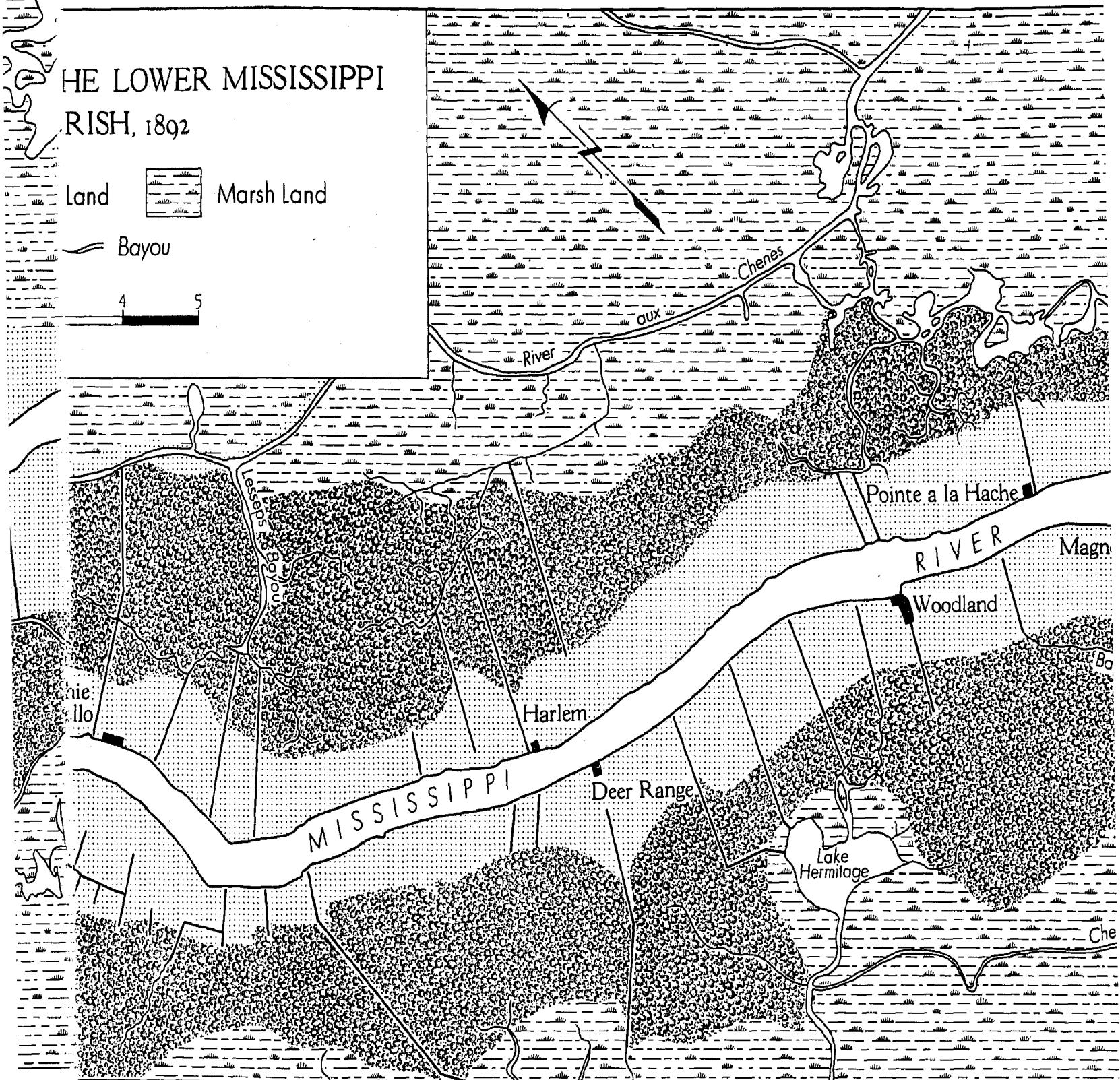
Land

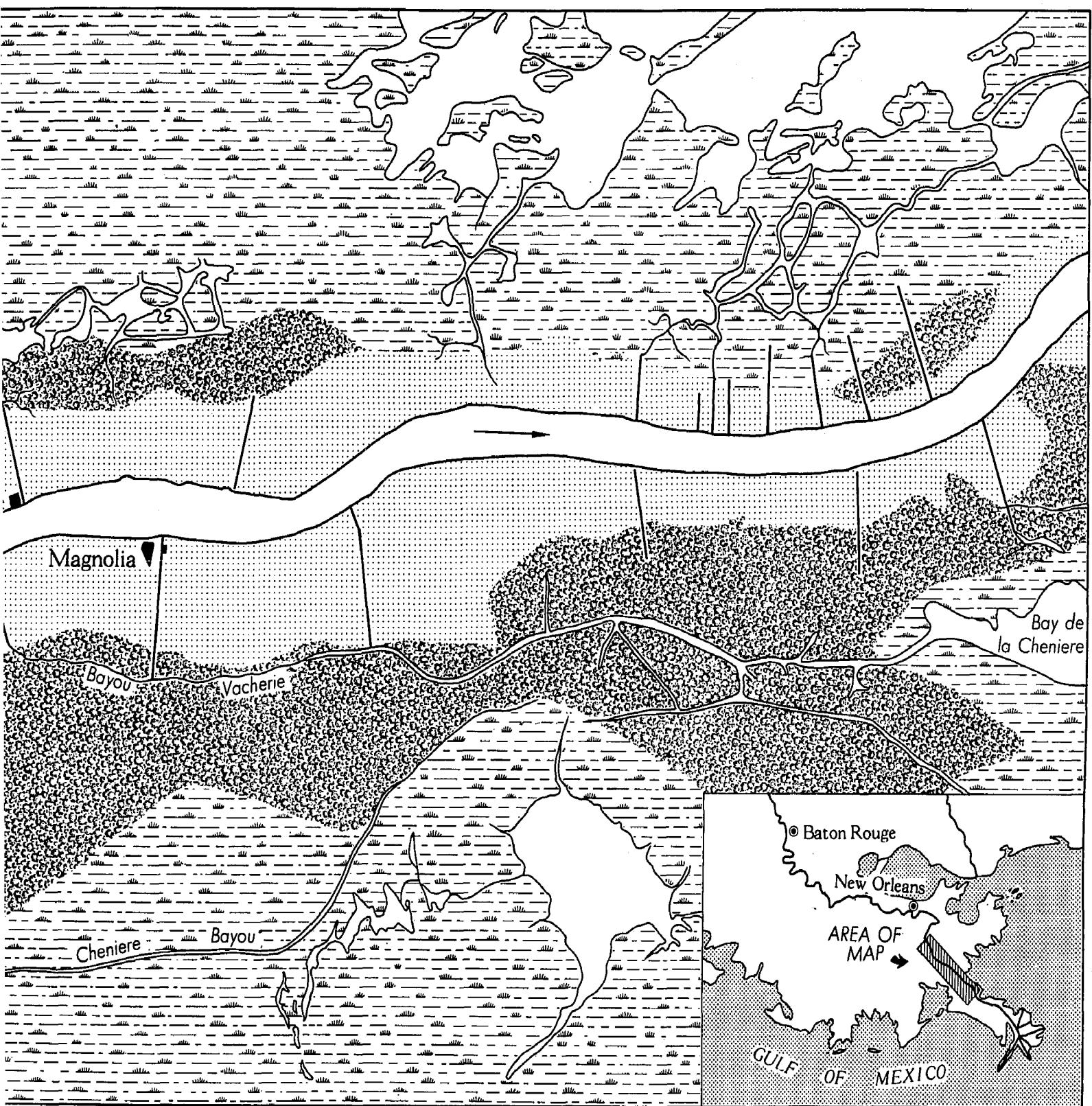


Marsh Land

Bayou

4 5





great alteration. Rice fields had a wider and denser ditch system for irrigation, and numerous cross-levees to hold water in sufficient depth. This slight modification of former sugar-cane fields is still observable, and it is recognizable on the aerial photograph appearing as Fig. 49.

River rice was primarily a development of French Louisiana, just as was Providence rice. There the traditional French Louisiana rural landscape continued as either the simple farmstead or as the larger clustered plantation combining former individual holdings. Thus the rural landscapes associated with river rice can be divided into two types: the individual small farm, and the plantation.

Before the Civil War, most of the rice farmers operated on a small scale, cultivating less than two-hundred acres, and many not more than fifty. Thus the simple farmstead was typical. There was a creole house at the front, with one or two outbuildings and sometimes a little enclosure for livestock set to the side. Dwellings and outbuildings were usually fenced. Fields extended from the dwelling and outbuildings toward the backswamp, in the aggregate many times longer than wide, usually forty arpents deep along the Mississippi River. In a general and most typical arrangement, every dwelling fronted on the stream and represented a narrow strip of land running toward the backswamp, thus constituting a "ribbon farm" (Knipmeyer, 1956, p. 58). This selection of type traits is skeletal, whereas the individual farmsteads were, of course, far more complex.

The plantation river-rice landscape developed after the Civil War, when the sugar-cane industry was in chaos. A considerable number



Fig. 49 Aerial view of a checkerboard pattern of rice fields. Cross-levees are shown by thin lines in the lower-left part of the picture. Sugar-cane fields, elongated rectangular in shape, are shown in the upper-left part of the picture. Bayou Coula, Iberville Parish, 1940, U.S.D.A. photograph.

of sugar plantations changed partly or completely to rice culture, without much change in landscape. Fields were modified to suit rice cultivation and the function of outbuildings altered without much change in external appearance. Some barns were used for animals, and sometimes large barns were used as threshing floors for rice. The plantation landscape was and is characterized by the "big house," the dwelling place of owner or manager. The most common plantation dwelling is a large creole house, differing only in size and refinement from the common folk type (Fig. 50). Near the plantation house were large barns and a rectangular cluster of "quarter houses" for the workers on the plantation. Several types of common arrangement within plantations are distinguishable, mainly with differences in position and structure of the quarter houses (Fig. 51).

Improvement of artificial levees along the Mississippi River and bayous is an important part of the change in the cultural landscape associated with rice. In 1812, the levee on the east bank extended from Pointe a la Hache to Pass Manchac, a distance of 155 miles, and from the lower Plaquemines settlement on the west bank to Pointe Coupee, a distance of 185 miles (Durno, 1900, p. 173). In 1860, there were 2,184 miles of levees on the Mississippi, with an average height of 8 to 10 feet and a width of 50 to 75 feet at the base, their width at the top being something less than their height (Ibid., p. 174). With an increase in flood menace, obtaining irrigation water from the streams through simple levee-cuts was gradually abolished, and after 1870 the sluice-gate was adopted (TPR No. 44, St. Bernard, Series 1. P. J. M. Vol. 1, 1870).



Fig. 50 Side view of plantation house, a modified creole type, Bayou Goula, Iberville Parish.

GENERALIZED PLANS OF PLANTATION CENTER

■	Plantation House	☒	Sugar House
■	Quarter House	==	Road
☒	Outbuilding	—	Fence

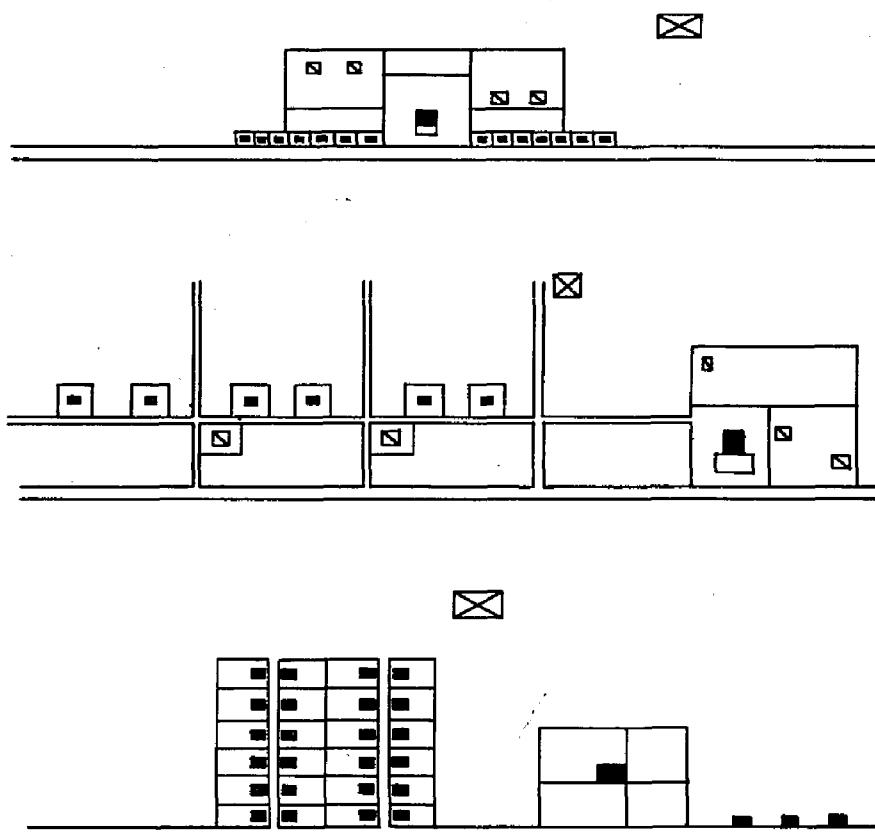


Fig. 51.

XI. River Rice after 1885 in Louisiana

The opening of the prairies for large-scale rice cultivation introduced a new era. After 1885, the nuclear area of rice growing in Louisiana gradually shifted from the river section to the prairies, where new ways of cultivation developed. Subsequently, the prairie method was partially adopted in the river section. An understanding of prairie-rice cultivation is therefore essential to the understanding of river rice after 1885, a period in which there were two conflicting trends: resistance to prairie methods, and inevitable modification of river methods by prairie-derived influences. However, prairie-rice culture has been so often described (Chambliss, 1920; Ginn, 1930; Post, 1936, 1940; Jones and Others, 1952; Taylor, 1956) that it will be dealt with here only in its early development and methods to afford comparison with river practices.

Development of Prairie Rice

Until about 1880, the prairie section was occupied primarily by Acadians, who settled along streams as they had on the Mississippi and associated bayous. They had herds of cattle, but they also practiced some farming for subsistence. On the sandy soils they planted small patches of corn and cotton. Nearly every family planted Providence rice in the marais, the seasonal ponds previously described.

The completion of the Southern Pacific Railroad across the prairies in 1882 stimulated new settlement and agriculture. Northern farmers with previous experience in wheat growing came to the prairies. Im-

pressed by the warm winter and prairie grasslands, they tried with little success to make this area corn-cattle country as in the Midwest. Incidentally, they learned of rice culture from the Acadian settlers (Ginn, 1940, p. 16), but they plowed and seeded the grasslands, applying to rice the same methods used with wheat in the Midwest. They found soon that natural precipitation in the prairies is not ideal for rice culture.¹ That is, they learned that irrigation was necessary, primarily to provide control of weed plants.

A satisfactory method of irrigation was devised by David Abbott, who had moved from Michigan to Acadia Parish near Crowley (Post, 1940, p. 583). According to Post, in 1888 Abbott made an endless chain with buckets attached for raising water from bayous. The power was furnished by a little three and one-half horsepower engine that had once done duty on a small steam launch. This was geared to an old threshing-machine rotating cylinder, around which was the endless chain with its arrangement of wooden flanges standing out at right angles. The device was so successful that the following year Abbott expanded its use and others imitated it. The first canal to be built for the purpose of supplying water to the fields on a large scale was built by the Abbotts in 1894, a canal some three and a-half miles long by twenty feet wide. X

For the first few years the bayous furnished an adequate supply of water. However, with increased use, especially in years of sub-normal rainfall, the flow of the bayous was not sufficient to supply the needed amount. A few wells had been drilled before 1901 to help supplement the water supply from the bayous. The dry year of 1901 emphasized the inability of the bayous to supply all demands for water,

and by the close of 1903 several hundred wells were in use (Hansen and others, 1956, p. 12). The use of water from wells was accelerated by the encroachment of salt water from the Gulf into bayous.

Abandoned Pleistocene river channels provided perfect gradients for irrigation canals (Post, 1937, p. 196). Fields were divided according to the range- and-township system except along the bayous, where the Acadians had carried the arpent method of division from the Mississippi River. Checkerboard field-levees like those used on the river were employed to keep a uniform depth of irrigation water. As early as 1895 the contour-levee method was developed (Fig. 52), where the levee followed closely the contours of the land with the aid of a transit survey. For the first time levees were made with plow and pushers throwing four or six furrows together. These levees, ten inches high at the most, allowed field machines to cross them. The contour-levee system helped to save time in plowing because it was not necessary to turn around as much as in checkerboard-levee fields. The prairie field pattern naturally lacked the drainage ditches running at right angles to the natural levee found in the river areas.

Wheat-farming equipment, such as gang-plows, disks, harrows, and seeders, were adopted in rice culture. A binder was introduced as early as 1884 and shortly after a slightly modified wheat threshing machine. Oxen were used to some extent as draft animals but were never popular for pulling the new machines. Creole ponies and mules were replaced by 'rice mules,' which were larger than the average Louisiana mules used in the cotton country. (Post, 1940, p. 585).



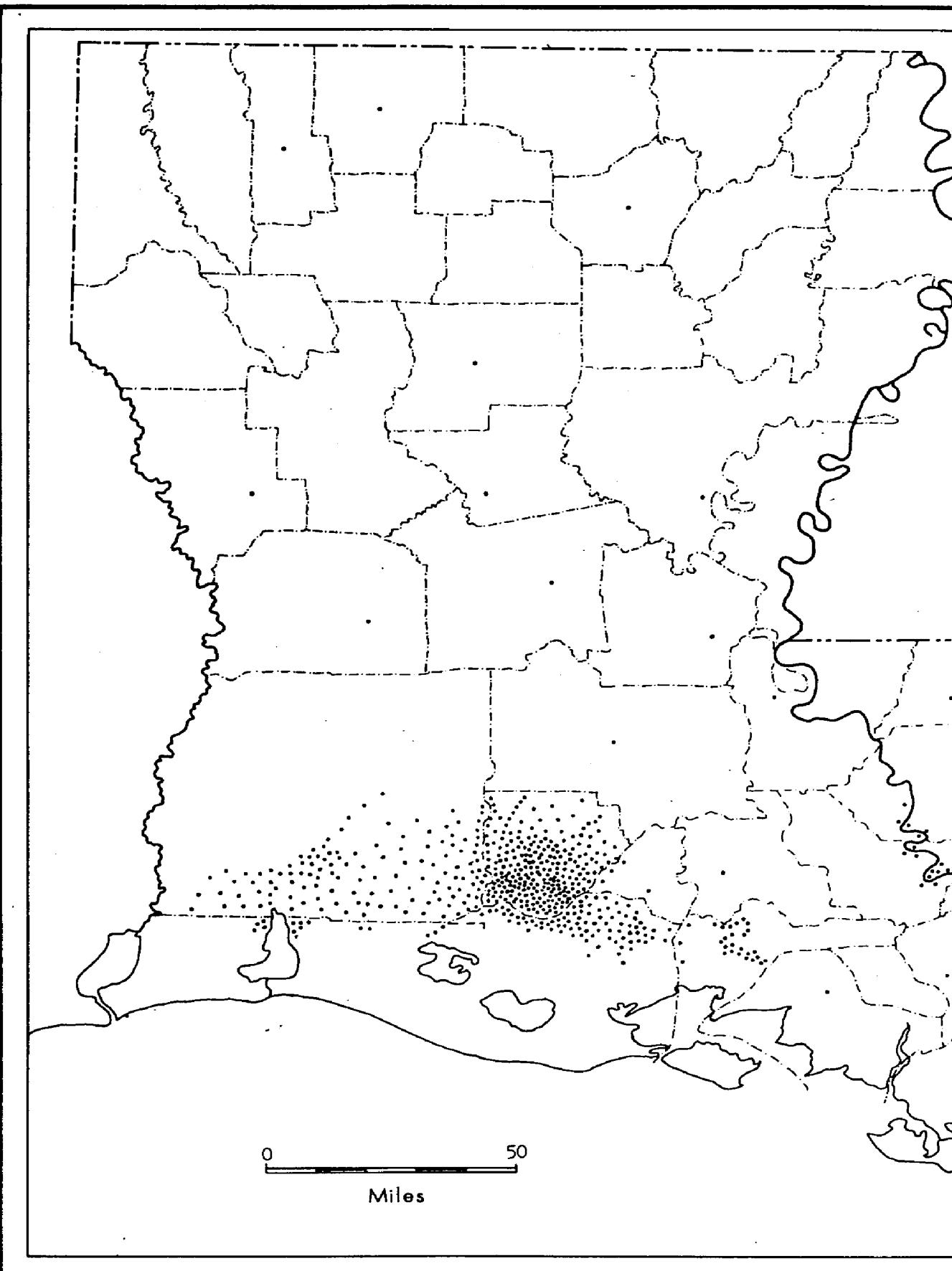
Fig. 52 The prairie-rice field pattern. Note tiny contour levees and the range-and-township system, Acadia Parish. Photograph by the U.S. Navy, 1952.

Shift of Rice Production to the Prairies

The census report of 1850 (1849 crop) shows that rice was produced in almost all parishes. However, about 87 per cent of production came from the parishes along the Mississippi River south of Red River, and associated bayous. Areas of rice production roughly coincided with areas of French settlement. The distribution pattern of rice in 1849 suggests a considerable amount of Providence rice (Plate 6). It occurred widely in the river section and on the prairies of southwestern Louisiana. A considerable amount of upland rice was produced around 1850 in hill Louisiana. This is the only census report which shows an appreciable amount of rice production in the hill section, 12 per cent of the total production from hill Louisiana.

Production of river rice increased rapidly until about 1927, when local economic depression curtailed it. However, the relative importance of river rice in Louisiana had declined abruptly after the 1880's due to the development of the prairie section. In the census report of 1880 (1879 crop), more than 93 per cent of the rice produced in Louisiana came from the river section (Plate 8). However, the river section produced only 68 per cent in 1889, and 27 per cent in 1899. Between 1880 and 1900 the principal area of production thus shifted completely from the river section to the prairies of southwestern Louisiana (Plate 11) and this pattern of distribution continues to the present (Plate 12).

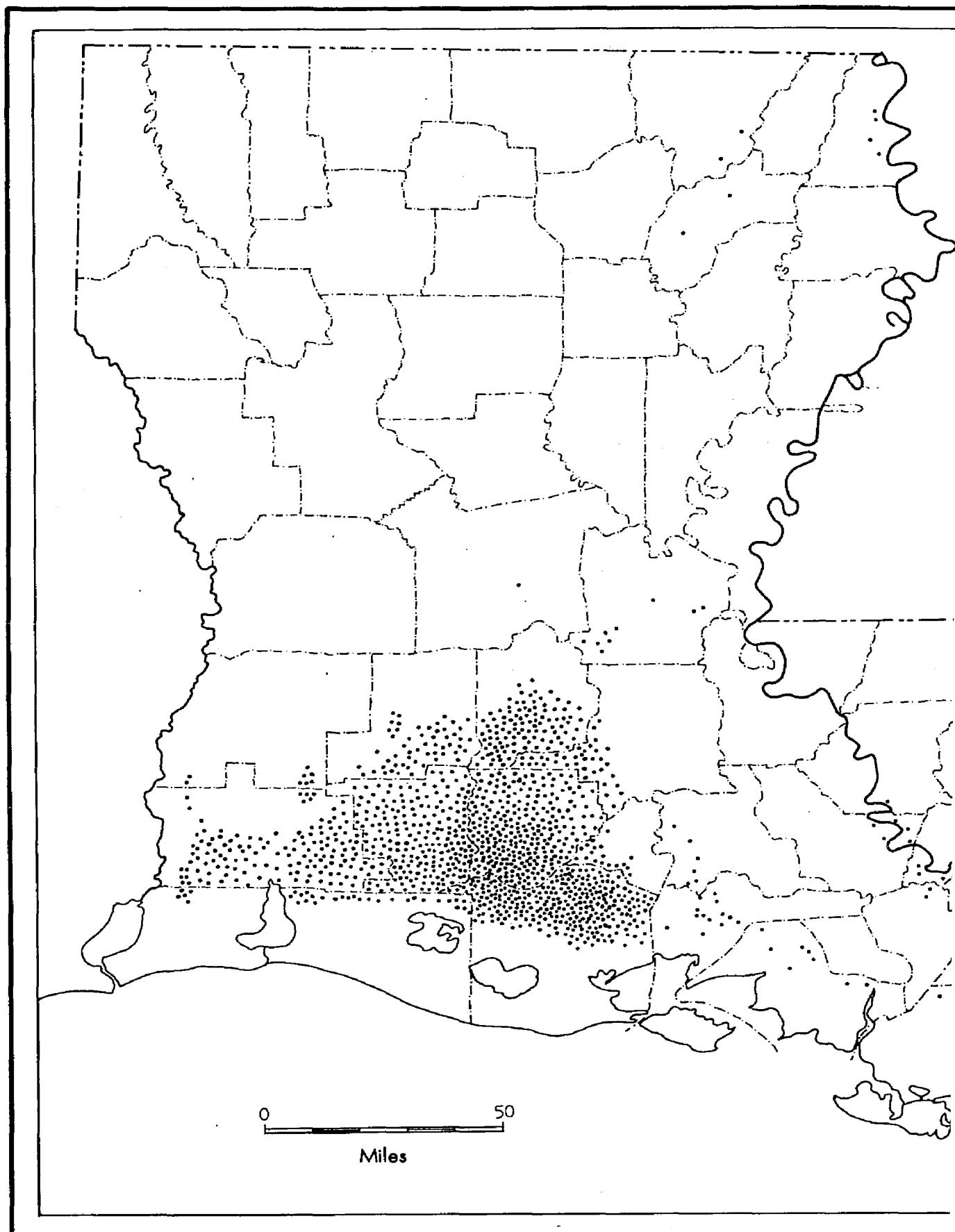
Natural factors may have been effective in the shifting of the rice area from river to prairies, but cultural factors played the more important part. The main differences of natural conditions as between river and prairie are configuration of the land, water resources, and



RICE PRODUCTION
IN
LOUISIANA 1899

Clean Rice 250,000 Pounds or Less.





RICE PRODUCTION
IN
LOUISIANA 1949

Clean Rice 500,000 Pounds or Less.



soils. In the prairies the flatness of land, as compared to narrowly restricted natural-levee slopes along the river, gives advantages for large-scale mechanized farming. Also, it requires fewer field levees to hold uniform depths of water than on natural-levee slopes; the river section needs generally three to four times more field levees than in the prairies.

In the prairie section, about 65 per cent of the total requirement of irrigation water comes from bayous, and the balance from wells (Sturgis, 1957, p. 658). In the river section most irrigation water is supplied by the active Mississippi and its abandoned channels, except for a small amount in the Tensas Basin.² The nature of stream irrigation is also quite different as between river and prairies. In the prairies, irrigation water is obtained by lifting devices and transported for long distances through canals. In the river section, however, irrigation water is lifted only when the river stage is low, and there are no long irrigation canals, since all fields are located along streams. The cost of irrigation water per unit on the river is less than in the prairies. However, total expense of irrigation water per unit area is not much different because the river section needs more irrigation water than do the prairies. Lack of impermeable subsoil on the natural-levee slopes necessitates about three times more water for irrigation than on prairie soils.

Natural factors involved in producing rice must be evaluated in terms of the level of technology and value system of the human group undertaking it. Without a lifting device to make available stream and ground water, water resources in the prairies would be of no value. As mentioned previously, the marais was the only suitable place for

rice culture on the same prairies about 60 years ago, or before the coming of the Midwestern farmer. Development of rice cultivation, thus, is connected closely with the technical level of culture; Providence rice almost without irrigation; river rice with natural flooding; river rice with controlled irrigation through lifting devices; and finally, open prairie land irrigated with water lifted from bayous and ground-water sources.

Level of technology alone fails, however, to explain the shift of emphasis from river to prairies. An effective lifting device for stream water was known and used somewhat by rice farmers along the Mississippi long before the coming of Midwestern farmers to the prairies. As mentioned before, a horse-powered water wheel and a steam pump for lifting water from the Mississippi River were recommended as early as 1854 (Wilkinson, 1854, p. 537 and 1856; De Bow, Vol. 21, 1856, p. 290, respectively). Though they were not widely accepted, water-wheels and steam pumps were used for irrigation purposes around the 1860's in St. John the Baptist Parish. The use of a steam pump in the Teche country preceded such usage in the prairies; one is reported for Franklin, Iberia Parish, for 1885.³

Rice farmers along the Mississippi and associated bayous could have used water-lifting devices and improved machinery more widely before 1885. However, the wide use of lifting devices for rice irrigation and the employment of improved machinery were accepted primarily as a result of the stimulus of prairie-rice methods. Rice has never been the dominant commercial crop along the Mississippi nor has it been on the distributary bayous. On the Mississippi rice could not meet the competition of sugar cane and cotton. Rice was

considered primarily as a subsistence crop or a temporary substitute for sugar cane in the river section. Lack of adoption of modern machinery in rice culture along the river is therefore not related to a general lower level of technology. Nearby sugar planters used steam pumps for a long time while rice farmers continued old hand methods without controlled irrigation. Possibly the basic ideas of Providence rice and natural flooding prevented even sugar-cane planters from adopting new ways of rice culture for a long period. Non-traditional attitudes of Midwestern prairie farmers with respect to rice, as well as the technological potential of the times, were therefore responsible for the development of new modes of cultivation.

Discovery of the prairies as prime rice country was accidental and not a result of rational planning. Post (1940, p. 58) quotes Lockett's Geographical Survey of Louisiana of 1873, where the latter made certain recommendations for the development of the southwestern part of the state, especially with regard to immigration and land utilization. He said that sea marsh could be used for raising rice and the prairies for stock rearing. His classification of land types is still valid, and his map of natural regions is hardly subject to change. Land use as recommended by Lockett, however, was not followed by the new settlers. Marshes have never been developed extensively as rice country; rather, their primary uses are for hunting, grazing, and recently for petroleum production. It was in the prairie, not the marsh, that the new rice country was opened.

After the opening of the prairies, the Teche area became important in river-rice production due to the migration of farmers from the elder river-rice sections. This move was further accelerated by

the stimulus of mounting prairie rice production. Decline of the cotton industry induced by the appearance of the boll weevil brought rice culture rapidly into the Tensas Basin; however, it was only for a short period, roughly 1907 to 1925 (Phillips, 1953, p. 134). During the 1920's considerable sugar-cane acreage was replaced by rice because of cane losses by the mosaic disease.

After the opening of the prairies, river rice continued on a high production level until the mid-1920's. However, economic depression beginning in the late 1920's brought rice production in the river section down to the level of the 1860's. After the depression, old hand-labor methods of rice culture could no longer compete with mechanized prairie-rice production. With the expansion of the cattle industry in the 1930's, rice fields were gradually turned into grazing land. Since about 1940, however, river-rice production has gradually increased again until it reaches the quantitative levels of the early 1900's. This increase has resulted primarily from the migration of prairie-rice farmers and methods to river lands. This movement took place because of the high price of rice on the international market. Rice was exported to Latin America, among other markets, because the former exporting countries in Asia could not supply the demand.

Modes of River Rice Cultivation after 1885

The time for preparing fields has remained primarily unchanged since 1885, usually occurring in February before the high-river stage. As had been previously the practice, preparation of the ground was begun by digging out new irrigation ditches or by repairing old ditches and field levees. The traditional checkerboard field pat-

tern remained the most dominant common practice in the elder river-rice section, along the Mississippi south of the mouth of Red River (Fig. 53).

Stimulus from the prairies and adoption of the prairie method brought partial modification of the old field levees. The first known practice of the contour field-levee method in the river section was around Oakville, on the west bank of the Mississippi, about ten miles south of New Orleans. This instance apparently lacked any connection with the prairie-rice method. According to Numa Hero, an elderly former rice farmer and engineer, his people employed the so-called three-stick method⁴ for making field levees on newly drained back-swamp, around the beginning of this century. Although the result did not quite match the contour levees of the present-day prairies surveyed with modern instruments, the principle was the same. The innovation was, however, not accepted widely among rice farmers along the Mississippi, partly because of the established checkerboard system which had been developed on the fields having the old arpenter system of drainage channels. The present contour field-levee method found in the river section was rather derived from the prairies by the actual migration of prairie farmers to the river section.

The first practice of the field contour-levee method in the river section was probably around 1909, along the Mississippi in East Carroll Parish, where there was no previous river-rice culture. As mentioned previously, river rice in East Carroll Parish followed the boll-weevil as a substitute for cotton.

One of the earliest attempts to introduce the contour levee into the elder river-rice section was made around 1920, without success.



Fig. 53 Checkerboard levees on the west bank of the Mississippi,
St. Gabriel, Iberville Parish.

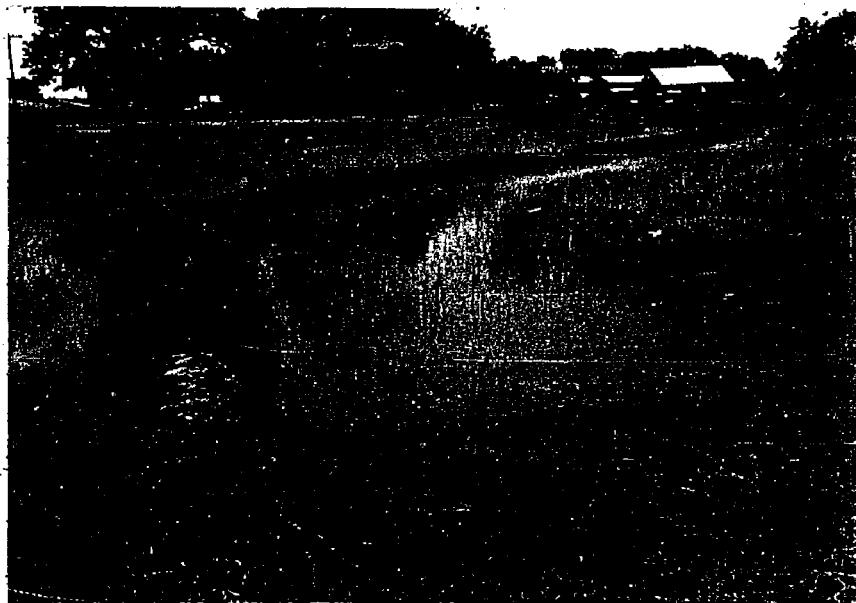


Fig. 54 Contour levees on the east bank of the Mississippi,
Iberville Parish.

A successful introduction of the contour-levee method in the established river-rice section was made along the Teche in the 1930's, probably by prairie farmers who moved to this area. The practice was then carried gradually eastward with the migration of prairie farmers to Bayou Boeuf and Bayou Black in the 1940's, and then reached the west bank of the Mississippi at Plaquemine, Iberville Parish, about 1950. The contour-levee method was readily adopted in the Teche section, even among the original river-rice farmers. However, in the elder river-rice section, the contour-levee method is still practiced primarily by farmers from the prairie section (Fig. 54).

The two methods of sowing known as the 'dry' and 'wet' methods, described previously, were continued during this modern period. Around the beginning of the century, hand sowing was gradually replaced by broadcasting with endgate seeders (Fig. 55). Sowing by airplane (Fig. 56) on flooded or dry fields began to be practiced around 1950 in the river section, primarily by prairie farmers, whereas most original river-rice farmers even today use endgate seeders.

implements used for preparation of fields were the same as those described for the previous stages up until about 1915. Simple moldboard plows were used for comparatively sandy soils, while creole plows were used for heavy lands, especially south of New Orleans. During World War I, mules were gradually replaced by tractors. Consequently, moldboard plows (Figs. 57, 58) and creole plows were also replaced gradually by gang-plows (Fig. 59), and recently by disc-plows (Fig. 60). Wooden harrows were replaced by iron harrows (Fig. 61).

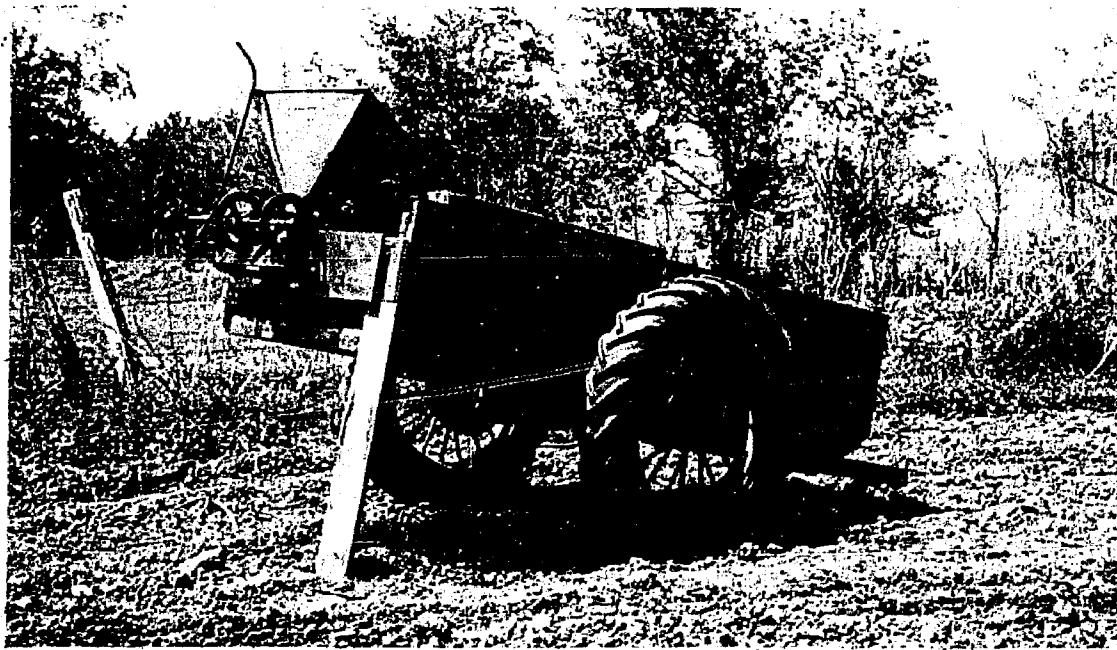


Fig. 55 An endgate seeder for broadcasting rice seed, Iberville Parish.

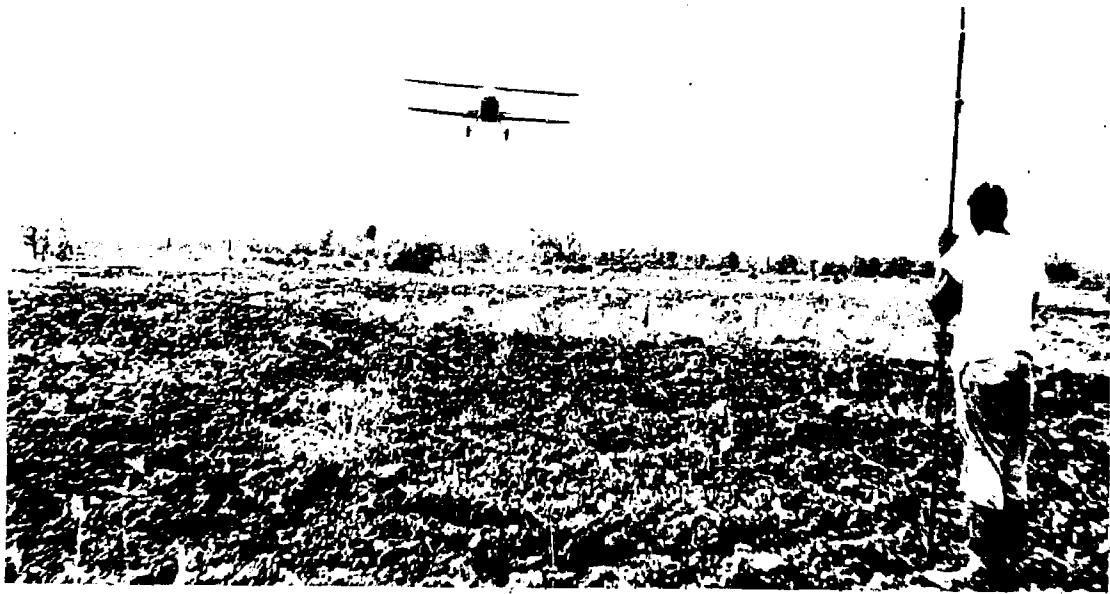


Fig. 56 Sowing by airplane on a dry field. The flagman in the foreground indicates a strip of nine yards to fly each time, Iberville Parish.



Fig. 57 A wood-beam moldboard plow used until the early part of this century, Vermilion Parish.

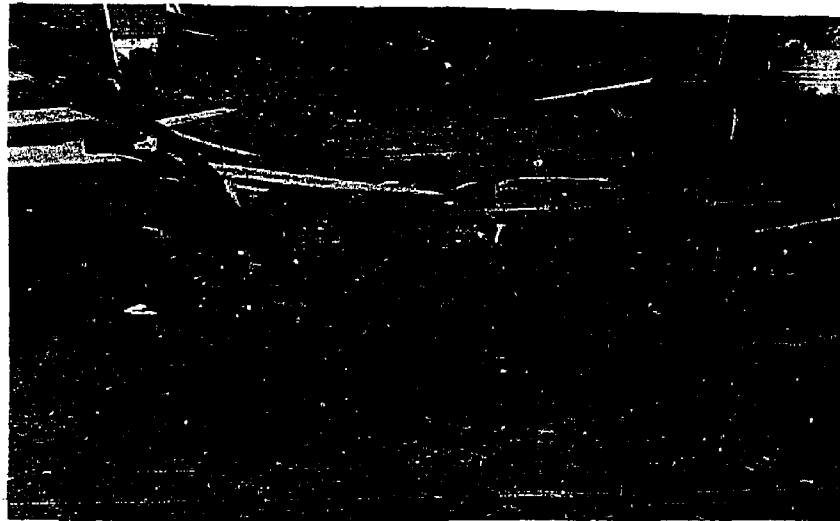


Fig. 58 A modern moldboard plow which was widely used before the adoption of tractors, Plaquemines Parish.

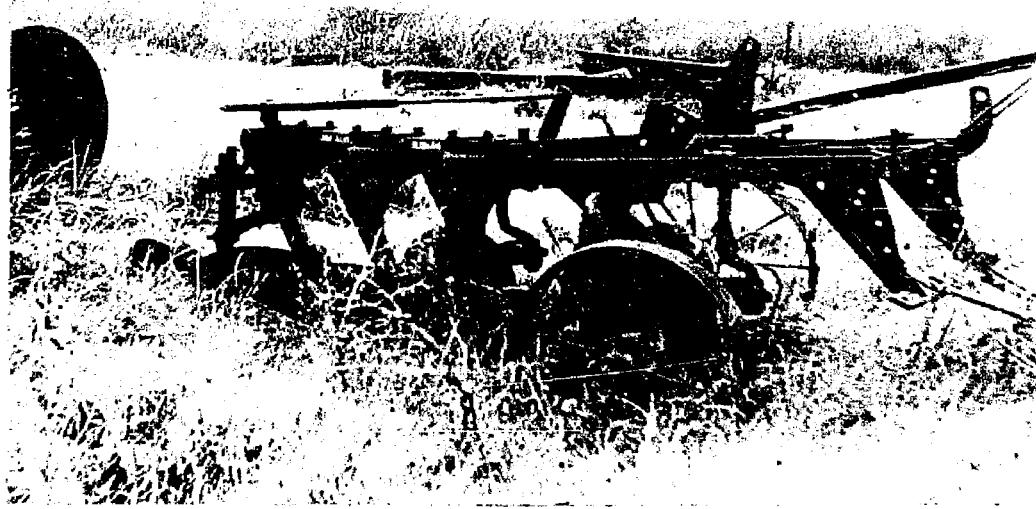


Fig. 59 A gang-plow for rice field, Iberville Parish.

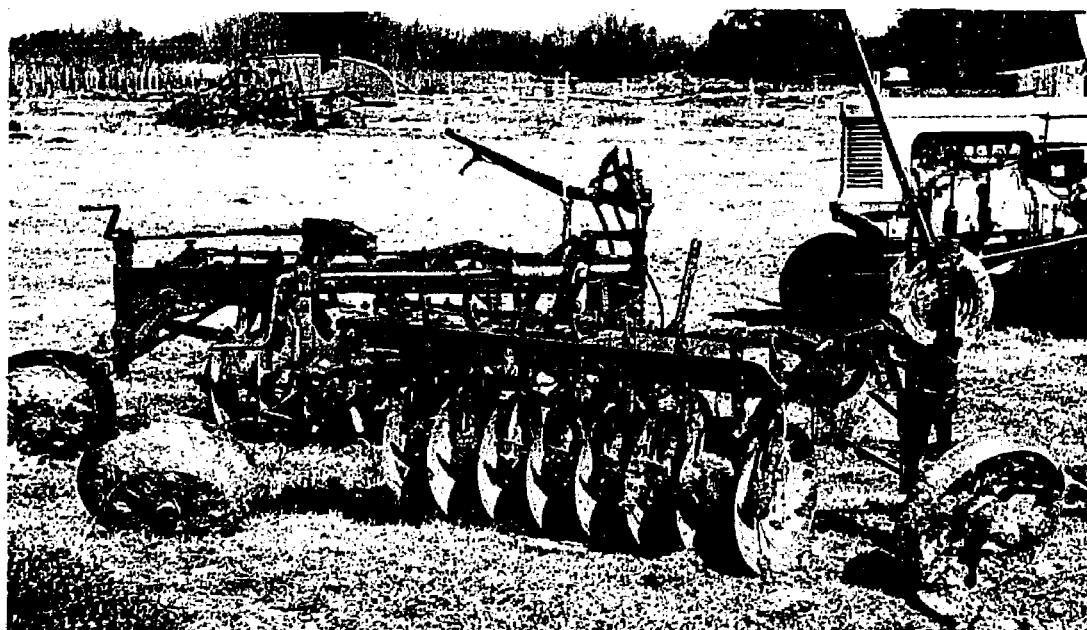


Fig. 60 Disc-plows and a tractor, Terrebonne Parish.

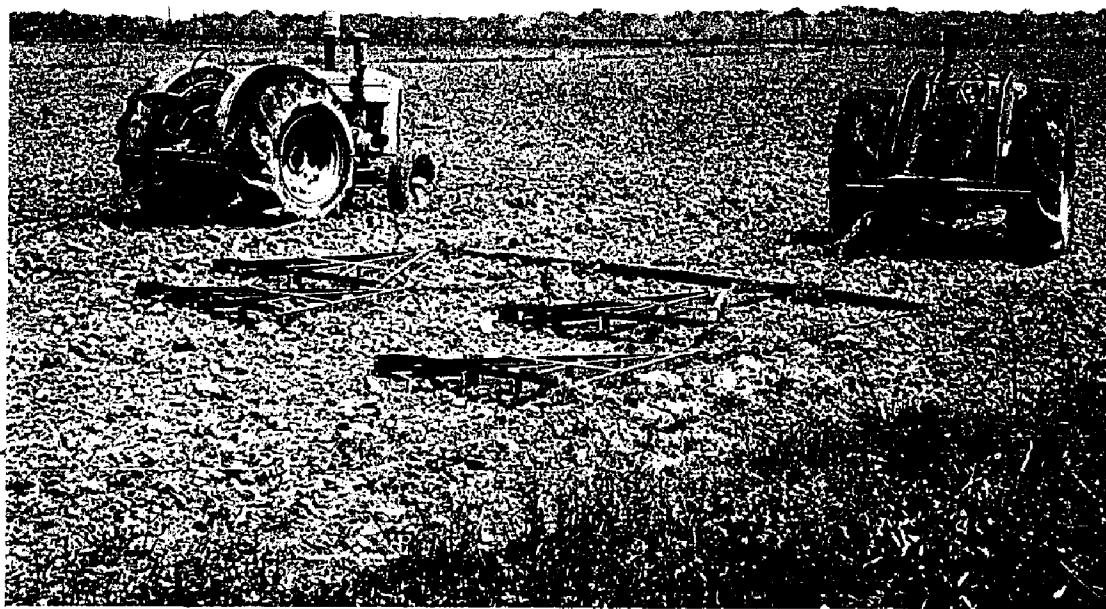


Fig. 61 Iron harrows, Iberville Parish.

Water-lifting devices gradually spread after the beginning of rice cultivation in the prairies. Though the principle of the device is the same, it varies from place to place in order to adapt to the different river stages and the configuration of the terrain. For convenience, the water lifting device may be divided into three main types: Mississippi, Lafourche, and Teche.

On the Mississippi a technique is employed which combines the traditional natural flooding method and an artificial water-lifting device (Fig. 62). When the river is high enough, irrigation water flows into the flume-ditch without being lifted from the Mississippi, a process of natural flooding called "free-water." It is believed that about half the irrigation water is supplied by free-water, especially in the months of April and May.

During low-water stages irrigation water is lifted by steam pump⁵ from the Mississippi into the borrow pits (Fig. 63). The borrow-pit reservoir is an elongate pond occupying irregular depressions made by the digging of earth to build the present artificial levees. Often there is an earth-bank passage across the reservoir, as shown in Figure 63, to go to the pumping station which is located on the stream side of the reservoir. Water is then drawn with a siphon (Fig. 64) into the main ditch (Fig. 65). The irrigation-ditch system is the same as for the previous stage; that is, the main flume-ditch or ditches run at right angles to the river, and cross-ditches or "shoots" lie between the main ditches. The flow of irrigation water in the main ditches is controlled and diverted into cross-ditches and finally reaches the fields through simple wooden sluice-dams (Fig. 66) made of cypress planks driven into the ground with oak or

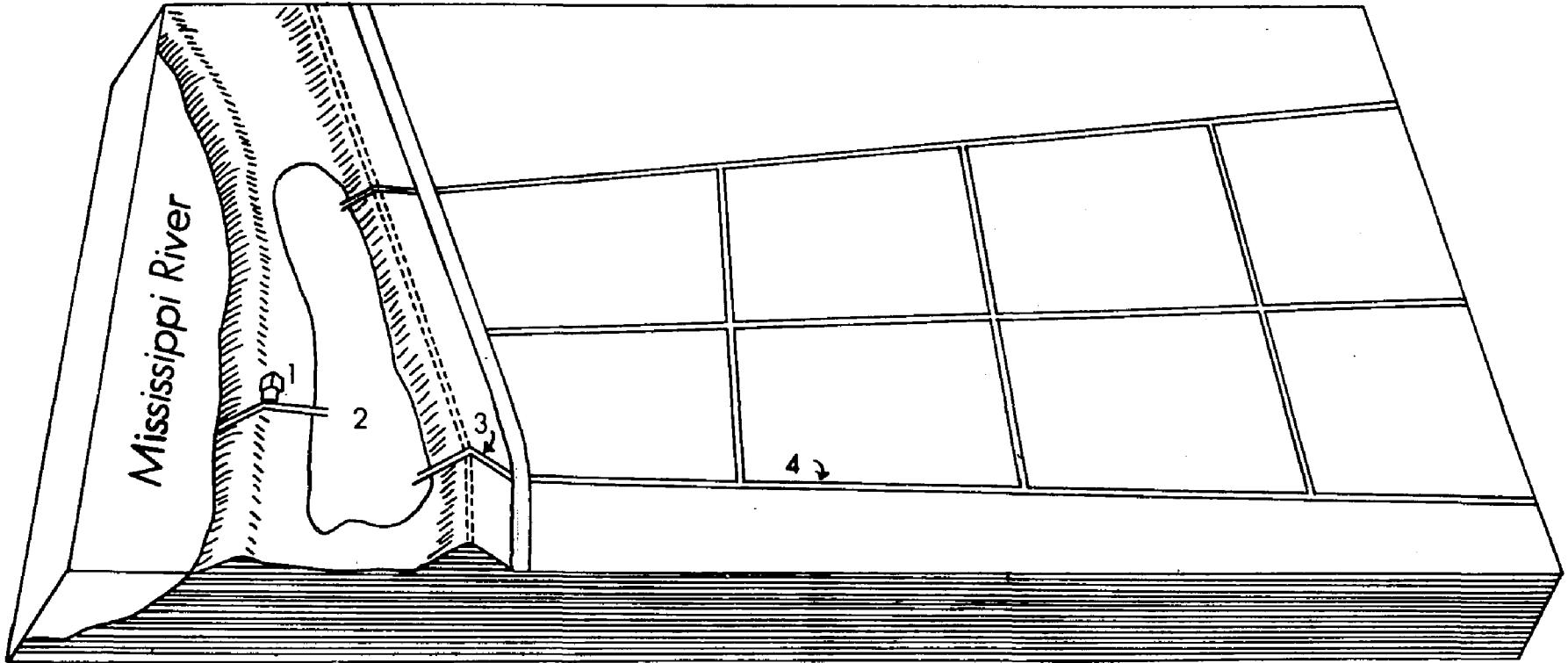


Fig. 62 A schematic diagram of Mississippi-type irrigation: 1. pumping station,
2. borrow-pits, 3. siphon, 4. flume-ditch.



Fig. 63 Borrow-pit reservoir along the Mississippi, Iberville Parish.



Fig. 64 View of a siphon which connects a borrow-pit reservoir and the main flume-ditch; east bank of the Mississippi, Iberville Parish.



Fig. 65 The main flume-ditch and a cross-ditch, showing a wooden sluice-dam to control the water flow; along the Mississippi in spring, Iberville Parish.



Fig. 66 Field levees showing wooden dam in the foreground and levee-cut on the middle-left portion of the picture. This picture taken in the same field as the picture above, but in early summer.

any other hardwood mauls (Figs. 67, 68). The volume of water flowing in the ditches can be controlled simply by taking out or adding pieces of planks at the dams. The techniques described above, use of both natural flooding and artificial water-lifting from the stream into the borrow pits, are adapted only to the area along the Mississippi River, due to the artificial control of Bayou Lafourche since the beginning of this century.

The Lafourche-type irrigation method began after the artificial cut-off of Bayou Lafourche from the Mississippi, causing an abrupt drop of water level in the bayou. Seasonal rise of river stage was no longer enough for 'free-water' irrigation along the bayou. Thus this artificial cut-off of Bayou Lafourche from the Mississippi was one of the main causes of rapid decline in river-rice production along Bayou Lafourche, as well as in Providence rice, mentioned previously. The Lafourche-type method which was adapted to conditions after the cut-off is a simple lifting of water from the bayou to the flume-ditch (Figs. 69, 70) without a borrow-pit reservoir and siphon. Now, without the menace of flooding, the old artificial levee is usually cut permanently at the place across which the irrigation pipe (Fig. 71) is to be laid.

Along Bayou Teche and partially on Bayou Black, a special technique has been developed, here termed "Teche-type." As shown in Fig. 72, Bayou Teche has two natural levees, a young and an old one, the present one being within and considerably lower than the older, a compound natural levee of the former Mississippi and Red River. Due to this peculiar relationship, irrigation water must be lifted from the bayou to land much higher than the present natural levee. The

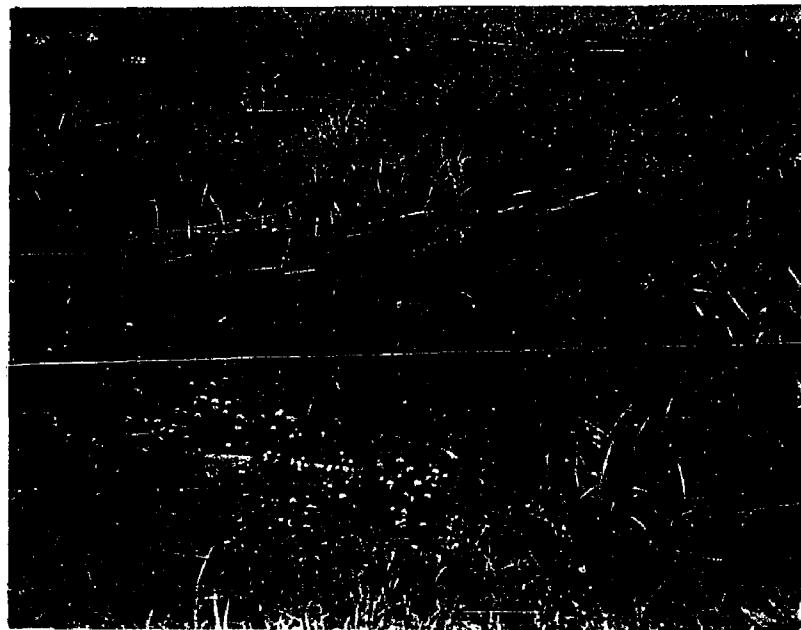


Fig. 67 Wooden sluice-dam on a cross-ditch, Iberville Parish.

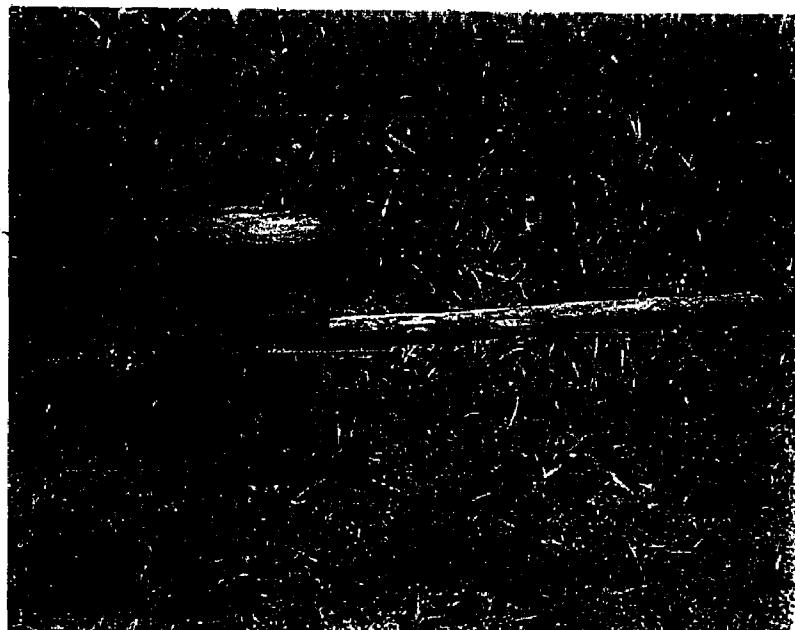


Fig. 68 A maul for driving planks of sluice-dam, Iberville Parish.



Fig. 69 A pumping station on Bayou Lafourche, Assumption Parish.



Fig. 70 A flume-ditch, showing a wooden sluice-dam at the upper-left of the picture for diverting water into the fields, Assumption Parish.

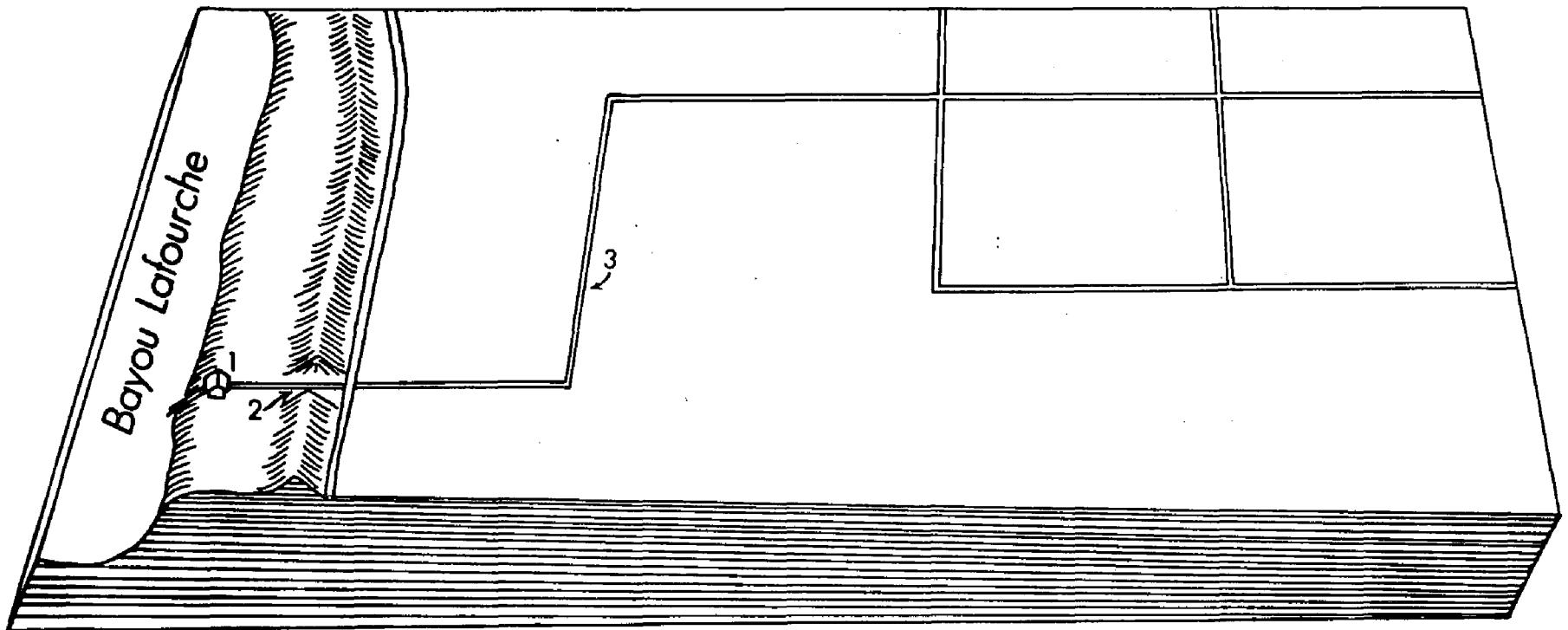


Fig. 71 A schematic diagram of Lafourche-type irrigation: 1. pumping station,
2. levee-cut, 3. flume-ditch.

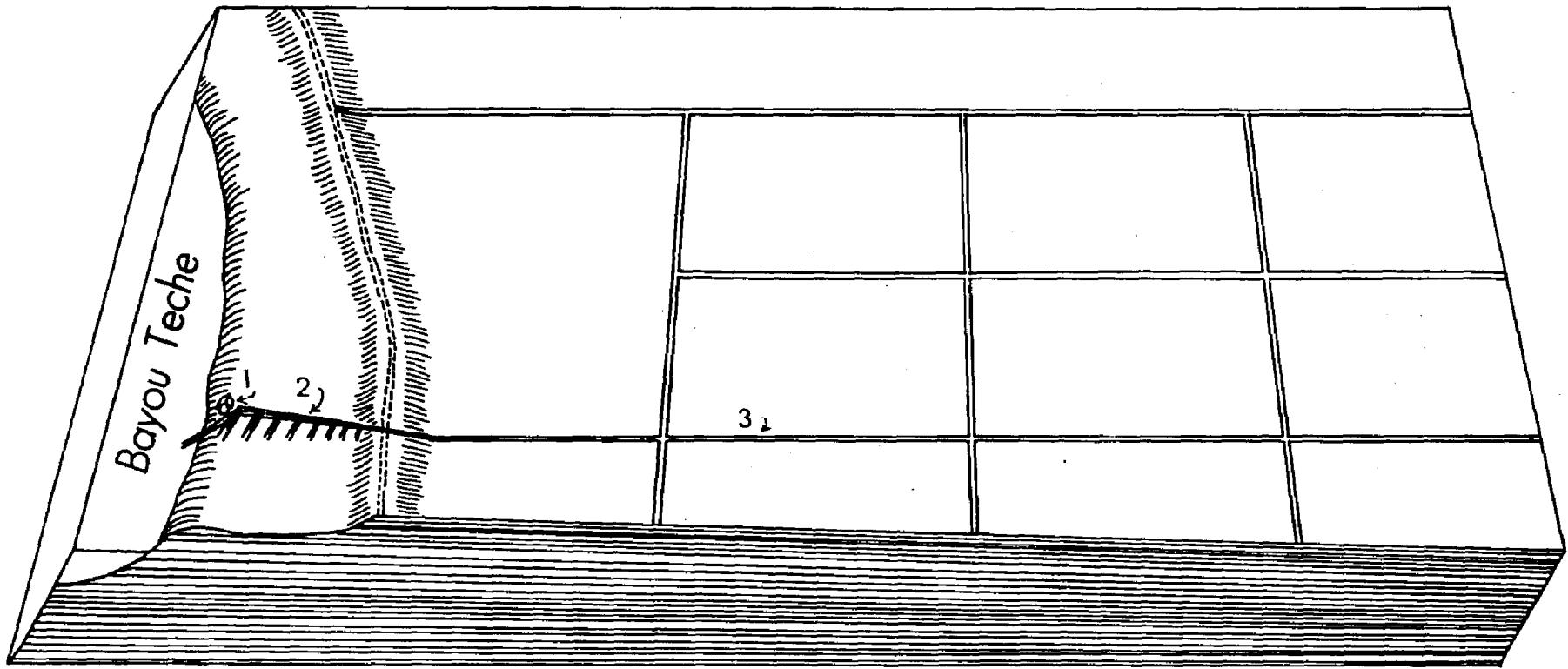


Fig. 72 A schematic diagram showing Teche-type irrigation: 1. pumping station,
2. wooden trough, 3. flume-ditch.

difference between the present and the old natural-levee height varies from place to place, from about 10 feet at New Iberia to 5 feet at Franklin. In order to get water from the present natural levee up to the older one, irrigation water must be raised to several feet above the older levee, a height sufficiently great so that gravity will make the water flow down to the old levee through a wooden trough. (Figs. 73, 74). A typical example occurs on the right bank of the Teche at New Iberia, where a pumping station standing 11 feet above Teche water-level has to lift water 25 feet from the Teche to make a four-foot gravity flow down to the old Mississippi natural-levee crest, 735 feet from the Teche levee. On Bayou Black, the wooden trough is partially replaced by a raised flume ditch with high banks to lead the lifted water into the main flume-ditch which is located on the higher natural levee.

Adoption of a water-lifting device made possible control of the time and amount of irrigation. Weed plants were consequently eliminated more effectively than before by the newly applied deep flooding known as "point flow." Hand weeding had continued until late in the 1940's when the labor supply became short and there resulted an adoption of a new weed-killing chemical, "2,4-D." However, some river-rice farmers have not yet adopted 2,4-D but continue to use the traditional weed-controlling methods consisting of deep flooding, hand weeding, and crop rotation.

The season of harvesting remains primarily the same, though it has been extended recently by the adoption of both early and late varieties of rice. Manual harvesting with the sickle has continued almost to the present in the river section except during World War I,



Fig. 73 A wooden trough or flume and pipe on Bayou Teche, Iberia Parish.

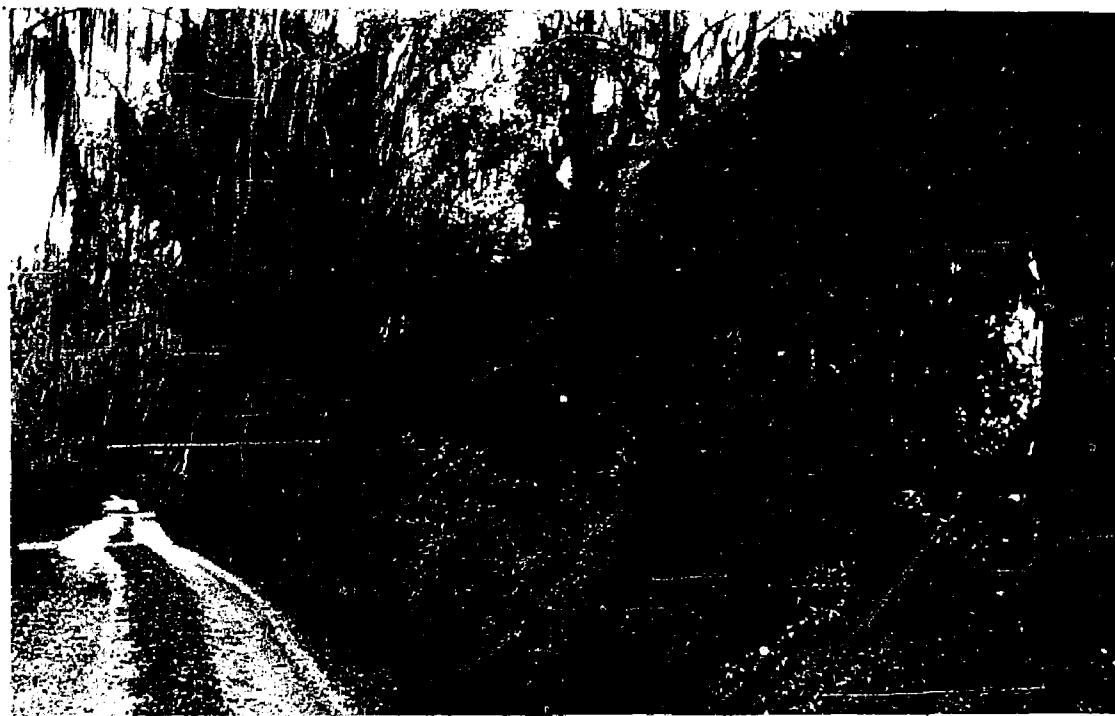


Fig. 74 A wooden trough or flume looking from the inside lower natural levee to the older natural levee on which the present highway (US - 90) runs, Iberia Parish.

when labor was in short supply. According to old rice farmers, rice harvested with a self-binder needs more time to dry before threshing, because the rice is cut and immediately bound into bundles, allowing no time for drying on the stubble. On the other hand, rice harvested with a sickle can dry one or two days and then be tied into bundles. Therefore it can be threshed within several days after harvesting. Another argument against introduction of the self-binder in the river section was the frequency of wet fields which were unsuited for heavy machinery during the harvest season. Though the above two factors may have played a part in preventing the introduction of self-binders in the river-rice section, a more important factor was resistance to the new method from the prairies while comparatively cheap labor was readily available.

Traditional manual harvesting, however, was discontinued with the adoption of the combine during the last part of World War II, when the labor supply was limited. This was also the time when most of the older generation retired from rice farming, and the younger generation readily took over the new machinery. Continuation of a farm-labor shortage after World War II, as a consequence of rapid expansion of industrial centers along the Mississippi River, and migration of prairie-rice farmers to the river section have also encouraged rapid introduction of new machinery.

Animal and flail threshing were gradually superceded by the thresher, introduced in the last part of the previous river-rice stage around the 1870's. Though its principle was the same, after about 1916 the modern thresher (Fig. 75) with self-feeder and chaff-blower was adopted, which was used until the coming of the combine, which

harvested and threshed at the same time (Fig. 76). After the appearance of the combined operation, harvesting and threshing, the traditional scene of field stacks of rice (Fig. 77) disappeared and brought a new harvest-period landscape (Fig. 78).

Rapid increase of production in the prairies and a demand for a more highly polished product brought further mechanical developments. A new machine known simply as shelling or hulling stones (Fig. 79) was introduced (Wise, 1916, No. 3, p. 25). This machine was essentially a pair of natural stones (or later, artificial, generally cement, mill stones), a bed stone and upper stone or "runner," which performed a part of the work formerly accomplished by mortar and pestle. The threshed rice fell through an opening in the upper stone, and the revolution of this stone over the bed stone removed the hull from the grain. This process is in general very similar to that employed in the milling of other grains. However, details are quite different. As previously described, most grains involve the breaking of the grain by rolling of furrowed stones. Rice milling, on the contrary, avoids breaking the grain in any way (Evans, 1921, No. 1, p. 24). Commercial mill stones for rice have smooth milling surfaces without furrows, and are set apart a certain distance to avoid breaking the grains. After hulling, the "brown rice" was polished by means of the traditional mortar and pestle until the introduction of the "huller," which will be described later.

For local use or preparation of the household supply of rice the "plantation huller" was adopted, probably during the last quarter of the 19th century, along the Mississippi River section. This machine, derived originally from the coffee huller (Ibid., p. 25) and still

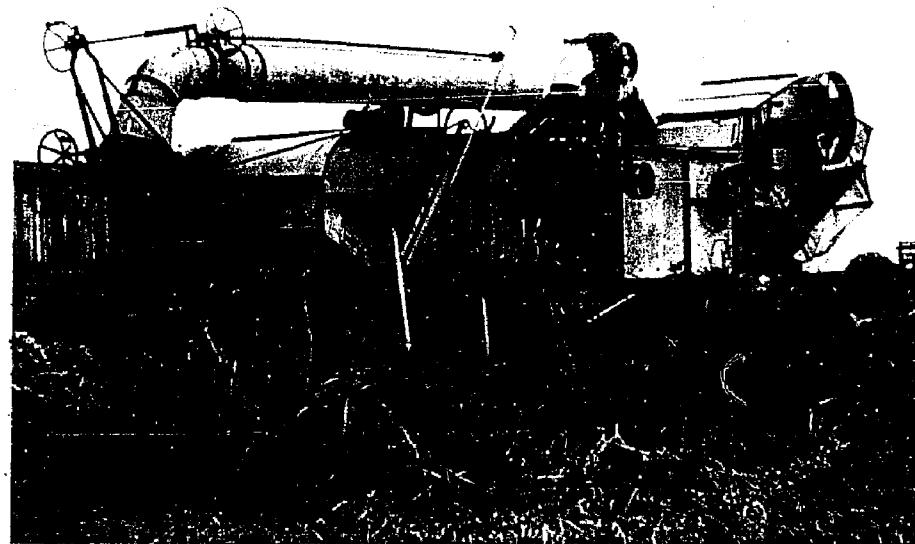


Fig. 75 An abandoned thresher of the type widely used until the introduction of combines in about 1943, Iberville Parish.

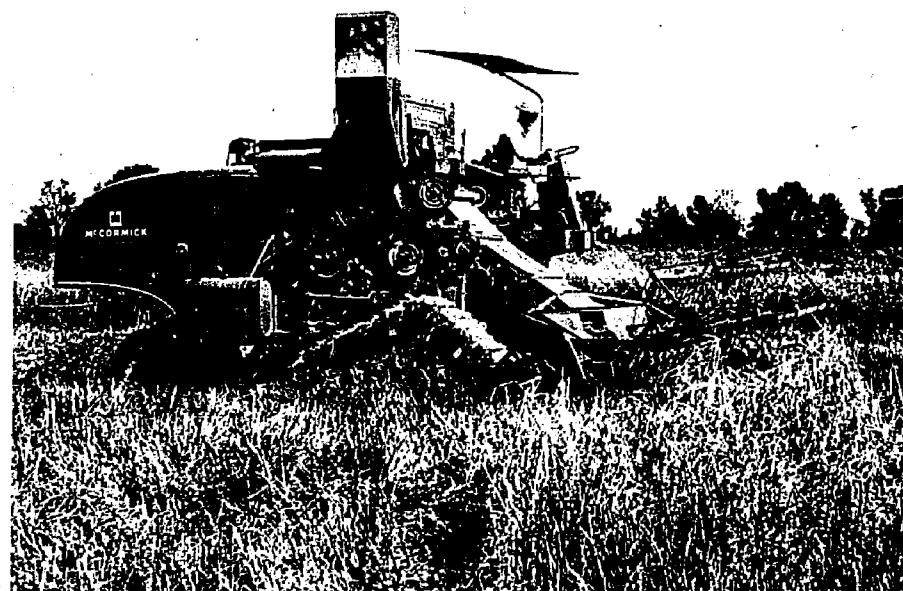


Fig. 76 A harvest scene, with a modern combine, in the river section, Iberville Parish.



Fig. 77 Stacks of unthreshed rice in Louisiana; picture from Knapp, 1907, p. 537.



Fig. 78 A field harvested by combine. Looking toward the natural-lèevee crest from the backslope, Iberville Parish.

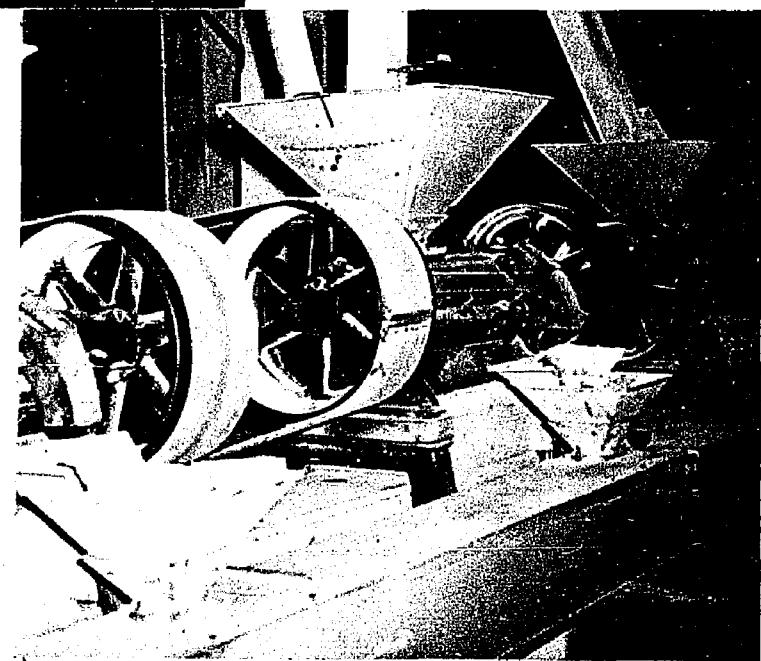
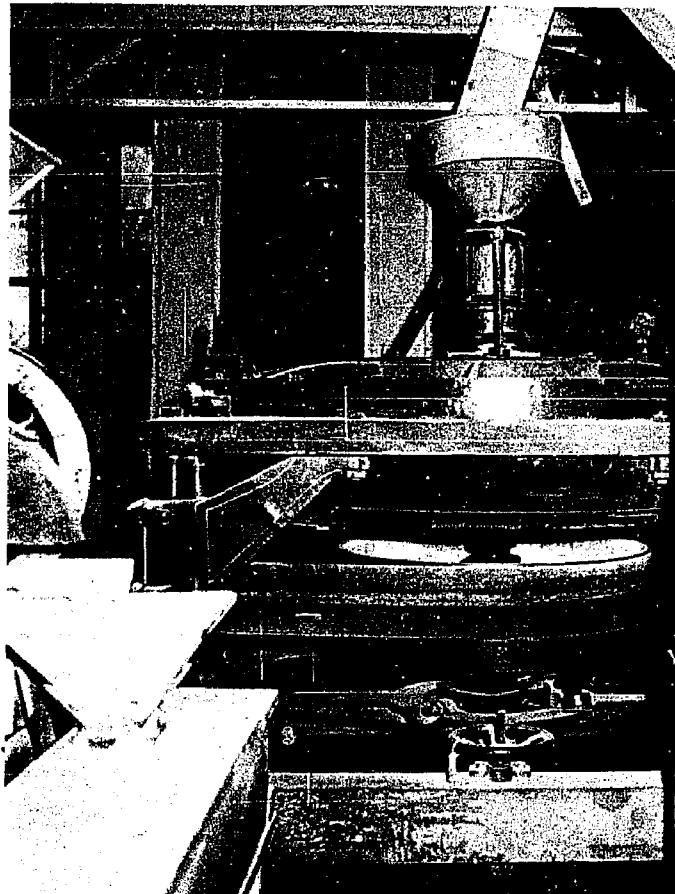


Fig. 79 Modern shelling stones in the upper picture; rice hullers below, Iberia Parish.

in use, is composed of a horizontal, tapering grooved cylinder within which revolves a ribbed shaft. The hull is removed by vigorous rubbing of the kernels against each other and by a scraping between the rough iron walls of the tapering cylinder and the ribbed surface of the rapidly revolving core. The grain is next screened and fanned free from hulls and passed a second time through the huller, after which it is again fanned, and is then ready for consumption (Wise, 1916, No. 3, p. 25). The power for this machine is derived from a small steam engine, or in later time from a diesel engine. This huller was used and is used today by some river farmers for both shelling and polishing rice, though it lacks the shelling stones described above.

For the large-scale commercial mills, polishing rice by mortar and pestle was gradually replaced, probably in the early part of this century, by a device known simply as a huller (Fig. 79). This machine is somewhat smaller but very similar to the plantation huller described above. The name huller is very misleading, because in reality this machine is used for removing the bran layer from the grain which has been hulled by the stone mill. Probably the name was inherited from the similar machine, the plantation huller, which removes hulls as well as the inside seed coat (Wise, 1916, No. 3, p. 26 and No. 4, p. 24). Though the modern rice mill (Figs. 80, 81) has added more steps to rice milling, the principle of hulling and polishing by both shelling stones and huller is still in use, having undergone no change since the time it was adopted.

Cultural Landscape

The French field pattern remains primarily the same. The strips

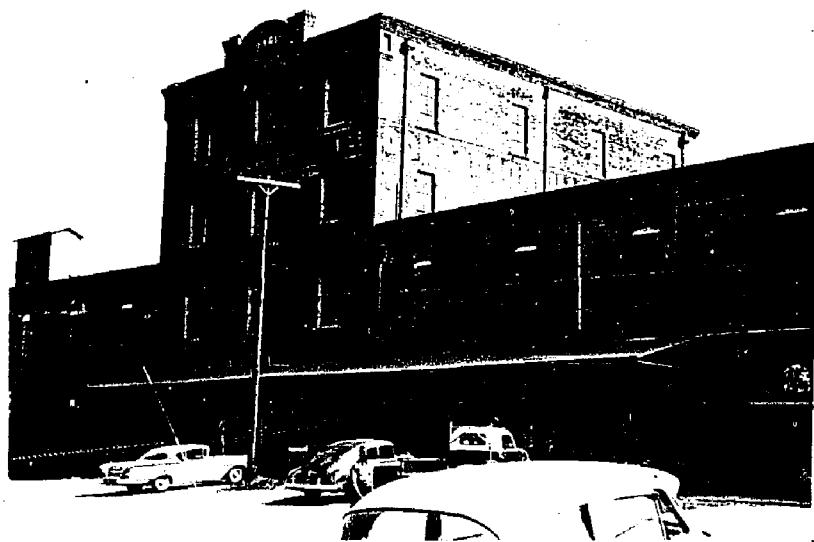


Fig. 80 Former rice mill, now used as automobile repair shop, Donaldsonville, Ascension Parish.



Fig. 81 A rice dryer and mill at New Iberia, Iberia Parish.

of land from the natural-levee crest to the backswamp, the flume-ditch or ditches parallel to the strips of land, and numerous cross-ditches at right angles to the flume-ditches have not changed. Fairly dense cross-ditch-system field patterns, developed on newly cleared areas, especially south of New Orleans, are still observable: abandoned flume-ditches, checkerboard levees, and fences, though the fields have been used for grazing land since 1930 (Figs. 82 through 85).

The rice-field pattern developed on old sugar-cane lands is typical in the elder river section between New Orleans and Baton Rouge (Fig. 86). Traditional practices, such as front land for sugar cane or cotton and backslope for rice, are also partially carried on today by some farmers (Fig. 87).

After adoption of a water-lifting device, the river-rice landscape spread from the Mississippi to areas where "free-water" irrigation is not possible because river stages are not sufficiently high; especially was this true in the Teche area as far north as Port Barre. The same field pattern was brought to the Teche section with the migration of river-rice farmers from the elder section. On the other hand, the eastward movement of prairie farmers brought the contour-levee method to the river section. This, however, is not a complete change of the old French pattern but only a partial change of field-levees. Flume-ditches and cross-ditches are largely unchanged; however, contour levees have replaced the straight checkerboard levees (Figs. 88, 89).

Associated with the water-lifting device, pumping sheds were built along the streams, and along the Mississippi borrow-pits were developed into temporary reservoirs. Boxed flumes or pipes inserted

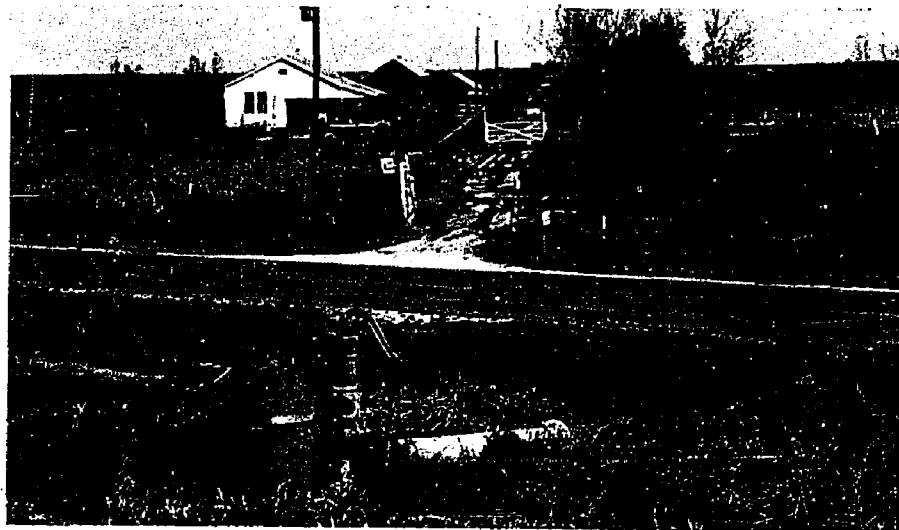


Fig. 82 Siphon and flume-ditch for former rice farm, now producing cattle, Plaquemines Parish.



Fig. 83 An abandoned rice field and old fence line, Plaquemines Parish

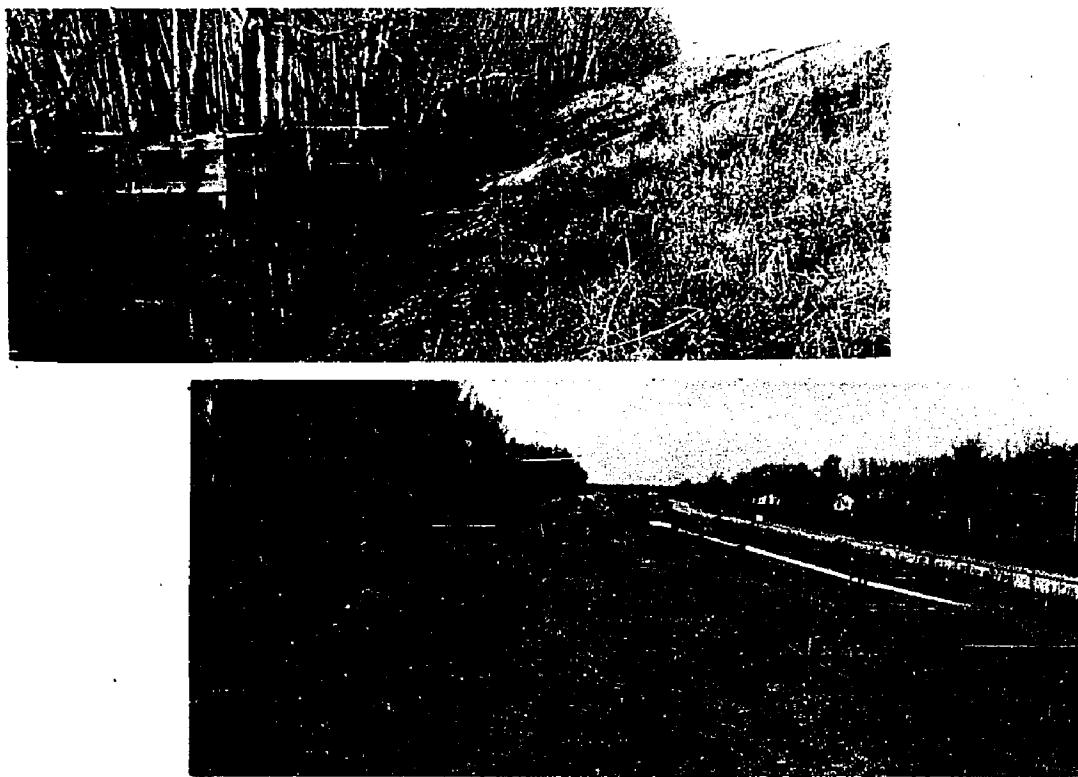


Fig. 84 Borrow-pits and abandoned siphon. The upper-left picture shows a crib to protect pipe intake from driftwood, Plaquemines Parish.



Fig. 85 An abandoned rice field, showing flume-ditch and traces of checkerboard levees, Plaquemines Parish.



Fig. 86 View of river-rice farmer's field, with an arpenter-system drainage ditch and checkerboard levees, Assumption Parish.

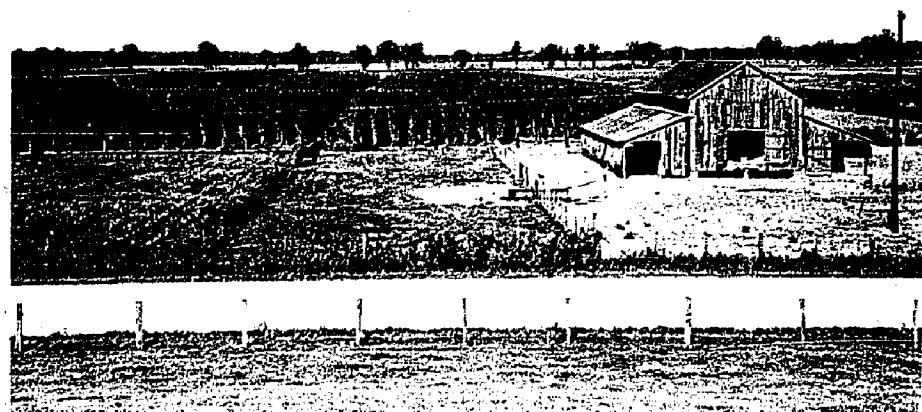


Fig. 87 River-rice, with sugar cane on the "front" and rice on distant backslope, Iberville Parish.



Fig. 88 Prairie-farmer's rice field on the Mississippi. Note contour levees derived from the prairies, and siphon and flume-ditch, traditional elements of the river section, Iberville Parish.



Fig. 89 A prairie-farmer's field along Bayou Black, Terrebonne Parish.

under or through the artificial levees were replaced by a siphon after 1890, when a law was passed which prohibited any type of boxed flume or pipes in artificial levees (Ascension Police Jury minutes, September, 1890). Rice pipes were and are, then, the obvious markers of rice cultivation. Along the Mississippi, former rice fields are traceable by the abandoned rice pipes as well as by relics of the field pattern, especially in the section south of English Turn (Fig. 84).

The introduction of mechanized farming after World War I brought notable changes in the Louisiana-French rural landscape. The individual small-scale farmers of less than 200 acres gradually disappeared between the close of World War I and the depression in the early 1930's, because no longer could the small-scale hand-labor method compete with large-scale mechanized farming. A few small-scale individual farmers south of English Turn remained after the depression ended, but by 1950 small-scale farming was completely discontinued because of salt-water invasion from the Gulf. This invasion was and is probably due to newly developed boat canals and possibly to natural subsidence. Most of the residents are no longer farmers, but small horse barns and implement sheds remain as reminders of the past.

The original pattern of the plantation river-rice landscape is still observable along the Mississippi, though most of the former rice plantations have turned to other activities, such as sugar-cane or cattle production. The old "big house" and the adjacent modern houses form a cluster on the plantation, along with the workers' houses and the traditional large barn set a little distance apart (Fig. 90). Since the introduction of the tractor, large barns are usually no longer in use or are converted into rice mills containing a simple

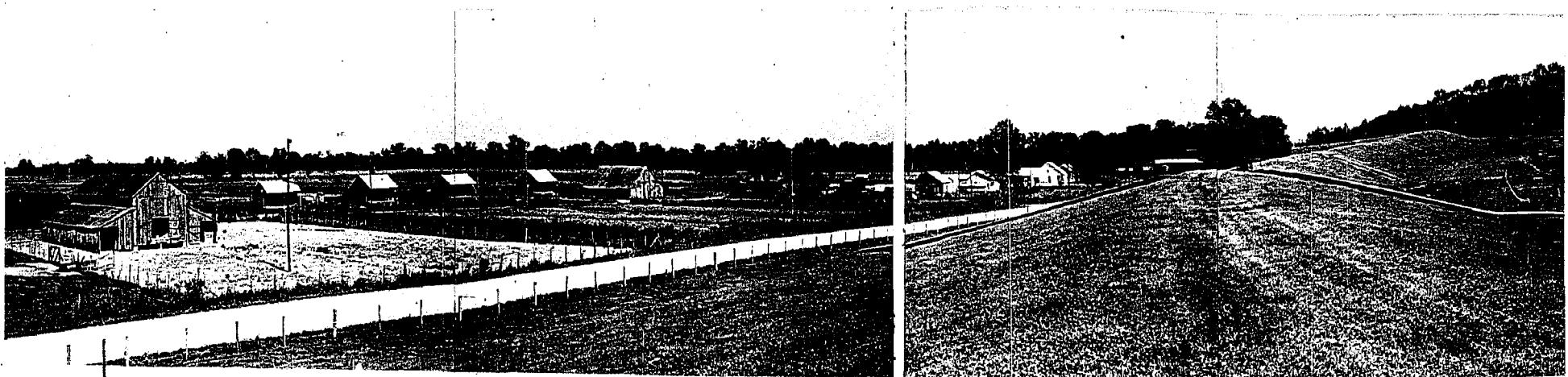


Fig. 90 A typical plantation assemblage, Iberville Parish.

"plantation huller" turned by a small power unit. A large repair shop and sometimes a plantation drier and storage sheds are located near the implement shed.

Traditional folk-type fences for keeping out farm animals have been replaced by modern fences in most places. However, old methods for passing over or through the fences, such as the stile and pass, often remain in use (Figs. 91, 92).

The change of the major means of transportation from river to railroad brought a partial change in the plantation landscape. Before World War I, every rice plantation had a landing place for the river-steamer which was the main means of carrying rice to the large mills in New Orleans. Harvested rice was threshed on the batture slope of the levee so that it was convenient for shipping. After the war the landings along the Mississippi gradually disappeared with the old steamboats. Subsequently the threshing ground was shifted from the levee slope to the railroad track, until it was abandoned with the introduction of the combine.

Large-scale rent farmers cultivating over 200 acres have been the typical rice growers throughout this modern period. They have moved from time to time, whenever and wherever there were lands to rent for rice cultivation. Since the rented land usually included certain outbuildings and sometimes dwelling houses, the resulting landscape has remained much the same as that of the older plantation. With the recent development of high-speed transportation and mechanized farming, some rent farmers no longer live near their fields. Sometimes they live many miles from the farms. Often they leave their implements near the field, unprotected except for the expensive machines



Fig. 91 A stile or escalier, Terrebonne Parish.

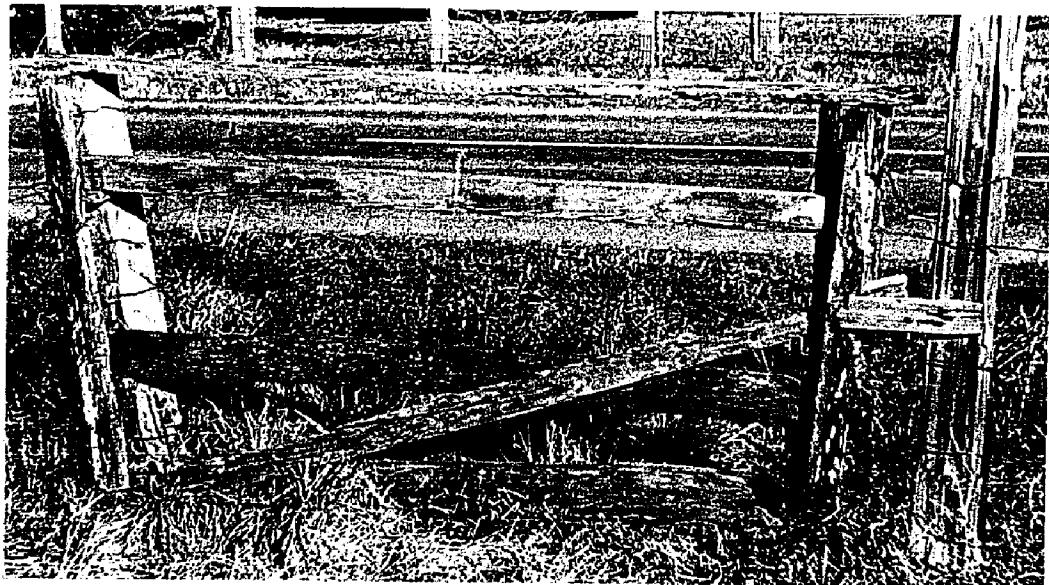
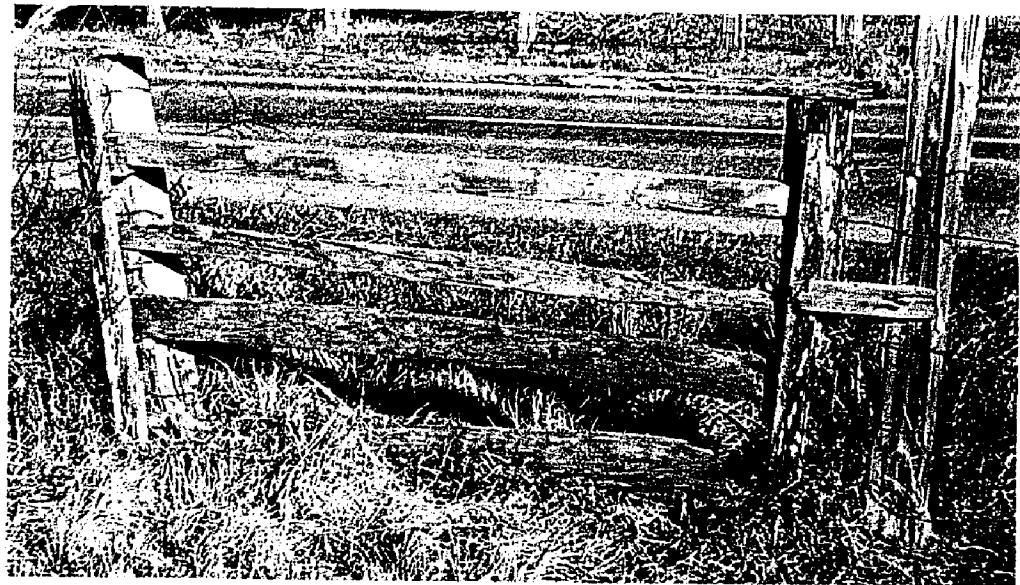


Fig. 92 A "pass," Iberville Parish.

such as the combine (Figs. 93, 94). The implement yard shifts position according to the seasonal demand: During the off-season it is near the highway; during preparation and harvesting seasons it is in the corner of the field (Figs. 95, 96). Farmers come to work with their field hands every morning and leave in the evening by car, like office workers. Their dwellings are not typical farm dwellings, but are much the same as those of city dwellers. Only the presence of an implement repair shop betrays their calling.

Prairie farmers in the river section have brought no change in the rural landscape except the partial alteration of the field-levee pattern, since they share, in general, a common French descent with the river-rice farmers. Thus there tend to be within wide limits similar types of dwellings and outbuildings, and there is lacking any kind of settlement assemblage truly distinctive of river-rice farming (Figs. 97, 98).



Fig. 93 View of an implement yard during the off-season. Shown are tractors, a storeroom for grease and small tools, and a discarded combine, Iberville Parish.



Fig. 94 A temporary shed for the combine in the implement yard shown in Fig. 93.



Fig. 95 A temporary equipment yard during preparation of the field, Iberville Parish.

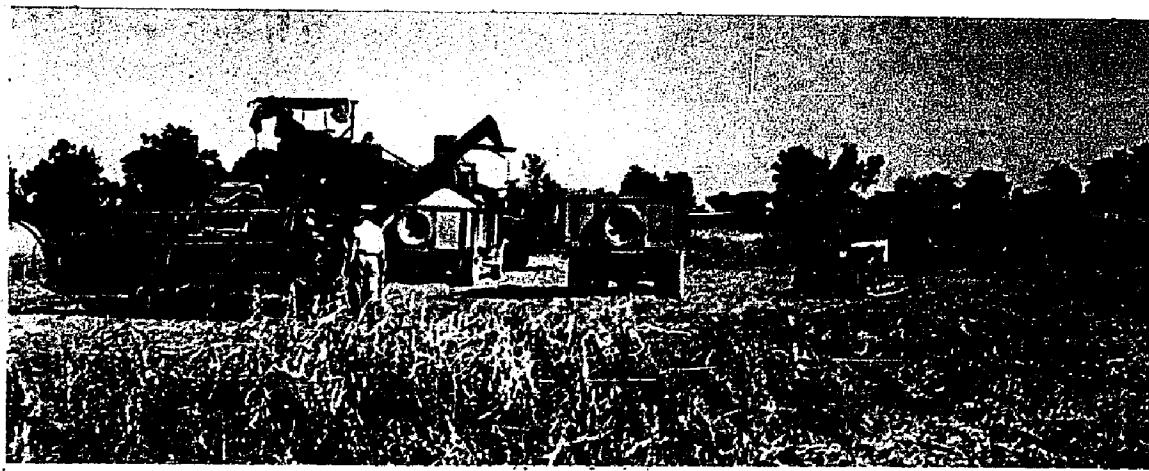


Fig. 96 Assemblage of equipment for the harvest, Iberville Parish.

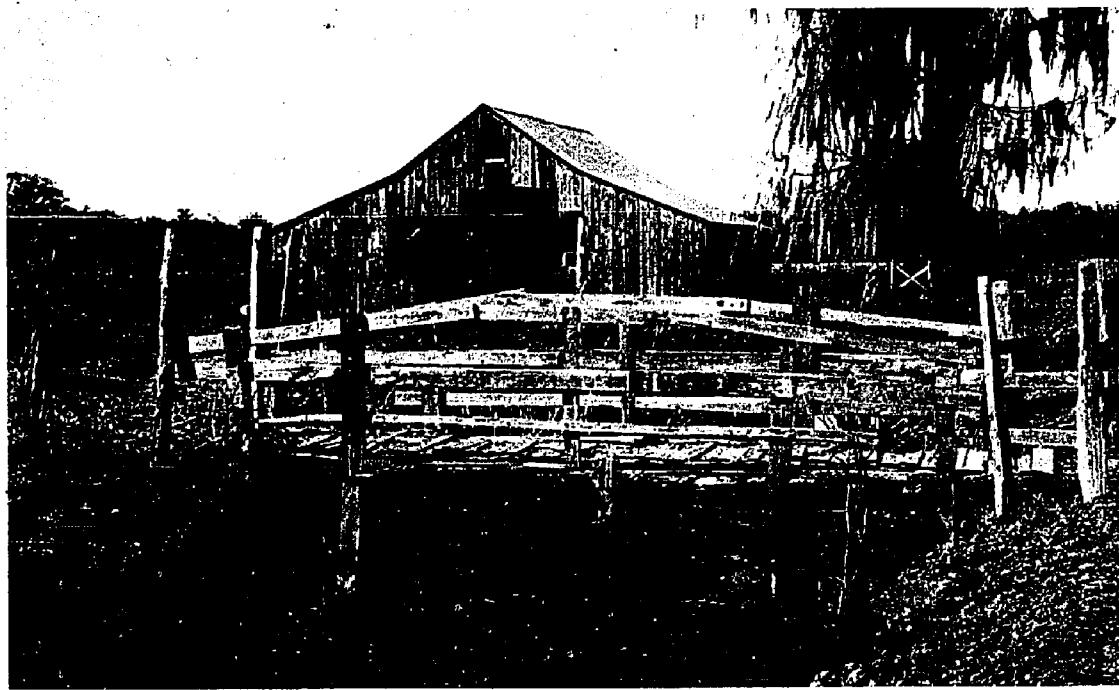


Fig. 97 A double-shed creole barn and wooden bridge over the flume-ditch, Terrebonne Parish.



Fig. 98 View of a tool-repair shop roofed with wooden shingles, Terrebonne Parish.

XII. Summary and Conclusions

During this study there have developed two major aims: one a study of the origin, diffusion, and evolution of different modes of rice cultivation; the other a systematic analysis of natural and cultural factors which control rice production, with brief mention of the accompanying cultural landscapes.

The botanical origin of domesticated rice is as yet uncertain. There are two schools of thought as to the identity of the progenitor of cultivated rice. One is the traditional school, which considers O. sativa f. spontanea as the ancestor of cultivated rice, O. sativa; the other considers O. perennis as the progenitor of both O. sativa in Asia O. glaberrima in Africa. Though they differ as to the ancestral family, they agree generally on the place of origin, namely, southeastern Asia. Maximum botanical variation in both wild and cultivated rice, most diverse linguistic terms for rice, and a wide range in modes of cultivation are found in southeastern Asia, though archaeological and historical evidences are not in conformity with these indications. It is likely that the hearth of cultivated rice is one of the small alluvial valleys of southeastern Asia, especially in the area from Bengal to Indo-China, where there are many vast marshes with low, intervening mountains. Here is the typical Asiatic monsoon climate, with year-round growing season, inundation of marshes during the period of growth, and a dry season for the harvest. Conspicuous valley-and-hill topography provides a diversity of plant cover and soils.

Considering people, time, and place, the first domesticator seems to have been neither Chinese nor Aryan invader of India, though the

former has the longest historical record. One of the neolithic Australoid or archaic Caucasoid peoples probably domesticated and cultivated rice along with their earlier root crops.

It is still open to question as to how rice was domesticated. However, it seems likely man's first rice field was swampy alluvial land where wild forms of rice grow commonly. The ancestry of rice culture may well lead back to earlier domestication of root crops. Planters of the latter may have domesticated semi-aquatic plants like rice by the act of transplanting seedlings to wet alluvial swampy lands, with partial extension of the vegetative planting habit learned earlier with taro. Rice seedlings may have been acquired as weeds from root-crop fields or from wild swampy areas. From these simple possible beginnings, modes of rice culture have evolved through time to fit varied natural conditions and to conform to different cultural values. These modes fall into five major types: 1) swamp rice; 2) slash-burn, shifting cultivation; 3) sedentary rice culture with uncontrolled irrigation; 4) irrigated rice with broadcasting of seed; and 5) irrigated rice with transplanting of seedlings.

Diffusion of rice is summarized in Plate 3. Both natural and cultural factors are responsible for the diffusion of rice. Natural factors such as availability of water and length of growing season still partially limit the spread of rice. However, natural factors responsible for the world distribution of rice have now been largely supplanted by cultural factors such as the development of new varieties, the improvement of techniques, and the use of special tools and machinery.

Migration of peoples as a means of spreading culture is the most important factor in explaining the present distribution of cultivated rice. Before the arrival of Aryans in India and Han Chinese in China, rice spread primarily through archaic Caucasoids into India and South China, probably as far north as the Hwang Ho valley. Malay-Polynesians were responsible for the dispersal of rice to Indonesia, possibly as far east as New Caledonia, and to Madagascar. The Arabs carried rice into Mediterranean areas and eastern Africa. Aryans and Chinese expanded rice production into lowlands with the introduction of the plow from the west. However, rice culture has never played a significant role in the Hwang Ho valley and the western part of India, due to cultural resistance and climatic disadvantages.

It has not been certainly determined whether rice in West Africa was developed independently or diffused from Asia. However, there are similarities in the religious significance and prestige value of rice, such as the ceremonial importance of red rice in both Africa and Asia, similar techniques in transplanting and irrigation, though with minor differences to fit natural conditions. Considering the above facts, the rice-culture complex may well have been diffused from Asia to Africa.

Europeans brought rice and its techniques to the New World with their expeditions: The Spaniards brought rice to the West Indies, Central America, and northern and western South America; the Portuguese to Brazil; British colonists introduced rice to South Carolina; and the French brought it to the Mississippi valley.

In Latin America, even today a subsistence economy dominates the manner of rice production. The modes of cultivation are very primitive;

the initial forms of cultivation when rice was introduced are still being practiced in Central America, the northwestern part of South America, and the Brazilian Plateau. The plow has never been successfully introduced by Europeans into tropical America. The Spanish-introduced machete is the most important implement in rice culture in tropical America.

Subsistence rice culture in Anglo-America likely stemmed from the West Indies. According to early descriptions by Glen (1716, p. 6) and Catesby (1771, p. xvii), it appears that the early modes of rice culture in South Carolina were almost the same as the primitive methods practiced in tropical America, that is, shifting, slash-burn cultivation, and swamp rice without controlled irrigation. Commercial rice culture with use of slaves gradually evolved in South Carolina. It may be divided into two stages: inland-swamp and tidal-water swamp rice. Until the close of the colonial period in 1776, inland-swamp methods were dominant, though tidal-water swamp rice was introduced in 1758 (Gray, 1933, p. 279).

Inland-swamp rice production was a hoe culture conducted by slaves. The use of plows and draft animals came after the Revolution, when a shift to tidal swamps took place. Tidal-water rice cultivation came only with the control and systematic use of water. While inland-swamp methods were somewhat an extension of upland farming, tidal-swamp rice was quite distinctive. During the later period the techniques involved in the preparation of fields, irrigation, threshing, and milling were improved greatly and laid the foundation for large-scale commercial rice culture. Thence the new techniques and improved implements were diffused gradually into the Mississippi valley,

and later into Latin American countries.

After a zenith between 1850 and 1860, the old rice-growing areas which led production in the United States for 200 years declined gradually. The causes of the decline were various: untimely storms and freshets; drop in the price; and migration of labor to other industries. An even greater cause of decline was the rise of rice culture in the prairie section of Louisiana during the last part of the 19th century and the beginning of the 20th century, with the use of modern machinery and new irrigation systems (Doar, 1936, pp. 41-42). The value of land for rice production in the older area has declined since the adoption of the newer methods. The tidal swamps, the best rice lands for a long time, were not suited to competition with the newly developed rice areas, since the comparatively small patches of rice swamps were not adaptable to the new machinery and methods.

Historical records are not available to indicate positively the first introduction of rice into Louisiana. However, on the basis of early documents it appears that the first rice seed were brought from the West Indies to Louisiana by way of Dauphine Island. The first rice cultivation appears to have occurred about 1718, or not later than 1719, judging from the proclamation issued by the India Company early in 1720 (Gayarre, 1919, pp. 286-291).

Both natural and cultural factors made for a successful introduction of rice into Louisiana: well distributed rainfall during the growing season, warm temperature, dark-brown clayey soils on the backslopes of natural levees, and comparatively flat terrain. The semi-aquatic character of rice favored the use of wet and heavy clay soils which were flooded annually. In the extensive areas of seasonal

inundation where rice grows best, crops such as sugar cane did not thrive. Besides natural advantages, the need of a substitute for wheat was an important factor in the successful introduction of rice to Louisiana. Though European settlers much preferred wheat flour for staple use, due partly to the damp climate, early colonists failed to produce wheat. Meanwhile the settlers grew to prefer rice to maize and to substitute it for wheat.

Since the introduction of rice into Louisiana, modes of rice cultivation have evolved and new methods adopted with the passage of time, accompanying advances in technological level and changes of cultural values. Rice culture in Louisiana may be divided into three main types, first appearing in time sequence but all persisting virtually to the present: Providence rice, or small-scale home-use rice with little or no artificial irrigation; river rice or irrigated rice along the Mississippi River, primarily commercial; and prairie rice, or mechanized large-scale rice culture developed in prairie Louisiana.

The term Providence rice is adopted here to stand in contrast to irrigated rice, that is, rice culture without controlled irrigation, and yields dependent on the nature of the weather and the suitability of the soils. Though the basic principles of production remain the same, Providence rice may be divided into three types to fit different natural conditions: row-rice on the upper portion of natural-levee slopes, swamp-rice on the edge of the natural levee slopes, and marais-rice on the prairies of southwestern Louisiana. The mode of cultivation was very primitive, with the hoe and sickle the main field implements. Providence rice was threshed with simple sticks or by

animal treading, and milled with the rotary pit-mill or Indian mortar and pestle, or both. Development of Providence rice has been closely related to the French in Louisiana. The known areas of Providence-rice culture are found in French-settled areas, roughly within a triangle connecting New Orleans, Point Coupee, and Lake Charles.

River-rice culture may have evolved from an advanced type of Providence rice grown on crevasse slopes. However, techniques in preparing fields and irrigation and milling practices suggest its South Carolina origin; minor changes are attributable to adaptation to different natural conditions. On the basis of irrigation techniques, river rice may be divided into two stages: river rice before, and river rice after, 1885. Before 1885, irrigation water was obtained primarily from the river, but only when the river-stage was high enough to permit gravity flow into flume ditches. Hence, time and amount of irrigation water could not be controlled since natural flooding and rain water were the primary sources. Adoption of irrigation techniques and use of the plow and draft animals brought new field patterns, a checkerboard type (Fig. 49) that contrasted strongly with the irregular small patches of Providence-rice fields. Lower swampy lands at the toe of the levee slopes were cleared and drained for rice fields and ditches were made for irrigation and drainage purposes (Plate 10).

Despite the distinctive character of the checkerboard fields, there developed no general settlement pattern peculiar to the commercial production of river rice. Rather it inherited the older form developed by plantations growing sugar cane or cotton. The needs in the way of field shape, buildings, and roads were not sufficiently

demanding or different to necessitate any marked change in the older settlement form.

After 1885, the nuclear area of rice growing in Louisiana gradually shifted from the river section to the prairies, where new ways of rice cultivation appeared. Subsequently the prairie method was partly adopted in the river section. River rice after 1885, thus, is a period in which there were two conflicting trends: resistance against the prairie methods, and the inevitable modification of river methods by prairie-derived influences.

Systematic analysis of the controlling natural and cultural forces behind the shift of rice production to the prairies shows clearly that the natural factors involved in producing rice must be evaluated in terms of the level of technology and the value system of the human group practicing it. Decline of the rice areas of South Carolina and the river section of Louisiana, and the rise of prairie-rice culture can be explained more by a changing technological level and altered cultural values than by natural factors such as water resources, configuration of terrain, and soil, comparatively constant through time, even though variable in space.

NOTES

Chapter II

¹"The suitability of water for rice irrigation depends not only on the concentration of its chemical constituents but also upon the stage of growth of the rice, the nature of the soil (porosity, permeability, drainage, and other factors), and the concentration of the harmful salts present in the soil prior to the application of the irrigation water.

It generally seems to be agreed, however, that water containing less than 600 ppm of sodium chloride (35 grains of sodium chloride salt, per gallon or 350 ppm of chloride) is not harmful to rice at any stage of growth." (Irelan, 1956, 330).

Chapter III

¹Wild rice, so-called, in North America does not belong to the same genus, Oryza, to which the cultivated rice belongs. It belongs to the genus Zizania (Zizania aquatica L.; Z. palustris L.) (Chambliss, 1922, p. 3).

Chapter IV

¹"The historian Ibn-Batouta (1350) mentions the existence of rice in Nigeria, which was certainly O. glaberrima Steud., for the Asian species were introduced into west Africa by the Portuguese in the seventeenth century and into Nigeria more recently. . . ."

²The age of Yang Shao is estimated as about 3000 B.C. by Andersson, and as 2000 B.C. by Menghin.

Chapter V

¹Data obtained by correspondence with Dr. R. S. Raman, agronomist of the Central Rice Research Institute, Cuttack, India, dated February 29, 1960.

²Tagalog refers to both language and people, a Malayan stock occupying central Luzon. They are one of the most numerous native peoples of the Philippines.

Chapter VI

¹About 90 per cent of the water supply in Arkansas and about 35 per cent in Louisiana are from ground-water sources (Jenks, 1950, p. 105; Sturgis, 1957, p. 658).

²The necessary growing season of rice varies largely with temperature and length of day. The same variety, Norrin-11, needs less growing period in southern than in northern Japan.

³Rivers are the chief means of transportation in central and southern China. The Chinese saying, "Boats in the south are equivalent to horses in the north," expresses its significance.

⁴He quotes from A Study of Ancient History of Communication Between Japan and China, by M. Fujita, 1943, "A sea route from Formosa to Japan through Ryukyu is a track of typhoons. Typhoons are so strong that drifting boats would seem to find it hard to reach the Japanese mainland [from Formosa]. Therefore, it would be difficult to believe that Formosan people reached Kyukyu [by drifting]. The number of drifted boats from the coast south of Yangtze Kiang to the northern coast of Kyushu would be much more than with the former route, though there were a few drifted boats from Formosa to the Japanese mainland" (Ando, 1951, pp. 41-42). [My translation]

⁵Huerta, a Spanish word meaning a garden or permanently cultivated plot.

⁶Religious importance of red rice was noted by Dr. R. C. West in his seminar titled "Economic Plants," offered in the spring semester, 1959, Louisiana State University.

⁷The writer could find no clear relationships between African terms and Asiatic terms, due partly to the lack of sufficient information. The following entries of African terms for rice are provided through the courtesy of Dr. Melville J. Herskovits and Mr. Hans E. Panofsky, Northwestern University.

Terms for rice in Wolof, a language spoken mainly between the Senegal and Gambia rivers, particularly near the Atlantic coast:

chu	a dish of rice
chura b	boiled rice
faro b	rice swamp
gob	to cut (rice, etc.)
malo m	rice
mbahal m	rice cooked without oil

(from the Wolof-English Dictionary by D. G. Gamble, London, 1958, mimeographed form)

Chapter VII

¹Information obtained from Dr. R. C. West.

Chapter VIII

¹In 1666, Robert Horne published a pamphlet in London advertising the resources of Carolina, mentioning rice produced in South Carolina (Salley, 1919, p. 1).

²This does not mean that the first rice seeds were introduced from South Carolina, because rice culture in the West Indies and Central America is much earlier than in South Carolina. Carolina varieties possibly replaced the varieties which were introduced by the Spaniards in the last part of 16th and the early part of 17th centuries.

³"The best land for rice is a wet, deep miry soil; such as is generally to be found in cypress swamps; or a black greasy mould with a clay foundation; but the very best lands may be meliorated by laying them under water at proper seasons." (Glen, 1761, p. 6).

"It agrees best with a rich and moist soil, which is usually two feet under water, at least two months in the year." (Catesby, 1771, p. xvii).

⁴A recent study, Seed from Madagascar, by D. H. Heyward (1937, p. 4), states that Carolina Gold rice came to South Carolina from Madagascar about the year 1685, instead of the traditional date, 1694: "Carolina gold rice, world renowned because of its superior quality as compared with all other varieties of rice throughout the world, was grown from seed brought to the province of Carolina about the year 1685."

⁵The origin of the name, plug trunk, is from a crude "hollow cypress log with a large hole from top to bottom, used in the early days. When it was to be stopped a large plug was put in tightly and it acted on the same principle as a wooded spigot to a beer keg." (Doar, 1936, p. 12).

Chapter IX

¹As far as my field work has brought to light, this method was in use until 1956 on lower Bayou du Large, Terrebonne Parish, and into the 1940's around Abbeville, Vermilion Parish.

²Information was obtained from Mr. W. D. Smith, a retired rice inspector in New Orleans, and Mr. Victor Naquin, Terrebonne Parish.

³"They bake bread of it [maize] like cakes (by baking it over the fire on an iron plate, or on a board before the fire) which is much better than what they bake in the oven, at least for present use; but you must make it every day; and even then it is too heavy to soak in soup of any kind....

They eat rice as they do in France, but boiled much thicker, and with much less cookery.... They make bread of it that is very white and of a good relish; but they have tried in vain to make any that will soak in soup." (Le Page du Pratz, modern ed. 1947, pp. 165-166).

⁴Inforamtion was obtained from correspondence with Dr. Phillips on Nov. 3, 1958. Dr. Phillips wrote: "I had the feeling in 1950 that I had found just about the last vestige of it [the upland-rice complex]." Attempts by the author to locate upland rice farmers around Como on November 16, 1958, were futile.

⁵Abandoned swamp-rice fields which were in use until 1955 were observed on lower Bayou du Large in 1958. (Figs. 28, 29).

⁶Mr. Naquin, the informant, cultivated rice on the lower part of Bayou Pointe au Chien, about five miles south of the present Cut-Off Canal.

⁷"It is absolutely necessary, Gentlemen, for to send to this colony some mills completely made to shell rice and corn. . . . They [mills] cannot be put on the river. That is impossible on account of the great quantity of trees that come down from above and which constantly would destroy the mills that might be there. . . . You must give [us] some that can be operated with horses. . . . They [engineers] do not understand it at all, and if in New Orleans there were two or three mills of the sort . . . it would be a great relief to the inhabitants. A negro must spend his day pounding [grain] in order to provide enough for two to eat." (MPA II, p. 310, Sept. 6, 1723).

Chapter X

¹"At the season of the year when this irrigation is acquired [required] in this period, the water is always within twelve or fourteen inches of the point from which free irrigation can be obtained." (Wilkinson, 1854, p. 537).

²Field investigation shows that the first thresher was in use about 1885 around Pointe a la Hache.

Chapter XI

- 1 About 32 inches of water are required to grow rice. The prairie section receives about 16 inches of rainfall during the growing season. However, a dry year may get about 4.5 inches during the rice-growing period. Therefore irrigation must supply some 16-27 inches (Jones, 1956, p. 446).
- 2 Recently, well irrigation has been practiced as a supplement to stream irrigation in East Carroll Parish.
- 3 Information obtained from one of the oldest living rice farmers, Mr. P. A. Conrad, New Iberia. His father and his uncle were once rice farmers at Reserve, St. John the Baptist Parish, and later in Pointe Coupee Parish. They then moved via Opelousas to Franklin on Bayou Teche.
- 4 The best available opinion suggests that the "three-stick" method involved a carpenter's level and 3 poles or rods.
- 5 Wood-burning steam engines for lifting water from streams were replaced gradually after World War I by diesel engines.

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Approved:

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