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# WILD RICE

## A Delicious Food

### FOREWORD

Back in 1939, our annual Holiday booklet was written about wild rice by L. A. Rossman, then publisher of the Grand Rapids Herald-Review. This year our title is the same. But the wild rice industry has changed dramatically in 35 years, and further developments lie ahead.

About 75% of the North American production of wild rice comes from Minnesota. Practically all of this wild rice is grown within 100 miles of Grand Rapids, and many people living "up in this neck of the woods" are engaged in growing, harvesting, processing and merchandising wild rice. So we observe developments in wild rice with more than passing interest.

With this booklet we extend our Holiday greetings and best wishes for the New Year.

George, Allen and Bob Rossman

Northprint Company  
Grand Rapids, Minnesota  
December 1973

For hundreds of years, wild rice was one of the main foods of the Indians of Minnesota. But for the last half-century, Indians have sold most of the wild rice they harvest. It is featured on the menus of many of America's best restaurants and graces the tables of those who prize it as a delicious companion for game and fish.

Most people outside the area where wild rice grows have seldom eaten it. Total annual production amounts to about one pound for every 100 people in the United States. Parched wild rice retails for about \$5 a pound in most parts of the country.

A new era lies ahead for wild rice. During the last ten years, some enterprising businessmen have set out to increase the supply of wild rice. Many feel the market for wild rice could be multiplied by ten or a hundred times if ways could be found to grow more wild rice.

Instead of depending solely upon the stands of wild rice that grow naturally on many shallow lakes and streams of northern Minnesota, paddies have been built in which wild rice can be grown and harvested as an agricultural crop. Researchers are engaged in scientific studies of how wild rice can be grown more successfully and economically.

The next ten years promise to be exciting ones for the wild rice industry. If research is successful in wild rice as it has been in other grains, wild rice will be developed from primitive plants to established varieties. In a quarter-century, as much progress may be made in wild rice as required hundreds of years of gradual improvement in wheat, corn, oats and other domestic grains.

What makes the new era in wild rice exciting is that no one can be certain that current efforts to expand the wild rice industry will succeed. Answers must be found to reduce the dangers from insects, diseases, weeds, bad weather, and variations in water supply. Methods of growing, harvesting and processing wild rice are still in the early stages of development. Effective and economical methods of marketing must be found to move larger crops at a profit. Large

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FRONT COVER PICTURE — The top portion of a wild rice plant in full bloom is beautiful. The grains in the head are nearing maturity while the male flowers below are still blooming.

amounts of money must be invested to build and operate wild rice paddies, processing plants and marketing facilities.

This booklet briefly describes several aspects of wild rice. The first section describes the wild rice plant and how it grows in its natural state. The second section tells of the unique role of wild rice in the lives and history of the Indians of Minnesota and nearby areas. The third section describes the commercialization of wild rice. The fourth section discusses the new era in wild rice development including scientific research and paddy utilization. The final section describes wild rice as a food and includes some suggestions for its preparation.

### How Wild Rice Grows

The wild rice plant is a distinct type of grass which grows in water. It was classified more than 200 years ago and given the Latin name *Zizania*. Four species have been identified, and there are several varieties of some of these. *Zizania aquatica* is the most common species in the northern part of the United States, along the east coast and in southern Canada. *Zizania palustris* is also found in the northern parts of the same general area and is distinguished from the more common variety mainly by having fewer flowers and seeds. *Z. texana* is a species found in a small area of Texas. *Z. latifolia* is found in Manchuria, Korea, Japan, Burma and northeastern India, and is quite different than American wild rice.

In the spring, wild rice paddies are flooded. Wild rice seeds start to grow late in April or early in May. By late May or early June, the plants are in the floating leaf stage pictured here.



### Aitkin County

#### Growth Curve

Dry Wt. (gm./plant)

WATER LEVEL

SOIL

Growth Phases

Submerged	Heading leaf	Emerging leaf	Flowering	Jointing	Boat	Flowering	Grain formation	Harvest
May	June	July	August	Sept				

This growth chart is for a particular strain of wild rice on a paddy near Aitkin. Actual growth varies with the strain of wild rice, temperatures, locations, soil, water depth and other factors.

The common name "wild rice" is misleading. It is a very different plant than domestic rice. The main similarity is that they both grow in water — though in very different ways and in differing soils and climates. The seeds or grain are also quite different.

In the early fall, the ripe seeds of wild rice fall into the muddy bottoms of shallow lakes and streams where it is native. The seeds lie dormant at freezing or near-freezing temperatures throughout the fall and winter. Spring suns warm the seeds, many of which then germinate at temperatures of about 40 degrees F. The seed sends out a root sprout which attaches itself loosely to the soft soil. It also sends out two long ribbon-like leaves which look like coarse grass. These do not reach the top of the water but do take the plant to the next stage when several larger floating leaves reach the surface of the lake or stream. These leaves utilize sunshine and collect other nutrients required for growth. As the stem develops, it then sends up stiff leaves which stand upright above the water.

In Minnesota, wild rice generally sprouts in late April or early May. The submerged leaves come by mid-May, the floating leaves are out by the latter part of May or early June, the stems and emergent leaves come out of the water during early June, and most of the plant growth is in June and July.

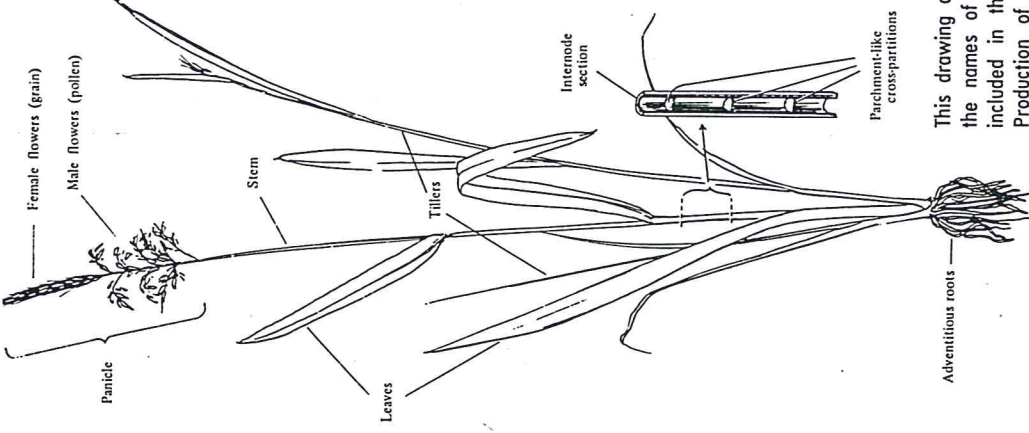
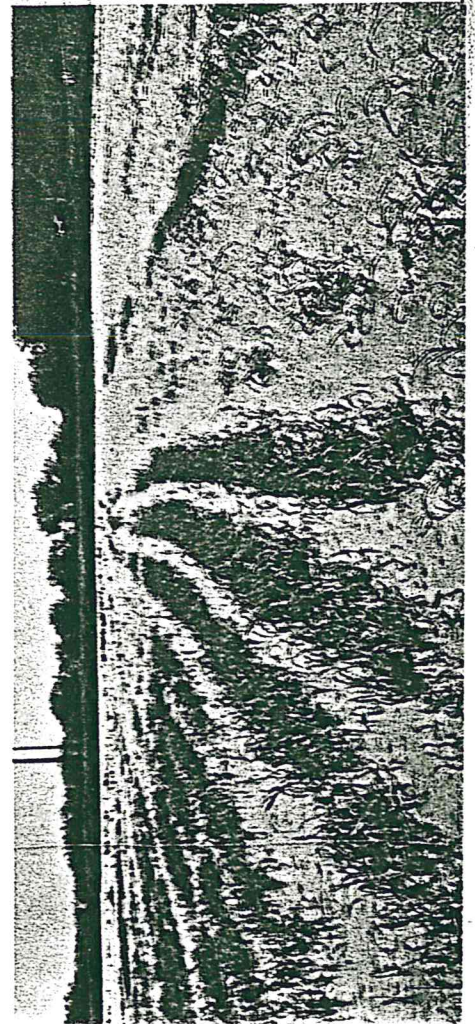
The height of wild rice plants varies greatly, depending upon the depth of water. The plants will generally germinate and grow best in from six inches to two feet of water, but can grow in four or more feet of water under favorable conditions. The stem of the plant is separated into waterproof hollow compartments which cause it to float upright. As the stem grows taller, additional roots develop which stabilize the plant in an upright position.

After the stem and leaves develop a foot or two above the water, the growth changes from vegetative to floral. Instead of leaves, spikelets develop which carry the staminate or male flowers. These surround the stem about a foot above where the top leaf joins the stem. After six inches or more of staminate spikelets, another type of spikelet is formed which bears the pistillate or female flowers. These spikelets lie close to the stem and nearly parallel to it. The top portion of stem containing both the male and female portions is referred to as the panicle.

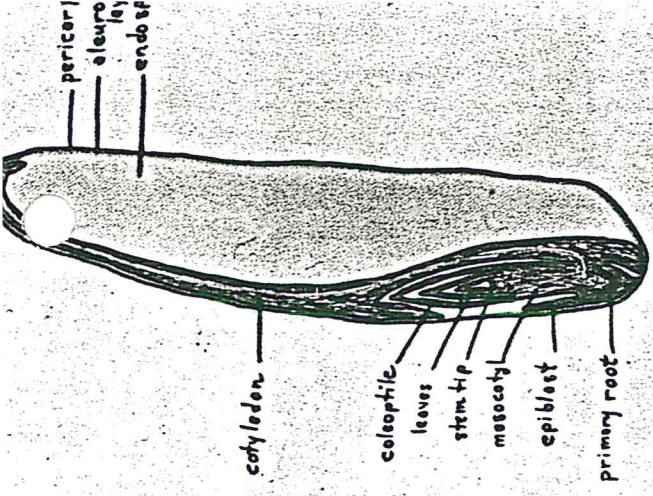
The flowers mature from the tip down. The female flowers being nearest the tip are in bloom first and must depend upon receiving pollen from other plants because the male flowers below are not yet in bloom. The female flowers are in bloom for only a few hours. The flowering season is usually in late July and August, depending upon location, weather conditions and strain of rice.

After pollination it takes two to three weeks for the seed to fully develop. The grain goes through milk and dough stages and finally reaches a more solid stage when it is a greenish-brown or greenish-black color inside the husk. When mature, the seed detaches easily from the stem. Because maturing proceeds slowly from the top of

In June, stems and leaves emerge from the water as pictured here. The wild rice plants grow rapidly during June and July, sending out tillers and leaves to fill the space between rows in paddies.



This drawing of a wild rice plant shows the names of the principal parts. It is included in the booklet on Commercial Production of Wild Rice issued by the University of Minnesota in 1973.



Wild rice grains appear simple. But they are actually very complex, containing all of the elements from which a wild rice plant germinates and grows after a period of dormancy. This greatly enlarged drawing was developed by the team engaged in basic research on wild rice at the University of Minnesota, Duluth.

the head down, not all of the rice is ripe at the same time. If the mature rice were all to be gathered, it would be necessary to pick a natural stand lightly every day or two over a period of about two to four weeks. For a variety of reasons, the times at which wild rice matures varies from lake to lake, or even from one part of a lake to another.

While the seed of the wild rice appears simple, it is really quite complex, as shown in the drawing above. The grain itself is usually about  $\frac{5}{8}$ " long by about  $\frac{1}{16}$ " in diameter. It is cylindrical in shape with tapered ends. It is covered with a paper-thin tough husk consisting of two parts, referred to as the palea and the lemma. The end

During the spring of the year, Indians tapped the maple sugar trees which edged the shores of many of the larger lakes. The sap was boiled down into sugar. While most of it was soon eaten, some maple sugar was stored in birch bark containers for use during the rest of the year.

Throughout the summer, Indians gathered berries of many kinds. Some were dried and put away for later use.

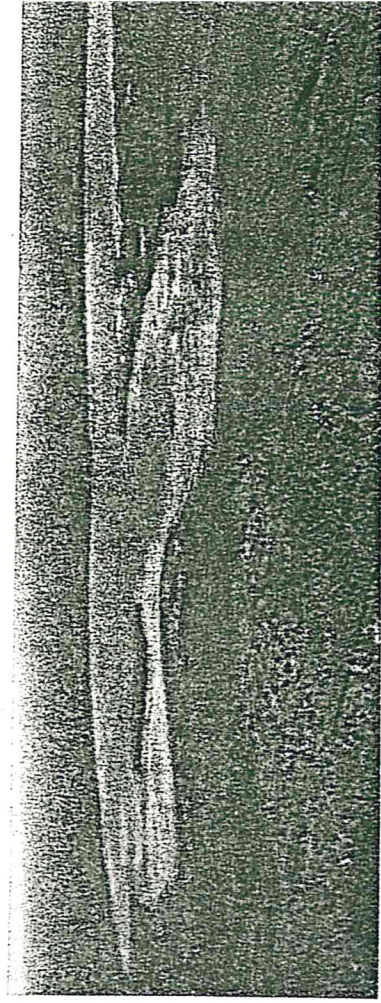
The most important Indian harvest of the year was wild rice, which usually grew plentifully in the shallow lakes and streams of the region. Large quantities were gathered, parched and stored for use the year-around. It was the principal vegetative food of the Indians who lived in an area where agriculture was difficult. In years when the wild rice crop failed, woodland Indians were hard pressed to survive the long winters.

Upper Michigan, northern Wisconsin and Minnesota east and north of the Mississippi were primary wild rice regions. The Indian word for wild rice is "manoma" and a tribe of Indians west of Green Bay was named the Menomonic because they subsisted largely on wild rice.

During the 1600's and 1700's, westward-migrating Ojibwas drove out other tribes living east of the Mississippi. The Fox, Winnebago and Dakota (Sioux) tribes fought bitterly but to no avail to keep the wild rice areas they had previously enjoyed.

Harvesting wild rice was traditionally a task for Indian women. Early explorers reported that Indians would push their birch bark canoes into the wild rice stand while the grain was in the milk stage. They would bend a group of stalks together and wrap the heads with bark strips. After the grain had fully matured, it would then be harvested. Tying the heads together would reduce loss to birds, rain and wind.

Nett Lake is one of the most famous wild rice lakes in northeastern Minnesota. It is surrounded by an Indian reservation, and harvesting there is controlled by the Indian band. Wild rice can be seen along the shore of all parts of the lake.



In shallow lakes such as Squaw Lake, wild rice stands fill most of the lake when conditions are good. But unfavorable water levels, overseeding, bad weather, insects and disease combine to seriously reduce the crop in three years out of four.

of the lemma develops into an awl or beard which is about the length of the grain.

The outside of the grain is covered by a hard, nearly-impervious layer called the pericarp. Until this becomes weakened after a period of winter dormancy followed by spring warmup, the seed will not germinate. Researchers have found that if this layer is pierced by a needle, the dormancy of the seed may be broken. This is now being used by researchers to speed up experiments with wild rice.

After the seed matures, the wild rice leaves die, the stem weakens and the plant falls down into the water. A wild rice stand that is thick and almost impenetrable in early August virtually disappears by the time ice forms in late October.

### Wild Rice and the Indians

Without wild rice, it is doubtful that Indians in substantial numbers would have been able to live in the big forests of the Upper Great Lakes region. Yet 500 years ago the Chippewas (or Ojibwas) of this region were the largest tribe in the northeastern part of the continent and were estimated at 50,000.

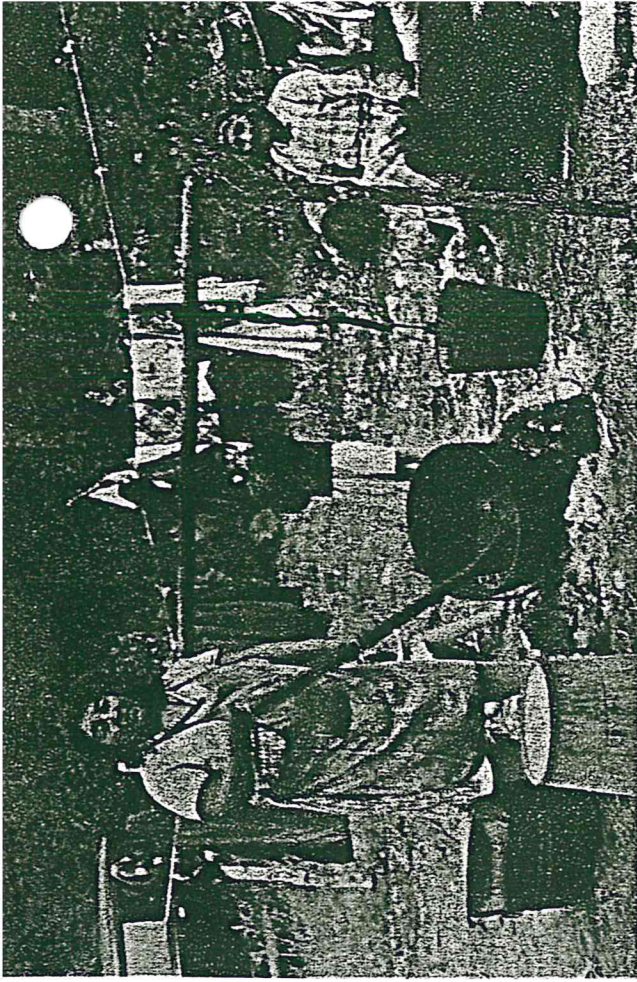
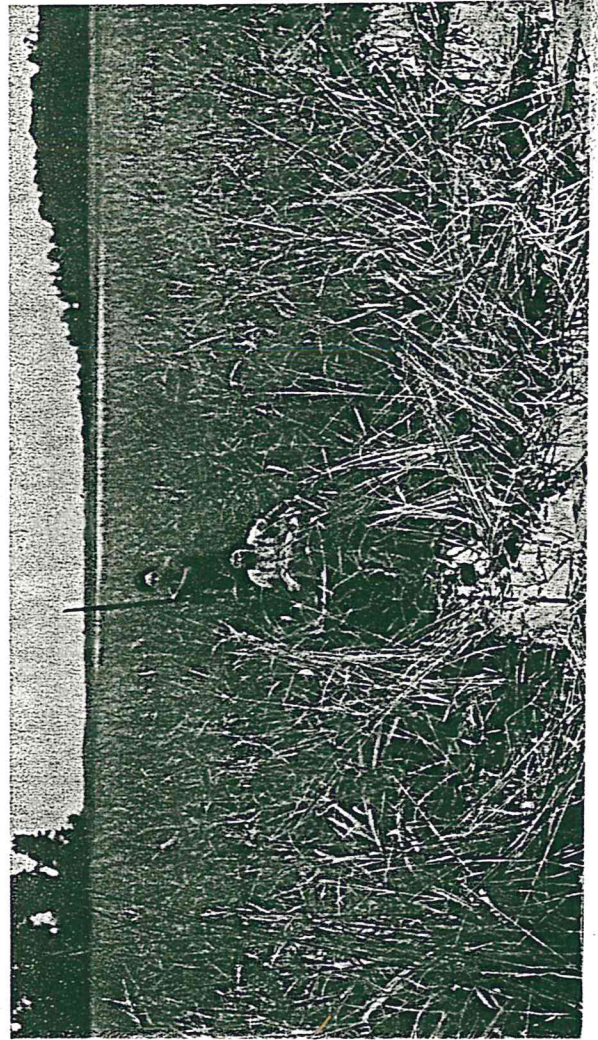
The diet of woodland Indians was based primarily on game and fish. But it was supplemented by a number of other essential foods.

Not all wild rice was tied and the custom was generally abandoned many decades ago. In 1820, an article in the Detroit Gazette described harvesting on Big Sandy Lake in Aitkin County, Minnesota, as follows. "It is now gathered by two of the women passing around in a canoe, one sitting in the stern and pushing it along, while the other, with two small pointed sticks about three feet long, collects it in by running one of the sticks into the rice, and bending it into the canoe, while with the other she threshes out the grain. This she does on both sides of the canoe alternately, and while it is moving."

Soon after the rice was gathered, a curing process was generally undertaken. Because some of the rice was not fully ripened, it was necessary to complete the process so that it could be stored without spoiling and so that the tenacious hull could be removed.

Several methods of curing were used. The simplest was to lay it out on mats or blankets in the sun for several days. At other times it was laid out on racks beneath which fires and smoke would provide the curing heat. Perhaps the favorite method used when equipment was available was to place a large iron or copper kettle over a slow fire and partially fill it with grain. The rice was constantly stirred with a paddle until completely dried or parched. In this process some of the grains would be popped and broken. But the flavor was preferred by many.

Originally wild rice was harvested by Indians using birch bark canoes. This picture, taken about 35 years ago, shows the narrow wooden boats used for ricing during most of this century. Aluminum canoes are now generally used by harvesters. Stands in public waters must be harvested using traditional Indian ricing sticks.



Wild rice was originally dried by the Indians. When large metal pots became available about a century ago, they were used for parching. This picture, taken in 1939, shows a ricing scene typical of those times. Today most harvesters sell their green rice to commercial processing plants to parch and finish the wild rice.

Threshing to remove the tough hull which covers the grain of wild rice was traditionally work for men and boys. Holes about two feet in diameter were generally dug a foot or two deep and lined with a skin. Cured or parched rice was put in the hole and Indians wearing mocassins would tread out the grain. Poles would be placed outside the hole which the thresher would hold for support as he skillfully worked over the grain with his feet. Sometimes the hulls were also beaten off with sticks or by hand. It was a hard job at best.

Winnowing or separating the grain from the hulls after threshing was done in several ways. One was to simply pour the combination over a blanket when a stiff wind was blowing which would take away the chaff. If there was no wind, a birch bark fan would be used to create a breeze. An intricate system of agitating shallow trays was used by at least one tribe to remove chaff. Winnowing was always women's work.

The finished rice was put in bags made of skins, cedar bark or fiber, or in birch bark boxes. Then much of it was usually buried where it could later be found by the owners. While the rice belonged to the family that harvested and processed it, food was generally shared in case of shortage.

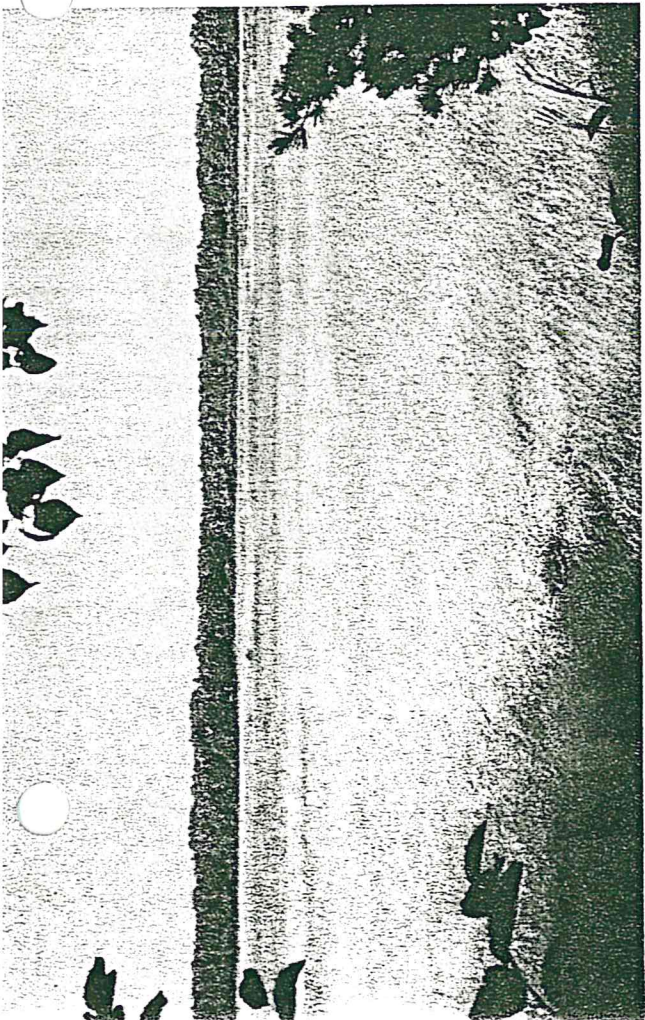
Studies of the composition of Indian foods indicate that wild rice was practically the only source of carbohydrates during the fall and winter. Parched wild rice is higher in this essential than wheat, barley, oats, rye or white rice (which were not available to Indians until recent years). In addition, wild rice contains considerable protein. Game, fish and fowl provided fat and protein. The woodland Indians had a well-balanced diet when wild rice was available in good supply.

Quality of food supply was the principal determinant of the size of families of Indian tribes in the early 1800's. Indian families living in the wild rice areas were 50% larger on the average than were most Indian families living elsewhere, for example in Ohio or Missouri. Indians of the wild rice region were noted for their size and healthy appearance.

While availability of wild rice was certainly essential to the existence of the woodland Indians, it may also have contributed to their failure to develop further. A. E. Jenks, author of the most comprehensive study of "The Wild Rice Gatherers of the Upper Great Lakes", puts it this way:

Wild rice, which had led their advance thus far, held them back from further progress, unless, indeed, they left it behind them, for with them it was incapable of extensive cultivation. Its supply was precarious, and there was no way of making it certain. One year the gathering of 3 or 4 per cent of the crop gave food for a winter's consumption, another year its failure, which might occur for any one of many reasons, threatened the people with starvation. In civilization one class of people at least must have comparative leisure in which to develop short-cut methods of doing old things, of acquiring the traditions of the race, and of mastering new thoughts and methods. Such leisure is impossible with a precarious food supply. But, in spite of these facts, for barbaric people during the period of barbarism, the most princely vegetal gift which North America gave her people without toil was wild rice. They could almost defy nature's law that he who will not work shall not eat.

What would have happened to the Chippewas of northern Minnesota had they been left alone is an interesting question. From descriptions of their lives by early explorers, it is clear that Indian life in the woods was exceedingly hard and precarious. Years of favorable conditions were followed by others when game was scarce, the wild rice crop failed and weather was harsh. Fighting with the Sioux was a constant drain. It is only remotely possible that the Chippewas could have risen much above the conditions under which they lived in the early 1800's.



This is a natural stand of wild rice on the Mississippi river near Schoolcraft State Park. Rivers were the main arteries of travel for Indians, explorers, traders, loggers and early settlers, and wild rice was an important food for them all.

Production of wild rice depended upon the ambition of each Indian family. The writer for the Detroit Gazette in 1820 reported from Big Sandy that "One family ordinarily makes about five sacks of rice (5 bushels); but those who are industrious sometimes make twenty-five - though this is very rare." Five bushels of wild rice would probably weigh about 300 pounds. Considering that wild rice when cooked generally weighs about four times as much as when dry, this would make more than a thousand pounds of cooked food. Other studies indicate that most Indian families did not average nearly five bushels each.

Wild rice was prepared by the Indians in many ways. Often it was boiled and eaten plain or with maple sugar. Much wild rice was used in soups and stews made from venison, bear, fish and fowl. A soup made of wild rice and blueberries was very good. Puddings were made of wild rice.

In addition to its direct provision of food, wild rice in lakes and streams also attracted tremendous flocks of ducks, swan, geese and coots. These fed on the wild rice and grew fat. Many of them were netted, trapped, or shot by the Indians and provided very rich food in the fall.

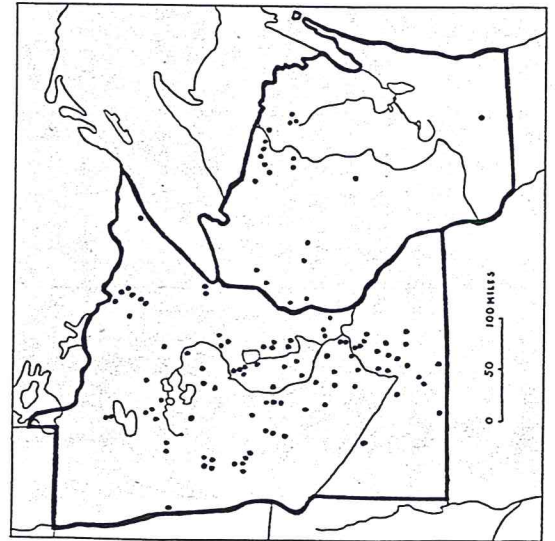
## Commercialization of Wild Rice

The first significant contacts between the white men and the Chippewas were with the French traders in the 1600's and 1700's. The French voyageurs lived with the Indians much of the year and learned the food value of wild rice. They called it "folle avoine" meaning "wild oat, mad oat or fool oat" because of the similarity in appearance of wild rice and oats.

During the later 1700's and early 1800's the fur trade was carried on in this region by the Northwest Company, with headquarters in Montreal. In 1805 Zebulon Pike reported the company's fort at Leech lake contained chests with 500 bushels of wild rice. Describing the company's station at Sandy lake in 1806 he said, "They raise plenty of Irish potatoes, catch pike, suckers, pickerel, and whitefish in abundance. They have also beaver, deer and moose; but the provision they chiefly depend upon is wild oats, of which they purchase great quantities from the savages, giving at the rate of about one dollar and a half per bushel."

Soon after the War of 1812 the American South West Fur Company became the chief trader in northern Minnesota. In 1820 a writer for the Detroit Gazette said, "The fish and wild rice are the chief sustenance of the traders, and without them the trade could scarcely be carried on."

Writing in 1899 A. E. Jenks summarized early use of wild rice by saying, "wild rice has been used by settlers and traders to the present time. If it could be cultivated with any certainty it would long ago have become a staple in America for the white population, as it was a staple for many thousand Indians before them."



Wild rice once grew throughout most of Minnesota as evidenced by the names given to lakes, creeks and rivers by explorers, traders and settlers more than a century ago. Each dot on the map indicates such a name. The map was compiled by Dr. Edward Taube who published an article on Wild Rice in the December 1951 issue of The Scientific Monthly.

Jenks reported, "Wild rice was offered for sale in 1896 in several towns in Wisconsin and Minnesota. In Minnesota it was sold in Bemidji and Park Rapids in Hubbard county, in Tower, St. Louis county, in Grand Rapids, Itasca county, and in Minneapolis. Besides in the above markets it is also sold at the various Indian reservations and at towns in their vicinity." A merchant in Duluth and Tower wrote, "Most of the cruisers, explorers and homesteaders take it (wild rice) out into the wood with them." In 1899 L. L. May & Co. of St. Paul advertised wild rice and reported that it sold about 3,000 pounds. The Indians gathered and processed all of the wild rice sold at that time.

As white settlers and businessmen followed the loggers into northern Minnesota in the early 1900's, a few turned their attention to wild rice. Following is a story written in 1939 by L. A. Rossman, then publisher of the Grand Rapids Herald-Review:

In about 1890 Frank Vance came into the north country. He deserves a niche in the wild rice Hall of Fame. For many years he was known, locally at least, as a wild rice king because he sold more than any one else in the early days.

Frank Vance was one of those fellows who was always looking for a frontier. He came to Grand Rapids in the early days. He then migrated to Deer River. When that community took on too many signs of civilization he moved up to that place where the north flowing Popple river, out of Squaw lake, joins the north flowing Bowstring out of Rice lake. Here he established a store and stopping place.

For some years Frank Vance bought rice from Indians. He paid a cent or a cent and a half a pound for green rice and five cents for the finished product. The market price for which he sold was, almost uniformly, ten cents a pound. . . .

Frank Vance was dark, short, beak-nosed and with an imagination which made up long and strong stories but also impelled him to invent things. He felt that a different process of preparing wild rice should be developed. He created one.

Frank Vance took a couple of large coffee roasters and installed them in a furnace where he could maintain a wood fire. The revolving roasters parched the green rice. Nearby was a huller. That completed the process. Frank Vance also had a grinder which made the rice into flour for his own use. He would sit down to a breakfast of pancakes made from wild rice flour and on which he poured plenty of Chippewa-made maple syrup. That was living off the country. . . .

Frank Vance did well enough. He used to sell about five or six tons of rice a year. The only thing that seemed to disturb him was that the country was settling up. Logging operations made for more activity. Homesteaders were coming in. Frank Vance could not stand



civilization. About 1920 he left for Montana and a few years after this migration he died.

During and following World War I, the price of wild rice increased from 10 cents a pound to 30 or 40 cents. Frank Vance had built a wild rice harvesting machine that did not work out well. In 1923 two local men improved on Vance's machine. It had a revolving reel on a front platform mounted on a flat boat. As it was pushed through the rice, the reel knocked the heads off on the platform and the rice was raked back into the boat. The new harvester could operate on deep water, in shallow water or even upon land. In one hour this machine gathered a ton and a half of green rice. But a loud complaint went up that the machine would rob the Indians and the homesteaders of the labor of taking rice. The state conservation authorities stopped operation of the machine.

Laws were passed by the Minnesota legislature requiring that all wild rice taken from public waters be harvested by the old Indian methods. All pickers and buyers are now licensed by the state. Only Indians and others residing on an Indian reservation are allowed to pick wild rice on the reservation. Hours of ricing are set by a state supervisor of ricing. These and other detailed regulations are enforced by the state.

During the last fifty years many people have been in and out of the wild rice business. One of the first to establish efficient processing and packaging methods on a substantial scale was Roland Hicks. In the late 1920's he built a wild rice plant at Remer. During the 1940's he built a new plant with further refinements and added capacity in Grand Rapids. In about 1950 he built the present Hicks Wild Rice Co. plant at Cohasset, which is still operated by his son, Dean Hicks. It was the largest wild rice processing business in the country until recent years. The Hicks Company sought to broaden the market for wild rice by establishing uniformly high quality, by modern packaging and by following good business practices. Canned wild rice, popped wild rice and wild rice flour were introduced in the 1950's.

Another pioneer wild rice operator in this area was George Kananen, who was raised near Squaw Lake, one of the best known wild rice lakes in the state. He started buying wild rice from the Indians in the 1930's. He encouraged several processors in the Squaw Lake area to build processing plants. Kananen moved his headquarters for packaging and sale of wild rice to Grand Rapids in the 1940's and established the Arrowhead Wild Rice Company as a substantial business. Following his death, the company was sold to Clifton



Wild rice from the lakes and paddies is processed in about 20 processing plants in the state. The plant handling the largest volume of wild rice is one operated by Arrowhead Products and Services near Outing. The green rice is laid out on plastic sheeting to cure for about two weeks. The piles are turned over by machines to keep it from heating and molding.

Nelson, who was already operating a large plant at Outing. Nelson has since expanded his operations greatly and is one of the leaders in the United Wild Rice Company which now is believed to be involved in the marketing of over half of the wild rice produced in North America.

Many others entered the wild rice business. The McGregor-Dennerly Co. of Aitkin is one of the pioneers. Holbert Brothers of Onamia were early in wild rice. Scores of other people have engaged in the wild rice business. Several cooperative processing plants were established but did not work out. The Indians at the Nett Lake Reservation continue to do their own processing, but their rice is merchandised by others.

The wild rice business has grown substantially since World War II. In the 1940's the average annual production from Minnesota was about 200,000 pounds of finished wild rice. During the 1950's average production was about 600,000 pounds per year. In the 1960's finished wild rice production averaged about 700,000 pounds per year, with variations from less than 400,000 to more than 1,200,000 pounds in individual years. During the 1970's production of lake rice in Minnesota has averaged less than 500,000 pounds of finished rice per year. However, wild rice grown in paddies has increased rapidly, and production from this source in 1973 is about 1,500,000 pounds of finished rice. Total Minnesota production is about 2,000,000 pounds of finished wild rice.

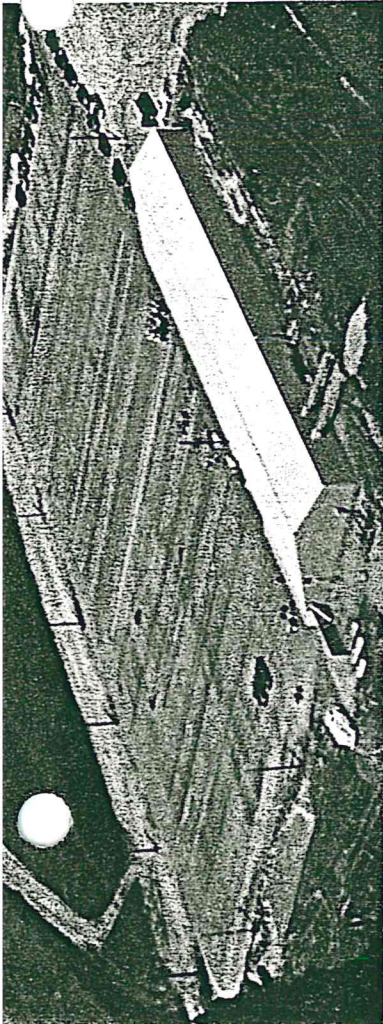
## The New Era in Wild Rice

As more people gained income from the expansion of the wild rice industry, increased attention was given to how the wild rice crop could be further expanded, and how larger production could be sold.

Some preliminary answers on how to improve growth of wild rice were found in the mid-1960's. Paddies were built to grow wild rice under controlled conditions and began substantial production in 1968 with an estimated harvest of 90,000 pounds of green rice from 900 acres of paddies. This increased to an estimated production of 3,740,000 pounds of green rice from 17,000 acres in 1972. The paddy production is now about three times the harvest from the natural stands in the lakes and streams of northern Minnesota.

Prior to a few years ago, many people with vision and money attempted to grow wild rice commercially and failed. Jeno Paulucci, the eminently successful specialty food processor from Duluth, invested hundreds of thousands of dollars in trying to grow wild rice but gave up in 1964 declaring, "There's nothing wilder than wild rice." E. Julian Davis from Aitkin worked for a long time in baffling attempts to grow wild rice successfully.

Some of the first wild rice paddies were developed near Waskish, and the acreage under cultivation there is large. Upper Red Lake appears at the top of the picture.



The newest large wild rice processing plant is that of the Gibbs brothers northwest of Deer River. Here the green rice is laid out on a large bituminous-surfaced area.

The increase in demand for wild rice has been reflected in the prices paid. In 1940 the harvesters, white and Indian, were paid about 10c per pound of green rice as it came from the lakes. This reached a high of over \$1.50 per pound during 1966 which was the third year in a row of small crops. Prices have stabilized since that time at between 40c and 75c per pound for green rice.

To make a pound of finished rice requires between two and three pounds of green rice depending upon the quality of the green rice. Prices for processed rice were about \$.50 per pound in 1940. These went up to about \$5.00 in 1966, and have gone down to about \$2.00 per pound in 1973. Wholesale prices for good quality rice are in the \$2.50 to \$3.00 per pound range. Retail prices away from the wild rice producing area were about \$1.10 in 1940. They reached a high of more than \$10.00 in 1966, and in 1973 are generally between \$4.00 and \$5.00 per pound depending upon grade, packaging, transportation and other factors.

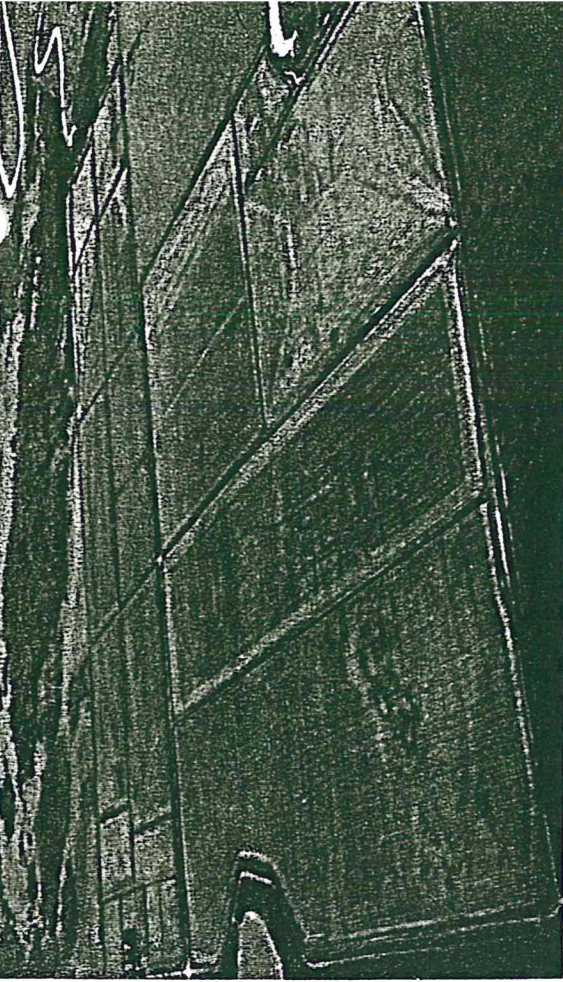
As prices paid to harvesters increased, more non-Indians took up ricing. Under reasonably favorable conditions, two energetic pickers can gather several hundred pounds of green rice in a few hours' time. Incomes from ricing were attractive, and many people like to do it as a diversion. The number of harvester licenses sold in Minnesota increased from an average of less than 2,000 in the 1940's to more than 16,000 in 1968. As prices have moderated and the yields have declined since that time, the number of pickers has dropped to less than 10,000.

During the last three decades the wholesale value of Minnesota's wild rice crop has increased from an annual average of less than \$500,000 in the 1940's to more than \$2,000,000 a year in the 1960's, and to about \$5,000,000 in 1973.

Algot F. Johnson of Minneapolis is the retired head of one of the largest heavy construction firms in the nation. From years of observing wild rice while duck hunting, he wondered why the production of wild rice could not be increased. In the early 1960's, he constructed a system of dams alongside the Tamarac river at Waskish on the east side of Upper Red Lake in such a way that he could flood the peat swamps near the river. He planted wild rice, and it grew well the first year. But he had trouble with the harvesting. In succeeding years he had problems with birds, insects, disease, weather and a myriad of other matters. He gave up on the Waskish project.

But Algot Johnson is a stubborn man and he was determined to find a way to succeed. He felt that the most important ingredient for success would be to develop a strain of "non-shattering" wild rice in which the ripe grains would not easily fall from the heads. If such plants could be grown in paddies where the water could all be drawn down before harvest, then the rice could be harvested with combines in a single operation instead of by repeated picking as ripening of the grain progressed. Amounts harvested per acre might be multiplied manyfold. Johnson enlisted the interest of the Agri-

Wild rice paddies are developed in large flat areas such as this near the Clearwater river in north central Minnesota. Ditches are dug by draglines or backhoes, and the earth is piled up to form dikes. Dams and pumps control water levels.



These paddies are west of Deer River. White Oak Lake and the Mississippi River can be seen in the background. Substantial amounts of wild rice have been harvested from these paddies, though the area is small compared to the large paddy developments in the Clearwater and Aitkin regions.

cultural Experiment station of the University of Minnesota in the problems of wild rice.

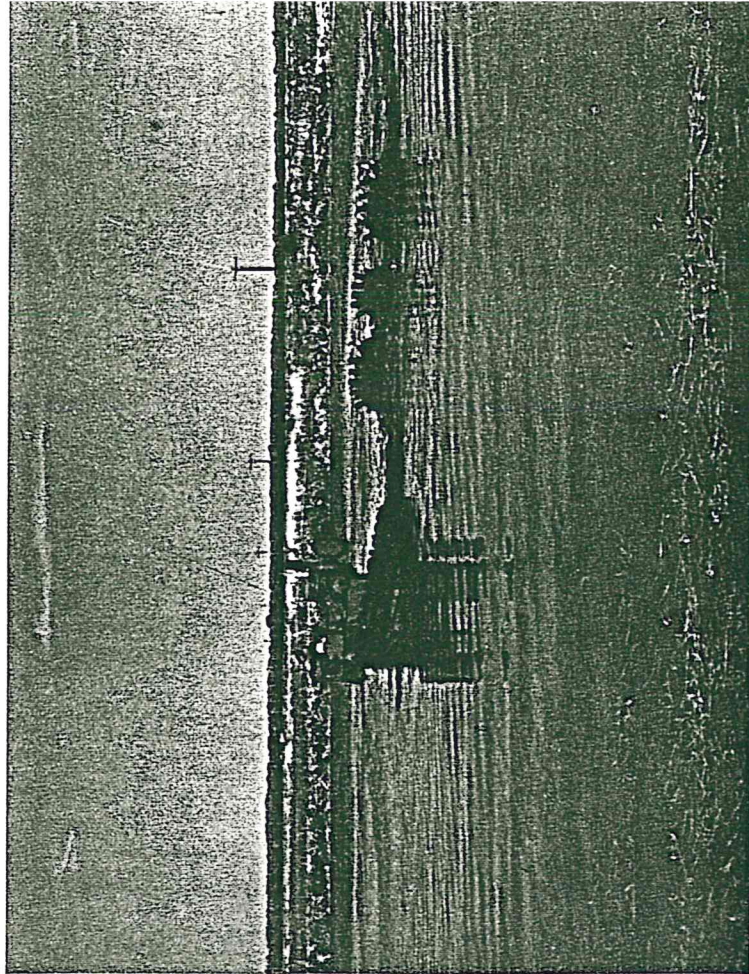
Beginning on a small scale in 1961, the University began research on wild rice. Starting with a few seeds selected by Johnson for their non-shattering characteristics, university researcher Erwin Brooks multiplied the seed, turning part of it back to Johnson and leaving part of it for further development by the university. Johnson meanwhile established new paddies in which the water levels could be better controlled, first near Mora and then near Aitkin. His company succeeded in the operation of its paddies but sold them in 1973 because Algot Johnson and his associates felt they had devoted enough time and money to the problems of wild rice.

In 1967 a group of Twin Cities investors organized the Manomin Development Company. They obtained additional funding from the Economic Development Administration with the goal of developing and propagating strains of non-shattering wild rice seed for sale to paddy growers. This company has encountered many problems and reorganized its operations so that it is now growing wild rice for the food market as well as for seed.

For the long run, the most important factor in the development of paddy wild rice may be the involvement of the University of Minnesota. Dr. William F. Hueg, director of the Agricultural Experiment Station, early saw the possibilities and problems in wild rice development. A staff meeting in 1964 developed a proposal for a 10-year program in wild rice research to be funded by the State of Minnesota with such support as it might be able to obtain from the federal government.

The wild rice research and development project was presented to the legislature in its 1965 session. But it got nowhere. There was opposition from some people who didn't understand what would be done. The proposals were not accepted in the 1967 session. In the 1969 session Hueg and his associates were back again. This time they had strong backing from the wild rice producing areas. Algot Johnson spent time in lining up support for the wild rice program. While Hueg did not get all that he would have liked, an appropriation of \$75,000 per year was earmarked for wild rice. This was increased to \$105,000 per year in the 1973 session of the legislature.

One of the problems in growing wild rice originates because a large portion of the grain is not picked, and the rice comes up too thick the next year. Paddies must be thinned. This is usually done in the floating leaf stage. Machines have been developed for thinning. This one is used by Ray Skoe on his paddies near Bagley.



By late July or early August, wild rice begins to form seeds and goes into bloom. This is a wild rice paddy of the Monomin Development Company near Aitkin in mid-August. It is planted with a non-shattering strain of wild rice in which the ripe grain does not fall easily from the head, and the male flowers also stay on longer. Black-birds are working over the stand.

When Algot Johnson started his experiment at Waskish, he hired Franklin Kosbau to assist in the work. Kosbau learned a great deal about wild rice and continued to work with it after Johnson withdrew from Waskish. A major breakthrough in paddy development came when he built a machine with special tracks to harvest paddies after they are drained but were still soft. After a few years he was joined by his brother, Harold Kosbau, who taught business education at the community college in Grand Rapids. Together they have expanded operations to include paddies in the area north of Aitkin. They have developed two varieties of non-shattering rice. They have also been successful in using a strain of rice from Canada which matures early in Minnesota before some diseases, insects and birds seriously damage the crop. They are also experimenting with other problems of paddy growing of wild rice.

Dozens of other people have gone into paddy development. The largest operations are near the Mississippi river north of Aitkin, near Waskish, and near the Clearwater river north of Bagley. Smaller but substantial paddies are located near Deer River, near Leech lake and in many other areas where flat land is located near a good source of water.

In 1967 the federal government provided funds through the Upper Great Lakes Regional Commission for an economic study of wild rice sponsored by the Minnesota Resources Commission. Funds were also provided by the commission to the University of Wisconsin for studies of wild rice processing and marketing.

The National Science Foundation has allocated small amounts of money to the University of Minnesota at Duluth to support summer research programs on wild rice by three faculty members. Dr. John B. Carlson, plant anatomist, Dr. George Ahlgren, plant physiologist, and Mrs. Helen Hanten, who works in both fields, conducted field and laboratory studies during 1971, 1972 and 1973. Their work has been devoted to basic scientific study of wild rice, rather than to wild rice management.

Following presentations in June 1972 to committees of Congress by officers of the Wild Rice Growers Association, the U.S. Department of Agriculture allocated \$100,000 to wild rice research. This program is administered by the Northern Research Laboratory at

Peoria, Illinois. In the 1973 session, Congress appropriated \$20,000 to continue wild rice research. The University of Minnesota and the University of Wisconsin are participating in cooperative programs with the Northern Research Laboratory.

The University of Minnesota researchers were ready to proceed as soon as the state funds were available. The principal project leaders were drawn from people already on the staff. Dr. E. A. Oelke, associate professor and extension agronomist in the department of agronomy and plant genetics, is in charge of studies on how wild rice can be grown better. Dr. W. A. Elliott, assistant professor in the same department, is working on seed selection to develop genetically improved wild rice plants. Dr. M. F. Kernkamp, professor in the department of plant pathology, is working with diseases of wild rice. Dr. D. M. Noetzel, extension entomologist in the department of entomology, fisheries and wildlife, is directing studies on insects which affect wild rice growth. Approximately a dozen other research people are devoting part of their time to wild rice.

Research on wild rice is now underway at the university's laboratories on the St. Paul campus, its research center at Rosemount, the horticultural research center at Excelsior and the North Central

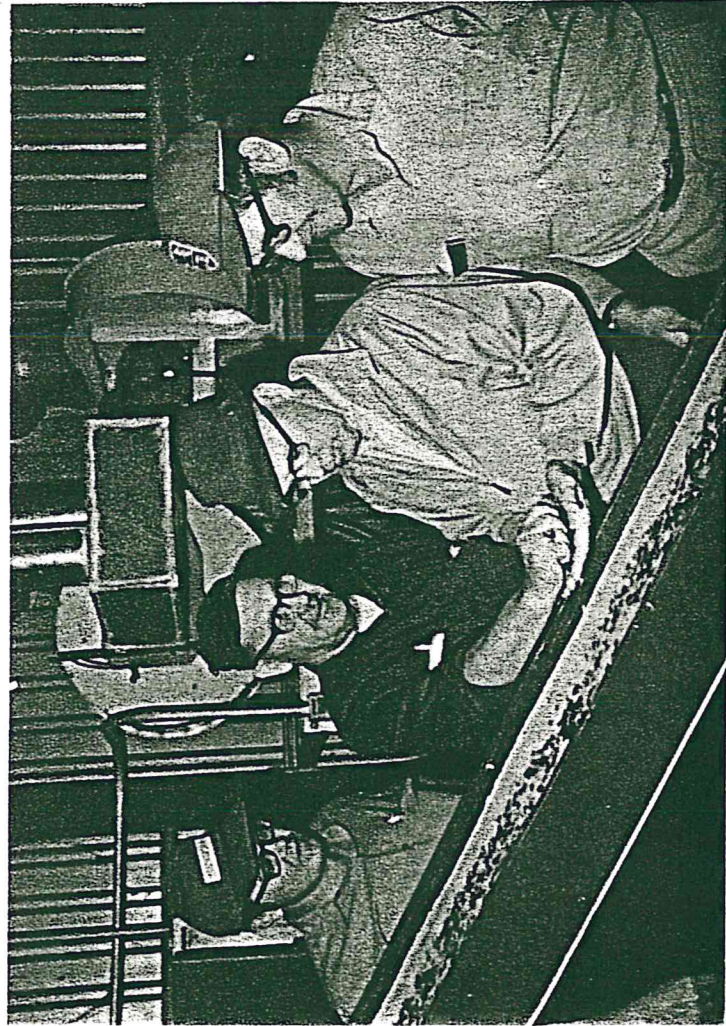


Severe blight infections can virtually destroy an otherwise good stand of wild rice. Leaves, stems and roots can be attacked by various forms of Helminthosporium, which is a type of plant rust. Diseases build up from year to year. Late maturing wild rice is most susceptible to disease.

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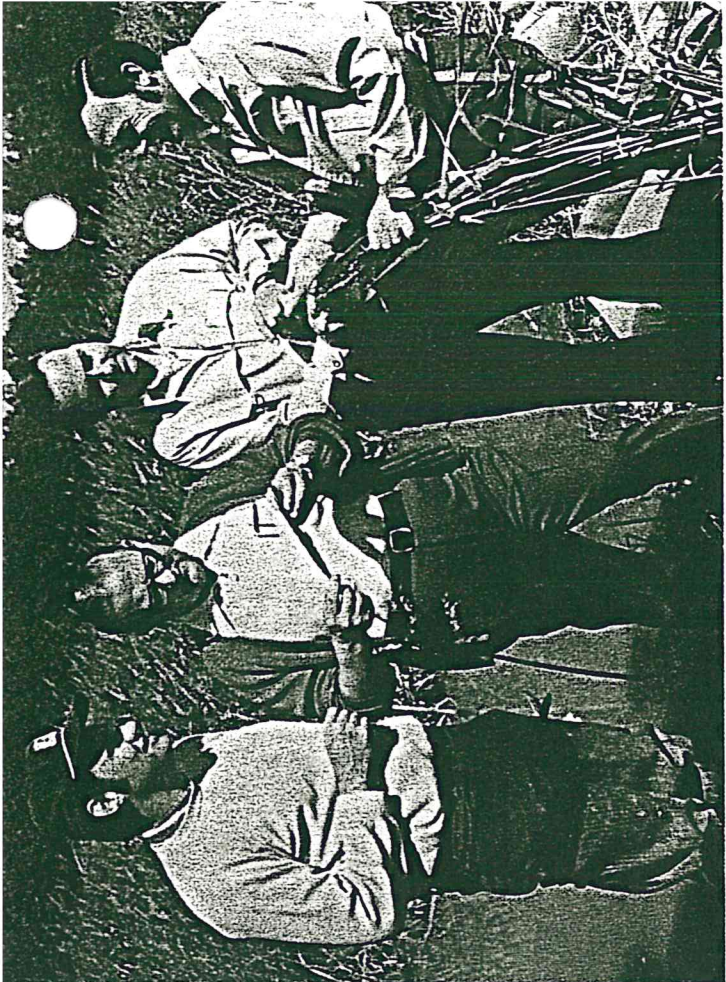
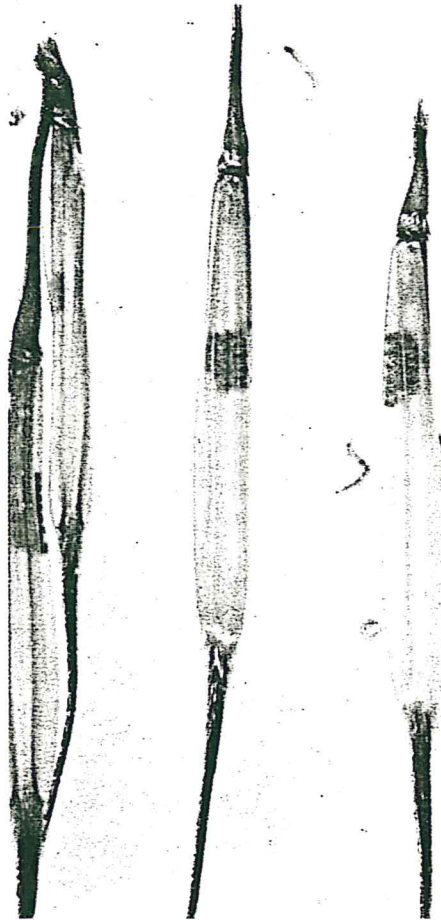


Wild rice growers and processors are working together to overcome the problems faced in expanding production and marketing of wild rice. Harold Kosbau, left, and Franklin Kosbau, right, inspect some of their early maturing rice being processed at the Deerwood Wild Rice Processing, Inc. plant. At the left center is Walter Leas, plant manager. At the right center is George Moriarity, executive secretary of the Wild Rice Growers Association.

Experiment Station at Grand Rapids. Following are some of the principal questions about wild rice to which research is being directed:

- (1) What kind of soil makes the best paddy? How should paddies be tilled and when? What fertilizers should be applied and when?
- (2) What is the best time to plant wild rice? Should it be spread on top, or drilled into the soil, and how deeply? What is the best spacing for plants? How much seed is required?
- (3) After the first year of use, how can natural over-seeding be avoided? What is the best method of thinning wild rice which has over-seeded in a paddy?
- (4) What is the best depth of water in which to grow wild rice? How long before harvesting should the paddy be drained?
- (5) How can various weeds be controlled? Are there safe herbicides which will kill weeds but not damage wild rice?
- (6) What insecticides can be used to control rice worms, midges and other insects which attack wild rice?
- (7) What measures can be taken to reduce the damage to roots, stems, leaves and heads caused by various diseases?
- (8) How can blackbirds be prevented from invading wild rice paddies?
- (9) If paddies cannot be kept in continuous production of wild rice, what other crops can be grown successfully and economically on paddies?
- (10) What is the best method of storing seed so that best germination will be obtained in the spring?

These enlarged kernels of immature wild rice show the eggs deposited by the wild rice worm moth and several of the worms which have hatched out. Methods of combating this and other insects are being developed. Strains of early maturing wild rice usually can be harvested before insect problems become too severe.



Much of the University of Minnesota's field work is being done on paddies at the North Central Station at Grand Rapids. Dr. W. A. Elliott, left, of St. Paul is in charge of plant genetics work. Dr. E. W. Oelke, right, of St. Paul, heads the research on agronomy. In the center are Dr. William Matalamaki, superintendent of Grand Rapids station, and Dr. David Rabas, agronomist at the station.

Thousands of tests are being made by university researchers to find the answers to these and other questions which are asked by operators of wild rice paddies. To some of the questions, answers are being found that are helpful. To other problems there are no indications yet of what can be done as a practical matter. But the wild rice studies are only in their early stages. Researchers building upon experience with other plants are hopeful at least partial answers can be found to the principal problems within the next five to ten years.

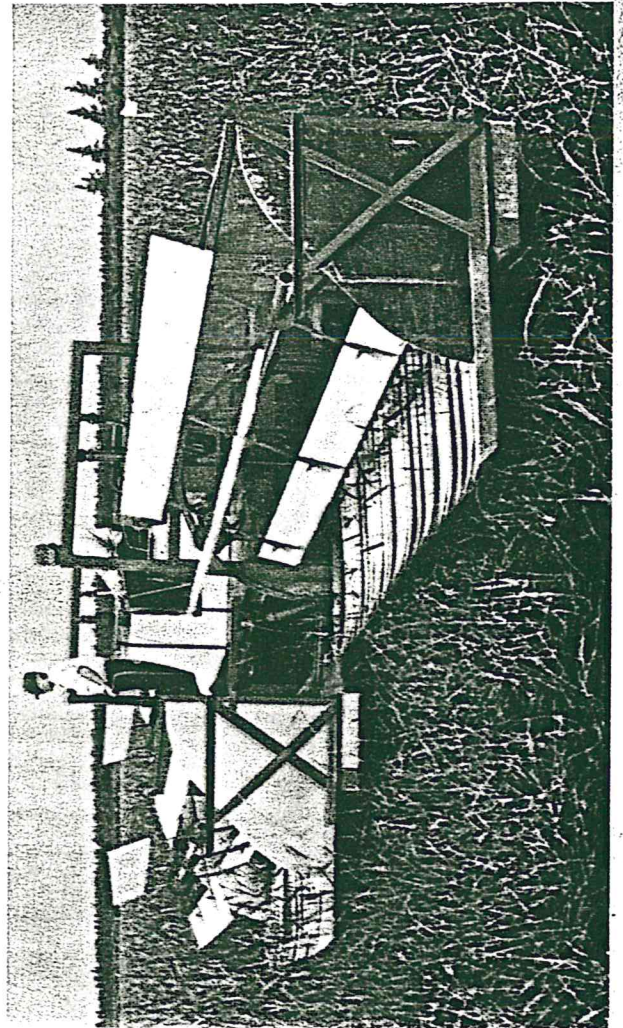
As indicated before, one of the primary reasons for research is to develop strains of wild rice that will be superior to wild rice as it now exists. The ideal wild rice would be: (a) non-shattering, the grain would not easily fall from the heads so it can be harvested by combines; (b) short and strong in stem so that it will not lodge or break down in wind, rain and hail storms; (c) early maturing so that disease and insects will have less time to do damage; (d) productive of heads

with many grains of good size; (e) low in number of tillers per plant so the crops will not be overcrowded; (f) good in germination; and (g) capable of consistently maintaining these desirable qualities. While considerable progress has been made in developing superior strains of wild rice, it may be impossible to develop a single strain that will be strong in all of the desirable characteristics. It takes several years to select a new strain of wild rice, test it in plots, and multiply it in sufficient quantities for commercial seeding. Several improved strains have been developed and are now in use by growers. New strains may become available every few years, but developing better seed will be a continuous process of selection and breeding as it is with other grains.

Wild rice growers have been optimistic that improved strains of wild rice will become available and that answers will be found to many of the problems of growing rice successfully. Paddy capacity was multiplied from 908 acres in 1968 to 2,645 acres in 1969, to 5,202 acres in 1970, to 8,705 acres in 1971 and to 17,000 acres in 1972, according to University estimates. However, the acreage of paddies increased at a slower rate in 1973.

Expansion of paddy acreage is reaching a plateau for several reasons. One is that the costs of establishing new paddies is very high. Low-lying land near water sources was available for about \$10 an acre ten years ago. Such land today may cost \$100 or more per acre.

The water in wild rice paddies is drawn down before the wild rice is ripe. On fields planted with unimproved rice which matures gradually and falls easily when ripe, the grain is picked by machines similar to this. It is necessary to go over the field several times to get a substantial share of the mature rice.



Fields planted with non-shattering rice are harvested by combines which cut off the wild rice plants and separate the grains from the stems and leaves which are cut up and put back on the paddy. Combines are generally also used as a final cut after fields of shattering rice have been picked. The combines are fitted with special tracks so they can operate on soft paddies.

An investment of about \$200 an acre is required for clearing, ditching, pumping equipment, ground leveling and soil preparation. Investments in special equipment for tilling, thinning and harvesting may run \$200 an acre. Some observers believe that it will require about 400 acres of paddies to make an economic operation. This would involve an investment of about \$200,000. Money for this size of investment in a relatively new industry is not readily available.

Paddy operators are hopeful that improved methods of growing and harvesting wild rice in combination with improved strains will eventually increase the harvest per acre. Because of troubles such as insects, disease, weather, birds, weeds, and over-seeding, average production per acre in 1972 was about 220 pounds of green rice per acre. Under favorable conditions on prime paddies, harvests of 700 pounds per acre have been achieved. The potential is well over 1,000 pounds per acre. Growers hope that the average yield per acre can be greatly increased during the next few years. They are concentrating more on this possibility than in adding new paddies.

by Clifton Nelson. The finished rice is stored in four bonded warehouses. Continental borrows money to partially pay for the rice growers deliver to the cooperative. Additional payments are made to growers as rice is sold.

United Wild Rice, Inc. is a companion organization owned by Continental. This organization buys processed wild rice in bulk from Continental. The rice is graded, packaged and marketed by United which is responsible for developing the market. In November 1972 Stanley T. Carmichael was employed as president of United and general manager of Continental. He is an aggressive man in his late thirties who has extensive experience in marketing and business administration. Immediately prior to joining Continental-United, he was a marketing executive with the Pillsbury Co. working with non-flour products.

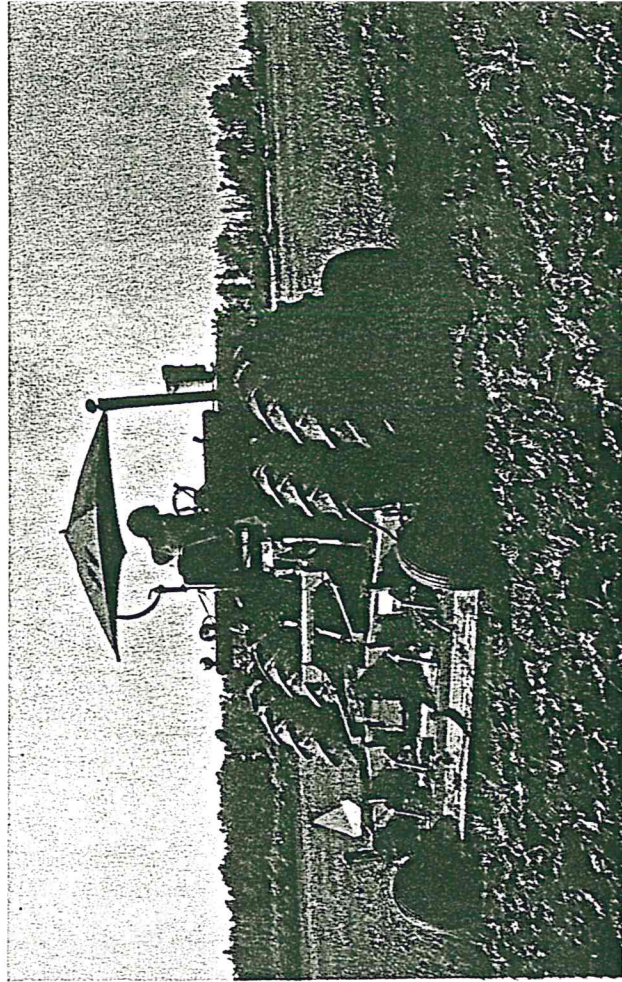
Carmichael divides his time between the operations headquartered in Grand Rapids and the sales and promotional efforts in other parts of the country. Sales offices are located in Minneapolis, Chicago and New York, with another planned for the west coast. The company sells wild rice through supermarkets, to specialty shops and gourmet sections, to restaurants and mass feeding facilities, and by mail order to consumers. The largest and most rapidly growing market is bulk sales to companies who re-use rice in some form to sell to the ultimate consumers.

Another factor temporarily slowing paddy expansion is that some growers feel that the marketing efforts of the industry must be further developed before more wild rice is available. The big expansion of paddy rice grown in 1972 left a carryover of about 1,200,000 pounds of finished wild rice a year later. This is twice the entire crop of a few years ago. It will take some time to develop markets that can absorb a full year of present production without reducing prices to uneconomic levels.

Paddy wild rice growers in Minnesota have banded together to meet the challenge of expanded marketing. In 1967 Kosbau Brothers began contracting with other growers to provide an advance market for paddy production and to assist growers in paddy design, seed supply, crop management and harvest techniques.

In 1971 the Continental Wild Rice Cooperative was formed with a membership of five wild rice growers which has grown to 23 in 1973. The production from their paddies is purchased by Continental after it has been processed. Most of the processing for Continental is handled by the Arrowhead Products and Services, operated

Rotofillers are used in wild rice paddies to break up the soil and work in the plant residue. Curved steel blades revolve vertically. Tractors are large and powerful and must be equipped with many large tires to avoid being stuck in the soft paddies.



After the paddies are picked and combined, the fields are cultivated. The picture below shows a paddy in which the tilling is underway. Tilling must be done in the fall between harvest and freeze-up, a very short time in many years.





In addition to selling parched wild rice in boxes, cans and bulk containers, United is promoting use of instant wild rice which has been pre-cooked and dried. It is packaged in moderate size containers for home use, in larger containers for big users, and in small plastic bags for preparing individual servings in restaurants. Instant wild rice costs a little more, but it is quick and easy to prepare. Wild rice is also sold in less expensive blends with brown or white rice. Wild rice pancake flour is widely used. Development is underway on a special flour for use by commercial bakeries in making wild rice bread.

The market potential for wild rice is many times the present market, which has been severely limited by the small, fluctuating and sometimes very-high-priced supply of the past. Carmichael is confident that within the next few years the wild rice industry can double its 1972 sales and provide a stable market for crops double the size of those of 1972 and 1973. Approximately half of the wild rice marketed in the United States is sold by United Wild Rice. Growers and processors not part of United are also expanding efforts to broaden their market for wild rice.

In 1965 when Dr. William Hueg made his original request for appropriations for University wild rice research, he predicted that some 50,000 acres of wild rice paddies might some day produce 65,000,000 pounds of wild rice per year. In 1973, he still feels his goals may be realized. He is pleased with the expansion which has already taken place. He is not discouraged because a plateau in production seems to be developing in 1972 and 1973. He is confident that breakthroughs in research and marketing will permit another period of rapid growth in paddy development within a few years.

Dr. William Hueg, Director of the Agricultural Experiment Station of the University of Minnesota in St. Paul.



After several years of growing wild rice, weeds and disease become severe problems and it is necessary either to let paddies lie fallow or to plant something else. This is a stand of buckwheat in one of the Kosbau paddies near Aitkin. Other possibilities as alternative crops include timothy, sunflowers, soybeans and other grass seeds, but considerable testing must be done to know what may be feasible.

### How to Use Wild Rice

Most people eat wild rice only on special occasions — with a meal served at an expensive restaurant, as part of a duck dinner served by a friend, or perhaps as stuffing or a side dish at a family Thanksgiving dinner.

Some others fare better. They have been brought up in the wild rice country, or they have friends who know about wild rice, or they may be gourmets who study good food and how to prepare it. Such people have learned wild rice is delicious when used in many ways, easy to prepare, and quite economical compared to many other foods in general use.

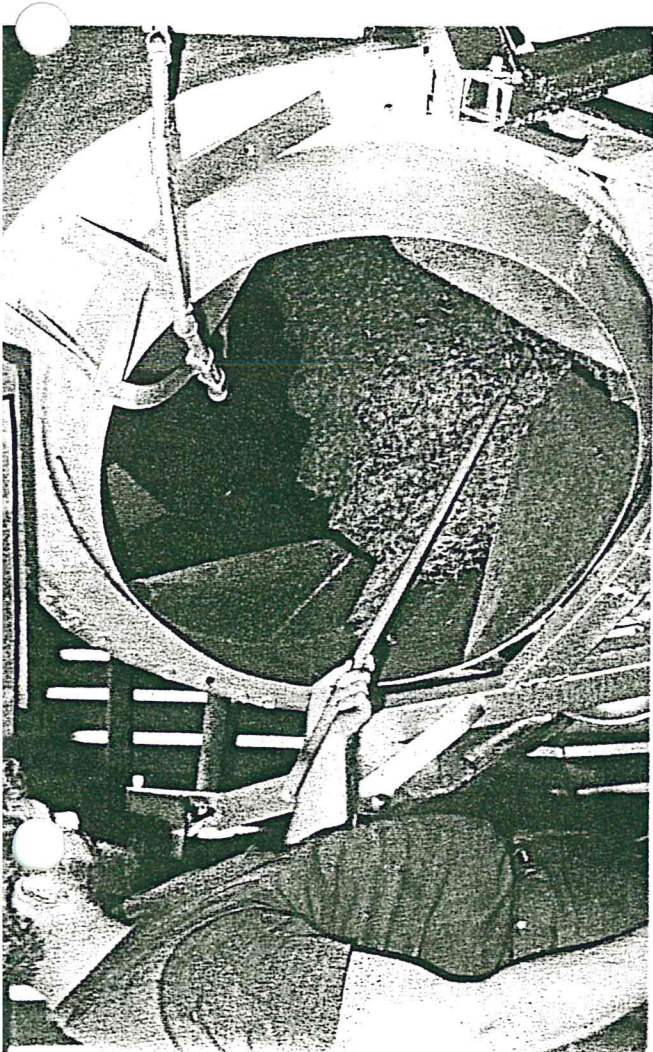
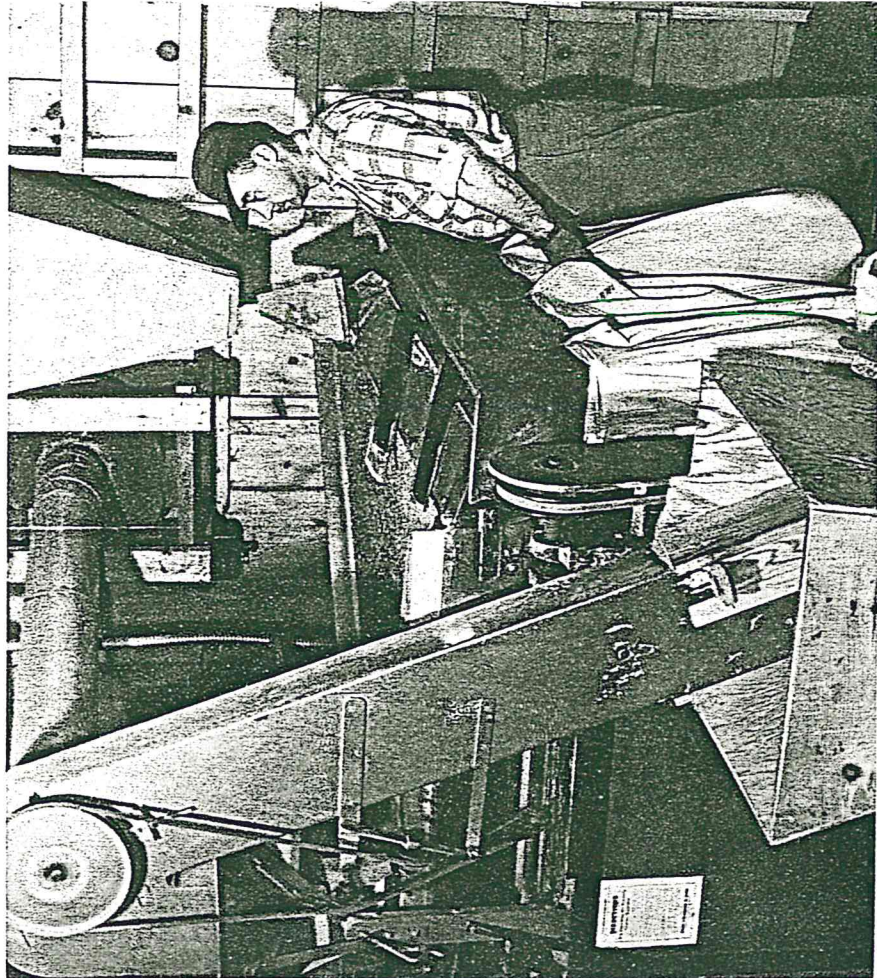
People have to get over the price hurdle before they begin to use wild rice as much as they would like to. Parched wild rice retails for about \$5.00 a pound, depending upon its grade and upon where it is sold. The box doesn't look very big, but the rice swells up to about four times the original size after cooking. A pound will make between 20 and 30 servings depending upon its use. Thus the rice in a good serving costs less than 25 cents. Wild rice is only expensive as compared to potatoes, domestic rice or ordinary vegetables. Wild rice also blends in with other ingredients, so that it can

wild rice kernels do not stick together and become mushy. Well done wild rice should not be stirred except when covered with water.

After wild rice has been boiled to the desired consistency, it can be drained and served immediately or the heat can be turned down and the rice will stand for quite a long time without changing consistency.

One of the best ways to serve wild rice is plain with butter or gravy and salt to taste. Some people like to fry diced mushrooms, green pepper, onions, celery and pimiento in butter and add the combination to the wild rice which has been cooked. The two parts should be mixed together with as little stirring as possible and be put together 15 or 20 minutes before serving. This can be served as a side dish with almost any kind of meat, fowl or fish. Usually wild rice substitutes for potatoes at such a meal.

Finished wild rice is run through grading machines to sort the grains by length and diameter and to remove small broken pieces. Sorted grains may be packed as they come from the machine or mixed together again to produce desired grades. In this picture Dean Hicks of the Hicks Wild Rice Co. bags wild rice coming from his sorter.



After curing, wild rice is placed in parching drums heated by gas to a controlled temperature. The drum turns at moderate speed. After an hour or more of parching, the rice is dried to the correct percentage of moisture. It is then run through a machine to remove the hulls, and through a polisher that scarifies or scratches the tough outer layer of the grain so it will cook easily. The parching drum shown is in the Deerwood plant.

add to appearance, taste and texture of combination dishes for only a few cents a serving.

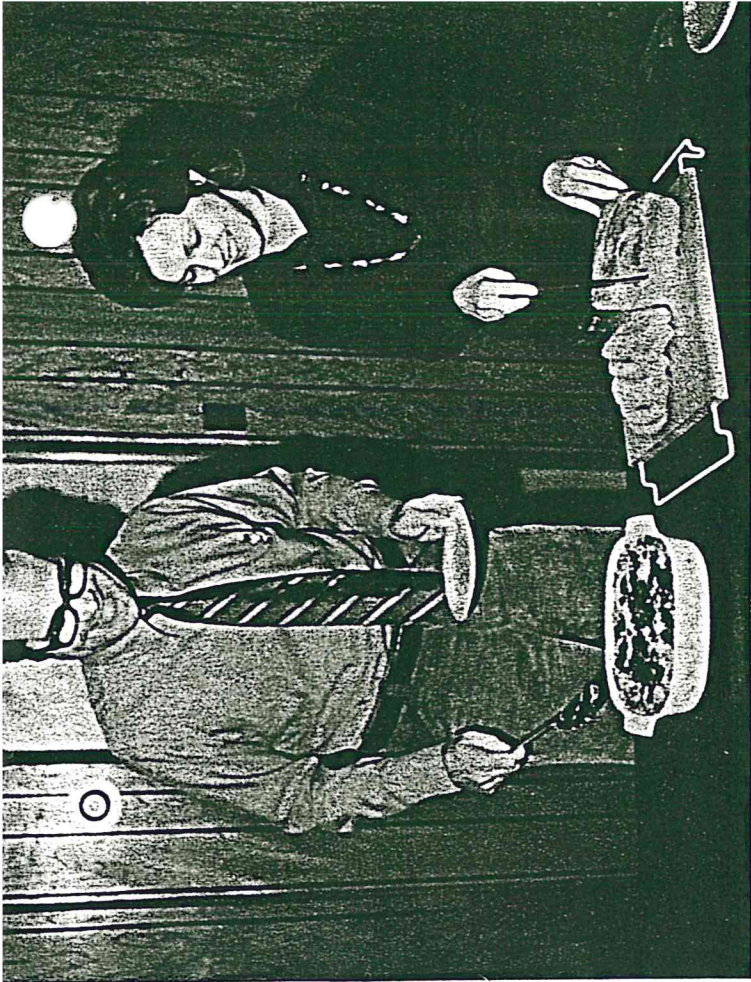
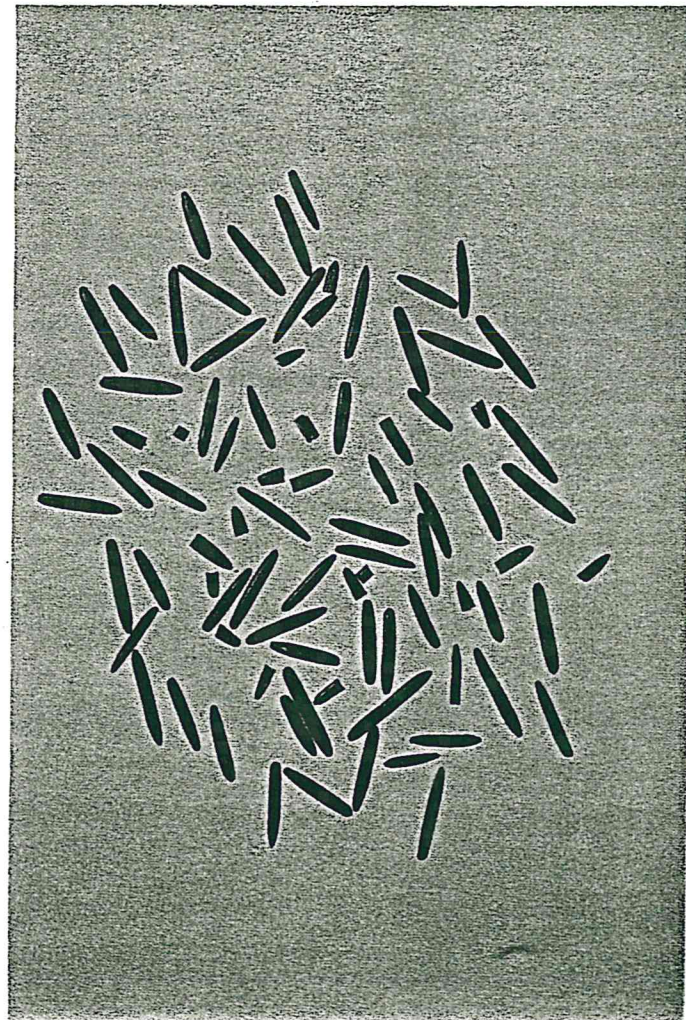
Preparation of wild rice usually starts with boiling it. Cooking time depends upon the size of the grains and how much the grain has been polished during the finishing process. Those who market wild rice generally tell how long the rice should be cooked. It is usually recommended that the wild rice be cleaned by washing in water. Then it is generally placed in a pot with about three times as much water as rice and some salt. Some people prefer to cook their wild rice to the stage where it has just broken open along the seam of the grain. Most good grades of wild rice will cook to this chewy or nutty stage after about 30 to 45 minutes of slow boiling. Water may be added or changed. Many people prefer their wild rice softer. After about an hour of slow boiling the grain will open up, the white inner portion will be more visible than the dark shell, and many of the grains will be curled. If the wild rice is being cooked to the soft stage, it is important to have plenty of water in the pot so that the

Wild rice may be used in hot dishes of many kinds. One of the simplest hot dishes is to add pieces of chicken, turkey or meat of almost any kind to cooked and drained wild rice, together with a can of mushroom soup. Mushrooms, green pepper, onion, celery and seasonings may be added to taste. The whole mixture should be simmered or baked about half an hour. This hot dish is the principal item at a meal which might include a salad, rolls or bread, and pickles. An ounce or two of wild rice per person will be required depending upon the appetites.

Another standard use of wild rice is as a breakfast cereal. The wild rice is generally cooked the day before and put in a container in the refrigerator. A desired portion is then placed in a pan, covered with water and heated thoroughly. The water is drained off and the cereal is put in a bowl. It can be eaten with milk or cream and sugar, or plain with butter and salt. Wild rice is very nourishing, has good flavor and texture and is not mushy like oatmeal.

Wild rice is good in soups. Uncooked parched rice can be added while the soup is simmering a couple of hours before serving time. It should be remembered that wild rice will swell up, and not much

There are no industry-wide standards for grading wild rice. However, each processor or distributor generally establishes several uniform grades which he sells. The sample below is one of eight standard grades sold by United Wild Rice Co. It is called "extra fancy" and contains mostly good-sized whole kernels with relatively few broken ones.



Expanding the market for wild rice is the principal concern of Stanley Carmichael, president of United Wild Rice Co. In addition to encouraging traditional uses of wild rice, he has employed two home economists to develop new uses of the food. Here he is preparing to serve a sample of a new wild rice casserole while home economist, Mrs. Michael Silvis, slices bread made from flour containing wild rice.

needs to be added. It can also be added to stews, either pre-cooked a short time before serving, or dry at the early stages of preparing the stew.

There is virtually no waste with wild rice. After cooking, it can be kept in a refrigerator for several days. It can also be frozen without affecting its texture. Many people prepare a full package of wild rice at a time, and use it in various ways over a period of days or weeks. Wild rice is popular on camping trips because it doesn't take much space. After cooking, it can be kept without refrigeration for several meals, if other ingredients have not been added.

Wild rice containers almost always include instructions for cooking and several recipes. Most distributors also have recipe folders with many tested ways of preparing delicious wild rice dishes. Standard cook books generally include a few basic ideas on cooking wild rice. If reasonable judgment is used, it is almost impossible not to

come out with a tasty wild rice dish. Instant wild rice is now available which cuts down cooking time and costs only a little more than parched wild rice. Wild rice pancake mix, muffin mix and other specialty products using wild rice are also available in many stores.

Wild rice will never be used in big quantities like peas, beans, corn, wheat, potatoes or other common vegetables. But growers are investing millions of dollars in expanding production of wild rice in the belief that the market can be expanded. Most people have never eaten wild rice in any form. If the people of the United States would eat an average of even one serving of wild rice a year, that would require multiplying present production by five times.

Most people who have been exposed to wild rice enjoy eating it several times a month. It is no wonder those who seek to develop the market for wild rice are optimistic about its potential.

During less than a century, wild rice has moved from a staple of the Chippewas to a delicacy prized by the few who have learned about it. Wild rice is now well on its way to wide recognition as a delightful food available to all who seek variety in their meals.

#### ACKNOWLEDGEMENTS

General information on wild rice has come from personal discussions with many people. Roland M. Hicks, one of the early wild rice processors who has retired to Arizona, was always willing to talk about wild rice, as is his son Dean Hicks. Clifton Nelson knows as much about processing wild rice as anyone in the world. Harold Kosbau is a thorough student of the wild rice business and of paddy production. Dr. William Hueg, Dr. William Matlamaki and Dr. E. A. Oelke, all of the University of Minnesota, are leaders in research on wild rice. Dr. John Moyle of the Minnesota Department of Natural Resources has studied wild rice in the natural stands for more than a quarter-century. Erwin Brooks has been an enthusiastic booster for paddy production of wild rice. Algot Johnson has been a determined advocate

for research to solve problems of growing wild rice. Stanley T. Carmichael freely discusses the marketing potentials of wild rice. Many others have also been generous with their time and knowledge.

The principal source of information on Indian use of wild rice is *The Wild Rice Gatherers of the Upper Lakes* by Albert E. Jenks, published by the Smithsonian Institution in 1900. A fascinating book on Indians was written by William W. Warren, a part-Indian member of the Minnesota Territory legislature, entitled *History of the Ojibway Nation*, published by the Minnesota Historical Society in 1885. Other books containing information on Indian use of wild rice include: *Chippewa Customs* by Frances Densmore, *Indian Life in the Upper Great Lakes* by George I. Quimby, and *The Woodland Indians of the Western Great Lakes* by Robert E. and Pat Ritzenthaler.

In 1969, the Minnesota Resources Commission published *A Study of Wild Rice in Minnesota* which summarized the developments in wild rice then underway.

The Agricultural Extension Service of the University of Minnesota in St. Paul published in 1973 a brief description of paddy operations entitled *Commercial Production of Wild Rice*, written by the wild rice research team of the Agricultural Experiment Station. A summary of preliminary work is contained in a *Progress Report of Wild Rice Research at the University of Minnesota, Institute of Agriculture, St. Paul, Minnesota* published on January 19, 1973.

The life history of wild rice and a detailed study of the plant is the subject of *A Developmental Study of Wild Rice* by Cynthia E. Weir and Hugh M. Dale, published in the Canadian Journal of Botany in 1960. One of the most comprehensive descriptions of wild rice is *Wild-Rice* by William G. Dore, published by the Canada Department of Agriculture in 1969.

Dr. John B. Moyle, researcher for the Minnesota Department of Natural Resources, collaborated with Paul Krueger, director of wild rice for the department, in writing *Wild Rice in Minnesota*, published in The Conservation Volunteer, November 1964. More detailed information is contained in *Wild Rice - Some Notes, Comments and Problems* by Dr. Moyle, prepared for a seminar on wild rice at the University of Minnesota in St. Paul, November 29, 1967.

The Upper Great Lakes Regional Commission provided funds to assist the University of Wisconsin in making an economic study of wild rice. The results of three years of study are included in the *Wild Rice Processors' Handbook* published by the Cooperative Extension Division of the University of Wisconsin in 1972.

Many other booklets, newspaper features and magazine articles have been published on wild rice. A bibliography on wild rice is maintained by the Minnesota Historical Society in St. Paul.

Pictures on pages 4, 5, 23, 25, 26, 28 and 31 were provided by Dr. E. W. Oelke. Those on pages 6 and 7 were provided by the UMD wild rice research team. Other pictures were taken by the staff of the Northprint Company.