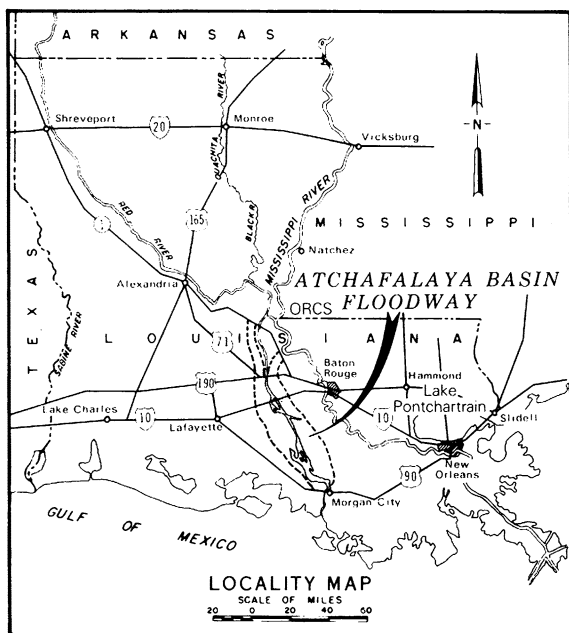


Dammed If They Do and Dammed If They Don't

The Mississippi River is slowly shifting its main flow from one channel to another while the U.S. Army Corps of Engineers tries to keep it on its course. Whether Mother Nature or the Corps wins, Louisiana is in for tough times.

By ALLAN CHEN



U.S. Army Corps of Engineers, New Orleans District



The Atchafalaya basin (top), dashed area, is topographically lower than the Mississippi's main channel floodplain. The Army Corps recognized in the 1950s that the Mississippi would someday switch paths unless something was done.

The Bonnet Carre Spillway, between the Mississippi and Lake Pontchartrain at New Orleans, is shown operating during the 1973 flood.

It may have started in 1980 when two scientists at Louisiana State University in Baton Rouge released a report detailing what might happen if the Old River Control Structure (ORCS), at the confluence of the Mississippi's main channel and a tributary called the Atchafalaya, failed. This structure, weakened by severe flooding in 1973, keeps 70 percent of the Mississippi's water flowing down the main channel to Baton Rouge, New Orleans and the state's hefty shipping trade. The river, Raphael Kazmann and David B. Johnson argued, is slowly trying to shift its course to the topographically lower Atchafalaya Basin.

By damming off the basin back in the 1950s, the Army Corps unwittingly set the scene for a disaster of epic proportions. If the dam fails—which Kazmann and Johnson believe is inevitable—bridges, roads and gas pipelines would be destroyed and Morgan City, La., would be washed into the Gulf of Mexico.

Then again, it may have started in 1927 when a flood, the Mississippi's worst ever by most accounts, killed more than 400 people and flooded more than 67,000 square kilometers of land. The disaster spurred Congress to pass the first Flood Control Act authorizing the Army Corps to control floods through a system of levees and floodways to shunt excess water away from the main channel. (In spite of these measures, flood crests have been rising, and in the 1973 flood, the worst since 1927, the water crested at more than 13 meters in St. Louis, a new record at that time.)

The concern that the restless Mississippi poses dangers to life and land from flooding is nothing new. Settlers on the Mississippi floodplain have been battling floodwaters with uninspiring results since the French first arrived in the New World. The Mississippi is a meandering river with a high sediment load—it drains 41 percent of the 48 contiguous states as well as two Canadian provinces, an area stretching

from the Rocky Mountains to the Alleghenies. As it meanders across the plain, it cuts off its own loops and bends and carves its way through new paths of least resistance. Over a period of 2,000 years or so, says Jim Coleman of the Louisiana Coastal Institute in Baton Rouge, the Mississippi has changed course perhaps six or seven times.

When it reaches the Gulf of Mexico, it creates a delta by dropping its sediment load at the river's mouth. The delta "progrades"—builds outward into the Gulf—creating new land in the process. Eventually, this branch of the delta overextends itself and is abandoned as sediments clog the channel. The river seeks a new course to the Gulf. A new arm of the delta grows elsewhere while the old arm is slowly torn away from the coast by storm waves and encroaching Gulf waters.

This is what is happening now, according to Coleman. Southeastern Louisiana is losing perhaps 40 square kilometers a year, and the delta at the mouth of the Atchafalaya is growing as the Mississippi throws itself against ORCS.

The problems the restless Mississippi creates are not as simple as the threat of a disaster if ORCS fails and the Atchafalaya basin floods in one catastrophic blow. But its possible failure is what threw these problems into the public eye. When Kazmann, a civil engineer, and Johnson, an economist at Louisiana State, released their report in 1980, they did not take into account the Auxiliary Control Structure, which the Corps had begun to build to strengthen the portion of ORCS that suffered the most severe damage in 1973. Without the auxiliary construction, Kazmann and Johnson predicted that ORCS could fail "next year, during the next decade, or sometime in the next 30 to 40 years," if there were a flood of sufficient magnitude. With 70 percent of the Mississippi flowing down the Atchafalaya, the insufficient flow of fresh water down the main channel would leave Baton Rouge



U.S. Army Corps of Engineers, New Orleans District

The Mississippi's Old River Control Structure, actually a complex of dams, locks and levees, diverts 70 percent of the river down the main channel.

and New Orleans as saltwater ports. That main channel is below sea level as far north as Natchez, which is 115 kilometers north of Baton Rouge. The cities on the main channel would be left without an immediately available supply of drinking water, since the Mississippi supplies much of their needs.

In the Kazmann and Johnson scenario for the Atchafalaya Basin to the southwest, several highways, bridges and railroad lines would be flooded out, requiring the re-routing of economically important land traffic from Texas and from the east. Two bridges likely to fail are those at Interstate 10 and U.S. 190. As many as five bridges, four roads and four railroad lines might be affected. Seven interstate natural gas pipelines passing through the basin might rupture, curtailing gas deliveries throughout the Eastern Seaboard. Finally, Morgan City, an oil and gas exploration center and the only town lying on the floodplain directly threatened by floodwaters, would be flooded out. The report conservatively estimated between \$1 billion and \$4 billion of flood-related damage, omitting many indirect costs such as losses from unemployment, re-routing interstate traffic, relocation of residents, disruption of the fishing industries and so forth.

The Army Corps believes that none of this will ever happen. Much of the damage to the Old River structure from the 1973 flood has been repaired, and ORCS has held through several major floods since then. But the Corps admits that one portion of it, the Low Sill Structure, is beyond repair. Bob Kaufman, acting chief engineer at the Corps' division office in Vicksburg, Miss., says, "It can't completely do what it was designed for in an emergency situation. For example, if a barge collides with it, we might have to close the gate [which allows water to pass through the structure] and this would put stress on the system."

The purpose of the Auxiliary Control Structure is to strengthen the Low Sill

Structure. By operating it some of the time, says Kaufman, the structure "reduces the tendency for scour [the erosive action of the river] to erode the channel." The structure is scheduled for completion in November 1985, at a cost of \$219 million. Kaufman says it is on schedule.

Once the structure is in place, the Corps believes the worst of the danger will be past. Although they assume a 100-year "economic life" for flood-control structures, Frederick Chatry, chief engineer of the Corps' New Orleans district, says, "A lot of the things we build can be maintained indefinitely. As long as there is a use for a structure, as long as Congress... allocates the money for it, we can maintain it... The kind of things we build," he emphasized, "don't fall apart."

Kazmann respects the engineering ability of the Corps and feels the structure "will buy some time." But as for the shift in the river's course, he says, "I think it will happen anyway." He believes that Congress and the Corps are suffering from inertia. The Corps is "a prisoner of events that happened 50 years ago. Congress mandated them to build a structure and control the river's course and that's what they've been doing ever since. The thought that things may be beyond their control never entered their calculations." The Corps also believes that the probability of a "project flood," the maximum discharge for which a structure is planned to withstand, is so small that it is not worth worrying over. "That's where a difference of professional opinion comes in," he says. There have been five major floods since 1927 and Kazmann thinks there has been an increasing frequency of severe flooding in recent years — 1975, 1979 and this past December all saw serious flooding along the Mississippi.

Others take a different view of the Corps' efforts. Johnson, the other author of the study, says, "My view is that the increasing costs of maintaining the river in its present flow become more and more

economically undesirable." The Corps builds something to maintain the flow, it holds for a while, then something happens requiring a new expenditure for a new structure. The Corps builds a new structure, and it holds for a while until something else happens, requiring yet another structure. ORCS has been operational for only 20 years. "Technically, the Corps of Engineers could run that river through Los Angeles if they had the money," says Johnson. But he wonders if it is worth the cost when they only have the technology to forestall, not solve, the problem.

Whether or not the structure holds, it seems that some kind of flood-related disaster is in the offing since Louisiana's problems involve more than just the increasing cost of maintaining ORCS. Corps engineers began to build levees against floods and to straighten channels for navigation in the early 1800s. By the latter half of the 20th century, the Mississippi River and Tributaries Flood Control Project (MR&T) had become the largest of its kind in the world. It is designed for a project flood of 3,000,000 cubic feet per second, corralled by more than 3,500 kilometers of levees and backed by four major floodways, one of which parallels the Atchafalaya tributary. The more the river is channeled and hemmed in by levees, the lower the volume of water it can carry. The more it is straightened and deepened for navigation, the faster it runs and the deeper it cuts into the riverbed, picking up more sediment. Before it was altered, the eroding bed increased the river's volume for floodwaters and the floodplain absorbed the rest. Since its modification, concludes C.B. Belt of Saint Louis University in a 1975 paper in *SCIENCE*, its volume has decreased by one-third from its 1837 volume. Flood stages have been increasing for the same amount of rainfall. Prevented from reaching the floodplain by levees, the flood crest rises even higher. Belt concludes that the more the river is altered, the higher the flood stage rises.



The Atchafalaya River, which Morgan City's Mayor Brownell remembers when it was "just a stream."



Morgan City, Louisiana, showing flood levees judged "too low" by the Corps of Engineers.

Photos: U.S. Army Corps of Engineers, Washington D.C.

"The 1973 flood's record," he writes, "was man-made."

Thus, in Morgan City, it might not matter whether or not ORCS fails. The Corps used the East Atchafalaya Floodway in 1979 to handle the overflow from the Mississippi, says Oliver Houck of the Tulane University Law School in New Orleans, and there was flooding then. "If [they] ever use that floodway again, it's probably going to sweep [Morgan City] into the sea.... The threat to those towns is not if the system fails but if it works."

Morgan City's mayor, C.R. Brownell, is aware that it won't take a disaster at the Old River Control Structure to cause one in his town. "We are used to living with disaster here," he told SCIENCE NEWS, noting that they have borne hurricanes, floods and "some of the highest tidal surges in the Gulf," which are eating away parts of their coastline. "The best defense we have is to take care of ourselves regardless of what happens...we're always ready to evacuate at almost any time."

Nonetheless, he says, "under no circumstances do I consider us adequately prepared for an emergency." Because the delta at the mouth of the Atchafalaya is prograding—building into the Gulf—their levees no longer reach far enough down to the Gulf, and the city is vulnerable to backflooding as water rushing down the channel reaches the delta and rises back toward the city, behind the levees. This is what happened in 1973, and Brownell says he has been fighting in Washington for more federal aid for flood control projects. "We don't want the Mississippi River down here. They can keep their Mississippi up there.... We're dealing with our survival, our land, our home, our work." But, "we're not going to move," he says of suggestions that Morgan City abandon its location on the floodplain. "That business is ridiculous."

At the Army Corps, Chatry notes that several floodwalls in Morgan City are "seriously deficient in grade—they're not

high enough." The existing 13-foot walls are being raised now, or in the planning stages of being raised, to 22 feet, and he estimates that "the whole shooting match will be completed in two years." An extension of the East Atchafalaya Basin Protection Levee down to the new portion of the delta, however, is still some years away, since "it hasn't been determined if there is a need for the wall yet."

If it is doing no other good in Morgan City, at least the Atchafalaya is building new land there. But even this is costing Louisiana much woe and many dollars. Mayor Brownell blames environmentalists, among others, for blocking Morgan City's badly needed flood control projects in order to protect the delicate but growing wetlands there. And as the wetlands grow in the southwest, they die in the southeast, according to Houck and others. Bayou Lafourche, the Plaquemine Parish and other fabled and biologically productive marshlands are being eroded away by storms and waves.

Houck ascribes this destruction to acts of man: "Because of what the Corps is doing down here, they have destroyed the building potential of the river's sediments...South Louisiana is collapsing. The cities down here...are going to be islands in 50, 80, 100 years. This state is very much in the position of a man who's torn down his back wall to shore up his front wall."

Coleman, a geologist by training, has a different view: "The things that affect land loss or gain are variable." One factor is land subsidence through geologic factors such as salt and shale compaction. Another is the sea level: when it rises, land is lost, when it drops, land is gained. Another is the stage of development of the delta: is it young and building out, or is it mature and clogging up with sediment? Add to that human activity, wave energy and effective tidal range, and, asserts Coleman, "to pick any one number out is just about impossible." He believes that "we are in a normal condition of loss be-

cause sea level is rising," the land is subsiding from the weight of sediment, and the delta is in its mature stage. A long-lived geologist will have seen 75 percent of the land that was there 15,000 years ago disappear by the present, he says. Humans have added to the loss, but how much is hard to say. "Having worked in ten or fifteen rural deltas around the world, I've found that people are always trying to place the blame on others [for the loss].... You're going to be facing land loss—you don't stop it, all you can do is face it."

"Facing it" will be hard for Louisiana since so much recreational and economic value originates in the wetlands, and so much of the state's economy depends on maintaining the Mississippi's present course. Some do not admit there is anything to face. Others, including Houck and Coleman, have speculated on the feasibility of letting the Atchafalaya catch the Mississippi's flow gradually. This would have long-term beneficial effects above and beyond creating new land in the Atchafalaya Basin, according to James Goselink, an ecologist at the Coastal Research Institute. The higher salinities in the estuaries would increase the productivity of fisheries there as trout, shrimp and redfish migrated into them. The fishing industry is a major money-maker in Louisiana.

But, says economist Johnson, no one knows how high the cost of letting the river shift will run. New Orleans would have to get a new water supply and the Corps would have to do a lot of expensive dredging to keep the old channel open. The long-term beneficial effects would not be felt for generations. And there is still the problem of Morgan City.

"The probability of [allowing the Atchafalaya to catch the Mississippi] is very low. The Corps of Engineers is a good agency to look at that, but they put out fires, they respond to things," said Coleman. Meanwhile, the Atchafalaya Basin is slowly, serenely growing. □