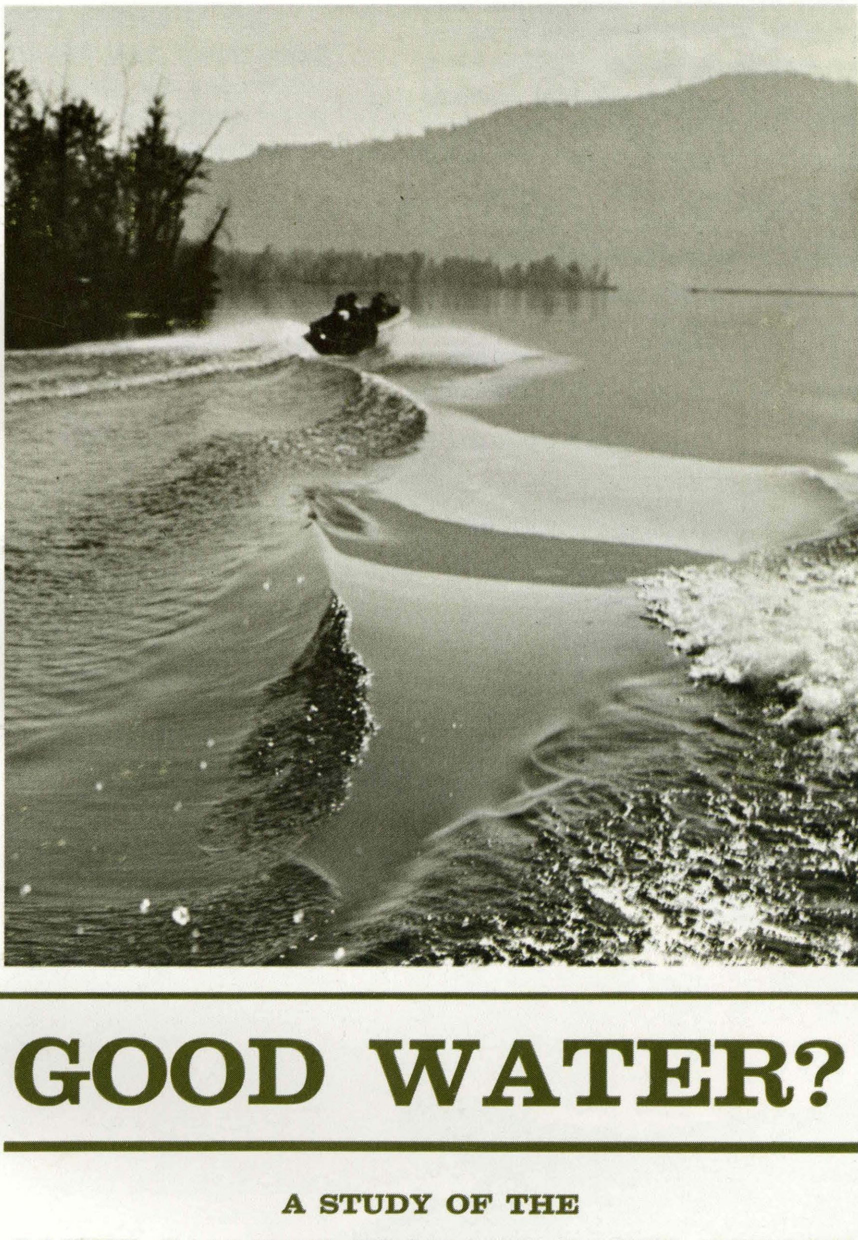


GOOD WATER?

A STUDY OF THE
COEUR D'ALENE-SPOKANE RIVER REGION

GOOD WATER?

A study sponsored by

U.S. Office of Water Resources Research

University of Idaho

Water Resources Research Institute

College of Arts and Sciences

Washington State University

Nuclear Radiation Center

College of Engineering

State of Washington Water Research Center

Contents:

Winter's ice seals much of the southern end of Idaho's Coeur d'Alene Lake

THE OVERFLIGHT

As the Cessna banks through a tight, head-swirling turn, you look straight down, past the pivoting wingtip. Hundreds of feet below, a large expanse of crinkled grey-white ice dominates the scene. In a few places, irregular channels of muddy water interrupt the surface of the ice. Along the sides, by the dark trees, some tiny docks protrude, disturbing the otherwise smooth arcs of the scalloped shoreline. Here and there among the trees, cabin rooftops reflect the early March sunshine.

You level the plane's wings to stop the turn, and head north, up the lake. Off to the right, you see a grassy river valley coming in graceful meanders to meet the lake below. Midway in the distance, up the valley, smoke from a sawmill burner marks the presence of a logging community.

It is St. Maries, Idaho. The river is the St. Joe, of northwestern fishing fame. The ice-assaulted water body below is the southern end of Coeur d'Alene Lake, noted throughout the world for its beauty.

In the story which follows, both the river and the lake play major roles, as do some other streams. The tale begins as a real western adventure, complete with rugged explorers and roistering miners. Then it changes to a recital of exploitation and pollution. Finally it ends as an account of some scientific "detection" to forecast the possible fate of the lake—upon which much of the region's future economic health depends.

The Cessna now is dipping and wallowing in light turbulence. About a thousand feet above you, in the eyeball-scorching-bright sky, are scattered white cumulus clouds, revealing the presence of some mild updrafts.

Ahead, through the blurred arc of the propeller, the expanse of the entire lake can be seen. First it stretches out to the northwest, then swings back to flow almost due north. Timbered ridges squeeze the lake tightly on both sides. In some spots, the lake is less than a mile wide. You note that about halfway up the lake, the ice coating comes to an end, exposing gray-green water.

Coming up ahead, on the right side of the aircraft, is a small collection of buildings on a pine-dotted bluff above the lake. Your map labels it as Harrison, Idaho, and discloses it has a population of 249. Even from a distance, it is obvious that the houses and other structures have been settling in place for a long time, absorbing decades of sunlight and wind.

Just beyond the bluff at Harrison you can see a river flowing into the lake, Large banks of earth can be seen along the main channel where the river emerges into the lake, and a difference in the color of the lake's water reveals the presence of an underwater delta. The stream is the Main Fork of the Coeur d'Alene River.

Easy pressure on right rudder and aileron starts the plane into a gentle turn to the east, up the river valley. Ahead, through the windshield, high peaks, shining with snow, can be seen. They are the Bitterroot Mountains.

The trees of the lower ridges, now passing underneath you, are dull and drab. It will take warmer sunlight and longer days than today before the green-giving chlorophyll in the pine and fir needles will awaken.

The "un-natural" river

In fact, the only splash of color in the entire landscape is the river below. It is a brilliant green. Against the dull trees, tan dead-grass meadows, and dark rocks, the river stands out vividly—and unnaturally.

You twist and bank the aircraft so as to follow the course of the river below as it bumps first against one side of the canyon, then wanders to the other wall. Before too many minutes pass, you come to a wide marshy-appearing expanse which the map identifies as Mission Flats. Angling in from the left are the two concrete ribbons of a major highway. Even from several miles away, cars and large trucks are visible. Some are speeding northwestward. Other vehicles are going southeast, the same way you are headed.

At the eastern end of the marshy area, a small white structure stands out clearly. It is the

Written and designed by
DAVID C. FLAHERTY

Cataldo Mission, erected in the mid-1800's by pioneering Jesuit missionaries to the Coeur d'Alene Indians. Just beyond the structure, the valley tightens, then opens up again, but instead of tan marshland, now there is a long canyon of brownish-red rock and dirt. About two miles wide, it appears as if a blowtorch has been used to scorch nearly every square foot of ground. You have to look to the tops of the east-west running ridges to find any forest.

The main features in the canyon which catch your eye are the squiggly channels of the bright green river along the north side, the contrasting straight line of the freeway bisecting the valley floor, and some massive yellow-tan piles. Grouped here and there are houses, along with some large buildings. Some of the latter have lofty smokestacks, appearing pencil-thin from your height.

You observe that another stream has come down from a northeast trending canyon to join the squiggly river below. The new stream is the North Fork of the Coeur d'Alene River. The watercourse under you is classified by the map-makers as the South Fork.

Silver and lead "magnets"

Further map reading identifies the two nearest communities as Smelterville and Kellogg. Up ahead, where the canyon swings gently to the right, are Osburn and Wallace. All were names to conjure with around western campfires during the 1880's when the silver and lead ores of this valley drew wealth-seekers from around the world.

When you reach Wallace, you wheel the Cessna hard in a bank to the left so as to head back down the canyon. As you again pass Smelterville, your attention is drawn to the difference between the colors of the North and South Forks. The North Fork appears to be a normal stream-green. The South Fork is the bright, unnatural green noticed earlier. The two colors are distinct where the two streams join, but gradually the bright green wins out about a mile below the confluence.

Flying back toward Coeur d'Alene Lake again, you look closer this time at a number of small lakes tucked here and there along the main river channel. The map indicates that most have a romantic ring to their names: Killarney, Cave, Black, Swan, and Blue (Lakes).

Shortly before you reach Harrison again, the varied landscape in the west—beyond the main Coeur d'Alene Lake—draws your gaze. Interspersed among some distant timbered ridges and peaks are lower, rolling, cultivated hills. It is the Palouse Country, noted for high yields of wheat and peas from light, wind-deposited soils.

After you reach Harrison, you turn north, toward the head of the lake. No V-tracks from speeding motorboats disturb the smooth surface of the cold water below. Later in the spring and summer, spreading wakes will be common, especially in the many bays along the shores.

Recent growth on the prairie

Shortly after the left wingtip of the plane passes a deep indentation in the lake's western side—the map refers to it as Mica Bay—the streets and buildings of a medium-sized city can be seen ahead. Prominent where the lake waters meet the rectangular blocks of what is Coeur d'Alene, Idaho, are a large wooded hill, a marina and a motel. From the air, it appears as if the recent growth of the city has been to the north, over the flat, tree-speckled land the map designates as Rathdrum Prairie.

On the west edge of the town, a large stream is visible. It is the Spokane River, which has its beginnings here at the outlet of Coeur d'Alene Lake. After flowing north for less than a mile, the Spokane River turns abruptly west—and so do you in the Cessna. As you make the turn, you notice a small sewage-processing plant on the bank of the river, near the city.

Visible downstream are smoke and steam plumes from several sawmills, reminders that this is wood growing and processing country. The last plume marks the small town of Post Falls. Nearby is a small dam on the Spokane River.

A glance at the chart discloses that you are now about to pass from Idaho into Washington. The prairie here is about four miles in width and is broken up into small farms and meadows. On both sides, timbered ridges climb to higher, snow-tipped peaks. Out the left window, to the south, you can see Mica Peak, rising some 4000 feet above the valley floor. On the right side, broad, curving ski runs can be seen on the eastern slopes of Mt. Spokane.

At right: The historic valley of the South Fork of the Coeur d'Alene River, source of millions of dollars worth of ore — and large quantities of water pollutants.

After a few miles pass by, scattered small towns and housing tracts appear. The river, which has been hanging on the southern edge of the valley, decides to angle over to the northern side. About where the switchover occurs, a large factory and some warehouses occupy considerable space on the valley floor.

After the second-hand on the Cessna's panel-mounted clock makes several more revolutions, the metropolitan expanse of the city of Spokane opens up before you. Straight ahead—in the bottom of the valley—are the cubes of the downtown office buildings. Residential districts are spread over higher terraces both to the left and right.

You observe that the watery bends of the Spokane River continue right on down through the business district. Just where the bridges seem the thickest, and near where a dam spans the river, some large scale construction is obviously underway.

Once past the downtown area, the Spokane River falls away into a deep, forested canyon, then makes a sharp bend to the right. Not long afterwards, the stream passes the circular filters and buildings of what appears to be a modern sewage-processing facility. According to a detailed map of the region, much of the land on both sides of this part of the river is dedicated to parks and golf courses.

After passing another dam, the river begins to bend to the west and becomes broader. The terrain here is handsome. Conifers are scattered over the ridges which descend sometimes gently, sometimes abruptly, to the river's edge. The whitish trunks of aspen and other deciduous trees foretell of riots of color, come autumn. Along the shores, cabins and other evidence of the hand of man are scarce.

You fly on for another 25 minutes, with more of the same attractive countryside flowing past below you. Only two more dams interrupt the downhill run of the water before the confluence of the Spokane and Columbia Rivers is reached. The meeting of the two streams is peaceful, with the muddier currents of the Spokane soon being lost downstream in the broad expanse of the Columbia.

THE PROBLEMS

Sure was a nice flight, wasn't it? Beautiful mountains, attractive lakes and rivers, prosperous-appearing communities. Everything is as it should be—right?

No. There are many environmental problems down there in the countryside you "traversed." Some are acute, some are growing, others are only potential in nature. Some are being worked on, while others are not generally known about. Let's take them from the beginning of the flight.

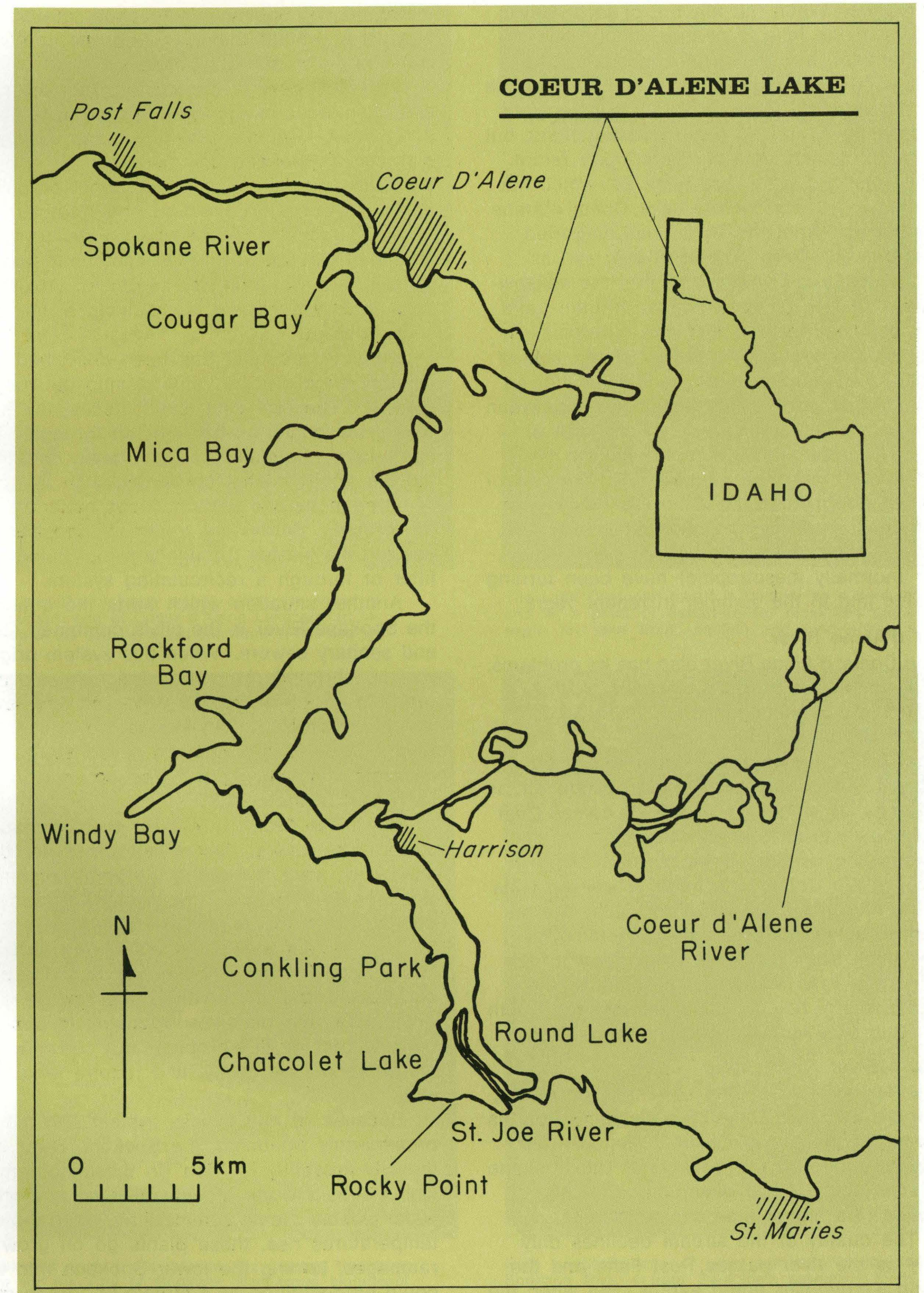
Coeur d'Alene Lake

First, let's look again at the muddy water visible in the ice channels at the southern end of Coeur d'Alene Lake. (Various parts of this section of Coeur d'Alene Lake are called Lake Chatcolet, Round Lake, and Hidden Lake. All, however, are parts of the main lake. See map on page 5.) The yellow mud in the water is soil which has been torn loose from the pastures, croplands, and hillsides of the St. Joe River and Plummer Creek drainages. The latter stream flows through part of the Palouse Country.

The mud from these streams is filling up the southern portion of Coeur d'Alene Lake which never was very deep to begin with. This end of the lake was brought into being when the Spokane River dam was added in 1906 at Post Falls.

Coming right along with the mud are the chemical components of agricultural pesticides and fertilizers. When you add the human wastes from the houseboats along the shore and the septic tank effluent from cabins, the resulting mixture has a lot of fertilizing ability. If the ice had been out, you would have seen thick growths of large water weeds over most of this part of the lake's bottom.

Scientists who specialize in the study of lakes classify them according to the fertility of the water in each lake. If the water is low in the major nutrients—such as phosphorus and nitrogen—which are needed to make aquatic plants grow, the lake is called oligotrophic, from the Greek oligos: few. If the lake is as loaded with fertilizers as an Iowa cornfield in the springtime, the scientists classify that body of water as eutrophic. The Greek word for well-nourished



is eutrophus. When the amount of fertilizing materials in the lake is neither scanty, nor over-abundant, but somewhere in the middle, scientists call that lake mesotropic. Yes, meso is Greek for middle! Other factors are taken into consideration in making these classifications, but the amount of nutrients is the primary factor.

The scientific team (see page 24) which has been studying Coeur d'Alene Lake, Coeur d'Alene River, and the Spokane River, has classified the extreme southern portion of the lake as strongly mesotropic. They add that the shallowest areas of this Chatcolet-Round-Hidden Lake region are "heavily enriched and eutrophic."

As for the fertilized condition of the rest of the lake, the situation gets gradually better as you go farther north. The section lying between Chatcolet and a point several miles north of Harrison is regarded as mesotrophic by the investigators. See map on page 15. The rest of the lake—approximately the northern half— is considered as still being oligotrophic in nature. However, some of the shallower bays in this sector (normally mesotrophic) have been turning eutrophic late in the summer in recent years.

Coeur d'Alene River

The Coeur d'Alene River also has its problems. From its mouth at Harrison upstream to the Kellogg/Wallace mining district, the river is almost dead, biologically speaking.

That bright green of the water in the Main and South Forks, so noticeable from the air, is the clue to the situation. The color comes from the mining and smelting wastes—such as zinc, cadmium, and copper—being carried along in solution in the water. The huge yellow-tan piles covering much of the South Fork valley are an attempt to solve this problem—by holding the wastes back from the river. In addition to the toxic metals, raw sewage from some mining district towns is being discharged into the South Fork. This situation also is being worked on.

Spokane River

The appearance of this stream is deceiving, for it looks very handsome (at a distance) from its beginning at the city of Coeur d'Alene all the way to its ending at the Columbia. The Spokane does start out in good condition, with the exception of a higher than desirable metal content. The quality of the stream declines only slightly as the river passes Post Falls and the mill and warehouses noted earlier. But when the metropolis of Spokane is reached, the quality falls off and stays that way, until the confluence with the Columbia is reached.

The villain here is the wastes from the homes and businesses of Spokane. As we saw in our aerial tour, both the downtown and residential districts of Spokane are modern. Unfortunately, the same thing cannot be said for the city's sewage collection and treatment system. Spokane is just now beginning to construct a plant to give its municipal sewage what is termed secondary treatment. At present, only primary treatment is practiced at the city's sewage plant.

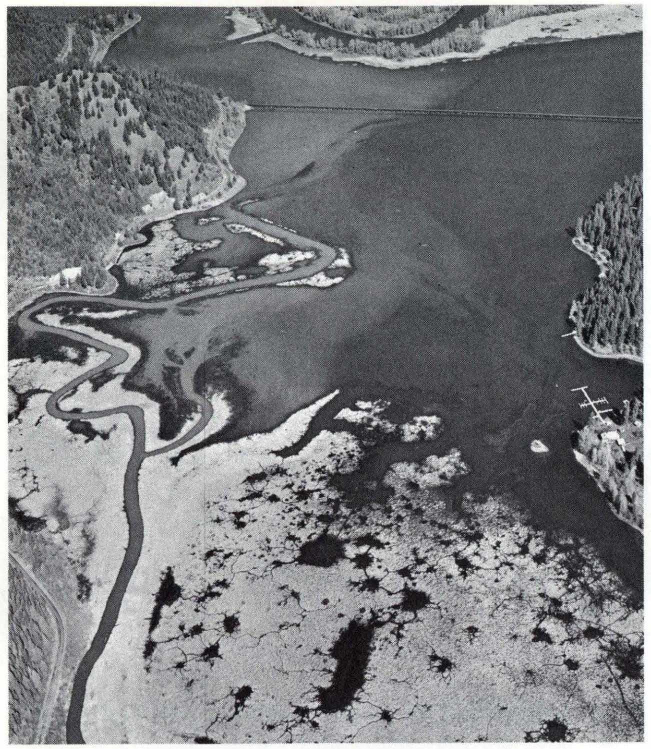
Primary treatment has been described by sanitary engineers as "only picking out the big pieces." The rest—the small pieces, the liquid waste, the bacteria—go right on through. The bacteria can be eliminated with heavy chlorination but the liquid wastes containing high amounts of nitrogenous and carbonaceous materials pass on through. Secondary treatment consists of passing the wastes through a living biological filter or through a recirculating system.

Another situation which hurts the quality of the Spokane River is the city's combined storm and sanitary sewers. When this system originally was constructed, the street drains for storm runoff were connected into the sanitary sewers which ran under the streets to the Spokane River. Such an arrangement saved the cost of separate installations, and was common in the early part of the century.

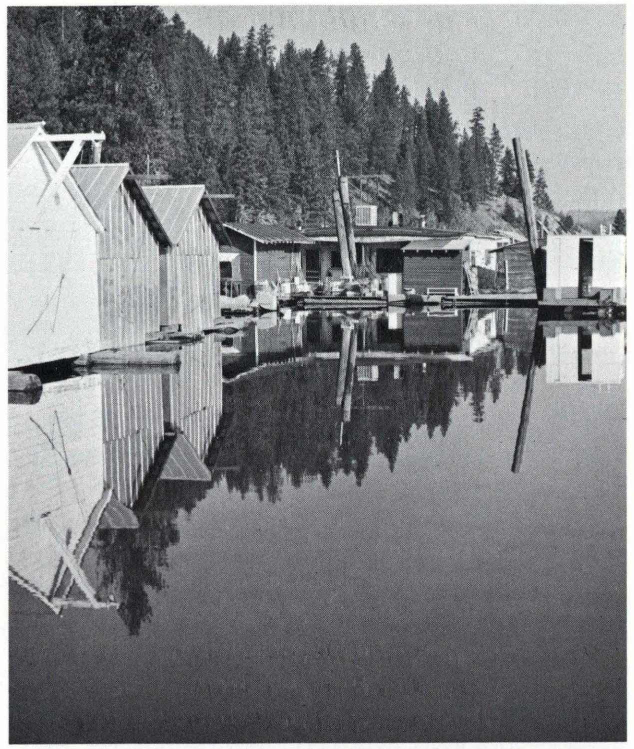
But in the 1950's, a system of interceptor sewers was added. These new pipes, for the most part, were laid along the banks of the Spokane River where they diverted the flow coming down the combined sewers.

This system works—except during periods of heavy rain. If there is more flow than the pipes can handle, the storm runoff and raw sewage go directly into the river. Planning is being done to remedy this problem, but corrective measures will be costly, and require lengthy work.

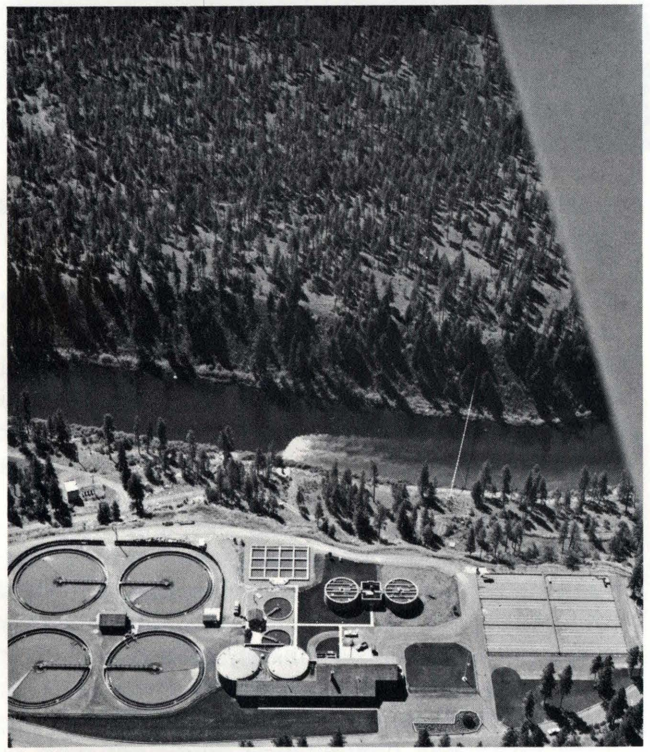
Because of this bypass system and the primary-only treatment, the Spokane River below the city presently is "rich" in those nutrients which stimulate the growth of algae and other water weeds. Come summertime, when the water temperatures rise, these plants go on growth rampages, turning the lower Spokane into what could be described as a stream of "green gunk"!



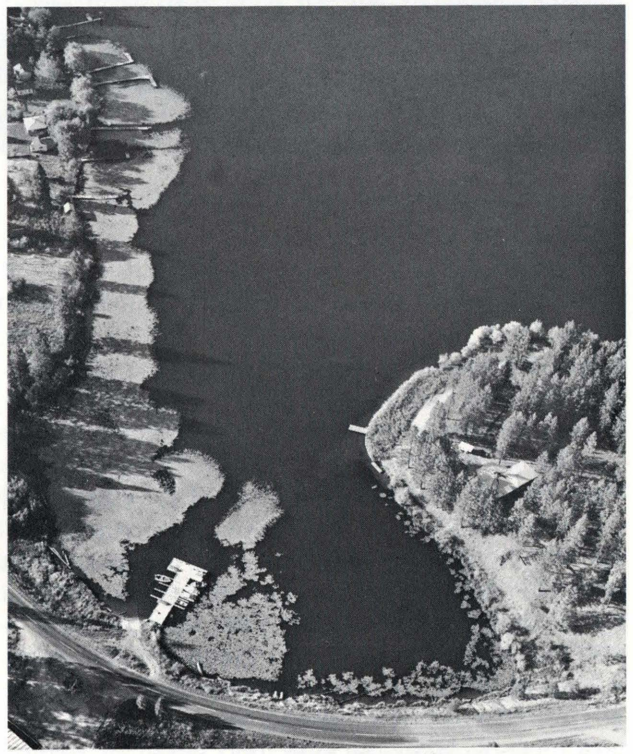
Heavy growths of water weeds along the shore of the southern end of Coeur d'Alene Lake are an indication of the over-fertilized condition of this sector.



The Lake Chatcolet resort is popular as a boat moorage and as a point of departure for fishermen planning to angle for lake trout, panfish and land-locked salmon.



Despite its modern appearance, the sewage treatment plant for the City of Spokane discharges significant quantities of water pollutants into the Spokane River.



High concentrations of plant nutrients in the lower Spokane River — from Spokane's sewage — leads to the thick growth of water weeds along the shoreline.

HOW THE DIFFICULTIES BEGAN

Yellow, shiny, wealth-creating gold! That is what started the Coeur d'Alene and Spokane region on the road to its present pollutional difficulties. Prospector Andrew J. Prichard found gold nearly a century ago, among the rocks of Eagle Creek, a sub-tributary to the North Fork of the Coeur d'Alene River.

Civil War veteran Prichard—along with many other fortune hunters—had been looking for the glint of gold throughout much of the West. Nearly all of these prospectors were dreaming of the "lucky strike" that would change their life style from a dusty scrabbling through hot (or freezing) canyons to a life of fabulous ease in New York, Paris, or New Orleans.

Few, however, were successful in their quest. Prichard happened to be in the right place at the right time. Historians disagree as to just when Prichard found, in the bottom of his rough sluice box, the flecks of shiny metal for which he was looking. It is not clear, either, as to whether it was Prichard, or some other miner working in the Eagle Creek area, who actually was the first to find the gold. The year of 1883 is pegged, however, as the year that Prichard, accompanied by mountain man Bill Keeler, rode into the small village of Spokane Falls. Prichard and Keeler had buckskin "pokes" loaded with the real stuff—heavy gold dust.

Thousands converge on Spokane Falls

It did not take long for the "stampede"to get underway. As word spread throughout the West, thousands of would-be wealthy men (and women) made their way to Spokane Falls. From there, the fortune-hunters pushed on east, by foot, horse, and mule, to the "diggins," where they hoped to scoop up gold by the shovelful.

The gold was there, all right, though many were not to share in it, nor could it be scooped off the ground. Two wild and wooly mining camps soon sprang up to house the thousands who struggled through the deep snows of that winter to the strike. Eagle City was hastily erected, near where Eagle Creek empties into Prichard Creek. It may have been wilderness all around but more than 20 saloons, dance halls, and casinos lined the one long street of Eagle City!

It was not long until construction of a second mining camp was started, some five miles up Prichard Creek from Eagle City. The new "metropolis" was called Murrayville—to be shortened in later years to Murray. One historical account relates that by the fall of 1884, ten thousand people were living in the two towns and on the surrounding slopes. Placer gold was reportedly being washed out of the gravel of the two creeks to the tune of thousands of dollars worth each day.

However, all paystreaks thin out, sooner or later, and so it was at Eagle and Prichard Creeks. Within a few short months, the gravel yielded the last of its flakes and nuggets, and the boom quickly went out of Eagle City and Murrayville. But back in the Spokane Valley, thousands of dollars had been pumped into the economy of Spokane Falls. The small village was on its way.

Growth was just beginning

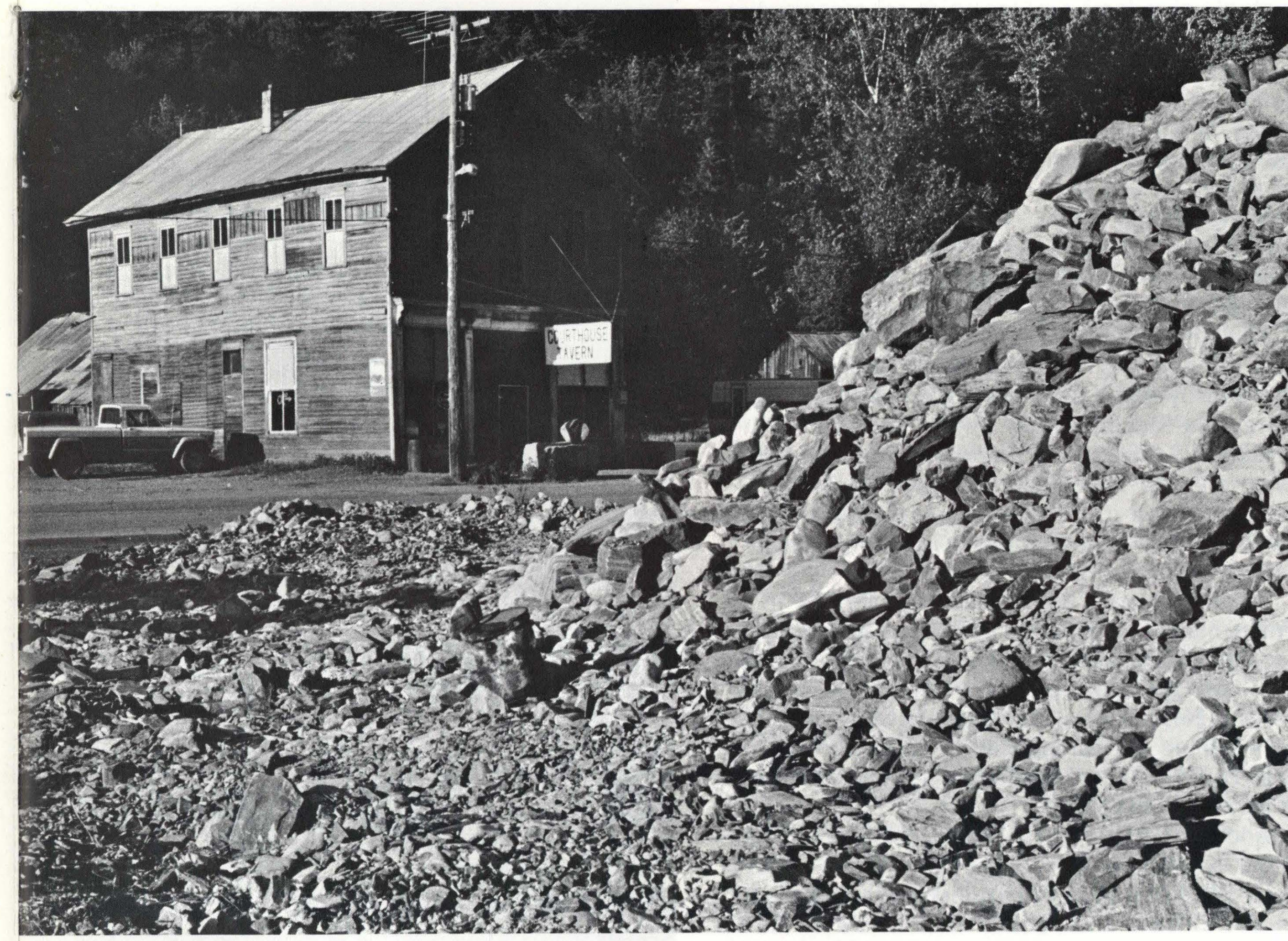
The mineral treasures of the Coeur d'Alenes, however, were far from exhausted. A second person now entered the scene who was to figure large in the overall destiny of the region.

Noah S. Kellogg had played no major role in the Eagle and Prichard Creek developments. Already past the prime of life, Kellogg had done some carpentry work in Eagle City and Murrayville but had taken little part in the actual mining and sluicing operations.

He still had dreams, however, of finding his own glittering bonanza. Kellogg persuaded two of Murrayville's more well-to-do citizens to grubstake him. Dr. J. T. Cooper and contractor O. O. Peck—for whom Kellogg had worked—put up ten dollars each to buy the old man a supply of "sowbelly, beans, flour and tools." Legend has it that Cooper and Peck put up the small sum more out of the desire to keep Kellogg from pestering them than out of any real hope he would find anything.

A decrepit and unowned jackass which had been hanging around Murrayville was furnished by Cooper and Peck to carry Kellogg's supplies. In the fall of 1885, the unlikely pair set out over the steep ridges south of Murrayville. Dense growths of fir, cedar, and hemlock made their travel extremely difficult.

Kellogg spent a number of weeks climbing up and down while gradually working his way to



A recent picture of one of Murray's historic buildings. The rocks are part of the massive piles of dredge tailings which cover much of the Prichard Creek Canyon.

the southwest. He crossed the South Fork of the Coeur d'Alene River and ascended the ridge on the other side of the stream which ran east and west. He kept swinging his pick at outcroppings, but found nothing he recognized as ore-bearing rock.

What happened next is clouded in history and was the subject of a later legal dispute. One account has it that when his supplies were nearly exhausted, Noah decided he had to return to Murrayville, strike or no strike. Getting ready to go, Kellogg started to round up his stubborn jackass, which had strayed away from their camp, located in a little canyon leading up from the South Fork. (Noah had called it Milo Gulch, after a distant relative.) Pursuing the little beast, Kellogg picked up some loose rocks to toss at it, hoping to herd the "mountain canary" the way he wanted it to go.

The rocks seemed heavier than normal. After tossing several at the pack animal, Kellogg reflected that these rocks, from a nearby outcropping, might contain valuable ore. Since he had nothing else to show his grubstakers Cooper and Peck back in Murrayville, Noah kept several to put in the little beast's pack. But the doctor told Kellogg he had brought back worthless rocks, and terminated their grubstaking arrangement, according to this one account.

As the story continues—Noah, tired and discouraged, sought solace in a nearby saloon. Here he met Phil O'Rourke, a previous acquaintance. Later described as "an irresponsible, irrepressible, happy-go-lucky Irishman," O'Rourke recognized Kellogg's heavy rocks as rich samples of galena, a mixture of silver and lead.

O'Rourke quickly got together three close friends. Accompanied by Noah and five pack horses, the fortune-hunters quietly left Murrayville that same night. Retracing Kellogg's route, the group arrived back at the fateful rock outcropping in Milo Gulch. Two mining claims were posted, one on each side of the gulch. One claim was named the Bunker Hill, and the other, the Sullivan.

The group stayed several days, collecting more ore samples. Then, on September 10, 1885, their heavily-laden pack horses arrived back in Murrayville, accompanied by the elated O'Rourke, Kellogg and friends. A second stampede followed almost immediately. Bonanza-hunters poured in from Murrayville, Eagle City, Spokane Falls, and eventually from the distant corners of the world.

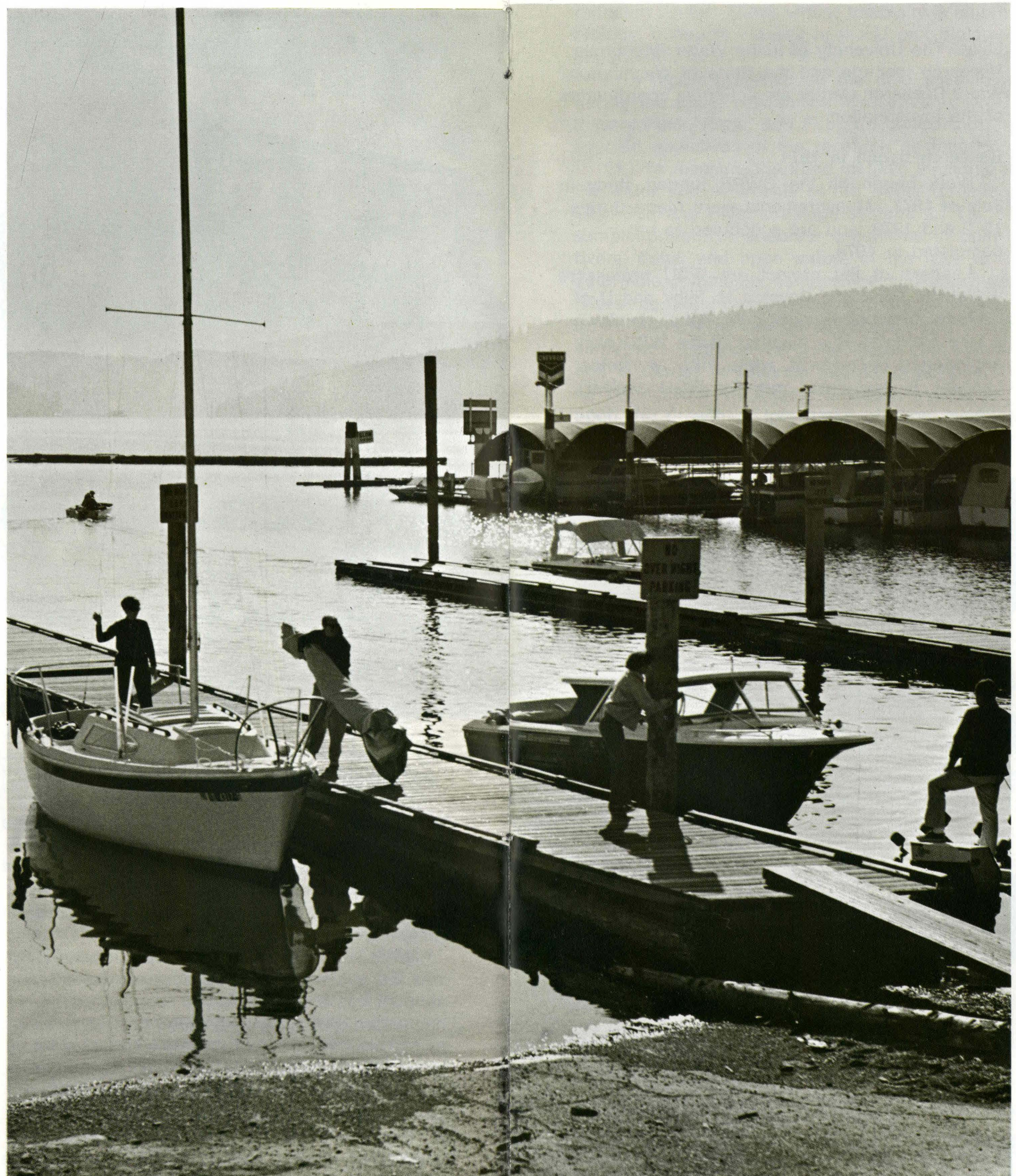
What happened next is firmly enshrined in mining history. Additional rich mineral outcroppings and veins were found along the South Fork. The Coeur d'Alene region was recognized as one of the richest mineralized areas of the world. Many miners and prospectors, including old Noah S. Kellogg, became wealthy beyond their wildest imaginings.

Another version of the Kellogg find was that he did, in fact, recognize the value of the "heavy rocks" and that he and O'Rourke conspired to defraud Cooper and Peck of their share of the discovery. This latter version was the one accepted by U.S. District Court Judge Norman Buck when suit was brought by Cooper and Peck. Buck ruled that Kellogg's grubstakers were entitled ". . . to a judgment of a quarter interest in the Bunker Hill claim."

Mining camps soon became towns

The legal dispute had little effect, however, on the activities along the South Fork. New communities soon came into being along the mountain stream. The mining camps of Wardner, Kellogg (named for Noah), Osburn and Wallace were established and grew into lusty towns.

At first, the ore, after being mined out of the hillsides, was transported down the Coeur d'Alene River valley by pack trains and boats to the town of Coeur d'Alene where it was loaded on



At right: The marina at the city of Coeur d'Alene is a focal point of much of the region's recreational life —which plays a major role in the area's economy.

railway cars for shipment to a smelter in Montana. Smelters later were built in the canyon proper to extract the valuable metals from the rock. The leftover "tailings" were deposited in the bottom of the South Fork canyon. Waste water from the smelting operations also was discharged down the river.

As all this took place in the Coeur d'Alenes, Spokane Falls was rapidly outgrowing its village ways. Some of the new millionaire miners began to invest their money in Spokane real estate and buildings. Coeur d'Alene Lake, too, began to develop as a vacation spot.

This growth of the Coeur d'Alene-Spokane region has continued up to the present. There have been some economic ups and downs, but the overall pattern has been one of steady expansion.

The village of Spokane Falls has had its name shortened, but its population has grown to nearly two hundred thousand. A trading center for much of eastern Washington, as well as northern Idaho, Spokane can now boast of modern stores, tall buildings and many large-scale activities. The availability of hydroelectric power during World War Two led to Spokane becoming a major processing center for aluminum ores.

The shores of Coeur d'Alene Lake also have had their share of increased activity, particularly in the past few years. The city of Coeur d'Alene now has some 16,000 permanent residents. Summer vacationers increase this total by a large number.

The population of the Coeur d'Alene-Spokane region is expected to take a dramatic jump in 1974, the year of Spokane's International Exposition. Most of the increase will be only temporary as out-of-state tourists make a visit to the Exposition, now under construction in downtown Spokane, part of their vacation plans. Some of the visitors probably will stay, however, drawn by the magnets of low population density, magnificent terrain, and what seems to be low pollution levels.

The environmental situation may be better in the Inland Empire than in many of the visitors' hometown regions, but there is still room for considerable improvement. It could be said, in sum, that at present much of the Coeur d'Alene River is a toxic sewer; only the northern half of Coeur d'Alene Lake is in good shape; and the Spokane River downstream from the city of Spokane is more polluted than it should be.

THE STUDY

Before an undesirable problem of any complexity can be corrected, the detailed facts must be known. This is especially true in environmental situations where too often the desire for a quick solution results in numerous would-be saviors galloping off in many directions.

To obtain scientific data about the Coeur d'Alene-Spokane environmental difficulties, the U.S. Office of Water Resources Research (OWRR) is supporting extensive research. Carrying out the studies are faculty scientists and graduate students at the University of Idaho and Washington State University. These educational institutions are located in Moscow, Idaho and Pullman, Washington—at the southern end of the Palouse Country—some forty air miles from Coeur d'Alene Lake. The University of Idaho Water Resources Research Institute and the State of Washington Water Research Center are acting as coordinators of the investigation.

Research began in 1971

Work began on the OWRR funded study in July of 1971. Measurements were made during 1972 and 1973, and are scheduled to be completed in 1974.

Leaders of the project are WSU professors William H. Funk and Royston H. Filby and U of I faculty member Frederick W. Rabe. Funk, a lake biologist, is a member of the WSU civil engineering department, while Filby, a nuclear chemist, is associated with the WSU nuclear radiation center. Rabe, whose specialty is aquatic biology, conducts classes in the U of I biology department.

Collection of aquatic insect specimens by University of Idaho graduate student Nancy Savage from the North Fork of the Coeur d'Alene River for comparison with the number of species found in the polluted South Fork.

In a report prepared on the data assembled during the initial year of the investigation, Professors Funk, Rabe, and Filby described the specific objectives of the research as follows:

"1.) To measure the trace metallic elements in the water and sediments of the Coeur d'Alene Lake-Spokane River drainage system; 2.) To sample bottom invertebrate organisms in both rivers, delta, and open waters of the lake to determine community composition and density as related to metal concentrations in the sediments; 3.) To measure by neutron activitation and atomic absorption methods the trace metal concentration in tissues of selected aquatic organisms; 4.) To measure the effects of added pollutants upon the growth of test algae utilizing modified bioassay techniques as outlined by the Provisional Algal Assay Procedures; and 5.) To establish base line data on the phytoplankton, composition, productivity and water quality of the Coeur d'Alene Lake and the Upper Spokane River."

To attain these objectives, the faculty and students from the two universities grouped themselves into several study teams, according to their backgrounds and areas of interest.

Dr. Fred Rabe, with the assistance of University of Idaho students, has been investigating the biological aspects of the Coeur d'Alene River and Lake, as well as those of the St. Joe River for a number of years. During the current study, Rabe and U of I graduate students Lawrence Bartlett, Jon I. Parker, Nancy Savage, and James Winner continued to concentrate on the Coeur d'Alene River and Lake.

Toxicity of metal wastes determined

Bartlett conducted laboratory tests to determine the toxicity to algae of some of the metal wastes found in the South Fork and Coeur d'Alene Lake. Parker studied the nutrients entering Coeur d'Alene Lake, and measured the algae growth patterns in various sectors of the lake. Savage collected aquatic insects and other forms of stream life from different places in the North, South and Main Forks as part of a determination of the health of those streams. Winner obtained samples of Coeur d'Alene Lake bottom organisms and sediments for the determination of species and chemical composition.

Dr. William H. Funk has been working for a number of years with his WSU associates and graduate students on water quality problems in various Spokane area lakes and reservoirs. Special attention has been paid by this group to algae growths and their trace metal contents. As a continuation of this specialty, Funk and the WSU researchers were given the responsibility of determining the water quality of the Spokane River, aiding in the bottom sediment work on Coeur d'Alene Lake and doing many of the laboratory water quality analyses.

WSU investigators taking part in the study included Richard J. Condit, Paul F. X. Dunigan, Kishor Shah, David Baugh, Ann Lydiard, and Neil E. Thompson. Condit analyzed the algae remains (diatoms) found in the lake sediments and performed algae species identifications for other members of the WSU and U of I groups. Dunigan investigated the inorganic nutrients and the trace element constituents of sediment cores taken from the bottom of Coeur d'Alene Lake. Thompson studied the water quality, algal, and bacterial makeup of the upper reaches of the Spokane River.

Minute quantities measured

One of today's most sensitive analytical tools —nuclear activitation—was used in the investigation to measure the minute, yet significant, amounts of metals present in plants, animals, and sediments of the Coeur d'Alene-Spokane drainage system. This part of the research was initiated by Dr. Richard Ragaini, and carried to completion by Dr. Royston Filby. In these efforts they were assisted by Kishor Shah, David Baugh and Ann Lydiard. Baugh and Lydiard are WSU students and Shah is a staff member of the WSU nuclear radiation center.

A staff chemist with the WSU civil engineering department, Paul Bennett, supervised the standard (wet) chemical analysis of water samples received from the study teams and also completed atomic absorption analyses of trace metal constituents of bottom organisms, fish, and algae. Leo Cunningham and Pat Syms of the same department assisted with the building of special sampling equipment and with the obtaining of sediment samples. Fred Bennett of Walla Walla College also was involved in the construction of the sampling equipment.

THE FINDINGS

Coeur d'Alene River

As mentioned near the beginning of this article, the Main and South Forks of the Coeur d'Alene River are regarded as being almost deserts, biologically speaking. This may not be an exact term to use as it has been demonstrated that many desert areas have a wide variety of life contained in their sandy washes and canyons. But if the term is defined as meaning almost devoid of living forms, then its use to describe this portion of the Coeur d'Alene River system is appropriate.

There is little life in the river, from Harrison to above the mining district—generally considered to end at Mullan, Idaho. The North Fork, in contrast, is teeming with the normal stream biota—aquatic plants of many species, insects and their larvae, and fish. The North Fork is especially known among fishermen for its healthy population of cutthroat trout. The difference, of course, is that there are no mining or smelting wastes being discharged into the North Fork, as is the case with the South Fork.

The dumping of left-over materials into the bed of the South Fork began after mining operations started at the Bunker Hill and Sullivan claims staked out by O'Rourke, Noah Kellogg and their fortunate acquaintances. The wastes had to go somewhere, and the valley of the South Fork is a narrow place. Besides, in the late 1800's, ecology and environmental protection were not exactly household words.

As stated in a report by Funk, Filby and Rabe on their first-year findings: "Tailings from ore crushing mills have been a source of large amounts of rock flour. Oxidation of heavy metal sulphides in subaerial tailings and subsequent leaching has contributed ions of heavy metals. Effluents from lead and zinc smelters have contributed particulate matter and heavy metal ions." The heavy metals referred to by the investigators are such materials as lead, zinc, cadmium, copper, etc. They are called heavy by reason of their dense nuclear structure. However, the term now is being commonly applied to all toxic metals, even those with low atomic weights.

Massive quantities of these wastes have been carried down the South and Main Forks and into Coeur d'Alene Lake itself. However, starting in 1968, the mining district firms began taking action to correct this dumping of sediments in the South Fork. Huge ponds were built to collect the tailings, the leftover material from the mining operations. It is estimated that over one million dollars were spent in the construction of these holding facilities.

Tailings also are being returned to the underground tunnels and stopes of the mines in another attempt to reduce the pollutional load on the South Fork. It has been estimated that 60 percent of the total tailings being created are being returned to the old mine workings.

Tailings ponds not complete cure

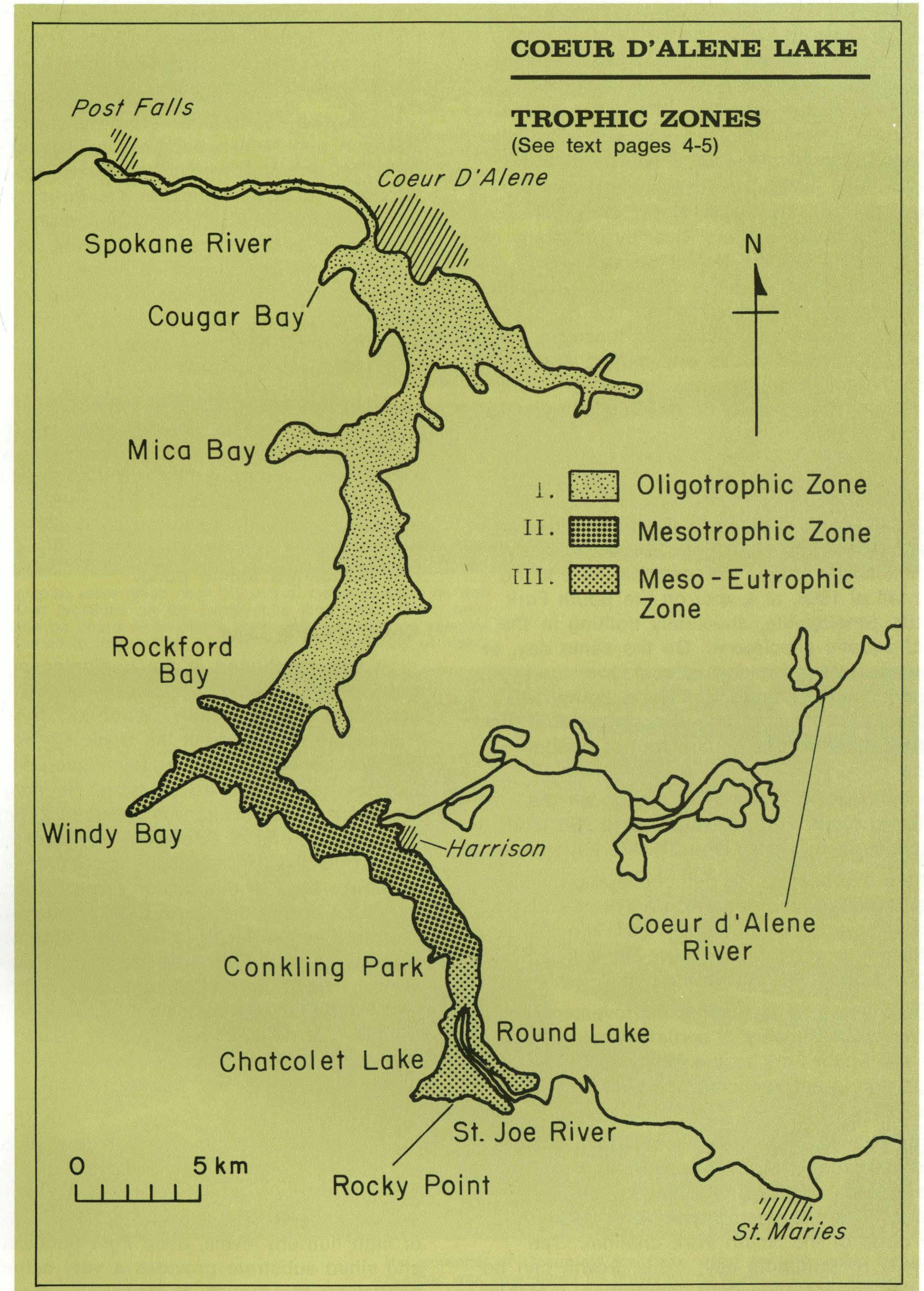
Unfortunately, however, the tailings collection ponds are not proving to be a complete cure. Cadmium, lead, zinc, and mercury are draining in solution form from the old tailing piles into the South Fork. These metals are not considered to be healthy for aquatic life when present in large quantities.

As far as the reactions of trout to these metals are concerned, the Funk, Filby, and Rabe report states: "These fish appear to produce a heavy secretion of mucus to rid their systems of metals absorbed from the water and as a result suffocation soon follows. Chronic exposure to low levels of metals also results in internal stress reactions."

Some tests were made back in 1969 by Claude W. Sappington, an earlier student of Professor Rabe's, on the specific effect of zinc on cutthroat trout fingerlings. Using a system of recirculating water in small tanks, Sappington exposed the fingerlings to different concentrations of zinc in the water. He found that when the level of zinc in the water reached 0.42 parts per million—i.e., less than half of one part per million— fifty percent of the fingerlings would die if kept in this water for 24 hours. If the tiny fish were kept in the tanks for 96 hours, and the concentration of zinc were cut to 0.09, fifty percent still would be killed.

Zinc concentrations as high as 21 parts per million were detected in the South Fork in 1969, according to a 1971 publication of the Idaho Bureau of Mines and Geology.

One of the yardsticks by which biologists



measure the health of a stream is the number of aquatic animals, such as the larvae of midges, mayflies and stoneflies, which can be collected from a certain area of stream bed, such as one-tenth of a square meter. In addition to the total number, scientists take into consideration the diversity and number of different species.

Collections of this nature were made at various spots on the South, North, and Main Forks of the Coeur d'Alene River by University of Idaho graduate student Nancy Savage. Her findings further illustrate the differences in water quality among the three streams. The North Fork sampling stations, as well as those on the South Fork located above any mining operation waste effluents, had many species present. She also found a high density of individual specimens at those stations.

No aquatic life opposite Smelterville

The sampling stations in the mining district proper, and on the Main Fork below the district, were a different story. For example, she found in the fall of 1968, at a spot on the South Fork opposite Smelterville, absolutely nothing in the way of aquatic specimens. On the same day, at a point several miles downstream from the confluence of the South and North Forks, 125 individual specimens of one species were all that could be found in one square foot of bottom surface.

In contrast, at a sampling station on the unpolluted North Fork, Savage found 368 individual specimens comprising 27 different species.

There has been some detectable improvement in total numbers and species present at some sampling stations on the South Fork since the tailings ponds were built. However, the contrast with the North Fork still is striking.

There has been a distinct improvement, however, in the amount of sediment being carried down the South Fork to the Main Fork. The tailings ponds are reducing the turbidity of the water.

This change in sediment load has had an unexpected result, according to Funk and Rabe. Large masses of a type of algae called the periphyton have become attached to rocks in some parts of the South Fork channel. The university investigators say: "This growth can be attributed to increased light penetration, a stable substrate and moderate to high levels of macronutrients." Funk and Rabe go on to say that an apparent source of these nutrients is sewage from the surrounding towns.

It may be a long time before the river between Harrison and Mullan becomes a productive place for anglers to cast their lures. However, improvement is expected in the human wastes aspect of the South Fork's water quality. In January of 1972, the residents of the South Fork mining communities decided it was time to stop dumping their sewage into the stream. A bond issue for a sewer collection and treatment system, which had been voted down in 1968 and 1969, was approved.

Until this new collection system is completed, however, raw sewage, including the wastes from homes and a hospital, will be coming down the South Fork, adding to the pollution load on that stream. It should be pointed out that the sewage from the community of Kellogg already is being treated along with mine wastes in the Bunker Hill Company's tailing pond.

Coeur d'Alene Lake

It was mentioned at the beginning of this article that lake scientists classify bodies of water according to their fertility. When Mr. Jon Parker, a graduate student from the University of Idaho, got done with his on-the-lake measurements and his back-in-the-lab analyses, he added up the score. The results—as mentioned earlier—the northern end of Coeur d'Alene Lake is oligotrophic, with the exception that some of the shallower bays in this sector verge on being eutrophic during the warm days of late summer. The area about Rockford Bay (see map on p. 15) south to Shingle Bay, drew the middle classification of mesotrophic. The rest—Chatcolet Lake and Round Lake, were called "strongly mesotrophic." Mr. Parker went further as far as the shallowest parts of Chatcolet, etc. were concerned, declaring them to be "heavily enriched and eutrophic."

Rooted aquatic plants—with tongue-twisting names like Potamogeton, Myriophyllum, and Anacharis—grow thickly in these shallow waters, according to Parker. He states: "A combination of high nutrient levels, deep light penetration and silted substrate provides a very suitable habitat for the growth of these . . . plants."

Water samples were taken near the city of Coeur d'Alene as well as at other locations on the twenty-mile long lake. Some tests were made on board while others were deferred until the samples were returned to laboratories at WSU and the University of Idaho.

The potential of Coeur d'Alene Lake water for stimulating the growth of algae was determined by University of Idaho graduate student Robert Minter. Light and dark bottles were used as part of C^{14} measurements.

There seems to be an inverse relationship between such large varieties as Potamogeton and the tiny algae on the opposite end of the aquatic plant size scale. Where Potamogeton, etc., are found in large quantities, there will be a scarcity of the planktonic, or free-drifting, forms of algae. Some varieties of the latter are so minute that thousands of individual specimens could co-exist comfortably on the surface of a dime.

Mr. Parker found that this inverse ratio between the large rooted forms and the tiny species exists in Coeur d'Alene Lake. At the Chatcolet end, where the rooted varieties were almost thick enough in spots to slow down a boat, the concentration of the planktonic drifters was low. Farther north in the lake, where the water depths were greater and the rocky shores less suitable for the rooted types, well-developed communities of algae were found. Lake scientists have theorized that the macrophytes (the term used for the rooted species) are either better competitors for the nutrients than are the phytoplankton (the tiny fellows), or that some unknown antagonistic mechanism or substance tends to limit the phytoplankton where the macrophytes are common.

Algae essential link in food chain

It should be pointed out that the planktonic algae, especially what are called the green forms, are vital links in the food chain existing in lakes and reservoirs. Algae utilize the sunlight which filters down through the upper part of the lake waters to change the inorganic salts present in the water into sugars. These sugars are stored in the tiny bodies of the algae.

The algae may be "grazed upon" by the protozoa, microscopic-sized animals which live in the water. The protozoa, in turn, may be food for small crustaceans, such as water fleas and shrimps, which also consume algae. Next in the consumption line are the carnivorous fish which may be eaten by the ospreys, herons—and man.

Thus one might draw the gross conclusion that if a large population of fish is desired, then a large population of planktonic algae would also be worthwhile. As a general statement, this would be true. If algae are not present to initiate the biotic part of the food chain, fish will not be present either.

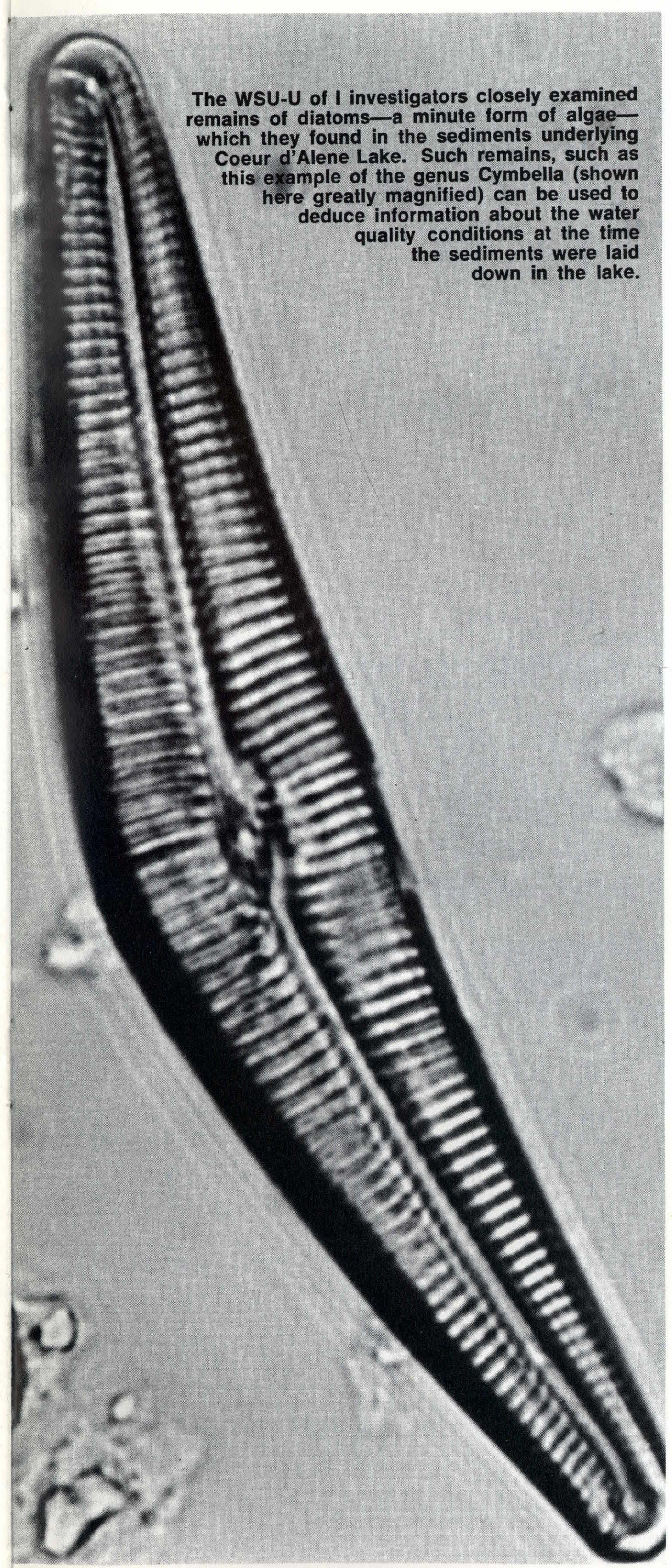
It should be pointed out, especially to those anglers who would like to head homeward with fuller creels, that there is a point of diminishing returns when it comes to encouraging the growth of more algae so as to grow more fish. Up to a point, more algae in the lake waters will mean more fish swimming to and fro. But too many nutrients in the lake may cause the algae to go on a population explosion. They may grow so thickly that the oxygen in the lake waters may become depleted. Without oxygen, fish cannot survive.

There are "good" and "bad" algae

There is another factor which should be kept in mind. There are good algae, such as the green forms referred to earlier. There also are bad algae, such as the blue-green forms. These undesirable fellows cause off-flavors and odors in drinking water, clog pipe filters, produce slimes, and induce corrosion of metals and concrete. And as if this were not a sufficient list of "crimes," the blue-greens also produce toxic materials which can cause the death of wild and domestic animals which drink water containing these algae. So it is of more than academic interest to note that the U of I-WSU investigators found that by July, the blue-greens had become the dominant algae in the southern end of Coeur d'Alene Lake. By August, when the water temperatures had climbed higher, the blue-greens were dominant throughout the lake.

Attempts are being made to correct some of the pollution problems at the southern end of the lake. Public hearings have been held with lake cabin and houseboat owners in the Chatcolet area to focus attention on the need to divert human wastes away from the lake. An expensive sewer collection and treatment facility may be a necessary—and expensive—answer.

University of Idaho graduate student James Winner took a close look at the aquatic insects which inhabit the bottom waters of Coeur d'Alene Lake. These tiny forms of life reveal much about the quality of the water they live in. Bottom-dwelling insects are excellent indicator organisms because many species are extremely sensitive to changes in water quality, relatively sedentary, and have a complex life cycle of a year or more. Thus, their presence or absence may reflect physical or chemical changes in the water over a period of time.



The WSU-U of I investigators closely examined remains of diatoms—a minute form of algae—which they found in the sediments underlying Coeur d'Alene Lake. Such remains, such as this example of the genus Cymbella (shown here greatly magnified) can be used to deduce information about the water quality conditions at the time the sediments were laid down in the lake.

Samples of these tiny aquatic animals were collected—with a small hand-operated dredge—from four areas of the lake during the summer and fall of 1971, and also during the spring of 1972. Sixty-two types of insects were identified and counted by Mr. Winner. Included were 26 species of Chironomidae (midge fly larvae), nine Hydracarina (water mites), nine Trichoptera (caddis worms), five Ceratopagonidae (fly larvae), and 14 other groups. The chironomids made up the majority of the organisms collected.

The sampling stations near Harrison, where the Coeur d'Alene River emerges into the lake, generally contained the least amount of chironomids and oligochaetes. Only at Cougar Bay, located at the north end of the lake, did the small dredge come up with lower numbers of oligochaetes. A factor here may be the dense layer of bark on the floor of Cougar Bay. Large log rafts are often moored in this area before they are towed down the Spokane River to the downstream sawmills. Mr. Winner speculates that the bark may be an unsatisfactory habitat for the oligochaetes.

Bottom sediments reveal trends

Another major part of the Coeur d'Alene studies was to scrutinize the sediments on the bottom of the lake. Such an examination provides a "look at the past" in terms of what has happened, both physically and biologically, and may provide a yardstick against which present trends may be measured.

Funk and Rabe knew that large amounts of fine rock dust from the ore-crushing operations at Kellogg, etc., had been carried down the South and Main Forks of the Coeur d'Alene River and into the lake since 1885. A study done in 1932 by M. M. Ellis for the Commissioner of the U.S. Bureau of Fisheries had found at that time rock flour almost everywhere on the lake's bottom.

However, it was not just enough to know that the mining wastes were there. Funk and his students wanted to know how thick these waste sediments were, how they were interacting chemically with the overlying waters of the lake, and if the rock dust was passing out of the lake and into the upper Spokane River. Underlying the desire for this information was the need to know whether or not the metals from the mining wastes, such as zinc, cadmium, copper, etc., were being concentrated up the food chain—algae to protozoa to fish to fish-eating birds and to man. Considerable attention has been focused in recent years on the concentration of DDT in similar food chains, but little is known about the possibility of the same reaction taking place with the mining metals.

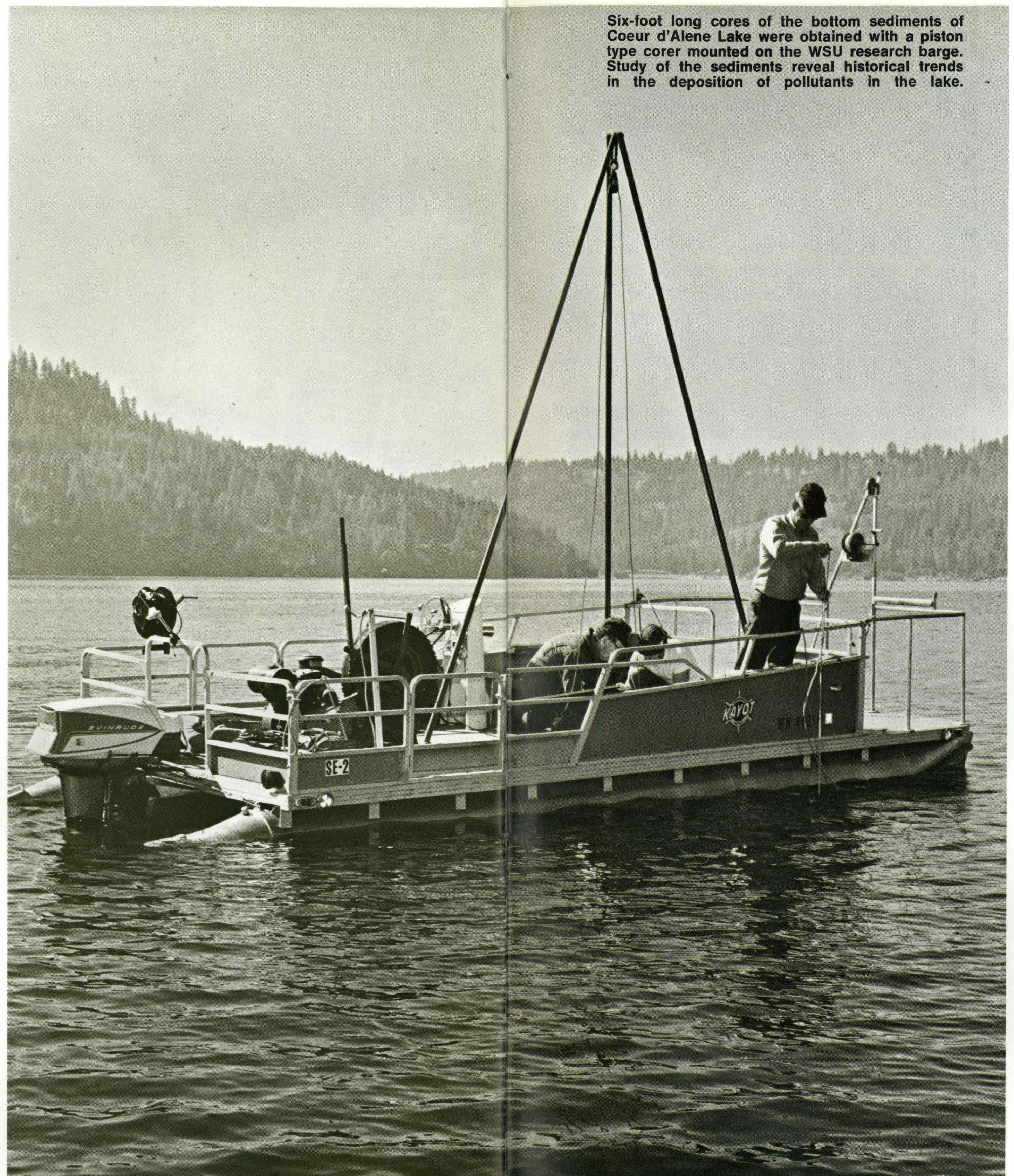
To collect the bottom sediments from different spots off the Coeur d'Alene River delta, a special core sampler was constructed in the WSU civil engineering shops and mounted on the department's pontoon boat. Once in position on the lake, the sudden release of a suspended heavy weight built onto the end of the core sampler jammed the device six feet into the lake sediments. Cellulose acetate liners were pre-inserted into the coring device so as to preserve an undamaged sample 1¼ inches in diameter and six feet long. After withdrawal of the core, the samples and the liner were cut into five-inch lengths and stored at 4°C.

High concentration of metals found

Upon return of the sampling party to the WSU campus, the core sections were subjected by WSU graduate student Paul F. X. Dunigan to a variety of analyses to determine their chemical and biological contents. Results of the tests indicated, as was expected, high concentrations of the mining district waste metals in the bottom sediments. In the core obtained just off from Harrison, significant amounts of metal were found to extend down to between 31 and 32 inches. Below that depth, the amount of metals in the sediments dropped dramatically. The sediments below this point, Funk and Dunigan believe, were deposited before mining operations began.

This shift in metal content was found at less deep points in the sediment cores taken farther out in the lake. The project report states: "The decrease in sedimentation rate with distance from the mouth of the Coeur d'Alene River reflects a particle size differential. Larger particles tend to settle nearer the mouth of the river. Smaller particles tend to settle near the middle of the lake. . . ."

Additional analyses were made, primarily by Richard J. Condit of WSU, to see if evidence could be found in the core samples of the mining wastes' biological impact. Tiny plugs (½ inch long and ¼ inch in diameter) were taken with a cork-type borer from two of the six-foot long cores. Each of the small plugs then were treated chemically and by boiling to isolate any algae from the sediments.



Six-foot long cores of the bottom sediments of Coeur d'Alene Lake were obtained with a piston type corer mounted on the WSU research barge. Study of the sediments reveal historical trends in the deposition of pollutants in the lake.

Careful examination under a microscope at magnifications of 600X and 1000X disclosed that the extremely minute forms of algae called diatoms had been affected by the mining wastes. The diversity of diatom species changed at the same point in the cores as the metal content changed. Also many of the diatom shells found in those sediments containing the high amounts of metal were deformed and twisted. The university investigators believe the change in diatoms was caused by the toxicity of the mining wastes, with the turbidity of the water containing the rock flour being a contributing factor.

Funk points out that the ponds constructed by the mines in 1968 to hold their tailings may be having a favorable effect on the diatom population of the lake. More of the types of diatoms commonly found in oligotrophic waters were present in the uppermost layers than in the lower sediments containing the high concentrations of mining wastes.

Spokane River

The research team was unable to obtain cores from the bottom of the Spokane River, primarily because of hard strata. Plans have been made to obtain sediment samples during the summer of 1973 by scuba-diving. However, a wide variety of other kinds of physical and chemical measurements were made over a period of a year on the Spokane River between Coeur d'Alene Lake and the city of Spokane by WSU graduate student Neil Thompson. Temperature, conductivity, bacterial contamination and oxygen, nitrogen, phosphorus and metal content were among the variables studied.

With regard to this section of the river, Funk states: "There is a great deal of human activity along the river in this region which includes additions of materials from domestic sewage effluent, four lumber mills, and an industrial park. . . . It is suspected that periodically slugs of water passing downstream with higher than average dissolved solids are the results of industrial or domestic dumps or possibly bottom scouring."

The authors report that the major algal nutrients—phosphorus and nitrogen—are not found in the river waters in large quantities. However, they add: ". . . to maintain the river in its present state of early mesotrophy, control of these two nutrients will be essential."

As far as bacterial content goes, the river waters are in relatively good shape. The number of fecal coliform bacteria (found in warm-blooded animals) is not high but the number of total coliforms is high enough to degrade this stretch of the river from Class A to Class B of federal water quality standards.

The upper Spokane River does have a higher concentration of metals in its water than do lakes in the region or the Columbia River, according to the Funk, Filby, and Rabe report.

Concentration by the biota

As mentioned earlier, one of the key questions the university researchers wanted to answer was whether the biota of the lake and the river—the algae and other water plants, the protozoa, and the fish—were concentrating the heavy metals in their tissues. The measurements made by the WSU-U of I team are not yet conclusive, but the preliminary results point to an affirmative answer. As phrased in the study team's report: "Analysis of bottom organisms, aquatic plants, and fish tissue . . . strongly indicate that many of the metals occur within the tissues of those organisms."

The investigators found what they term "very high . . . concentrations" of copper, zinc, cadmium, magnesium, mercury and lead in the larvae of caddis and mayflies. A similarly high concentration of metals was found in a species of snail Physa sp. which apparently eats algae, and scavenges dead plant and animal matter.

Tissues of such Spokane River fish as perch, bullhead and squawfish were examined for the presence of the heavy metals. The results, though labeled as preliminary by the authors, indicate a postive concentration of the metals. Funk, Filby, and Rabe state: "Inspection of the data indicates . . . larger quantities of the heavy metals in the filter bodies (kidney and liver tissue) of all species of fishes.

The researchers go on to point out that fillet tissues taken from the same fishes were considerably lower in metal composition, and that the fish, however, appeared to be healthy.

Additional analyses are planned on more specimens of fish during the 1973 summer.

THE OUTLOOK

An additional year of data gathering lies ahead for the U of I-WSU research team, but some preliminary conclusions appear obvious. At the southern end of Coeur d'Alene Lake, in the Chatcolet, Round Lakes sector, the fertilization of the water must be arrested. Otherwise, swamps and grass will replace the water of the lake and the rich aquatic biota that accompanies it. As for the middle and northern portions of the lake, their condition is not as critical as the southern end, but there is no reason for complacency. The eutrophication of some of the shallow bays during the late summer is a warning sign that should not be ignored by the users of the lake.

The Main Fork of the Coeur d'Alene River has been improved in turbidity since the installation of the mining firms' holding ponds for their tailings. The construction, now underway, of a sewage collection and treatment system of the communities in the South Fork Valley will help considerably in reducing the pollutional load on the river. However, with such high concentrations of mining waste metals being leached into the river, it would be difficult to forecast when the many miles of the South and Main Forks ever will be anything but a toxic, open sewer.

More optimism can be marshalled about the upper Spokane River since it is presently in relatively good shape. However, if the Spokane Valley and the Rathdrum Prairie should have a large population influx following EXPO 74, the quality of the river could be seriously threatened.

The citizens of northern Idaho and eastern Washington owe a great deal—both economically and aesthetically—to the streams and lakes of their region. The well-being of these aquatic resources should be at the top of any priority list. They are too important to be left to chance or to random development.

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by William H. Funk, Fred W. Rabe,
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