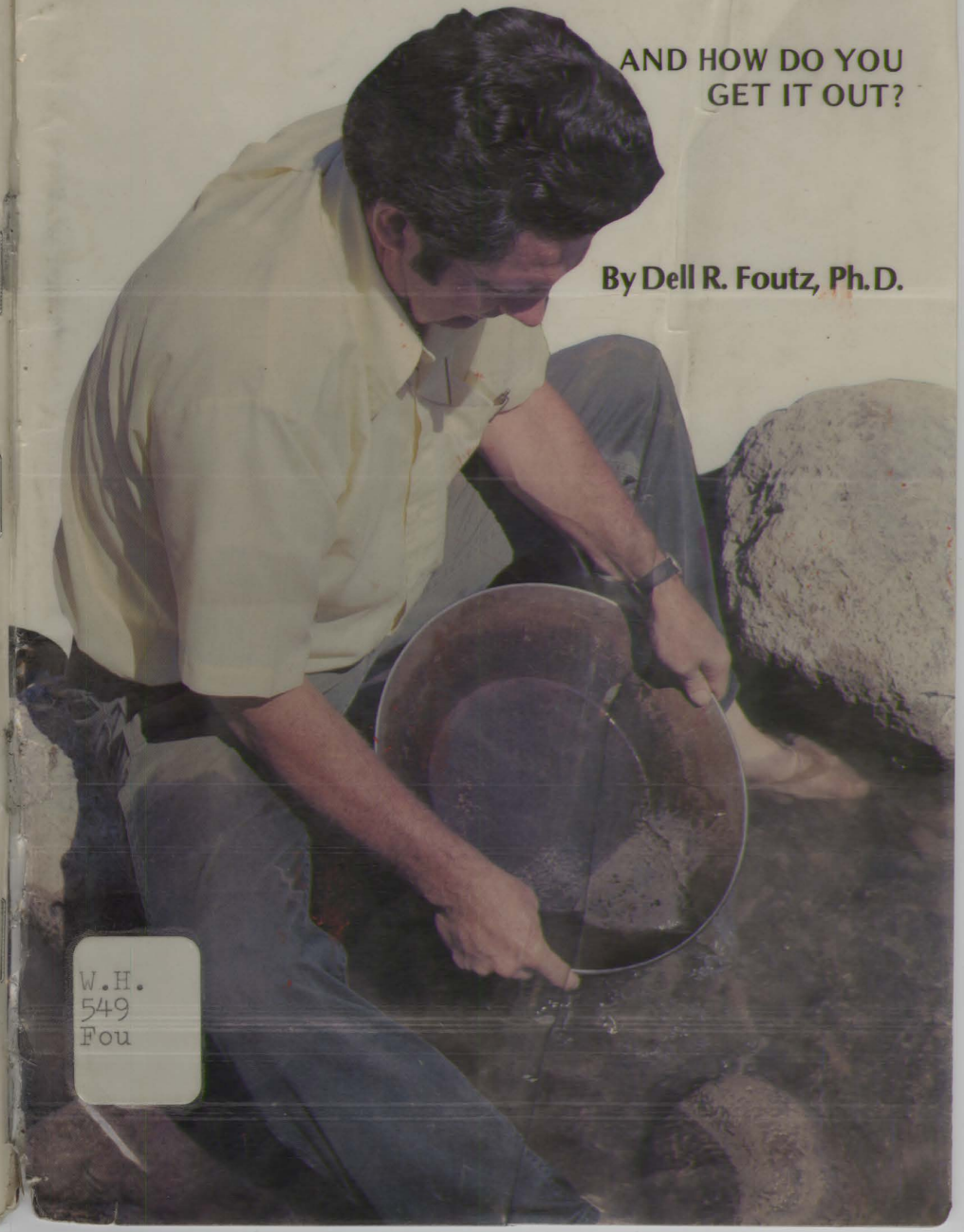
A battered Lincoln penny with 1 mm flake of stream-flattened gold from the Colorado River. At $400 an ounce, the piece of gold is worth approximately one cent.

Where is the Gold on the Colorado River?

AND HOW DO YOU GET IT OUT?

By Dell R. Foutz, Ph.D.



W ld ?

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WHERE IS THE GOLD ON THE COLORADO RIVER?

INTRODUCTION
(Or, Who Cares About It Anyway?)

Gold occurs along the Colorado River from Granby, Colorado to the Gulf of California—and, if that is really all you wanted to know, you could toss this book aside right now. But gold is an "enchanted metal" and, if you are one of the millions who have been touched by that enchantment, you want to know some of the "wheres" and "how muchs" and "how bigs" of the gold accumulations along the Colorado. The metal is capricious and there are some interesting surprises.

This book documents a few genuine concentrations of gold along only the Colorado River. Because of the peculiar nature of the concentrations, there is a lot of discussion to explain why the gold is in one place and not in another. That sort of information will be useful on any river or creek in the world. I still remember Jack London's short story, "All Gold Canyon", which I read as a youngster in the 1940's and I realize now that the principles that were used by that old prospector still work. In that story the old timer worked upstream and checked for where the gold stopped on a stream. When he no longer found gold in the main stream, he checked to see which *side* of the stream supplied the gold from his "Mister Pocket." And that is where the plot gets exciting. Jack London was no geologist, but he knew some of the eccentricities of gold. Even for a novelist, gold follows some of its own rules.

As a college geology professor living a mile from the river, I have been aware of a renewed interest in placer* gold since the government-controlled price of $35 per ounce was dropped in 1970, the questions about gold increase in direct proportion to the market price. And, in the teaching business, I soon found that a guaranteed way to perk up a dead college class was to mention that there is recoverable gold a mile from the classroom and potentially commercial gold within 100 miles in two or three different directions from the campus.

In 1979 an engineer at Montrose, Colorado, named Ed Adamson, offered a night class on gold panning and about 70 students enrolled. The class learned some of the details of placer deposits and recovery methods and then spent a day on the stream panning the gold themselves. The class was so successful that the instructor decided to offer the same class in the spring of 1980 on the Mesa College campus in Grand Junction. Enrollment was closed when 120 students signed up, and when the first night class assembled there was standing room only with students and "class crashers" jammed in the hall to hear what they could about that mysterious metal—GOLD!

I attended that course. In fact, I anticipated the course and had a full line of rock hammers and gold pans available at 30% discount. I nearly sold out during the coffee break on the first night and could not get re-supplied before the class ended six weeks later. During one of the sessions the instructor asked if there were any good gold gravels near Grand Junction. I volunteered that there were none and that the panning trip probably should go back to his old stomping ground near Montrose, Colorado. As soon as I told him that there were no good spots near Grand Junction, I knew I was in trouble. I didn't know *for sure!* I would have to find out. This little book would *have* to be written!

*Placer deposits are those in alluvial deposits of sand or gravel as contrasted with the more typical mineral deposits in veins or hard bedrock.

CHAPTER I

First things first—Put the Gold in Colorado

Let's start with a 20-second course in historical geology. About 65 million years ago the American Plate of the Earth's crust slammed into the Pacific Ocean Plate. Part of the American Plate tried to grind upward, over the ocean plate, causing a spectacular wrinkling, buckling and up-thrusting of the rocks in the Western Americas. As the continental rocks pushed upward, some of the ocean plate was forced downward into the hot mantle, where some of the ocean plate was remelted. The origin of Colorado's gold is in that hot, molten rock that tried to boil its way back to the surface.

In some places, the molten stuff, with its volatile gases, pushed all the way to the surface and exploded into Mt. Saint Helens—like volcanoes in the San Juans and West Elk Mountains. In other areas, depending on the thickness of the crust and the pattern of faults and wrinkles, the molten stuff did not have enough oomph to break through; so it crystallized below the surface in huge pods of igneous rocks. The little veins of quartz and other minerals that leaked out of those pods of molten rock carried the accessory stuff like lead, silver, copper, zinc and gold. As rock minerals crystallize, some of the more volatile elements, such as chlorine, hydrogen, sulfur and the valuable metals, move in solutions at high temperatures into cracks and soluble zones of the overlying rock and get deposited as ore veins or pockets. This mountain-building took millions of years and left a fantastic variety of metal deposits. Names like Butte, Montana; Coeur d'Alene, Idaho; Bingham, Utah; Goldfield, Nevada; Cripple Creek, Colorado; Morenci, Arizona; Cananea, Mexico; Chuquicamata, Chile and the Yukon River, Alaska, are just a few of the local spots that were blessed with bonanza values in this mountain-building chapter of the earth's crust.

Now for this book, let's focus on the headwaters of the Colorado River in Colorado. Gold was injected into the San Juan Mountains in the southwest,and in the Front, Sawatch and Park Ranges near the center of the state (Figure 1). These areas have gold and lots of it. Most of the original gold deposits have been in place for over 15 million years and the streams

and glaciers have been tearing away thousands of feet of bedrock to expose the rich veins and "mine" them out. Today there are actually tons of tiny specks of gold left scattered along the riverbanks all the way to the Gulf of Lower California.

Glaciers were intermittently active only for the last two million years, and they were capable of pushing any size nugget as far as they went. Where the glacier ended there is a pile of unsorted "moraine". The moraine in each valley has a terrace or fan of "outwash gravel" on the downstream side. Some outwash gravels go tens of miles downstream. When the glaciers were around, there was more precipitation and much bigger streams. So, each glacier episode left a high-water mark. There is a gravel terrace for each surge of the glaciers, and there were at least four major surges. Today there are only scattered remnants of the old gravels (see Figures 1, 2 and 3). They remain as flat-topped gravel benches that occur in a haphazard pattern along the valley wall wherever the modern stream has not washed them away. Glacial terrace gravels may *have more gold* than the gravels in the present channel. Remember that the glacier scraped out the gold above the moraines. Lake Granby is on the end moraine

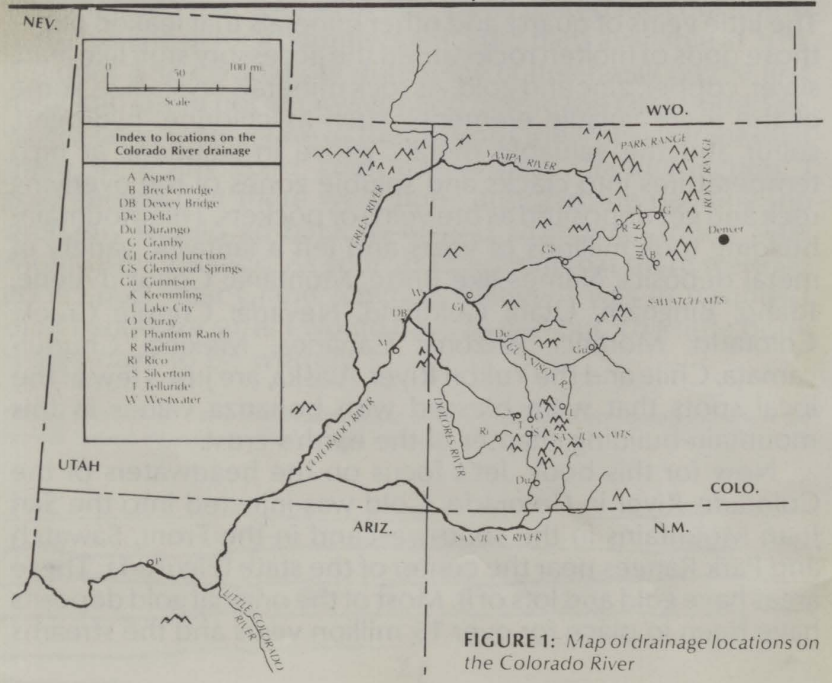

FIGURE 1: *Map of drainage locations on the Colorado River*

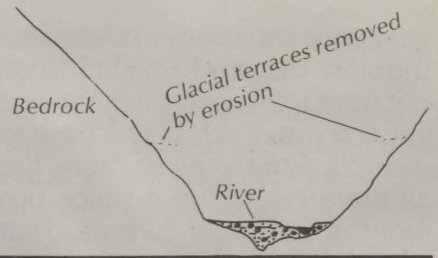

FIGURE 2: *In steep canyons gravel is scarce and mostly in present channel*

for the upper Colorado River. The gold upstream from the moraines has had only about 10,000 years to collect. Below the moraines it has been accumulating for millions of years. However, close to the source, there is a lot more gold to start with and much less gravel. Some of the gold on the lower Colorado comes from the Green River, which picks up gold from the Wind River Mountains in Wyoming. Some of the San Juan River's gold comes from New Mexico and there is gold from sources in Arizona and probably California. However, the interesting parts of the river for gold "prospecting" are mostly upstream from Moab, Utah. Below Moab most of the river is tied up in special federal reservations and, although there is gold all along the river, there is not much the average citizen can do with it below Moab. It would be tough to develop a good mine under Lake Powell, Lake Mead or in the bottom of the Grand Canyon.

The Silverton mining district is in the San Juan Mountains; and Ouray, Telluride, Powderhorn, Lake City, Placerville and Rico all produced (or still produce) gold. In the central part of the state, Aspen, Leadville, Breckenridge, Gilman, Climax, Quartz Creek and Gold Creek should remind us that there is gold in the headwaters of many of the tributary streams of the Colorado River.

We have now introduced several ideas that you will need in order to understand the rest of this book. We have said *glaciers* and *tributary streams*. Glaciers have a lot to do with

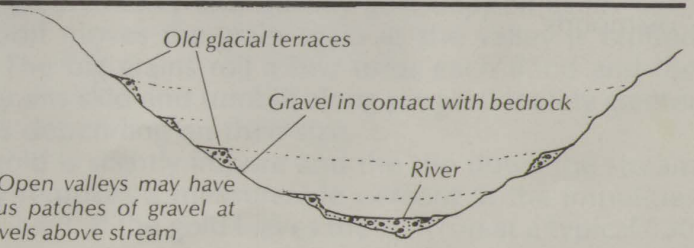

FIGURE 3: *Open valleys may have discontinuous patches of gravel at persistent levels above stream*

gold concentrations in old, elevated stream terraces. And the tributary streams brought the gold to the Colorado. If you do not want to plow through the rest of this book, and you want to get rich with gold, all you have to do is to go to the old mining districts, pan the rivers there, find a good zone, stake claim to all the area, set up a sluice box or dredge and retire in 18 months with your fortune. That is what the old timers did when gold was worth $20 an ounce or so. The only problem is, virtually all the big and rich placer deposits on the entire length of the Colorado and its tributaries are already claimed. Some are still being worked commercially today. Here is a warning. Just knowing how and where to look for gold does not give you permission to take it. There are still things like property ownership, state and federal laws governing mineral extraction, and so on. In most cases, a person with a gold pan is not much of a threat to the owner of a deposit of gold-bearing gravel. A few pan loads of gravel are insignificant. However, being in an army of gold panners or being the person with a sluice box or dredge on private ground could be hazardous to one's health. The special state or federal reservations present similar problems.

If you are an attentive reader, you have guessed that this book will not tell you how to get rich from gold along the Colorado River. If it were that easy, your writer would be out getting rich instead of writing about it. If you want gold, go to Clear Creek, near Golden, Colorado, and elbow your way in among the Sunday tourists and you can pan a few colors there. You can do the same thing on the Blue River near Breckenridge or along the San Miguel any place between Telluride and its confluence with the Dolores River. The entire Dolores is also good. You could even try the Uncompahgre River between Ouray and Montrose. The gold is bigger in Australia and Alaska, or even in California. The richest place of all is in South Africa with potential bonus nuggets called "diamonds".

It's a tough trip downstream

Now that all the "get-rich-quick" readers have packed their gear and left for one of those exotic places, let's get back to the Colorado River. Perhaps you are stuck somewhere along the river because of a messed up vacation—or the fish quit biting. Whatever your reason, let's look at the possibilities to find gold at any given point along the stream.

First, the gold is in larger pieces but, oddly enough, slightly poorer quality in the headwater areas. Nearly all gold is rather *finely disseminated* in its original deposit. In fact, when the Standard Metals mine at Silverton was among the top five gold producers in the nation, I could find *no visible gold* in the high-grade ore—either at the vein underground or on the ore pile outside the mine. One of the mine geologists showed me a sample on the outside ore pile which had visible gold, but even there all the gold was very hard to see, especially without a hand lens. Before you throw this book down in disgust, let me remind you that I *know* about the rich bonanzas at Cripple Creek, and the 30-pound chunk of ore taken from a road cut in Leadville in the 1970's. And the many pounds of Australian nuggets, and the satchel loads of nuggets from California and Alaska. Even the dazzling Colorado specimens at the Denver Museum and the Colorado School of Mines display at Golden, Colorado. But my statement is that "*nearly* all the gold is rather finely disseminated in its original deposit".

For every spectacular chunk or nugget found there are fortunes in tiny specks. The larger pieces enter the stream at the original deposit right along with the finer "dust". The larger the piece, the heavier it is and the more likely it is to become lodged in the streambed in a place where the spring floods cannot dislodge it. Eventually the streams erode the place of lodgement and the grain can renew its journey. But, if the grain is big, it is very heavy and quickly gets trapped again. Each major flood moves the grain again as the valley is eroded deeper. The big grains roll a few turns each flood and the smaller grains skid and tumble along proportionately greater distances depending on their size.

The gold is slightly impure and the trip down the stream gradually removes a measureable percent of the impurities (mostly silver). If the gold leaves the outcrop at a typical 830

fine (83% pure) it may be cleaned up to 880 fine or possibly 900 by the time it moves 200 miles down the channel. So, the grains get smaller as they move downstream. Mostly it is selective winnowing because the stream cannot move the larger grains. There is also some abrasion to the grains as they scrape and slide among the moving boulders and pebbles of the stream bed. Color Plate 1A shows a rough grain, which has travelled a short distance, alongside some smooth grains which have moved 100 miles or more.

On the Colorado the "grains" are in fact tiny specks. The largest I have seen are flakes slightly larger than 1 mm or about 1/20th of an inch (Plate 1B and 1C). These would be worth about a penny each with gold at $400 per ounce. The vast majority are less than ¼ mm. I know there are coarser grains than these, and a ¼" piece was reported from the commercial operations at Dewey Bridge, Utah. This is more than a hundred stream miles from the nearest source. The biggest problem with recovering the gold on the Colorado is the small size of the grains. It has been dubbed "flaked gold" and "flour gold". If you had a cup of the stuff you would surely call it "dust". Even with very careful panning, it is easy to lose a few of these "colors". To increase your chances to find more of the little specks, let's set up a few rules.

Rule No. 1: It's in the gravel

Gold tends to concentrate among gravel (pebbles, cobbles, boulders) rather than with sand alone. Sand will be in the spaces among the larger rocks, but sand alone, with no gravel, usually has little gold—or none.

Pure gold weighs 19 times as much as water. "Dirty" placer gold is about 17 times as heavy as water. This is the "specific gravity" (S.G.) of the mineral. Most sand grains weigh about 2.6 times as much as water (S.G. of 2.6). This means that gold is about 6 times as heavy as typical sand grains. When the grains are under water we can subtract the buoyancy of water (S.G. of 1.0), and the *relative S.G.* becomes 1.6 for average sand and about 16 for gold. Under water then, the gold is effectively 10 times as heavy as the other grains. As the grains move downstream gold will tend to migrate to the bottom of the sediment in the channel. Because it is 10 times heavier than

the other grains, the gold also tends to move only when the gravel moves. And it sticks tight when the currents are only strong enough to move the sand-sized grains.

When I was a fledgling gold panner, I recall fighting my way through some dense willows along a reported gold-bearing stretch of river. When I reached the stream bank there was a smooth sandbar that angled down into the quiet water of an eddy current near a tangle of roots and driftwood. The top of the sandbar was dry and it was a cinch to scoop up a bucket of sand and take it to the water's edge and pan it out. No gold!. Less than 10 feet away and at the same level, about 4 feet above the water, I could get 20 grains per panload. It was tougher digging. I needed a pick to loosen the boulders, and I scrubbed most of my fingernails away scratching the sand out from among the bigger rocks. But, the gold was there. The channel was barren where only sand occurred. The gold was in with the boulders.

At Dewey Bridge, Utah, there is an active placer gold mine on the east side of the river, mining a gravel terrace about 20 feet or so above the water level. They use front-end loaders to collect the gravels and put them on the screens for a big shaker that feeds a sluice box. I panned nearly 400 grains per pan from that gravel. Across the river, at stream level, in a zone of coarse sand only a couple of inches thick and sandwiched between gravel beds, I could only recover 9 very small flecks per pan. In that vicinity, by staying with the gravels, 20 or more grains were guaranteed. In sand alone, you could get skunked.

Don't be fooled by those zones of black sand that the river has separated for you. Even the black sand grains are lightweights compared with gold. Magnetite, an iron oxide that is magnetic, is the dominant mineral in most heavy black sand concentrates in the streams. With a specific gravity of only 5, magnetite is still only about ⅓ as heavy as gold. Under water it is only ¼ as heavy. If the stream has neatly sorted out black sand, it has only been ¼ efficient enough to separate gold. Pan the stuff if you want, but unless the black sand is

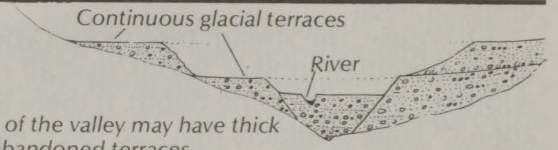

FIGURE 4: *Broad sections of the valley may have thick accumulations of several abandoned terraces*

among the gravels you'll be disappointed. We'll hear more about black sands in the "how to pan" portion of this book. For now, remember—Rule No. 1: The gold is in the gravel!

Rule No. 2: Gold migrates to the bottom of the channel

Most of the year the average stream runs clear with very little movement of the grains in the streambed. Sand grains may move from steep riffles to the quiet pools, but most of the heavier or larger grains will do little more than settle downward as the sand cushion is withdrawn from the other large rocks below. The gold stays with the gravel.

Spring runoff is a different story. Most streams redistribute the top few layers of rocks with each spring flood. When the current is strong enough to move the gravels *and the gold* there is a lot of action with moving and bouncing. Even some rather large sand grains stay in suspension with the powerful turbulent flow of high water. Gold is the heavyweight, slow to get into the action and one of the first to find a spot to rest. The net result is that gold tends to migrate downward in the sediment each time the sediment is redistributed. It cannot move downstream as fast as normal sand either.

For many years, only the top few inches or feet of gravel are affected. But then comes the real flood. Maybe only once in 20 or even 200 years can the stream muster up enough power to stir up all the gravel in the bed and actually scour the solid bedrock on the bottom of the channel. The annual spring runoff and the occasional big flood all give the gold a chance to work downward in the sediment. Although I think some of the gold must forget the rules because some can be found near the top of the sediment, there should be *more gold and larger grains* the deeper you can get in the channel gravels. The best place of all should be in the cracks and natural "riffles" of the bedrock itself.

Of course, the stream tries to fool you. Suppose there are 20 intermediate-power floods that all re-sort the gravels to approximately the same depth. If there is a sort of hardpan or zone of large boulders that can force each flood to scour to approximately the same level, there will be a "false bedrock"

that could make an especially rich zone of gold with no apparent relationship to the bottom of the channel.

I have not documented a good example of false bedrock on the Colorado River. But I have found a tremendous variation in the amount of gold that could be recovered from different levels of the same gravel terrace. At Radium, Colorado, I panned a sample from near the top of the most prominent gravel terrace. The sample came from an estimated 100 feet above the present river level and I recovered 6 "colors" (small grains). Pans taken from an estimated 40 feet above the present river made about 5 grains each. One zone about 20 feet above the river produced 45 grains per pan. At the river level, with a dozen pan loads checked, I could get 4 to 13 grains per pan. Then I began scraping the sand from little crevices in the bedrock that were exposed on a bend of the river. I actually broke some of the bedrock out with a rock pick and washed off the sand from the fractures. It took ten times as long to get a couple cups of sand—but the 9 specks of gold recovered included 3 of the largest that I have collected on the Colorado.

At Radium I was testing all the variables that I could think of. The high terraces were glacial terraces. The fractured bedrock was not in the bottom of the present channel, but it was the scoured bedrock bottom of part of the stream at some time in the past. Most of the rules were working—some very well, some not so hot! The pans that made 45 grains may have been taken above a false bedrock, or they may have been taken just above the real bedrock on an old scoured surface that is now covered. Although a bit sloppy, either way, they fit Rule No. 2—gold migrates to the bottom of the channel.

The scoured bedrock at Radium worked so well that I was eager to try the scoured bedrock at Westwater Canyon, right on the Utah-Colorado state line. There is a lot of gold at Westwater. At the boat landing where the rafters check with the BLM officer in "downtown" Westwater (one trailer house), I have panned a dozen loads to demonstrate panning to students. The number of gold grains ranged from 14 to 54. A few miles downstream, Westwater Canyon is a scenic whitewater stretch that is very popular with the river runners. Boatmen usually point out the abandoned "Miner's Cabin" (there are about six old cabins) on the east side of the river about four miles downstream from the boat landing.

Another ¼ mile downstream, still on the east side, is an abandoned placer operation. In 1980 the site was one of controversy because the area is proposed for a Scenic River designation—and some people want to re-open the placer mines! Anyway, the location needed to be sampled for this book.

The simplest way to sample the old mines at Westwater Canyon would be to step out of one of the rafts, pan a few spots, get back on the raft, float the rest of the canyon and get out at the Cisco Road. With no raft, I guessed it would be easy to cross the river at the BLM trailer in my canoe and hike to the old mines. It *was* easy if you don't mind fighting some horrible snarls of brush and hiking a couple of hours each way. The float trip is so simple that one forgets that trails and rivers are not always compatible. The temperature at nearby Moab that day was over 100° too!

On the east side is a road to the location, but I had heard rumors that it had some locked gates on private property. Eventually, I checked some scoured bedrock at the entrance to Westwater Canyon. The gravels at the water level averaged 12 grains per pan and a beautiful band of very black sand on a sandbar, concentrated by the river, had 0! I found a shelf in the bedrock behind a four foot high "riffle" and scraped out a scant panful that contained a disappointing 14 grains.

Finally, I found my hoped-for dream site. It was a softball-sized pothole, scoured by many generations of swirling pebbles that had drilled a perfectly round hole about 12" deep. Eagerly, I dug out the ½ pound of sand and fine gravel in the bottom and panned it down. No gold! Then, using a short piece of wire I "sniped" about ½ pound of sand from some cracks in the bedrock. Only three very small grains. Most of my rules were being violated here because less than a mile downstream is the abandoned placer.

I took just one sample from the old mine, at the last area to be worked, about 40 feet above the river. That one panload contained an estimated 200 grains. (I had to stop counting at 140 because it was time to go home!)

Westwater Canyon becomes more of a puzzle with every new sortie that I make along the river. Why is it so good? If most of the gold is from the Gunnison River, why don't I find more gold between Grand Junction and Westwater? If the

gold is coming from other tributaries that enter above Grand Junction, where are the other hot spots upstream from Grand Junction?

My guess is that there *are* other good spots. Another possibility is that there is an unfound local source near Westwater. The rich placer at Dewey Bridge belongs there because it is the first really good gravel bar below the confluence of the Dolores River. In fact, there are good, active placer mines all along the Dolores. One is just upstream from its confluence with the Colorado. The best placer at Dewey Bridge is on the same side of the river that the Dolores enters. But Westwater is *upstream* from that source. And it is hundreds of stream miles downstream from the other recognized sources on the upper Colorado. While you ponder that problem, let's give you another rule.

Rule No. 3: Barren tributaries "dilute" the gold in the main stream

Perhaps a better way to say this rule is: "Where barren tributary canyons dump gravel into the main channel, the gravel may be barren in the main channel for some distance downstream". One of my first real surprises with the "enchanted metal" came from this rule. On the Dolores River, a couple of miles downstream from the confluence of the San Miguel (below Uravan, Colorado), is the famous "hanging flume". At this spot in about 1890 somebody tried to hang a wooden ditch to the side of the cliffs and transport water to a known placer deposit downstream. Any tourist who has stopped to read the big billboard could guess where the water was supposed to reach the gold-bearing gravels. After traveling the road several times and telling students (and trusting friends) where the gold-bearing gravel was and how rich it should be, I finally planned far enough ahead to get a good sample of the gravel.

I was on a business trip with non-geologists in a relatively clean car, but I was determined to get plenty of gold. I brought two plastic pails and stopped at the massive outcrop of gravel in a fairly new road cut just downstream from the pock-marked placer zone that is pitted and messed up by generations of fortune seekers. (In 1980 there was a sluice box

at the end of the gravel plant screens.) I knew that I was not sampling the favorite spot on the old gravel bar because there was no evidence of prior work. However, I was "close enough", and, with good clothes on, it was much handier to take the sample from the massive cut rather than go grubbing around in the weeds and stickers. Naturally, because I was greedy and had filled the pails too full, one of them tipped over in the car on the way home. I worked a long time on that remaining pail of sand. I couldn't believe that there was no gold in the first pan so I did a second one to find out what I had done wrong on the first one.

My error was to take the sample from the delta of gravel that comes in from Mesa Creek which enters the Dolores from the east at that point. Within six months I did the same thing again on the Colorado at Grizzly Creek in the scenic section of Glenwood Canyon, just upstream from Glenwood Springs. Here there is a nice gravel cut just upstream from Grizzly Creek. The creek is in a narrow gulch and goes under a bridge as it enters the main stream, so I didn't even notice the stream. I panned the sample, expecting the usual dozen grains for the area, and got none. Then it dawned on me why the stores at Grizzly Creek are called "Grizzly Creek". A tributary stream enters there!

Rule No. 3 is strong enough to smother Rule No. 2 and Rule No. 1. This one was the worst surprise of all. Between Glenwood Springs and Newcastle (just east of milepost 107 on Interstate 70) there is a classic example of glacier outwash gravel deposited on top of some steeply tilted layers of Mancos Shale(Figure 5). The old shale bedrock is tilted in such a way to form a perfect riffle on the ancient stream channel. A frontage road makes a neat cut there to expose the beds. A perfect natural sluice box!

Several times I told students (and trusting friends) that there was gold along the Colorado River in the present channel on the other side of I-70; and without a doubt there would be *more* gold at the base of the gravels where the surging glacial meltwaters once were moving more gravel and bigger gold than the present river normally carries. Like so many things we say and repeat, we start to believe them.

One day, when I was driving the road alone, I edged my car as far over on the shoulder as possible in the westbound lane, put on the emergency blinkers and scampered up to that

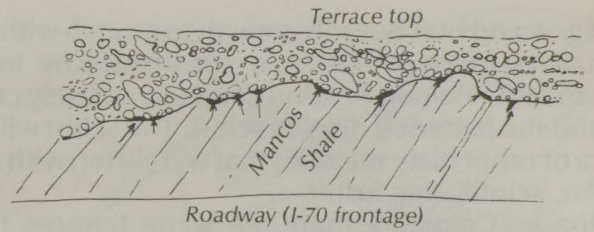

FIGURE 5: *Idealized sketch of gravels in contact with tilted bedrock near Newcastle, Colorado. This natural riffle should have concentrated gold where the arrows indicate. Apparently side canyons have diluted the gravel in the main Colorado River channel. No gold was found.*

perfect, textbook example of the best place to look for gold on the old stream bed. I had an ice cream bucket and no tools to dig with. When I got to the spot I found it a rather tricky challenge to fill a bucket of sand with my bare hands without falling 20 feet back to the roadway. However, I knew there would be enough gold there to justify the risk. There was no gold! Barren Canyon Creek sneaks into the Colorado just upstream from the site.

When you sample the gravels at the confluence of a tributary canyon, you essentially sample the tributary canyon. Those gravels need a few hundred yards of mixing with the sediment of the main stream before they can pick up much gold. So, stay away from the deltas and terraces that are dumped in the main canyon from the side canyons. The side canyons ususally have a steeper gradient and will have very tempting coarse boulders and cobbles. Occasionally there are some rock types that can help determine where the gravel is coming from.

An example is where Rifle Creek enters at Rifle, Colorado. Most of the headwaters of Rifle Creek come from areas of sedimentary rock. That means most of the rocks in the stream channel will be sandstones, limestones and smaller pebbles of chert and reworked quartzites. The main Colorado, however, drains the ancient crystalline rocks of the high peaks. Metamorphics, granites and a variety of other igneous rocks have been injected into the Colorado's headwaters.

You don't need a degree in geology to recognize the difference between the softer sediments and the hard, crystalline "basement rocks". The soft and somewhat gritty sandstones will be rich red, buff or pale yellows. Shales will be platy and soft with no visible crystals. Limestones will be all

shades of gray and buff but soft enough to scratch with a knife. The crystalline rocks of the main stream will be intensely rounded and will include banded gneisses, coarsely crstalline granites and the flattened discs of schist. The schist will have a lot of mica or other platy minerals that will glisten with a rather spectacular, scintillating luster.

At Palisade, Colorado, there are some terraces that are mostly rounded boulders of black basalt–with many gas bubble holes. These came from the top of nearby Grand Mesa–avoid those terraces. Don't waste a lot of time counting the percentages of each type of rock. The pros may do that and learn a lot of good information. But when *you* approach a gravel cut to sample for gold, if you notice a high percentage of only one type of rock, or a high percentage of soft colorful sandstones, be suspicious that you do not have a representative sample of the main stream. Oil shale comes in between Rifle and DeBeque, and will be characteristic of the main channel below that area. Oil shale is soft, but distinctive, and is recognized easily 100 miles downstream near Moab, Utah.

Do you still remember Rule No. 3? "Barren tributaries dilute the gold in the main stream."

What about meanders and midstream gravel bars?

There are a few other ideas that I have seen in print about where to expect better concentrations of gold in stream channels. They do not seem to work very well on the Colorado so we will not make them rules to memorize.

I have heard that gold is more abundant on the inside bank of river meanders. In my experience on the Colorado River, it looks as though all the old glacial gravels that formerly filled the entire valley were deposited by a *system* of criss-crossing meanders. The result is that everywhere in the gravels the location was once on the inside of a meander. So, at least in the case of reworked sediments, the meanders are not very important.

In principle, the rule works fine. One type of ore concentrator is the "cyclone", which washes a finely milled slurry of ore around and around a shallow, descending corkscrew gutter. At the end a divider cuts the slurry and puts the outside of the turn into the waste pile and puts the heavy minerals

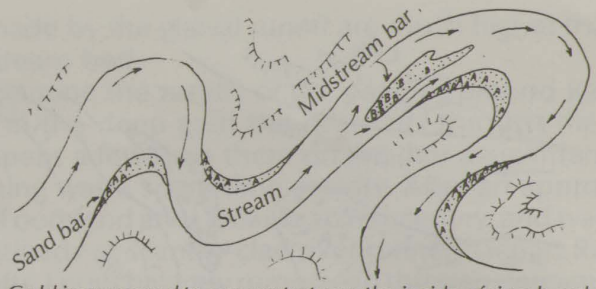

FIGURE 6: *Gold is supposed to concentrate on the inside of river bends (A) and on upstream part of mid-stream bar (B). But when the entire valley contains gravel from glacial outwash, all of the gravel may have been on the inside of a bend at some time in the past.*

from the inside of the turn into a cycle for further processing. Bends in the river should separate "heavies" just as the cyclone concentrator. The concept is good–but on the Colorado it is not important.

Another popular idea is that the upstream end of a mid-stream gravel bar is supposed to be better than the other parts of the bar. Figure 6 illustrates the situation. This rule is illustrated in Bateman's 1950 version of *Economic Geology* and retained in the completely revised 1980 edition by Bateman and Jensen. I learned the rule well and have taught it for years. It figures that the upper end is all that remains as the bar is being swept downstream. The gold holds back. The lower end is partly re-deposited from the upstream end.

An interesting thing happened when I was panning a stream with several students. We were at the confluence of the Dolores and San Miguel Rivers. (Figure 7 shows the pattern of the streams at that point.) The trip was in spring semester; the rivers were high and the water especially cold. We panned a lot of very small flakes on the inside of the "Y-shaped" confluence–especially on the San Miguel just above the confluence. That's where the road was.

It was an overnight trip and several times I mentioned the idea that the gold should be better just downstream from the massive boulder near the far shore of the stream. Finally I convinced a couple of the students to cross the stream with me and we would get some of the hidden bonanza that obviously was waiting behind that huge boulder. The water was very cold–which we already knew from the numb fingers we all had from panning in the streams. And, it was nearly waist

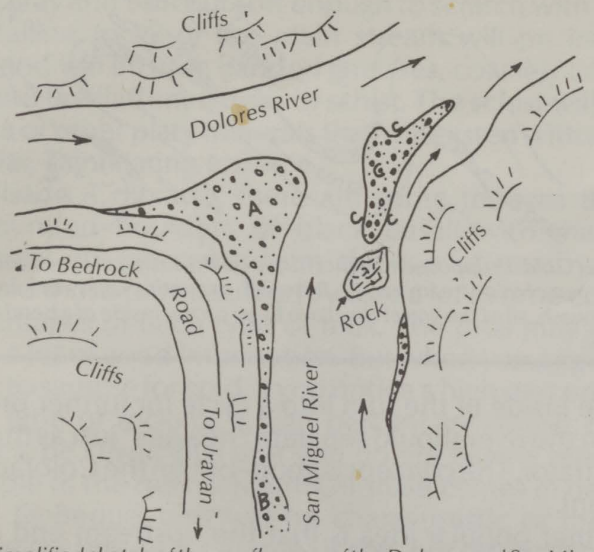

FIGURE 7: *Simplified sketch of the confluence of the Dolores and San Miguel Rivers. Gravels at A and B contain gold, but samples taken from the midstream bar (C) had none. (Site was covered by a 1979 placer claim)*

deep–which was a little bit of a surprise–a chilly one! We dug some gravel with a shovel and screened it. I commented that the gravel was nice and coarse and should contain a lot of gold. I expected more and larger grains than we had been getting on the inside of the "Y". We had been getting 20 to 40 grains per pan. To my astonishment (and chagrin) we got *none!* So, if you want to remember that the gold is better on the upstream end of a midstream bar, go ahead and remember it–but don't put unshakable trust in the idea.

Perhaps you have heard the old adage "Gold is where you find it". The more you look for the stuff, the more you will believe the old adage.

Let's review the rules we have learned so far:

Rule No. 1: It's in the gravel.

Rule No. 2: Gold migrates to the bottom of the channel.

Rule No. 3: Barren tributaries dilute the gold in the main stream.

The Unwritten Law: The gold has not memorized these rules and does a lot of crazy things to violate them!

Don't forget that the floor of the valley was not at its present depth when the glaciers were here, and the gravel

terraces made by the glacial runoff are much higher than the present stream bed.

Let's examine the results of the panning around Radium, Colorado in the deep gash the river cuts through the Gore Range. I spent a few days there on another assignment, and gold panning was a spare-time activity. After an appropriate number of oohs and ahhs looking at the scenery, and watching a few boatloads of scantily-clad river runners depart Radium on their rafts, I nonchalantly rummaged through my camp gear and produced the "everpresent" 16-inch gold pan, a dropper bottle, rock hammer (already attached to my belt) and my small screening box.

First, I panned the creek in camp (Sheepshorn) to make sure it was not carrying gold. Two pans with no gold convinced me to walk down to the main river. In an hour or so, I had found a few colors but went back to camp for fishing gear to try my luck for the evening. I caught 8 big suckers in a hurry where Sheepshorn Creek enters the Colorado, but no trout! Working Sheepshorn Creek back to camp I still couldn't get any trout, so I resolved to play with gold the next evening.

The next two evenings I panned out 12 more samples. I could have panned more gravel by just working one spot by the river, but I was trying to learn where the gold was most abundant. Naturally I stumbled onto the gravel for the best three pans on the last day and had to leave just when it got interesting.

All the gold that I recovered was worth only a few pennies, but what a delightful experience. Playing with the "enchanted metal" in the heart of the Rocky Mountains was a noble substitute for the poor fishing on that particular stretch of river on that particular week.

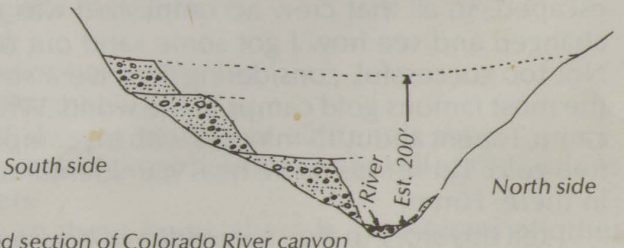

FIGURE 8: *Idealized section of Colorado River canyon near Radium, Grand County, Colorado*

CHAPTER II

How do you "pan" gold?

If you have never attempted to pan for gold, you had better plan to practice a little before you commit your whole vacation to a search for gold. On one of my sightseeing tours, I came upon a dozen people on a small creek just north of Cripple Creek, Colorado on State Highway 67. One man had a cast iron skillet, one had an aluminum meat pie container and a couple of them had small, shiny, new gold pans. One woman was changing a baby and a couple of kids were throwing rocks at a chipmunk. With that kind of activity, I guessed there might be some gold in the creek. So I took my "everpresent" gold pan over to the creek to see what was going on.

"Are you finding any gold?" I asked.

"No, not yet," said the man with the frying pan.

"Is this creek supposed to be good?" I asked.

"Ya, our book says it has some gold in it," he said.

It only took me a couple of minutes to screen out a panload of sand and, because I had a hungry family in the car, I intended to take the pan back to camp to do the panning. While I was at the creek, though, I noticed that the man with the frying pan would scoop up about one-fourth of the pan full of rocks from the streambed, and with a little water he would slosh the stuff around a few swirls and look intently into the pan, throw it all away, then scoop up another pan load. I was not close enough to see how the shiny new gold pans worked but the meat pie pan worker just watched me.

By the time I finished on the creek the chipmunk had escaped, so all that crew accomplished was to get the baby changed and see how I got some sand out of stream gravel. Not too successful, considering they were so close to one of the most famous gold camps in the world. When I got back to camp, I spent about 15 minutes with my sample and found no *free* gold. There was some heavy, unidentified light gray stuff in there. Hmm?

I tell this story to give some idea of how *not* to find gold! I don't know what "book" they got their tip from, but unless

there was a *lot* of free gold there they weren't about to find any. If you know your gold prospecting, you know this:

1. You must treat a new metal pan.
2. You must get rid of the lightweight rocks and sand.
3. Tin cups, mixing bowls, dinner plates, wash tubs, or half a dry gourd *will* work on gold *if you know how to use them.*
4. Much of the gold at Cripple Creek is contaminated with tellurium and it isn't gold in color. It is calaverite, not free gold.

Just in case that crew of "prospectors" is still at work someplace, let's give you a quick primer on how to pan gold. No matter how well you read this, plan to practice your technique *before* you get to that ideal stretch of river bank. One demonstration by an experienced panner is worth five hours of straining your back out there with numb fingers, mosquitoes and deer flies. As a quick preview, this chapter will cover: a) the essential equipment; b) screening; c) getting out the mud; d) working down to the black sand; and e) picking out the gold.

The essential equipment

In order of importance, these are the items that I take panning:

1. a rusty old 16" gold pan
2. a ¼-oz. glass dropper bottle

These two items are the basics and you can do the whole job with them alone. To speed up the work, and make the job more comfortable I usually take some or all of the following:

3. a screen box
4. a geologist's rock pick
5. a shovel
6. a 10-power hand lens
7. a small magnet
8. a pair of shower sandals or old tennis shoes
9. a dozen rock picks and gold pans to sell to the curious onlookers

In addition to these items, there is a truckload of other stuff that usually goes along so that I can cut up driftwood for

my fireplace, take pictures, cook, eat, repel mosquitoes and so on. You'll notice that equipment for gold panning is very simple. If you were backpacking and took a 10-inch pan, the job could be done with about 5 oz. of equipment (and you could cook in the pan).

Item Number 1 is the pan. I hear the black plastic ones are the only way to go. I have used them and they are fine. Personally, I prefer a 16-inch Estwing steel pan because, while I was an Estwing dealer, they sold better when I was using one when my customers were around. The plastic ones are lightweight, won't bend or dent and have a black background to illuminate the gold in the pan. If lost in the desert sun, I suspect the plastic will crack in a year or so. Steel pans are excellent also. When properly cured they have a good contrasting color and they can be used for washing up in camp and boiling water on a contaminated creek. I keep my magnet stuck on the pan so that it is always handy. Besides, how can you look like a genuine old sourdough if you use a pan that was invented after jet airplanes? The sun won't hurt a metal pan, but lost in the tropics they will rust out in a couple of seasons. (The brand of pan doesn't matter much to an experienced panner.)

There are all sizes. I have used 10-inch, 12-, 14- and 16-inch sizes. The 10-inch is handy for backpacking. Smaller pans are excellent—they just cannot handle as large a load as a 16-inch pan. You will lose fewer grains if you have a little spare room in the pan when you first get going on the sand.

Some pans have a variety of riffles on the rim and even in the bottom of the pan. They are fine. But, as stated before, with a little experience, the brand of pan doesn't matter much. There are copper pans. These are not just the executive models. They are designed to use with a mercury coating to pick up the gold as an amalgam. I've never used one. They are expensive, I want the gold as is, and I do not want to distill mercury to get my gold back from the amalgam. Besides, improper handling of mercury can be fatal.

Steel pans have two problems. They must be cooked to remove the stamping oil and to get rid of the slippery coating. Oil is the unseen plague to a gold panner. If a speck of gold can touch even the smallest amount of oil, it can form an air bubble that will float the gold away. Commercial

concentrators use the "flotation" process to float away the valuable metal ores from unwanted rock at the mill. A great variety of flotation oils are used depending on which mineral is to be floated to the top for recovery. Whether it is factory oil used to make the pan, peanut butter or the old Penzoil can you are using to bring the sand into camp—don't let the gold sample touch *any* oil!

The easiest way to treat a steel pan is to put it in a campfire for a minute or two until it turns blue-black. With continued use you can let water dry a few times in the bottom so that it will rust a little also. The rust makes the bottom a little rougher which makes the pan work better than a new one.

A dropper bottle is my Number 2 item. This is used to suck up the gold when you get it isolated in the bottom of the pan at the end of the panning process. Any small container will do. Test tubes are especially good because clear water in a test tube will magnify the contents and make the 1 mm grains look like 5 mm grains. I quit using test tubes after I broke a few and had a week's collection roll off a table and splash away on a tile floor. The corks are easy to lose also.

With a dropper bottle, you have your suction device on the bottle at all times. When you have the bottle, you have the rest of the needed equipment. I have seen lists of equipment that call for a pair of tweezers instead of a dropper bottle. That might be OK in Alaska or California, but, for me on the Colorado River, most of my grains are too small to pick up with tweezers. I am counting all the grains I find and I have to remove them from the pan as I count them to avoid counting the same speck twice. You won't need salad tongs to remove the gold from the pan; nor will you need a Clydesdale horse to haul away your treasure from the Colorado!

Item Number 3 is a screen box. An engineer would call it a "classifier". All the screen does is remove all the grains that are far too big to worry about and lets you spend all your time on the grains that will be with the gold in the final stage of the job. A shovel full of typical river gravel has about 10 to 20% sand-size particles. The rest are pebbles or larger grains that only waste your time in the pan. I ran a series of pans down to the stage of removing the gold and found that, if I try to hurry, but use enough caution to get statistical data on the pans, it

takes about 18 minutes to shovel, screen, wash and get the sand down to the black heavies.

Without the screening stage, I can get the load to the water a couple of minutes quicker, but the total job takes over 22 minutes and there is only about 20% as much sand as in the full panload of sand. So, the screen makes the job 5 times as efficient.

I have seen experienced panners get a panload finished in about 8 minutes. I can do it that fast too, but I think I lose a lot of the fine stuff that way. If you are only collecting the large grains, you can be a lot sloppier in the work. I have tried several panloads where I caught all the waste sand and panned the sample over again. With most pans I lost none of the good grains and only about 10% or fewer of the smallest ones. For my work, I am counting all visible grains and some of them are pretty tiny. In fact, one area on the Dolores River was yielding a lot of minute, light-colored sand and I guessed a lot of it was microscopic gold. I saved several batches of the black sand left over after all the visible gold had been sucked away. Checking later in the lab with a binocular microscope I found no more gold, even among the very finest objects in the pan.

The lesson here is that gold is very bright. It is hard to mistake free gold. If you work in direct sunlight and have normal vision, you can see whatever gold is there. If there is some of the ultra-fine stuff such as is mined at Carlin, Nevada, I must lose it in the panning. (The Carlin gold was overlooked for decades until someone assayed some "crummy brown rock" and made a fortune!). So, the screen is a time saver. If you suspect that there are some nuggets in the area, go to a larger screen. I have a black plastic "classifier" that I use on those occasions. (Actually, I use it when my students or friends have my screen busy.)

I heard of one miner in Alaska who was picking over the gravel that had been rejected from a sluice box by the pipe grating that is called "the grizzly". This unit is a set of rods or pipes spaced about 1 to 3 inches apart, depending on the type of operation, designed to reject all the really large cobbles before the gravel gets down to the screen shaker. (The screen shaker can handle more sand if you get the big stuff out of the way first.) Well, the old miner in Alaska found a nugget that the grizzly classifier had classified right out of

the sluice. I hope I never hear that I threw out a grain larger than my screen. So far, none of my grains are even close to the ordinary window screen that I use.

Incidentally, I got the screen box at a garage sale for 15 cents. Someone had made it to get sand for a child's sandbox—and no longer needed it.

Next on my list of equipment is a rock pick, Item Number 4. The rock pick helps loosen the cobbles so that I can get at the sand. On most gravel bars the pick is more useful at first than a shovel because the large rocks are tightly packed. After the pick loosens the gravel, I can scoop up the sand with a shovel or by hand. If you forget the pick *and* shovel, you can use a stick or anything else available. Your fingernails are only good for scratching out about ½ a pan load without some sort of digging tool. If you are scouring the sand out of cracks in the bedrock you will wear out your fingertips anyway. A stiff piece of wire (clothes hanger) helps in the crevices.

Item Number 5 is a shovel. With or without a pick, the shovel is handy for digging the gravel for screening. With large boulders on a tightly packed bar you could wear out a good shovel in a few hours unless you use a pick or stick to loosen some of the rocks.

The hand lens, Item Number 6, is just part of the clothing to a geologist, and you can get along fine without one. Occasionally I'll look at the gold flecks with my lens but, more often, I'll be checking other things for information that only a geologist worries about. I may try to see if zircons are present. Are the garnets euhedral? Are there octahedral magnetite crystals? Is that plagioclase? Is that brown stuff epidote? Well, look at that crinoid stem! Lots of things that a weekend panner doesn't care about.

I have a magnet listed as Item Number 7, but I rarely use mine. Some panners say it speeds up their work near the end to pull the magnetite out of the black sand. Magnetite is usually about ½ of the dark heavy sand that includes the gold. Occasionally I want to check to see how much of the dark sand really is magnetite—so I always have a magnet along.

If you do use a magnet, put a layer of plastic wrapper over it because magnetite is very difficult to remove completely from the magnet. If there is a layer of plastic between the

magnetite and the magnet, all you have to do is separate the wrapper from the contact and all the magnetite falls away.

I wear my sandals, Item Number 8, at the water's edge while panning. If you have good field boots you will ruin them in the water, and, with all the scrambling on the cobbles to get another panload, my feet are too tender to go barefoot. Most areas have a lot of broken glass anyway. Tennis shoes would be fine—I just don't like to hike in tennis shoes.

The panning procedure

Screening. This step is simple and requires only one statement. Dry sand screens easily, but damp sand is sticky and separates better if you submerge the screen in water.

How much sand? (Don't put any sand in a steel pan until it has been roasted—see page 23.) Put about two quarts of material in the pan. A 16-inch pan will hold a lot more, but for my purpose I want some room to work with. If you are after volume of gold, 4 quarts can be panned faster than two 2-quart loads. You may lose a little more gold, but there is a net gain in gold per hour if you pan bigger loads. But remember, 2 quarts of sand covered with water weighs about 10 pounds. Four quarts in water is about 18 pounds and a heaping 16-inch pan weighs over 20 pounds. You've got to shake and slosh that mess a lot of times—and with a full pan that's a lot of work.

Free the mud. When your pan has a load of sand, submerge the whole mess in water and with your hands mash and slosh the sand around to break up the mud lumps. If the water is so cold your hands hurt right away, you might have to skip part of this step—but your hands will probably get used to cold water somewhat. If the water is near freezing and your hands don't start to improve by the end of the first pan load, you may have to read a good book instead of pan gold on that day. I have suggested gloves, but I have never had to use them myself. Usually the first pan is the worst shock with cold water. Nearly half my students can continue their panning with ice floes in the water.

I recall one instance where I had four dedicated students that had been panning for an hour or so in the morning. Later some others joined us when at least the air was warmer. The

late group couldn't handle the cold on the first pan and they found something else to do.

Freeing the mud is important. At the water's edge on a good gravel bar there is not much mud to start with, but, on an old terrace with 10,000 years of soil development, there may be a lot of mud. Fine gold will stick in the mud lumps. The mud also prevents the grains from shaking free in the water. If the grains cannot shake freely, the gold can't get to the bottom of the pan and your vigorous shaking will not do the job. You probably will not get all the mud out at first, so, after your pan volume is down to a lighter load, check again, submerge the whole load and with your hands scrub out the mud lumps.

The sooner you have all the mud removed (it sloshes out of the pan as the murky water) the sooner you will be "concentrating" only the heavies and pouring off a good proportion of the light grains. If you are working by a running stream (the best situation), some of the lightweight sands can be "floated" out of the pan by the turbulent water plunging over the rim into the sand and "boiling" out some of the light sand grains while you mash the mud with your hands.

Shake it, shake it, shake it! When the suspended mud is starting to clear up, you are ready to go to work. Most writers describe a swirling motion for gold panning, but there is probably more shaking than swirling. The process goes about like this: dip-shake-pour; dip-shake-pour; dip-shake-pour; dip-shake-pour; dip-shake-pour. If we slow the action a little, here is the way it goes. **Dip** enough water into the pan to more than cover all the sediment in the pan (if your pan was heaped full to start with, go back under water and massage the sand with the current "boiling" away the light grains until there is enough room in the pan for the sand plus a good layer of water above the sand). Back to **dip.**

With enough water to cover all the load, **shake** the pan **VIGOROUSLY** from side to side. The shake has to be a quick movement back and forth for about 5 to 10 cycles. At first, when the pan is very full it is awkward and heavy. You may only get the top ¼ of the sand in the pan to get into the agitation. Maybe only a layer of grains or so. Nevertheless, pour out a portion of those grains that are stirred up. The lightweight grains race each other to get washed out of the pan. The heavy grains try to hold back and dig into the loose grains that remain.

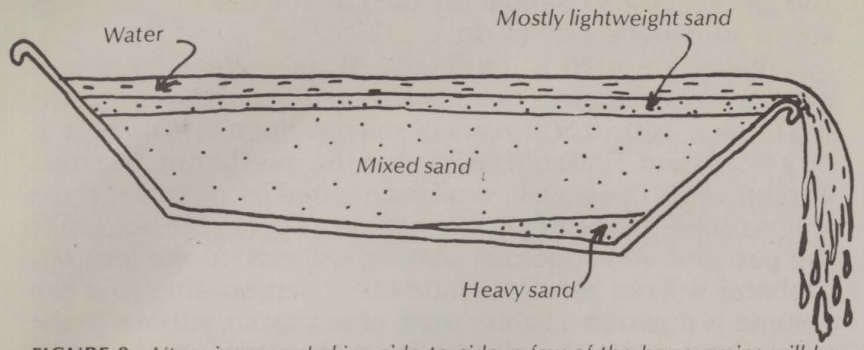

FIGURE 9: *After vigorous shaking side to side, a few of the heavy grains will be concentrated in the crease of the pan. Some of the lightweight grains will be separated in the top. As the water drains out, it erodes the layer of lightweight grains.*

My wife saw me from the rear one time as I started to shake a full pan from a standing position at a high sink. "That's quite a wiggle you've got!" was her comment. Well, it needs to be a bit suggestive to do the job!

As you approach the end of the shake cycle, tip the pan slightly so that the water layer runs over the rim and erodes a few layers of sand away as it goes out. The shake fades to a tip to the right, left, right and left, so that the water sloshes back

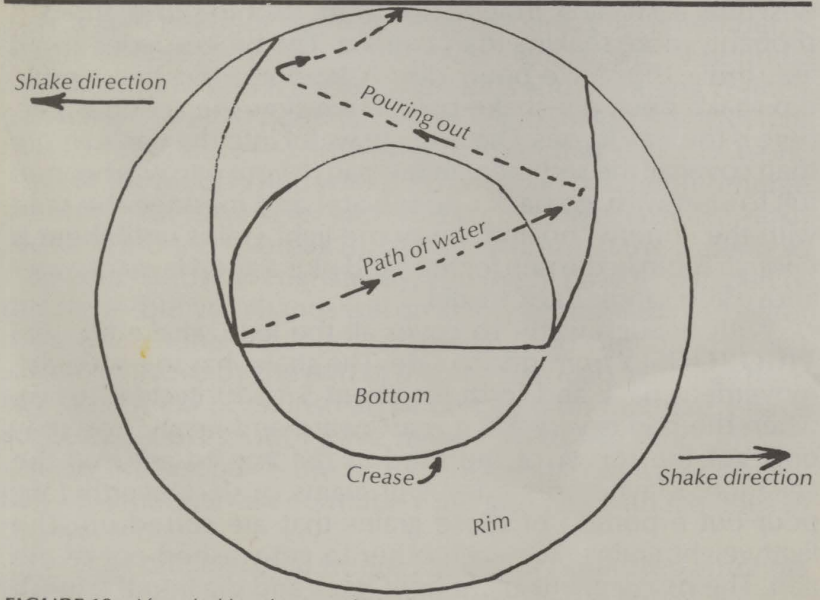

FIGURE 10: *After shaking the pan, drain the water in a quick zig-zag to keep more of the lightweight grains suspended in the stream.*

and forth a couple of times as it pours out of the pan. This keeps the water layer moving over a broader band of grains as they start to settle back solidly into the pan. About 1 or 2% of the sand should roll out with the water layer. Repeat the dip-shake-pour cycle a few times and then rotate the pan 180°.

Fill the pan with lots of water and swirl and slosh the water around until the grains have mostly shifted from the side you poured from to the opposite side of the pan. You can tell at this point if there is a muddy zone stuck in the bottom. Loosen any mud with your fingers. When the load has shifted to the opposite side, start again to dip-shake-pour, dip-shake-pour, etc. It feels awkward and you feel sort of stupid doing it—but you'll get the hang of it. It may seem like a lot of work for your arms and shoulders, but when you get a little practice it will be your back that suffers most.

If you pour out only about 1% of the total each time, you can plan on about 100 dip-shake-pour cycles. I have counted them. It takes about 100, or even more. An experienced panner can get most of the gold in about 50 cycles, perhaps even 30. But for my needs, I do it the hard way because I am after the statistics.

When the pan has been rotated a couple of times, you will start to see the black sand on the very bottom of the pan. If you look carefully you will see a gradual decrease of the black sand upward in the pan. When you have worked out about ½ of the

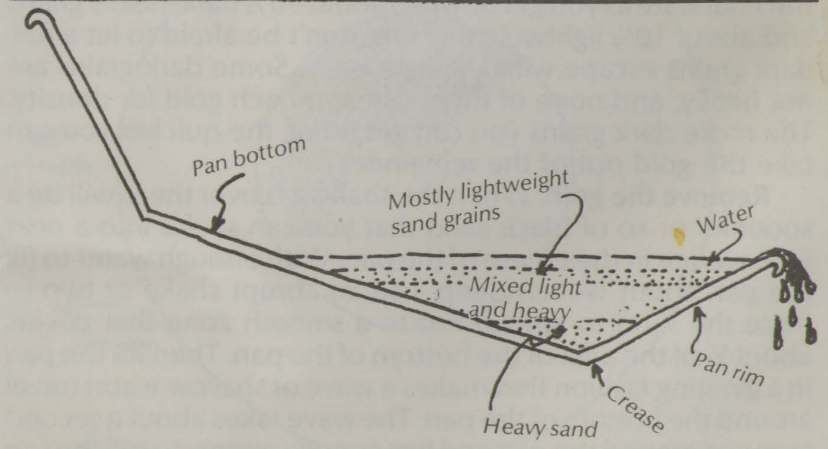

FIGURE 11: As the volume of sand becomes less, the zone of black sand becomes thicker and it will help you see how much sand you can pour out without losing the heavies.

original material you can start using that black sand as a guide to show you how much sand to let roll out with the water. When the black sand tries to get away, that's enough for that pour.

Even with careful panning you will lose some black sand. A little is OK because the heavy black sand includes a lot of dark grains with densities ranging from 2.8 to about 5. The gold is still 3 times as heavy. At Grand Junction the magnetite is about 63 percent, and has a specific gravity of 5. Other grains, recovered by a sophisticated magnetic separator, include:

Mineral	% of dark sand	Density
Quartz (not dark, just hard to remove)	15	2.6
Hematite and Ilmenite	12	5.3 and 4.7
Hornblende	4	3.0
Garnet	2	4.0
Zircon	2	4.7
Epidote	1	3.5
Apatite	1	3.1
Sphene and Tourmaline	Trace	3.5-3.1

Many of the garnets on the Colorado River are red and can be spotted easily with the dark sands. The lightweight grains are mostly quartz. Also abundant are feldspars and mica. In the final state as you get down to about 90% dark, heavy grains and about 10% lightweight grains, don't be afraid to let a few dark grains escape with the light ones. Some dark grains are not heavy, and none of them can approach gold for density. The more dark grains you can get rid of, the quicker you can take the gold out of the remainder.

Remove the gold. When the shaking is over there will be a spoonful or so of black sand that you can shake into a neat little wedge in the crease of the pan. With enough water to fill the pan about ¼-inch deep, use an abrupt shake or two to force the sand to spread out to a smooth zone that covers about ⅓ of the area of the bottom of the pan. Then tilt the pan in a gyrating fashion that makes a wave of shallow water travel around the bottom of the pan. The wave takes about a second to move around the pan and has enough energy to roll the top layer of black sand a few turns, causing the upstream edge of the black sand to retreat a short distance.

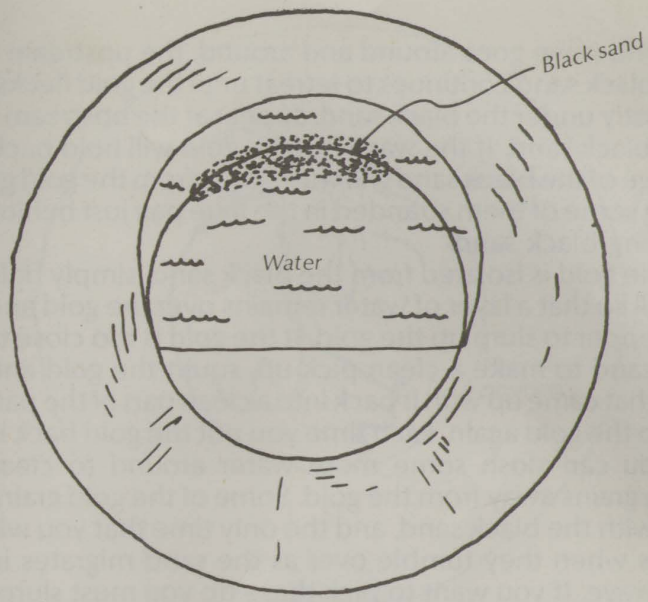

FIGURE 12: *This sketch shows black sand (and gold) shaken into one corner of the pan's crease.*

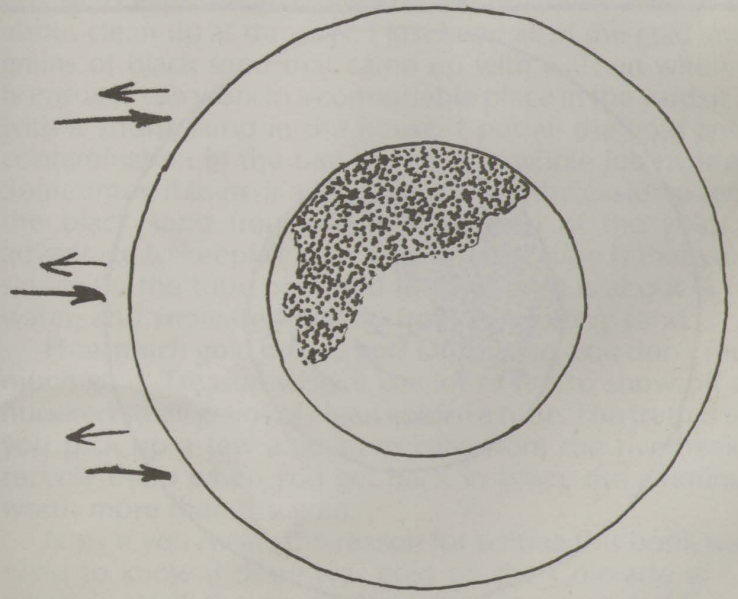

FIGURE 13: *Abruptly shake the pan to one side to spread the dark sands over the pan bottom.*

As the wave goes around and around, the upstream edge of the black sand continues to retreat until the gold flecks, that are mostly under the black sand, appear at the upstream edge of the black sand. If the wave is right, gold will hold back and the edge of the black sand will wash away from the gold grains, leaving some of them stranded in the bare pan just behind the retreating black sand.

If the gold is isolated from the black sand, simply hold the pan still so that a layer of water remains over the gold and use the dropper to slurp up the gold. If the gold is too close to the black sand to make a clean pick-up, squirt the gold and the water that came up with it back into a clean part of the pan and pick up the gold again. Each time you put the gold back in the pan you can slosh some more water around to clear the foreign grains away from the gold. Some of the gold grains will move with the black sand, and the only time that you will see them is when they tumble over as the sand migrates in the water wave. If you want to pick these up you must slurp up a lot of black sand. But the clean-up process is the same.

Keep putting the dropper-full of material in a clean part of the pan and pick up the gold again. Each time, there will be

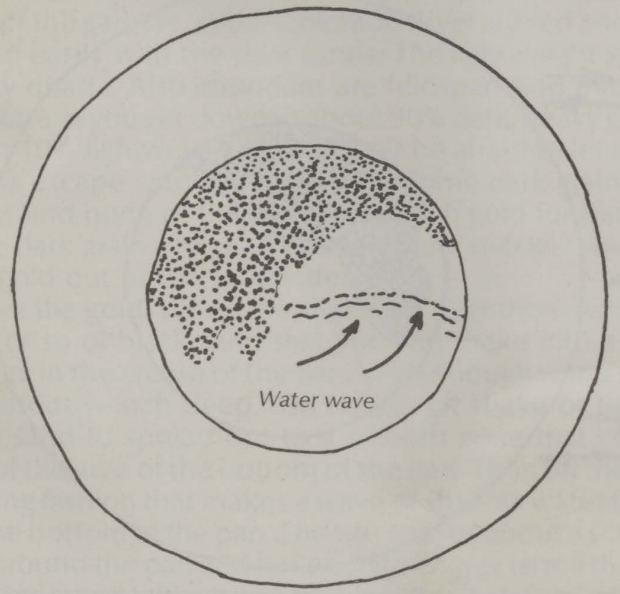

FIGURE 14: *Use a thin layer of water surging around the pan to form a wave that moves the sand along the bottom.*

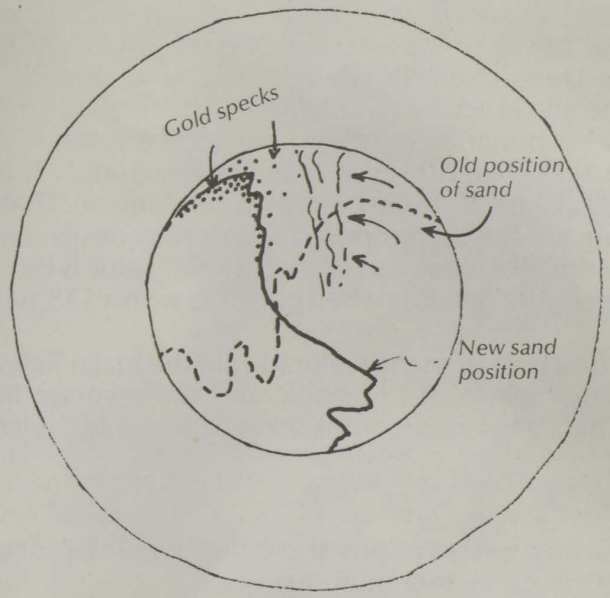

FIGURE 15: *Repeated surges of the water wave will move the black sand. The gold hangs up and is concentrated along the edge of the sand.*

less sand with the gold. When I am in a hurry, I don't worry about clean-up at the river. I just keep all of the gold and the grains of black sand that came up with it. Then when I get home and can work in a comfortable place in the yard or even with a strong lamp in the house, I put all the gold and the contamination in the pan and do the whole job over again. Sometimes, if there is a lot of gold, it may be easier to remove the black sand from the pan—instead of the gold. One advantage to keeping your gold in a test tube is that you can slowly tip the tube back and forth when it is about ¾ full of water, and separate the gold from some stray sand.

How much gold do you get? Dollarwise, you don't recover much gold. Treasurewise, it is a lot of fun to show off a few hundred small grains of clean gold in a tube. The truth is that, if you pick up a few aluminum cans from the riverbank and recycle them when you get back in town, the aluminum is worth more than the gold.

Now if you recall, the reason for writing this book was my need to know if there was gold on the Colorado at Grand Junction. Well, there are a few colors in a panful of Colorado River gravel in town. But, I consistently recovered more than

20 flecks per pan from gravels taken from the Gunnison River—in town! Just downstream from the "Black Bridge", near the Department of Energy compound, one can scrape out some gravel on the river edge where the road crosses the railroad. No bonanza, of course, but good enough to practice on. The real gold, however, is at Dewey Bridge. It is all on patented claims. Next best is Westwater Canyon. That is even worse because of the proposed scenic river designaion. Now nobody can take it out. Part of the "scenic" value is those rustic old placer workings, dug when gold was worth $35 per ounce or less.

The *best* gold from the Colorado are the magnificent grains in the color plates of this book, and the revenue from the book. Thanks for your contribution to my gold "mine".

The following photographs show the panning process with one picture every two minutes:

FIGURE 16: *(1st minute) Shoveling gravel into screen.*

FIGURE 17: *(3rd minute) Screening sand into pan.*

FIGURE 18: *(5th minute) Still screening sand.*

FIGURE 19: *(7th minute) Mashing mud out of the sand.*

FIGURE 20: *(9th minute) Shake-pour, dip-shake-pour.*

FIGURE 21: *(11th minute) More dip-shake-pour.*

FIGURE 22: *(13th minute) Still shaking and pouring.*

FIGURE 23: *(15th minute) More of the same.*

FIGURE 24: *(17th minute) Mostly black sand.*

FIGURE 25: *(19th minute) Only black sand.*

FIGURE 26: *(21st minute) Slurping up the gold!*

FIGURE 27: *(21st minute) Ah, there's a "giant"!*

The following list of sample localities were panned for gold from 1-80 through -82. Unless otherwise noted, a five pound sample of screened sand was examined.

Sample Number	Grains Per Pan	Position in relation to Stream Level	Location and Remarks
			Granby Area
1	6 (small)	in creek bed	Denver Creek Campground 100' upstream from bridge.
2	23 (all v. small)	+3 ft. (Aug.)	Gravel operation at Frazer River bridge in Granby. Heavy sand is not black, includes much garnet.
3	4 (v. small)	at highway level	0.2 miles upstream from Highway 34 exit toward Granby Lake. A large gravel terrace 30' high. Sample from base of terrace.
4	9 (v. small)		Same as Sample 3 but 15' from top of hill. Not much heavy sand.
5	0	approx. high water line, Lake Granby	At gravel operations ¼ mile downstream on west side of Granby Dam. High percent red garnet, low percent dark sand.
6	0	+10' (Aug.)	0.1 mile north of Colorado River. Road cut between Granby and Granby Dam. Much bronze mica in sand.
			Byers Canyon
7	12	+1 (Aug.)	Downstream end of Byers Canyon (3.5 miles south of Hot Sulfur Springs). South end of bridge.
8	1	+50 (?)	Same as No. 7 but 6' above gray shale on southeast side of road cut near bridge. Much black sand.
9	12	?	1.4 miles east of Troublesome Creek (6 miles east of Kremmling). Road cut west end of RR overpass. 10 ft. below top of gravel bar.
			Kremmling Area
10	5	+20 (Aug.)	Gravel pit 5' above road, south entrance to Kremmling on Blue River, Highway 9.

Radium Area

11	17	+20 (June)	Road cut on dirt road 1.2 miles downstream from RR crossing in Radium north side of river. Scant pan load.
12	15	+20 (June)	Same as No. 11.
13	45	+18 (June)	Same as No. 11 but deeper–less soil, bigger pan loan.
14-19	22 to 51	+18 to +21	Same as No. 11.
20	5	+35 (June)	Same area as No. 11 but upstream a few hundred feet to top of broad gravel terrace.
21	6	+80 (?)	South side ¼ mile upstream of Sheepshorn Creek along trail used by fishermen to cross high cliff area. Gravels in contact with metamorphic bedrock.
22	4	+150 (?)	Same as No. 21 but higher on slope. Much higher above stream. Bedrock is red shale.
23	2	+175 (?)	Same as No. 21 but near top of terrace. Away from bedrock.
24-25	0-0	N/A	At lowest campground in Sheepshorn Creek. In creek; probably does not include Colorado River sediment.
26	11	+2 (June)	At upstream edge of cliff area of No. 21 where bedrock is exposed at water level. Stream impacts dark metamorphics and is deflected to right around cliffs. Scattered patches of gravel are left in contact with fractured bedrock.
27	9 (3 large)	+2 (June)	Same as No. 26. About 1 quart of sand laboriously scraped from cracks in bedrock. Some blocks of bedrock pried out and the sand from cracks brushed into pan.
28	6	+0.5	Same as No. 26 but at water's edge; not at bedrock contact.
29	13	+1 (June)	Same as No. 28.
30-36	5 to 22	+1 to 4 (June)	Within 10 feet of No. 26.
37	6	+15 (?)	From farmed terrace, south side of river between Sheepshorn Creek and bridge at Radium.
38	9	+15 (?)	Same as No. 37.
39	6	+4 (June)	Just upstream of south end of Radium bridge.
40	6	+6 (June)	Downstream of south end of Radium bridge.

Bond Area

41	1 (v. small)	+100 (?)	2.4 miles downstream from RR crossing at Bond; 10 feet below top of gravel bar (in gravel pit). In sight of RR bridge between Bond and McCoy.

McCoy Area

42	3 (small)	+20 (?)	0.1 mile northwest of Rock Creek Bridge at McCoy. Gravel at contact with bedrock.

Burns Area

43	5 (v. small)	+30 (?)	6 miles upstream from Burns Store and 6.3 miles downstream from junction with Colorado Highway 131. Sample from road level.
44	5 (v. small)	+30 (?)	Same as No. 43.

Sweetwater Canyon Area

45-54	0-21	variable	In 1978 10 samples were collected from several gravel road cuts between Dotsero and Sweetwater Canyon. Sites were not documented for this book, but none of the samples taken in 1980-81 had as much gold as the best 1978 samples.
55	4 (v. small)	+50 (?)	Gravel pit 2.8 miles upstream from Sweetwater road. Low percent black sand. Hard to separate heavy dark sand from heavy (?) brown sand. Much red garnet.
57	0	+30	Cut on sharp left turn (northbound) with gravel on bedrock between Deep Creek and Sweetwater Creek (2.0 miles from Sweetwater).

Glenwood Canyon Area

58	1 (small)	+6 (July)	North bank 100 yards upstream from French Creek. Not gravel; mostly silt and sand among roots.
59	0	+20	Patch of gravel north of highway about ¼ mile upstream from Grizzly Creek.
60-61	0-0	+20	Gravel cut just upstream from Grizzly Creek (is Grizzly Creek sediment!)
62-66	2-11	0 to +25	Samples from north side of river near big No Name gravel bar. Samples downstream of bar near I-70 exit. Bar should be better.
67	12 (1 large)	+25	Patch of gravel pasted on crystalline bedrock just below East portal of I-70 tunnel near No Name exit, north side of river. Gravel is in west side road cut of abandoned paved highway near the end of a straight strip of old highway where downstream traffic would start a sweeping right turn.
68-74	6-15	+25	Same as No. 67.
75	0	+30 (?)	North road cut on frontage road between Newcastle and Silt. Ideal site with gravel on tilted shale bedrock. Side stream gravels (?).

Rifle Area

76	8	+150 (?)	0.4 miles east of Rifle on Highway 6, north side of road. Abundant clay, few heavies.
77	7	+100	Same as No. 76, more heavies.
78	6	+100	Same as No. 76.
79	6	0	West side of bridge at east entrance to Rifle. Much mud, few heavies.
80-84	0	+1 to +13	Gravel bar at south side of bridge at Rulison exit. (Highway 322). No visible gold in 5 pans within 300 feet of bridge.
85-86	2-3	+4 (Oct.)	South bank of river near 45.5 Road at DeBeque. Much clay, few heavies.
87	1 (big)	0 (Oct.)	Same as No. 85, more heavies with depth.
88	2	0 (Oct.)	Same as No. 85.
89	4 (v. small)	−1 (Oct.)	Same as No. 85.

DeBeque Canyon

90	2 (good size)	+3 (Oct.)	½ mile east of milepost 56 at picnic area.
91	5	+3 (Oct.)	Same as 90 but 150' upstream.
92	3	0 (Oct.)	0.4 miles east of Horseshoe Canyon.
93-95	1-3	0 to −2 (May)	These pans were taken on a canoe trip. Exact locations were not logged.
96-100	6-11	+50 (?)	West end of DeBeque Canyon at upstream end of square concrete canal (10 feet above canal).

Grand Junction Area

101	2 (v. small)	+18 (July)	Highway 6 bridge at Palisade, west end at city limit sign; gravel terrace.
102	1 (small)	+3 (July)	Between lowest roller dam and I-70 bridge near Palisade, west side of river, boulder bar.
103-111	0-4 (small)	+3 to −2 (July)	Same as No. 102–different sites in relation to water level and position of large boulders.
112	5	+50 (?)	0.2 miles east of milepost 43 in road cut of westbound I-70, 3 feet above road level.
113-116	2, 2, 4, 5	+50 (?)	At gravel operations south side I-70, west end of river bridge; at road level.
117	1	+10 (July)	Under west end of Grand Ave. bridge.
118-122	1 to 3	0 to +2 (Sept.)	Same as No. 117.
123-124	0, 0	0, +2	50 feet downstream from No. 117.
125	6	0 (July)	100 feet downstream from No. 117.
126	4	0 (July)	200 feet downstream from No. 117.
127	0	+60 (?)	Grade on road exiting cemetery toward Dept. of Energy offices. Top of gravel terrace is Gunnison River material. In South Grand Junction.
128	0	+55 (?)	4 feet below top of terrace for sample No. 127.
129	4	+70 (?)	High on gravel terrace, East above RR alongside dairy stock fence, about ¼ mile downstream from metal "Black Bridge" over Gunnison River. Near Dept. of Energy offices. Pan was about 50% powdered cow dung.
130-150	3 to 46	−1 to +4	About ¼ mile downstream from Black Bridge where small creek, RR and paved road all approach Gunnison River. This is student practice site. The closest fair gravel to Grand Junction. Gold is from Gunnison River drainage.

Fruita Area

151	3		1981 gravel operation for Corn Construction ½ mile upstream from Highway 340 bridge, north side of river. Surface of floodplain gravel.
152	5		Bed of small trickle of swamp water 2 feet below level of floodplain.
153	5		Same as 152.
154	2		5 feet below floodplain in gravel pit.
155	7		15 feet below floodplain in gravel pit. Near bottom of gravel.
156	3		Bottom of gravel pit at contact with clays.
157	1		3 feet above bottom of gravel in pit.
158-61	0-4 (small)		Corn Construction Co. gravel stockpiles. ½ mile upstream from Highway 340 bridge.
162-165	0	+4 to +10	At boat landing near Loma exit from I-70.
166	2	+1 (Sept.)	Same as No.'s 162-165.
167	1	0 (Sept.)	Same as No. 166.

Westwater Canyon

168-186	16 to 60	−1 to +6	Another student practice area (at BLM check station for float trip permits.) Samples taken within 300 feet of station and on opposite bank of river.

187	12	0 (Aug.)	At entrance to Westwater Canyon; east side of river; gravel bar.
188	0	0 (Aug.)	Same as No. 187. Sample was all river-concentrated black sand.
189	14	2 (Aug.)	Same as No. 187. Sand and gravel from cracks around and below loose bedrock boulder that was pried out.
190	0	+1 (Aug.)	Same as No. 187. One quart of sand from softball-sized pothole.
191	3	+2 (Aug.)	Approximately 1 lb. of sand picked with wire from cracks in bedrock.
192	200+	+40 (?)	Downstream from "Miners Cabin" at site of grates and trenches of most recent digging. Stopped counting at 140. Sample from near top of terrace. Much suspended fine soil. Most grains are very small and roll easily with black sand–hard to separate with pan action.
193-194	11, 14	+10 (May)	Cisco Road float trip pick-up area. North side of river, exact location not marked.

Dewey Bridge Area

195	6 (v. small)	+20 (?)	Gravel pit 3 miles upstream from Dewey Bridge, north side of river. Sample from previously sorted (?), screened (?) sediments. North part of Northeast quarry area. Very little sand, mostly mud. Very little black sand.
196	2 (v. small)	+20 (?)	Same gravel pit as No. 195. Sample probably piled during screening operation. Very little black sand, mostly pea-sized gravel.
197	29	+25 (?)	Road cut 0.1 mile upstream from Dewey Bridge gas station, northwest side of road at ranch entrance.
198	9 (v. small)	+4 (July)	On river bank in front of Ballard home (at Dewey Bridge gas station). Thin band of sand among gravels; no mud; clean sand.
199	31	+15 (?)	10 feet southeast of gate to Harris home. This is top of gravel terrace. Much black sand.
200-205	15-45	+15 (?)	Several different visits near the gate by the gas station for No. 199. Just a flat area of soil and gravel–which is the top of a very rich terrace that is being mined on several ranches in the area.
206	391	+20 (?)	Herod's Placer, ½ mile upstream from south end of Dewey Bridge. Estimate 4 times normal black sand.
207-210	100-400	+20 (?)	Return visits to Herod's Placer–samples from stockpile that feeds sluice box.
211	31	+20 (?)	Herod's operators sent me to the "hot spot" where the best sand is supposed to be. I did not follow directions properly (or it was a phony gold chase).

212	41 (small)	+20 (?)	Same as No. 211.
213	59	?	Tails from sluice at Herod's Placer, 1980. (Sluice extended in 1981.)
214	0	+30 (?)	0.8 miles downstream from Dewey Bridge on Highway 128. Very little black sand.
215	18	+25 (?)	Same as No. 214 but 5 feet lower in gravel terrace.
216	24	+1 (July)	300 feet north of confluence with Tower Wash. Scant pan, hard to recover 1 quart of sand from boulders.

Grand Canyon

217	3	+3 (March)	On south side of river about ¼ mile downstream from silver-colored pipeline bridge atBright Angel Creek (Phantom Ranch) station.

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