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on

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March 30-31, 1983
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University of Alaska
Fairbanks, Alaska

School of Mineral Industry
and
Alaska Miners Association

An abridged format of papers, presentations and addresses
given during the 1983 conference
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WELCOME

Dr. Jay Barton
President, University of Alaska and Chairman, Resources Committee

On behalf of the Regents of the University and the entire University of Alaska system, I would like to welcome all of you to the Fifth Annual Placer Mining Conference. You have seen many changes in the five years you have been attending this conference, but in some ways the changes have been short-term, and superficial. They deal with buildings, faculties, programs, students and so on, but from a broader prospective that the state sometimes takes, perhaps things haven't changed too much. I read the minutes recently of the Board of Trustees of the Alaska College of Agriculture and School of Mines in 1917 through 1925. A fascinating set of minutes. Would you believe that people were concerned then about the high cost of building and about the high salaries and the high fees paid to architects and yet the building they were talking about was going to cost up to $50,000 and was going to serve as a dormitory, offices, classrooms, laboratories and include the heating plant.

It was a new different world when we began back then and yet the concerns are very much the same as they are today. More importantly, I think that from the very earliest days of Alaska, to these days as a College of Agriculture and a School of Mines, the idea that a land grant university reaches out to the development of industry and economic life in the State has never been more obvious. It began that way in 1917 that those were the concerns of Mr. Nordale and many others who met on that first Board of Trustees and they continue to this date. On behalf of the University, I wish you success in this conference.

WELCOME

Bill Walley
Mayor of Fairbanks

As I look around the audience today, I see many familiar faces, not only from the Fairbanks area but from out-of-town, too. I would estimate that 5% of you I have either interviewed on television or the radio somewhere in Alaska.

Mayor Allen is in Juneau. Things are exciting in Juneau these days and we go back and forth with every movement that takes place down there. He could not make it this morning so on behalf of the North Star Borough, Mayor Allen and Carleeta Lewis, the Mayor of North Pole. I certainly welcome you to the conference.

You know it is amazing the involvement that local government can and should have in this industry. The lure of gold and mineral extraction has been the focal point of our economic history for a long, long time and now we think in local government that mineral activity is the future development of the entire stability of the Alaska economy. We believe that! This constant viable force should be the center and the focal point of all our future economic planning.

The reason I brought up local government in connection with this mining conference is because I think it is very important that you understand clearly who the best lobbyists in Alaska are. They are local government. The people who get the most from Juneau are the municipalities. They get the most in capital projects, shared revenues and are the best lobbyists in the State of Alaska. Therefore, I think it is very important that you as a Conference, because you are the experts in this field, tell those of us in local government where we are going and how to get there. We, then, who believe that the industry you are here to talk about today, can be sold to the State government. I believe the State government must spend the funds that are necessary to move this industry to a functioning, economic, viable process in our State and they have to do it before they lose the funds that they have.

As I mentioned before, things are weird in Juneau right now and the funds are leaving us very, very rapidly. I think we have talked about oil and we can not pass up oil, of course. It is a very important part of our past and will continue to be a very important part of our future, but probably, because of the oil syndrome, as I call it, we have just not spent enough time on the mineral development in our community. We sort of shoved it in the background and I think with the help of local government, the Boroughs, the Cities and the Municipalities, we can bring it from the background and put it in the forefront.

There is a fellow who spoke to the College Rotary Club by the name of John Sims. He gave a fascinating speech and I was taken back by it. That is why I am here today. John said that mining gold with modern technology can bring mind boggling profits to Alaskans and a boom to our economy. That is probably the understatement of the year and our University of Alaska can play a vital role in developing 21st century mining technologies and make this a reality. Gold mining, of course, gave birth to Fairbanks and it has been resurrected in the 1980's. The only problem is, Mr. Sims tells us, that they are gold mining with sluice box mentality when they should be in the computer age. And I hope that this conference will come up with the proper ideas and that you will relay them to local government so we can lobby in the State of Alaska for an industry that should be in the forefront and not in the back room of our future economic development. I hope you have a great Conference, I hope you will visit all the areas. Welcome to Fairbanks, North Pole and the North Star Borough. Most of us in the room are members of the Alaska Miners Association and to introduce you to the morning's program and to explain how the next 2 days will be conducted, I would like to introduce to you the President of your State Association, Mr. Paul Glavinovich.

INTRODUCTION

Paul Glavinovich
President, Alaska Miners Association

As President of the Alaska Miners Association, the honor of the official introduction falls upon me. I'm not going to go through the program and introduce you to it and explain it. I think it is very self explanatory.

The thing I have always enjoyed about this conference is that we always emphasize nuts and bolts mining. The Fall Conference in Anchorage frequently gets into more abstract political terms but Fairbanks always gets back to basics and I truly appreciate that. Something though that is very obvious by its omission is credit due to some of the people who have put this conference together. I would like to mention them right now rather than at the summary so that as the conference proceeds you will have the opportunity to personally thank them as you see them on the floor. These individuals are Ernie Wolff, Chris Lambert, Don Stein, Jim Barker and Tom Bundtzen. If I have forgotten someone, it is an act of ignorance, not intent.

There is another article that I would like to call your attention to early in the conference and that is a circular that has just been published by the State of Alaska, and is available in the lobby. This is John Sims' publication, 'Impact of Placer Mining on the Economy of Alaska'. For years we have discussed this impact of placer mining on the State with no real facts or figures. This circular does provide that and certainly in reading it you will be quick to note that we are not competing with Prudhoe Bay yet, but the numbers in there are real and do represent basic wealth. They are not government dollars, but basic dollars and a real impact on the economy. The direct impact by the placer miner is, from John's research, somewhere between $80-83 million in 1982. With trickle down economics this adds up to somewhere in the neighborhood of $235-244 million. Like I say, not a Prudhoe Bay, but certainly it has to be significant.

This research was the product of much contact with placer miners actually operating in the field and I would like to personally thank each and every one of you who did contribute to that study. I know that you, as miners, and any of us in the industry in the last year or 2 years have been deluged with questionnaires from various State and Federal agencies. The fact that 127 individual miners responded to that questionnaire, out of 600 mailed, I think is very exceptional and I personally thank you. That sort of cooperation is going to get this industry moving.

THE CAPTURE OF TIN AND FINE GOLD

James Madonna
Assistant Professor of Mining Extension
School of Mineral Engineering, UAF

During this past year, my wife Leah and I had the good fortune to travel to Australia where we visited and became familiar with some of the Australian placer mining operations.

With this in mind, I would like to take time to share some of the knowledge gathered at these mines. Further, there is little doubt that using the ingenuity inherent within all Alaskan placer miners, you will be able to glean some knowledge, modify some of the concepts and ultimately adapt some of these mechanical techniques to your specific mining needs.

In the Australian placer mining district visited, which included the towns of Glen Innes and Emmaville in the State of New South Wales, the most common piece of concentrating equipment was the pulsator or jig. Jigs come in a variety of sizes ranging from 1 yard an hour single units which can be adapted to small clean up needs, to the large doublets capable of processing between 50 and 75 yards per hour or even larger units.

The basic components include a divided water tank which features water inlets positioned halfway up the side, as shown in Figure 1, and outlets at the bottom.

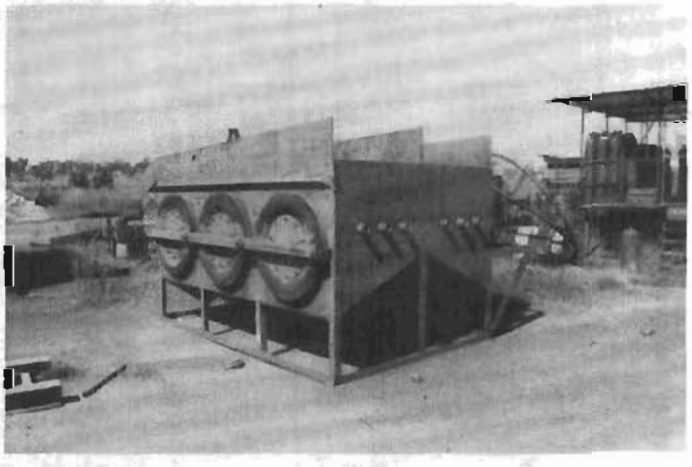


Figure 1. Divided water tank

Each tank division has attached a corresponding pulsator consisting of a half-tire-diaphram clamped to a flange surrounding a circular opening in the water tank. The inner portion of the tire is filled by two circular plates, one on each side of, and clamped securely to, the bead of the tire. Attached to the outer plate is a bar or framework which when driven by an electric motor attached to a piston forces the flexible rubber tires back and forth, thereby creating a pulsating effect on the water filling the tank. All this is mounted on an angle iron support. Figure 2 shows a screen mounted on a slant within the top of the water tank framework, a fine screen in the upper half and a somewhat coarser screen in the lower half.

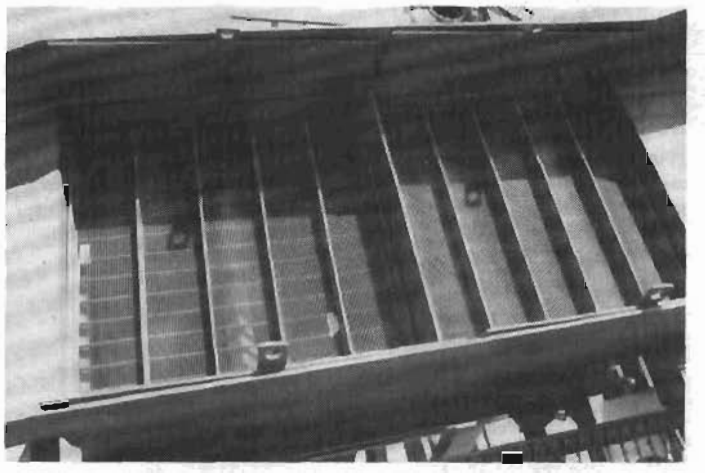


Figure 2. Sizing screens at top of water tank

The material is fed into the receiving hopper which then passes it onto the screen. An electric motor drives the diaphram piston (Figure 3) creating a pulsation on the water within the tank. The pulse forces the bedload of material to move upward permitting the higher specific gravity material to settle through the gravels or pass through the screen while forcing the lower specific gravity material up and out the overflow. The water which is pumped through a pipe into the jig is maintained at the proper level by a simple water control valve. From the top of the jig, it is possible to see the effect of the pulsators on the water (Figure 4) and a closer view reveals the bed load of natural gravel rather than a prepared bed of steel shot or hematite pebbles sometimes used in jigging operations.

In a gold mining operation, the pre-screened feed, perhaps 1 inch minus material, would enter the feeder hopper. The material passing across the screen would be processed by the pulsating motion of the water which fills the tank and covers the surface of the bedload. As the diaphram moves in, it forces the water up, thereby raising and momentarily suspending the bedload. Simultaneously, the high specific gravity material, including the gold, works its way down through the gravels. The backward motion of the diaphram has a gentle pulling effect on the material thereby returning it to the screen's surface. Assume now that the screen is 4

Figure 3. Electrically driven diaphram piston

Figure 4. Top view of pulsating jig

mesh, which would permit material of pea-size or smaller to pass through. Clearly then, material including gold larger than pea-size would accumulate on the screen's surface beneath the bedload and the concentrate smaller than pea-size would be drawn through the screen and fall to the bottom of the water tank and ultimately through the outlets at the bottom and into a catch hopper.

This minus 4 mesh material is then pumped to the receiving hopper feeding the three secondary jigs. The screens which nestle within these jigs are each of a different size. Perhaps, in the first tank a fine 30 mesh screen would be appropriate, followed in the second tank by a somewhat coarser 16 mesh and perhaps, in the third a still coarser 10 mesh. The larger gold will simply accumulate, trapped safely on the surface of the screen beneath the bedload. It follows then, that the gold and concentrate falling to the bottom of the first tank would be the fine -30 mesh fraction, in the second tank the +30 -16 fraction and that accumulating in the third would be the +16 -10 mesh fraction. These size fractions are then directed through the orifices at the bottom of the tanks and into receptacles ready for final upgrading. Finally, the low specific gravity material is discharged from both jig units into a tailings bin. This material is subsequently pumped off into a tailings dam.

The question which must be answered is what type of recovery can one expect, or what percentage of the gold will be lost? One can expect 99.9 percent gold recovery or virtually no loss. The rather attractive recovery record of these machines is the result of their extremely low operational energy requirements to process the gravel, thereby permitting the very finest of flour gold to be trapped.

The jigs shown and discussed here were not manufactured for gold mining but rather for sapphire and cassiterite (tin) mining. Sapphires have a specific gravity of approximately 4 to 5, and cassiterite a specific gravity of about 7. The gems of value mined in the sapphire mines are of +10 mesh or larger (wooden match head size) that, interestingly, accumulate on the screen's surface. In contrast, the fine cassiterite (tin ore) passes through the screen and is collected from the bottom of the tank. When we consider that gold is roughly three times heavier than either of these minerals, it isn't hard to visualize just how efficient these units might be in a gold placer operation.

The Glen Innes Sapphire Mine

The sapphires of the Glen Innes area are found disseminated in the gravels of a broad drainage called Redistone Creek. The material is excavated by a backhoe, deposited in a large truck and transported to a log cribbed bin where it is reduced to a slurry by a hydraulic monitor in an effort to break up the associated clay and free the sapphires

This slurry is picked up by a dragline and deposited into a hopper which leads to a vibrating screen (Figure 5). As the material moves down the hopper towards the vibrating screen it is washed once again by high pressure water, this time issuing from a spray bar. During operation a truck is backed beneath the vibrating screen to catch the oversized tailings. The one inch minus material passes through the sizing screen and onto jigs for processing. Shown on the left side of the sizing screen and hopper structure in Figure 5 is the primary jig. Also visible in the foreground and extend-

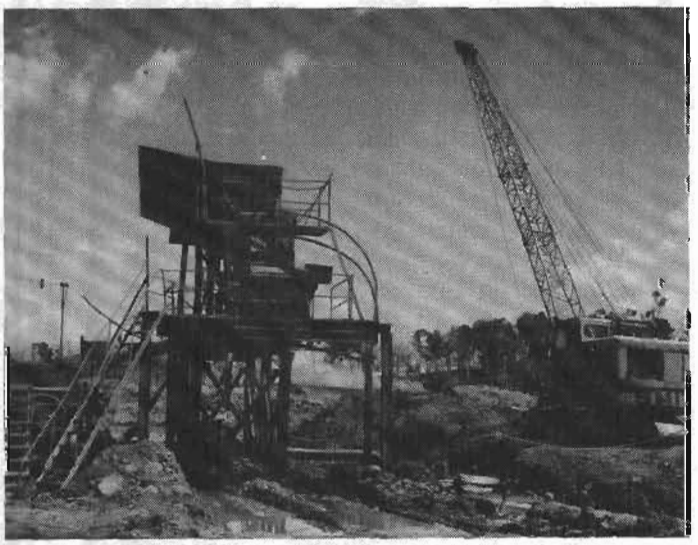


Figure 5. Sizing screen and hopper structure

ing beneath the structure is the high pressure water line which supplies water to the jig. The water line enters a distributor which has a number of pipes complete with adjustment valves leading to the individual water tanks.

A pipe leading from the bottom of the sizing screen directs the undersized material to a feeder box. (Figure 6, lower left) Also note there are three water tanks in this jig, each with its own diaphram assembly.

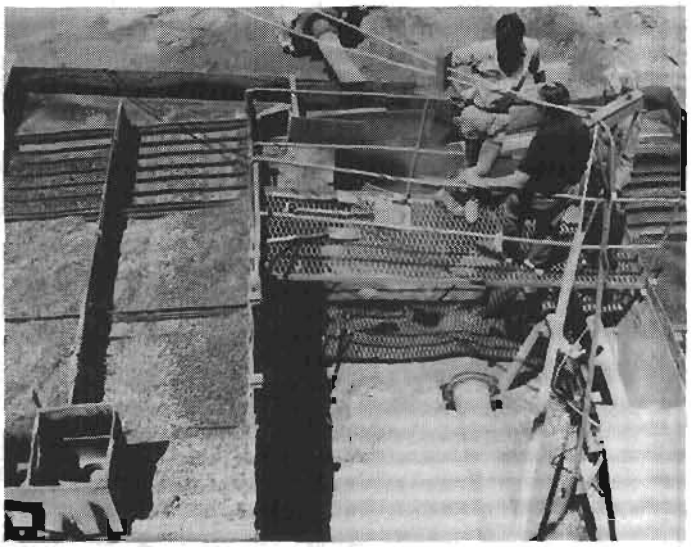


Figure 6. Sizing screens and feeder box for undersized material

These primary jigs are equipped with 4 mesh screens, consequently sapphires larger than 4 mesh, of which there are many, accumulate on the screens' surface beneath the protective bedload of gravel. The high specific gravity material finer than 4 mesh passes through the screen and through outlets at the bottom of the jig and into a catchment tank from which it is pumped up and into a secondary jig for upgrading.

The minus 12 mesh material which passes through the secondary jig screen along with the low specific gravity tailings from both the primary and secondary jigs is pumped through a pipe to a tailings pond.

The final step is the sorting of the sapphires according to size and quality and of course faceting into finished and marketable stones.

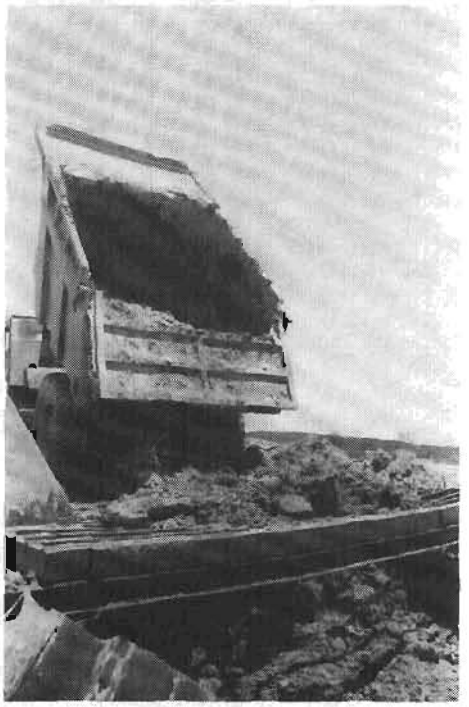


Figure 7. Loading onto the grizzly

The LoLoma Tin Mine

The cassiterite mined by the LoLoma tin mining operation is disseminated as fine grains generally 10 mesh or smaller within the gravels of a wide drainage system. The actual mine is approximately one half mile from the processing plant. Similar to the procedure used in sapphire mining, the ore bearing material is loaded into large trucks by a back hoe and transported to the processing plant. The processing plant consists of several major components. In capsule form these include a grizzly where the ore is dumped, a control shed where an operator hydraulically controls the direction of water monitors and the raising and lowering of the grizzly, a trommel through which the material is passed for initial sizing, a conveyor belt for discarding the oversized tailings and beneath the trommel, twelve jigs, six extending from each side which concentrate the cassiterite.

Upon arrival with a load of material the earth movers deposit it onto the grizzly (Figure 7) where for the most part it passes through to a hopper below where it is vigorously washed reducing any clay balls and clumps to a slurry (Figure 8). The slurry along with the accompanying larger stones moves down the hopper and into a chute which leads to the trommel (Figure 9). During

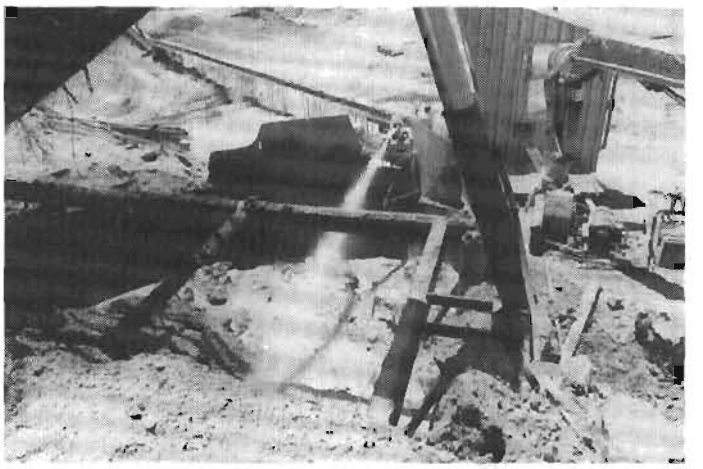


Figure 8. High pressure nozzle

passage down the steel trough the material is subjected to additional washing and agitation by a series of rotating spray bars, thereby insuring that the clay is completely dispersed and the fine tin ore (cassiterite) is free for extraction. As the material passes through the rotating trommel, additional washing is conducted by high pressure water issuing from jets (Figure 10) in an attempt to free the last small cassiterite particles which might be attached to the larger stones before they fall to a conveyor belt and are carried hundreds of feet away to the tailings dump. Interestingly these stones drop from the conveyor and come into momentary contact with a nobby surfaced one foot diameter steel drum rotating at high speed. In most cases the rocks are disintegrated into fine particles and thrust several hundred feet away. As a consequence it only requires a few minutes twice a day for a cat to smooth out the tailings pile.

Figure 9. Chute leading to trommel

The 1" minus material which passes through the orifices in the trommel is directed to the jigs. through troughs. The minus 8 mesh ore-bearing concentrate passes through the jig screen while at the same time, the low specific gravity material passes across the jig into a tailings trough leading to a catchment hopper from which it is pumped through a pipe to a tailings dam. Meanwhile the cassiterite bearing concentrate falls to the bottom of the jigs where it passes through a series of hoses and pipes to a catch basin from which it is pumped up and into two secondary jigs for upgrading. The upgraded concentrate is channeled through two pipes which lead from the bottom of the secondary jigs to a holding tank where it awaits final treatment in the cleaning room.

The final upgrading is conducted by Gordon Lynn, the tin cleaner at the LoLoma mine. Gordon fills the head box of a cleaning trough with water, then by carefully adjusting the water valve permits the water to overflow gently into the cleaning trough. He then opens a valve on the pipe which connects the outside concentrate tank to the cleaning trough. The valve is carefully adjusted to permit an even flow of concentrate. Using a square shovel, he paddles the concentrate back towards the head of the box where the heavy tin ore collects. The gentle flow of water carries the lower specific gravity material out as tailings. Note in Figure 11 there is a water pipe leading to a water tank at the bottom of the clean-up trough and that this tank has attached to its top a one foot square hopper. The steel plate separating the water tank from the hopper contains hundreds of pin head sized perforations which permit the transfer of water from the tank into the hopper. Now when Gordon places the concentrate from the first box into this hopper and has the water turned on and adjusted properly it suspends the material according to specific gravity, the heavier lying nearer the bottom and lightest foreign material carried to the top and over the edge into the trough. When the water is shut off, the grains settle. However, the cassiterite still has a thin layer of material lying on it which is skimmed off.

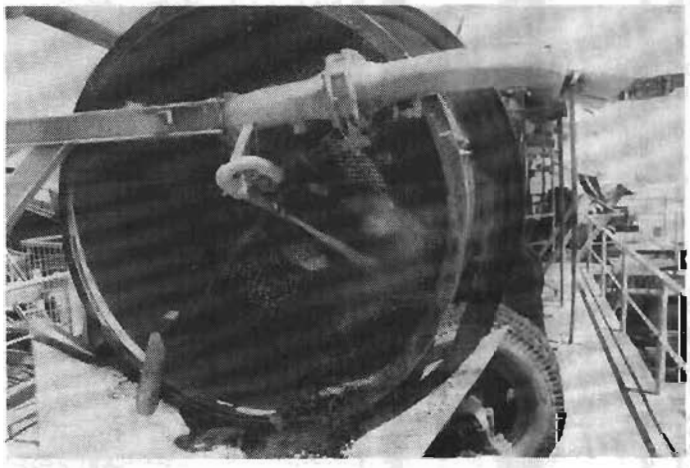


Figure 10. Jet washing inside trommel

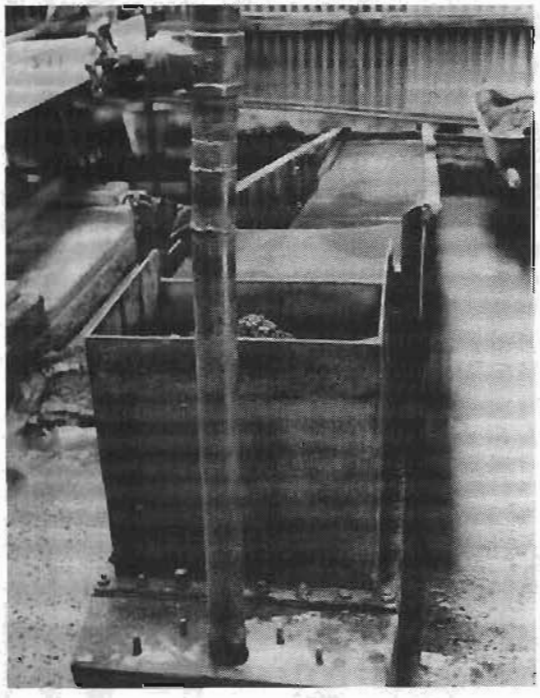


Figure 11. Clean-up trough for concentrate

The concentrate consisting of over 90% cassiterite is ready for bagging (Figure 12) and shipment to the smelter. The light weight material which was paddled in the first clean-up trough, the material that was washed over the hopper in the second trough and the material skimmed off is all placed in a hopper for final treatment across a vibrating table in an effort to extract the last traces of cassiterite.

In summary, we see how jigs have served to extract the valuable sapphires by trapping them on the screens' surface beneath the bedload and, in another case, how

valuable cassiterite has been extracted from the concentrate which has passed through the screen. With these operations in mind it is not difficult to imagine how jigs might serve in a gold placer operation. The larger nuggets, like the sapphires, would be trapped on the screens' surface while the finer gold, as was the cassiterite, separated from the concentrate which passed through the screen.

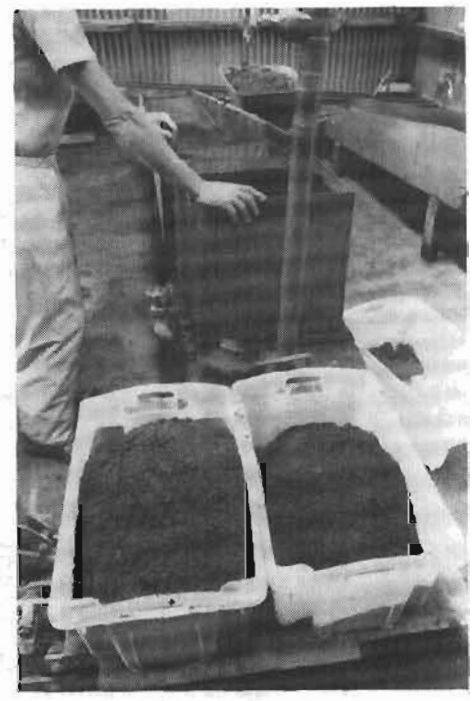


Figure 12. Cassiterite concentrate ready for bagging and shipment

GOLD MARKETING

Rich Calamari
District Manager, Oxford Assaying and Refining, Fairbanks

The market price for gold one year ago yesterday was $318.50. We had a price of $412.75 yesterday which posted an increase of $94.25 per ounce, or as they say on the market, a bullish move of 22.8% in one year. Silver was $6.92 a year ago and $10.66 yesterday. That is an increase of $3.74 but the important thing to note is that it is an increase of 54.1%. So the market is much more encouraging than it was last year but we do issue a word of caution and that is that one must be on top of everything or else what happens is that we get caught in a slide or a correction that we do not expect. I mentioned silver a minute ago because I strongly believe that this system metal can be a better way to make your gold work for you. It may sound crazy that I am saying this to gold miners but this is exactly what I am advocating here. Each and every one of you ceases to be a miner, for the time being anyway, after he takes the gold out of the ground and like it or not, he automatically becomes an investor. It is true that more sweat hits the brow while actually pushing the dirt or keeping the equipment working but from what I can see and from the feedback I get from you folks, the hardest part is marketing this gold. Of course you want the best price that you can get for your gold and it is true that at this time it becomes an investment which means transferring it possibly to another commodity, which has a better outlook for percentage growth. The one I am advocating right now and the one I would like you to take a look at is silver. Let us go to an example. Two hundred ounces of gold on March 29th of last year was worth $63,700 which if transferred to silver would yield 9,205.2 ounces of silver. If you took that 200 ounces of gold and held it for a year and had you marketed it yesterday, that gold would be worth $83,160 so you made $20,000 over the year in the gold. But, if you had converted it to silver, that 9,000+ troy ounces at $10.66 would be worth $98,127+. So, if the miner had transferred the gold to silver instead of keeping it in the original commodity, we would have seen a more positive return after one year in the amount of $14,967.

Now what about the forecast for gold and silver for this year. I can only repeat what you hear. There are so many major influences on the market now that it is very hard for us, who are constantly working, to be able to pinpoint so we have to take the advice of those who sit behind the desk and do the trading. The major investors are filling the airwaves with predictions of $575 an ounce by year end and silver - and this is the shocker - $51.00. There are some people who even say $100.00. I personally take a more conservative view. I like to be surprised the right way, so I would say that a more realistic view would be that we are going to be looking right around $450-475 for the major part of the season with maybe a peak at $525 and I would be very happy to see silver stabilize at around $23.00 an ounce at years end. The rise in gold at those forecasts would be 26.5% but note that the silver increase is 115%. It is much easier to double a commodity that is at $10 or $20 an ounce than it is to double a commodity that is at $500 an ounce. I realize that a lot of these numbers do not strike home until they are in black and white and you actually work with the figures. I hope you will think about this idea of changing the gold into another commodity, not necessarily silver, it could be penney stock or many things, but think about it. It is real nice to hold on to that gold - that yellow, beautiful shiny stuff, but when you are digging it out of the ground and you need the money to push it, you have got to think of ways of making it work for you and this is one of the things that we have researched and we hope that you will take into consideration. I can really get involved in the marketing but a lot of it is hearsay and a lot of you get letters from different investors, etc. Just keep your eye open. Keep in contact with your brokers, keep in contact with your smelter, keep in contact with the miner down the road and watch it real closely.

Now I would like to make a few comments on a number of things that would interest you concerning the industry. Our company will be returning 15 cents an ounce to the respective mining districts for any gold

turned in by any dues paying member of any district in hopes that this district would use this small rebate and I would like to call it a thank you token, in organizational and legal fees to help keep mining in Alaska a viable industry. I would appreciate having the respective District presidents stopping by to see me so I can work out the arrangements.

Our company has also been involved quite heavily in two issues these past winter months. One is the Birch Creek nemesis - and that one really strikes home. The other issue that seems to have caused quite a fury is this new tax law labeled TEFRA. There are a lot of misunderstandings about it. I have tried from many different angles to get a handle on this law but the Senators do not know, IRS does not know, nobody knows what is going on. I cannot understand why we should get excited if nobody knows what is going on. As far as we are concerned, we are just going to continue business as other businesses have decided. Senator Stevens has told us that it does not look like there is going to be too much effect on our industry. Since we have not received any formal instructions concerning social security numbers, and until we have something definite, I along with others just consider it business as usual. The other thing is this 15% that has nothing to do with us selling gold. The 15% surtax that they are pulling out now is an investment tax to the effect that the IRS wants to withdraw, not get their 15%, their income tax, out of your investment profits. You cannot tell me how much profit you make in the middle of the season so there is no tax. Also, it must be understood that they can do this with a federal agency, such as a bank or brokerage, because they are federally regulated. We are private industry so we have some rights and these are the rights that we have to protect. Any thing that we can do as individuals, or as a group, in petitions, letters or whatever, we would encourage.

Point 2: at the convention in Anchorage in 1981, we introduced an Oxford silver bar for investment. Then in Fairbanks in 1982 we introduced an Alaskan silver ingot to show our pride in the State and to allow our pride to be shown as folks use them as gifts and investments and I was really overwhelmed by the number of people outside who have called or requested Alaskan metals. Then at the convention last fall in Anchorage, we unveiled an Oxford one ounce gold bar. It is at this time that I take great pride in announcing that we are in the process of manufacturing an Oxford Alaskan bar very similar to the silver bar. What makes us very proud about it is that this bar is nothing but the toil of your work. It is Alaskan gold and it is the gold that is taken out and processed this year. What we are using right now is what we have gotten through the last winter months. But it is guaranteed, it is going to be Alaskan gold and this is one of the things that makes us very proud about it.

Point 3: is the construction of a new smelter facility in Fox. We have written a letter to all the Senators, to the Borough and to the Chamber of Commerce, concerning the mining industry. The threat of closing down a certain district, or closing down a certain creek, has an impact that a lot of folks do not realize. Closing down districts and closing down creeks because of somebody's good idea, may seem right but closing down the pocket of the hand that feeds you, is not right. I have received some good responses from the Borough and I have some good responses from the State Legislature. We are in the process right now of putting together an ad campaign to let the people of Fairbanks know what we in this industry are doing for them. I do not know what came out of the Interior last year, but I can tell you that just through the accounts to the Interior miners, not those in different districts, we have issued, in sold gold, not gold on deposit, over $9 million and I would say that at least 85-90% of that money returned back to the City or the Borough through industry and other things. It is because of this industry that we have decided to go ahead and build. We are putting a 3,000 sq. ft. building out in Fox at 10-1/2 mile Steese. It took us 3 years to find this place. It took us 3 years of fighting the economy to get into a position where we did not have to fall behind. It will be a smelting and assaying operation but it is going to be done here. The gold will be processed here. Any gold that is brought in by 4 o'clock any day will have assays the next day. It will be manned by people of Fairbanks. We would like you to come out and see us there. The doors will not open until June 15th. I, myself, am moving out there and am learning quite a bit about living out in the bush. As soon as the weather breaks, we are going to break ground.

THE GEOMORPHOLOGY OF CLEAR CREEK PLACERS YUKON TERRITORY

Steve Morrison
DIAND, Whitehorse

What I am going to talk about in this discussion is not really the Geomorphology of Clear Creek, but a detailed understanding of the sedimentology of the Clear Creek gravels which are being mined. They are being mined by Queens Stake and by a few other operators and at the end of the talk I will have a few brief comments on the type of glacial materials in the valley as well and there will be a few technical terms to make you aware that geology does play an important role in placer deposits.

The objectives of this summer's field work was to understand the geology, the sedimentology and the kind of environment that deposited Clear Creek gravels. We also wanted to put together a heavy mineral suite of the gravels so that source problems could be worked out as well. Also, the glacial history of the quaternary deposits were mapped in the valley. A very general map will show the rough distribution of placer areas in the Yukon-Klondike area, Clear Creek and Stewart. The map should also show Barlow Creek, Squaw Creek, Clear Creek, and Stewart River in Central Yukon.

How did we do this work this summer? Basically, from Placer operations, the cuts they exposed with their Cats, and describing the sections in a very detailed way. After describing the sections we took samples, I called these bulk samples, although they were pretty small, only about 1 cubic foot. We then rock them, and this rocking is an extraordinary job performed by George Gilbert of our Department. After the samples were rocked we panned them.

Again, the first thing deals with the gravels which are being mined at the present at Clear Creek's Queens Stake operation. The Valley is rather broad. It should be noted that the morphology of the stream itself reflects a rather meandering type of morphology, very slow-moving, low energy type, low grading stream. That is an important feature to remember.

After describing those trenches all summer we came up with a story. What we have done is basically taken the dominant sedimentological characteristics of the gravels and compiled it into a section.

The materials had a radio carbon date performed which indicated an age of 6,280 plus or minus years. So basically we are dealing with gravels deposited within the last 10,000 years.

I will explain what the geology is like and then we will put together a three-dimensional story. The first facies we are going to deal with is the fine facies at the top which is basically laminated silty fine sand. It's laminated oxidation bands are convoluted as well. The convolutes and disrupted bedding are easily visible. The bedding appears as small stringers which have been disrupted. This disrupted and convoluted bedding is interpreted as being the result of liquefaction and settling processes in this type environment.

The interpretation we can attach to this facies is an overbank environment. In other words, a channel is active at one time, then abandoned and filled in with fine material. It is basically an abandoned channel. Also in this fine facies we occasionally get trough crossed beds. The explanation for these types of features is basically the reactivation of the channel. In other words, the channel is active, abandoned and then reactivated. The water starts flowing through it again, leaving scours.

The next facies is the sandy trough-crossed bedded facies. The interpretation of this type of material is basically a sandy dune migration in an active stream or channel scour so these might represent shallow channels as well.

Next is a massive to laminated sandy facies. It is massive near the top and laminated lower down. The explanation for this type of material is deposition as a channel filling or perhaps planer bed flow in a very high energy environment.

The next facies is the gravelly facies - gravelly sediments. It is important to note that the gravels are angular to subangular, locally derived materials. A description or a summary for this type of material is a poorly sorted clastic supported matrix filled gravel. This basically summarizes the physical attributes of the gravel. It is all locally derived material from the Valley.

The first thing to be aware of is that the gravelly facies is a massive, trough crossed bedded unit. When dealing with sedimentology of gravels, the structures are very difficult to see and one must use a bit of imagination at times. A plane that moves up represents a trough crossed bed. Pebbles that are lined in a trough fashion are important to pick out in a section because they indicate a stream that has deposited gravels under very high energy conditions and the troughs themselves either represent a channel that is migrating in the stream or it represents something called a transitory bed form or a gravelly dune. What that means is that at the bottom of the stream there are gravels that are being picked up and redeposited - looks like a great big ripple and it moves down the stream so it constantly reworks bottom sediments and gold.

The next facies is a massive gravelly bed that is poorly sorted and is angular. This represents something called an agrading diffuse gravel sheet. Again, it represents a stream that has a very high energy and its pebble by pebble accumulation of gravels as the stream flow changes. Also, in this facies we have a thick version that is crudely bedded. The interpretation for this type of gravel is a proximal bar form. In other words, when one examines a braided stream, they see bars in the middle and that is what the bar would look like when you cut it in half. We dated the wood from this section which gave an age of about 7,000 years.

The last facies is a gravel which is open work and massive. Open work means that fines and finer clastics did not infill between the gravel clast. It is associated with a very, very high energy environment. In fact, it is moving so fast (the stream) that the finer clastics were not deposited in the gravels and you can see all the coarse gravels touch each other. This is an important facies to understand as well for distribution of gold.

The final unit is a facies which is stained black. Here the gravels are all touching each other, very, very little fine sediment and basically this material has been reworked by a perched water table. What does all this mean? When one puts all the pieces together, and thinks about them, it comes awfully close to what a braided environment looks like. In other words, 7,000-10,000 years ago Clear Creek looked much different than it does today.

What do the sediments tell us in the Valley? There are 2 alternatives in understanding Clear Creek gravels. The first alternative is this one: it deals with the classical braided system lots of bars, a diagonal bar, longitudinal bars, and all kinds of channels. In some channels we have migrating gravelly dunes which result in the trough cross beds so we have all kinds of things going on in this Valley which definitely control the distribution of gold. The other alternative is a sub-braided system. All this one means is that there are not as many bars. There are not as many channels. The type of stream which deposited the gravels people are mining in Clear Creek, deposited the gold in the Valley very sporadically. It is random, and there will not be a pay streak. For the people who are actively mining, that is the important message.

A geologist who understands something about fluvial sedimentology, and has looked at enough sections can tell you what kind of stream deposited the gravels.

When testing, do not waste time looking for a pay streak. I think that has important implications for miners just starting up in a valley like Clear Creek.

The kind of gold we find in the Valley reflects the streams' character. Remember we are dealing with a very high energy stream environment, and the gold should reflect that. Some pieces stretch out a couple of inches just like a piece of tin foil. The gold is extremely flattened, reflecting the kind of environment that deposited the gravels.

Again, when a miner works up to the headwaters of Clear Creek Valley he gets occasional nuggets and they are very commonly associated with Quartz, very little dendritic or wire gold so we are definitely looking at detrital gold compared to authigenic gold and we can predict the kind of distribution of gold that should be in the Valley based on this type of geologic model.

The second part of this talk deals with the glacial materials in the Valley. Again, a map of Yukon showing the glacial limits is important. At Clear Creek, there are basically two types of materials. The gravels they are mining today for gold and the associated glacial materials.

There are glacial materials in Clear Creek that contain gold, but whether they are economic or not is a fairly complex question that several people have to address. We can also determine which materials have gold and which are barren. Just briefly, a glacial limit map of Yukon shows at least 4 ice advances over the last 2 million years - the McConnel advance, the Reed advance, which occurred about 40,000 years ago, and the pre-Reed advance, probably older than a million years. We are in an area of fairly old topography, fairly old terrain. We are past the limit of the last ice advance and situated somewhere between 40 thousand to a million year old glacial material.

Two examples of glacial sediment are interesting in the Clear Creek Valley. The first are some terraces found right at the junction of Right and Left Clear Creek. Also, at the headwaters of Left Clear Creek there are some different glacial materials.

The Valley bottom contains Holosome gravels, described previously, that contain gold. Also present are terraces, or benches, rising about 70 meters above the present valley. These are very interesting terraces because we have a preserved pre-glacial fluviatile channel. In other words, we have preserved alluvial gravels that are virtually identical to the gravels in the Valley bottom, underneath glacial drift. These alluvial gravels, 60 meters above the creek valley, are very rich in gold. So, we have a preserved channel below the glacial material. This glacial material is frozen so it presents a problem and there is an awful lot of it to move. However, there are certain glacial units that do contain gold derived from this material. So what the Company did was dig a monster trench across the bench. The bottom of it was 15 meters deep and they extended it to about 100 ft. long. The material is alluvial gravels virtually identical to Holosome gravels in the valley bottom. These are alluvial gravels that are pre-ice advanced and that last ice advance in the valley is quite old, let us say a million years just to put a date on it, so we are looking at very old material. It is very similar to the gravels described earlier, angular local material, some trough crossbeds, pockets of clastic supported gravels throughout, and occasionally sandy trough crossbeds that are truncated by gravelly material. Basically, we are looking at material again that is very old but is very similar to the younger gravels in the valley bottom and it has gold in it.

Looking up the column there is a contact which is rather spectacular as it passes into the glacial deposit. This consists of lots of sandy silty material and rounded irratics. The irratics are not striated but they are nice and rounded and they are foreign, they did not come from that Valley. Consequently, there is quite a difference in that material.

The last section I am going to talk about is at the head waters of Left Clear Creek. This is interesting because it represents a different type of ice advance. The glacial material we have been talking about, up to now, deals with continental ice, ice that has covered the whole country. This, on the other hand, represents a local ice advance out of a local drainage system and it is being mined today for placer gold. There is an altered bedrock horizon lower down, and higher up is glacial drift. These are Holosome stream deposits and the material represents a local Alpine ice advance.

The gold taken from the local glacial material at the headwaters of Left Clear Creek is marketedly different from the gold obtained from the Holosome gravels. Remember how the Holosome gold was described as flattened and thin. In contrast the gold out of that glacial material is very chunky, very coarse and rugged. Glacial transportation is very passive under certain conditions so the gold will not be reworked and pounded as much.

In summation, in Clear Creek in Yukon they are mining Holosome gravels, which have been deposited in the last 7,000 years. The deposit is very thin, 5-6 feet in places, and was deposited by a very high energy, high sediment type stream with the result of a very dispersed nature of gold distribution. There are no pay streaks in the Valley.

The Holosome gravels are one type of sediment in Clear Creek that can and are being mined now. The other potential material that could be mined is glacial drift. I will not go into the technical details of the glacial materials because it is fairly complicated but I have discussed certain types of glacial drift in Clear Creek which are being mined very successfully and I think that if we approach placer deposits from a technical, earth science point of view and attempt to understand the environments that deposited the material that contains the gold, any mining operations will be more successful.

Q. Did we do pebble fabric and did we measure pebbles to get approximate past stream currents and velocities?
A. We did do that and it led to very complex currents and very complex stream directions based on the fabric of the gravels that were deposited 7,000 years ago. We also did pebble fabric, the orientation of the pebbles in the glacial material as well and we have come up with some source areas for the glacial material. The reason I

am calling it Alpine material is because the pebbles point straight up into the mountains and the material is very similar to the material in the mountains and it has to come from there.

Q. Are the glacial gravels a source for the gold in the Holosome gravels?

A. It's 'a' source but not the whole source. I think there is a local source as well associated with the bedrock because some glacial material is barren, because regionally it is from a much different area. The only time that the glacial gravels would be a source would be when you are looking at a reworked glacial fluvial deposit which has been reworked and cut by a present day stream.

Q. What was the lithology of the gravel in the bedrock?

A. I should have mentioned that. The bedrock is a quartz chloritic schist, to a graphitic and chloritic phylite and the Holosome gravels consist basically of quartz cobbles and pebbles, schisty fragments, angular to subangular schist fragments and quartz. It is all local and comes from the Valley itself. That is the other thing, in the Holosome gravels, there are very few irratics in the gravels themselves, which again leads to the conclusion that the glacial materials have played some role but not a large role in the reworking process.

CASE HISTORY OF THE PLACER MINING OPERATION OF EVECO ON TOO MUCH GOLD HILL

Harold Ellingson, President, EVECO, Inc.
Alice Ebenal, Vice President, EVECO, Inc.
Earl H. Beistline, Mining Consultant

Gold mining followed the initial discovery by Felix Pedro on Pedro Creek, Fairbanks area, on July 22, 1902. The point of discovery is located about 17 miles from Fairbanks on the Steese Highway and is marked by an appropriate Bronze Plaque mounted on a large granite boulder obtained from nearby Pedro Dome. The discovery claim is now owned by Igloo #4, Pioneers of Alaska, it having been deeded to the organization by the United States Smelting, Refining and Mining Company.

Pedro Creek and Gilmore Creek join at about mile 12 of the Steese Highway to form Goldstream which flows in a westerly direction for a number of miles. Part of the Steese Highway is located in the Goldstream Valley on dredge tailings and at about mile 9 on the Highway, it leaves Goldstream. It is at this junction of Goldstream and Engineer Creeks that the placer mining operation of EVECO, Inc. is located.

From the time of discovery, mining has continued in the valleys of Pedro, Gilmore and Goldstream -- first by open cut methods and drift mining, followed by large-scale dredging (four dredges operated in the valleys in years gone by), and now by a number of 'mechanical' placer mining operations at various locations in the watershed.

EVECO's mining property is located in an area that has had considerable past, as well as present activity. Thus, across Goldstream Valley on its right limit, the Tanana Valley Railroad roadbed was constructed in about 1905, and higher on the hill above the railroad is the location of the 92 mile long Davidson Ditch used in the past to bring water into the Fairbanks area for large-scale dredging operations. Upstream, about two miles on the left limit of Goldstream, is the location of the Cold Regions Research and Engineering Laboratory -- the permafrost research tunnel of the Corps of Engineers.

On the mining property itself, conventional drift mining took place, as well as an early attempt at underground hydraulic mining. Also, on the property was the Headquarters Camp for the Fairbanks Exploration Companies (F.E. Company, USSR & M Company, UV Industries, Alaska Gold Company) operations in the area.

Currently, the Alaska Oil Pipeline is immediately adjacent to the area being mined, as are both the "Old" and "New" Steese Highways. The claim is bordered by private land to some degree. Power transmission lines are nearby.

Not part of EVECO's operation, but nearby is another proposed activity scheduled to begin this summer about May 15, 1982. This is a tourist mining trip and is known as:

Gold Dredge Number 8
'Catch Gold Fever'

The F.E. Company mess hall-bunkhouse, located on EVECO mining claims has been moved to the immediate vicinity of Dredge No. 8 to give an atmosphere of a typical gold mining camp of past years. The non-operating dredge will be prepared for tours for visitors and tourists and gold panning facilities will be on site. The anticipated price being considered for the tour is $5.00, which includes the tour, a gold overlay souvenir,

Excavating gold bearing gravel with a backhoe, which will be moved toward recovery plant by a bulldozer and then moved to the recovery plant by 6 cubic yard loader. Tractor driven pump removes excess water.

panning of gold (keep what you find), and the opportunity to catch 'Gold Fever'.

It is in these surroundings with numerous complex situations that a mechanical gold placer mining operation was developed by EVECO, INC., and who successfully mined during the 1982 season and began stripping overburden in January for the 1983 mining season.

The mining area is on a patented mining claim owned by Alice Ebenal, Vice President of EVECO. The area, not previously dredged, but worked by drift mining, is triangular in shape and is between Engineer Creek and Goldstream.

The interesting story of the formation of EVECO and the initiation of mining operations in 1982 is well told in the words of the president of the Company, Harold Ellingson. I quote:

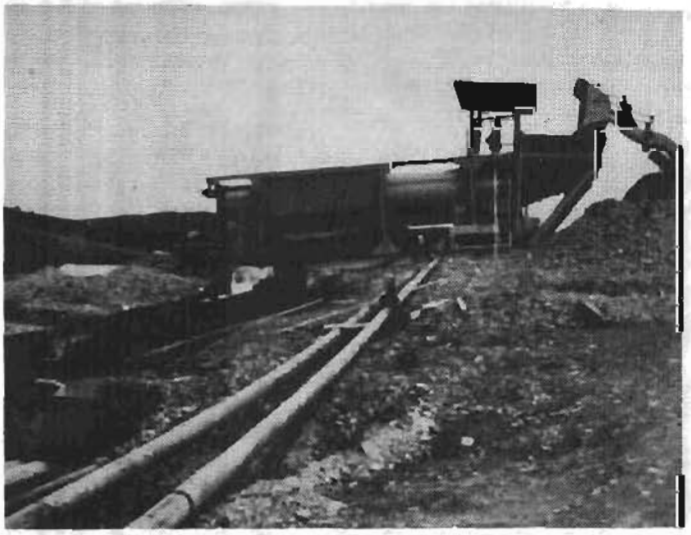
"Several years ago, I began searching for placer mining ground and this study led me to the triangular shaped area between Goldstream and Engineer Creeks, two creeks that had been dredged in the past by the Fairbanks Exploration Company.

Close-up view of tractor driving a pump and section of overburden and gold bearing gravel.

"Numerous stories were told to me as to why the triangular shaped piece had not been mined, such as: the ground was chosen by the F.E. Company for their field headquarters in the Goldstream area, and to provide sites for facilities such as: a pipe yard, a transformer station, a coal bunker, a blacksmith shop, and a mess hall and bunkhouse for mining crews. Other stories stated that the ground was too poor and the overburden too deep, while others said it was very rich and was intensively drift mined. I discussed these stories with the owner of the undredged ground, Alice Ebenal, who is also owner and president of ACE Construction Company, with office headquarters nearby. Alice told me that often she had thought about initiating a mining operation on her ground but did not know of a person who was willing to undertake such a job. I told Alice that I was qualified to build a placer gold recovery plant, along with having the knowledge to operate such a plant.

Close-up view of backhoe feeding hopper of recovery plant.

"After many meetings, we decided to take an initial step -- that of prospecting the ground, as well as locating a competent earth-moving company to join us in the venture. We knew that the entire project was going to be a large undertaking and that we were not financially strong enough to undertake such an operation on our own. The type of participating company desired would be composed of people who had heavy equipment, knowledge in dirt moving and were interested in gold mining. Richard Karr and Robert Southwood, owners of Alaska Unlimited, were definitely equipped and skilled at earth-moving, along with having the driving ambitions to do a job quickly and completely. We met with these people and found them to be very interested but cautious enough to analyze the project and justify the outlay of capital needs to mine the property. An agreement was reached to strip and mine the ground, but first it would be necessary to drill enough holes to prove the economic value of the deposit. After negotiations with the adjoining land-owner, and leasing his ground for overburden disposal, a churn drill capable of boring six-inch holes to bedrock was



Overall view of backhoe feeder, trommel screen, coarse tailings conveyor, sluice box and water intake pipes.

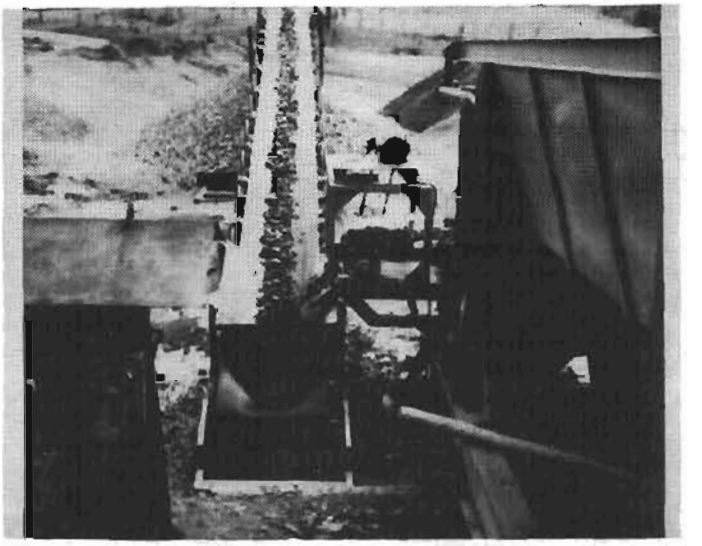
rented. In a ten-day period, two holes seventy-five feet deep were completed showing that there was approximately 1 - 2 feet of surface vegetation, 45 feet of ice-rich muck overburden and 25 feet of gravel. The top 23 feet of gravel had traces of gold, but the pay was in the bottom 2 to 3 feet and on and in bedrock. Based on the results of the drilling and nearby past mining operations, Southwood and Karr agreed to risk the cost of stripping six to eight acres if we were willing to risk the building of a recovery plant to process the gravel.

"At this time, Alice Ebenal and I formed a company known as EVECO, Inc. We reasoned if Alaska Unlimited was willing to take a risk on stripping the overburden, we would follow suit and hopefully make a mine out of the bench ground on her property. Alice named the ground, 'TOO MUCH GOLD HILL' and we had high hopes that the name would prove to be truly descriptive of the facts. The arrangement with Alaska Unlimited was a major step forward because we realized more than ever that EVECO could not concentrate efforts on the numerous other facets of the operation without having

Overall view showing Alaska Gold Company bunkhouse-messhall, *coarse tailings conveyor and stockpile, trommel screen coarse product discharge end and sluice box.*

to become involved in the details of purchasing and operating heavy equipment for stripping and mining or the design of a method to remove the overburden.

"Some of the other problems requiring solutions are described as follows: The Trans-Alaska Pipeline was buried underground just 50 feet from where the eighty-foot deep mining pit would be located. The mining plan required that the pipeline corridor be crossed numerous times daily with equipment and that EVECO's service pipelines must be placed over the oil line to carry wash water and waste water. This assumed that sufficient water could be developed to supply the washing plant for an economical operation. Another concern was that if a pit several acres in size were excavated to a depth of about 80 feet, the four walls must remain frozen to prevent an inflow of water from the nearby dredge tailings. If a breakthrough did occur, it was believed that the inflow of water would be too great to allow economic

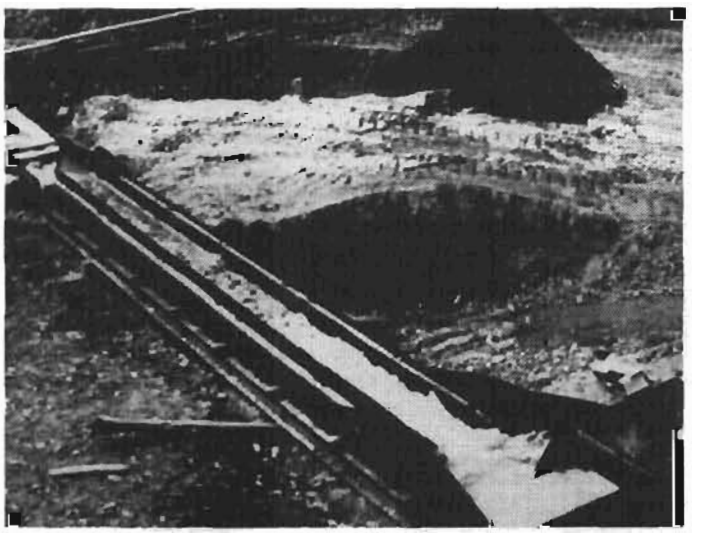


Coarse tailing conveyor.

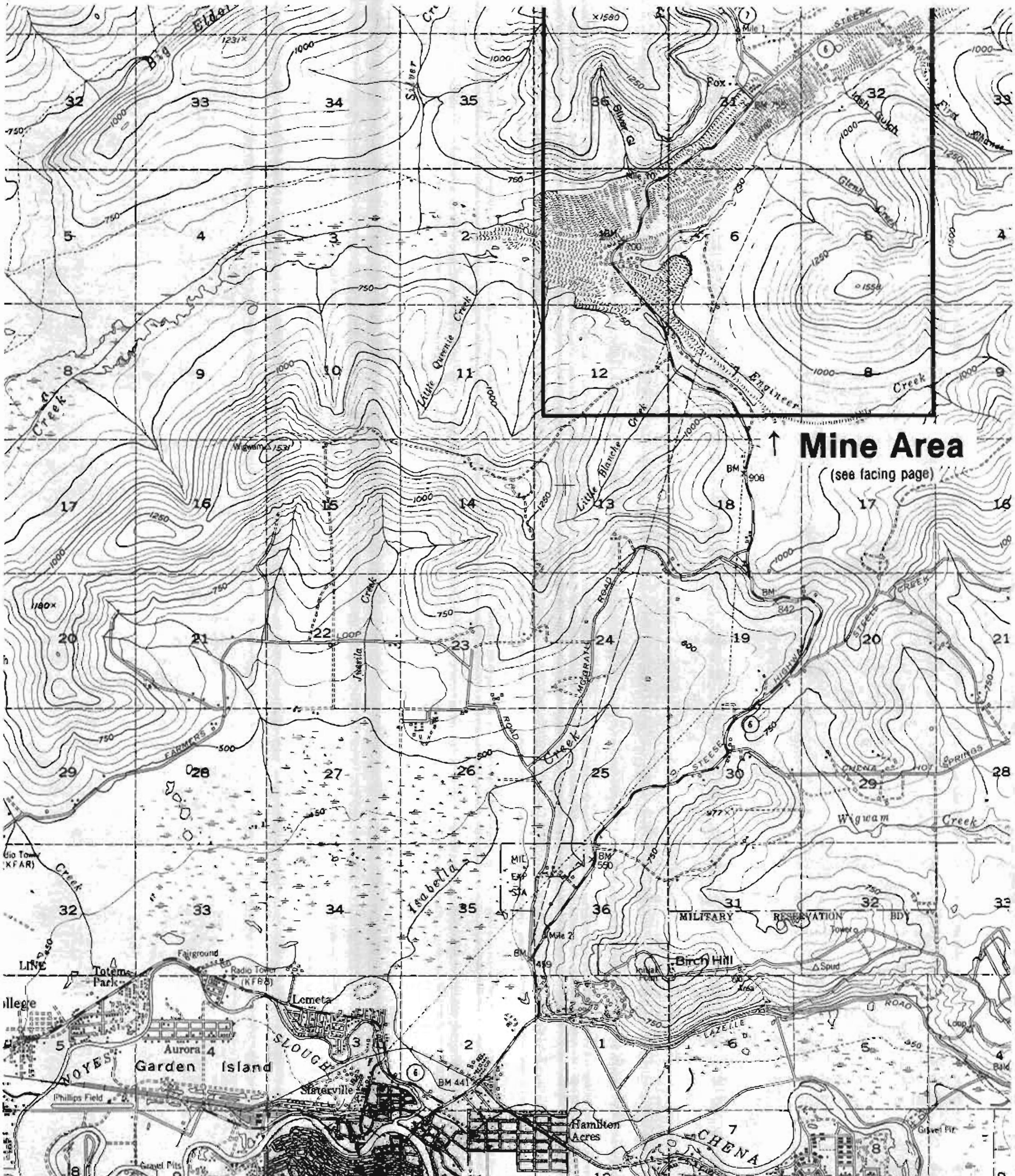
pumping of the water and thus prevent further mining. Also, sufficient area was not available to stack tailings so the thought evolved that salable products could be made and that these could be marketed in the Fairbanks area.

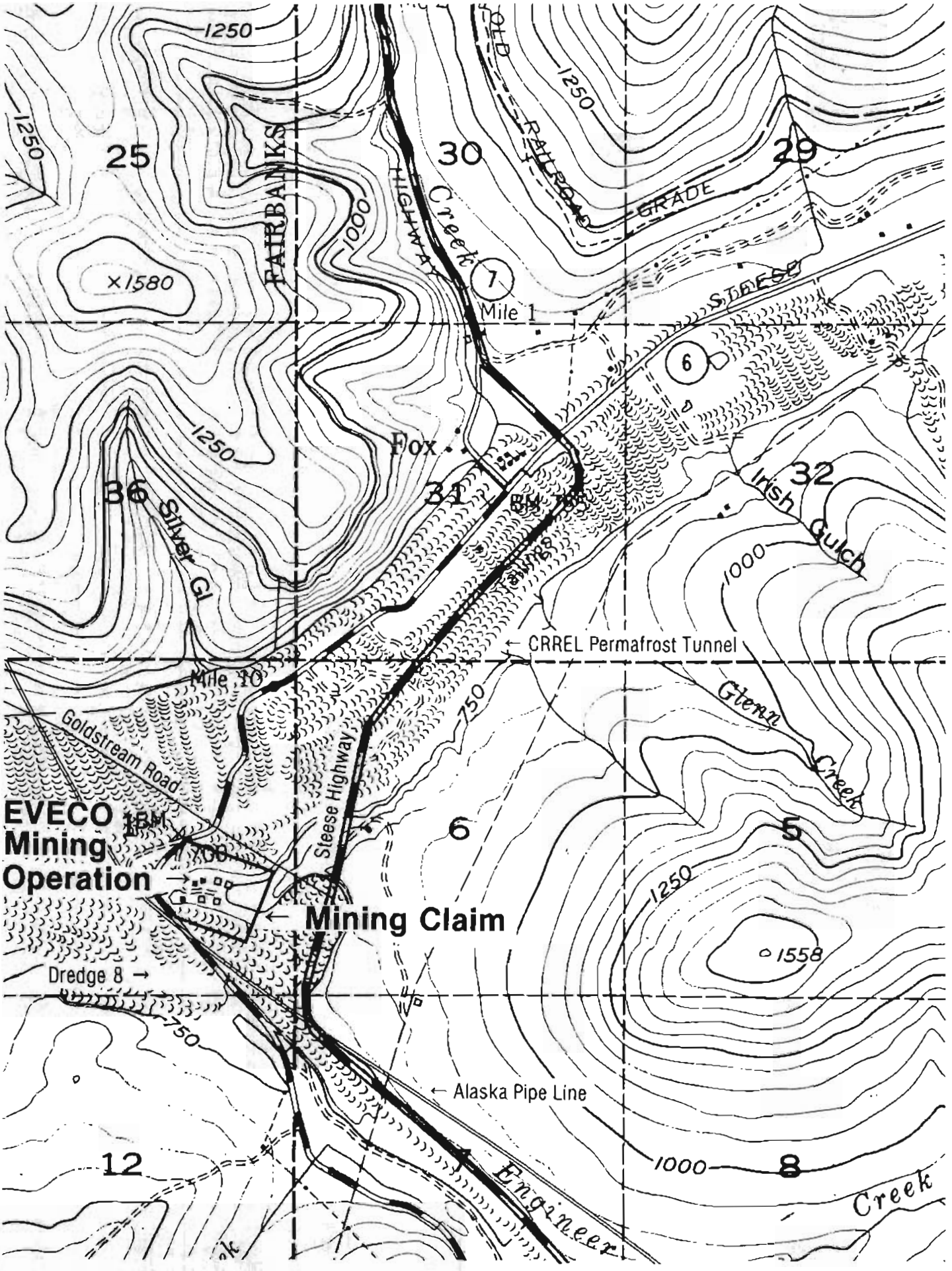
"Also of concern was dewatering the tailings through coarse material, complicated by the relatively low grade of Goldstream Valley. In any event, it was now late fall and Alaska Unlimited knew that stripping of overburden must be done before spring. This had to be accomplished during freezing weather to enable heavy machinery to operate on the waste disposal site with out sinking in the moisture-laden muck that would have thawed with the return of warm weather. Also, their equipment was needed to meet commitments on numerous other jobs.

"During the winter months, EVECO must either purchase or fabricate a gold recovery plant. It was my belief that a revolving screen, in conjunction with a high pressure water scrubber, would be most desirable because of a considerable amount of clay existing in the



Three channel sluice box, fine tailing conveyor and fine tailings stockpile.


Mine Area
(see facing page)
Fox
Silver Gl.
Engineer
Creek
Little Quennie Creek
Little Blanche Creek
Wigwam
Isabella
Wigwam
Creek
FARMERS
LOOP
STEESE
HIGHWAY
CHENA
HOT
SPRINGS
MILITARY
RESERVATION
BDY
Birch Hill
Totem Park
Fairground
Lemeta
NOYES
SLOUGH
Aurora
Garden
Island
Slaterville
Phillips Field
Hamilton Acres
Westgate
FAIRBANKS
CHENA
RIVER


1250
25
FAIRBANKS
Highway
Creek
30
OLD RAILROAD GRADE
29
1250
1000
×1580
Mile 1
7
6
STEESE
Fox
1250
B6
Silver Gl
31
BM
Irish Gulch
32
1000
← CRREL Permafrost Tunnel
Mile 10
Goldstream Road
750
Glenn Creek
EVECO Mining Operation →
BM
Steese Highway
6
5
1250
← Mining Claim
1558
Dredge 8 →
750
← Alaska Pipe Line
12
1000
8
Engineer
Creek

gravel, which was determined from samples taken from drilling the frozen ground. A search for already fabricated screens in the size and shape desired did not produce the items. Next, bids were obtained for constructing two 56 inch diameter, 36 feet long revolving screens with scrubbers, each having a capacity of 50 cubic yards per hour. The bids received from competent contractors were reviewed and because of high prices and the desire to change my specifications, a contract was not awarded but rather it was decided that I would build the units.

"Because I had shop facilities and material available in the States and would be free to work as I desired, EVECO decided that the plant would be fabricated in Helena, Montana. In addition, also to be constructed were a feeder, three conveyors and a motor control center. The component parts of the plant had to be designed in size and weight to allow them to be trucked over the Alaska Highway. Within 90 days, the unit was built, loaded on trucks and enroute to Fairbanks.

"In late March and early April, Alaska Unlimited started their stripping project. Utilized were two D-9 Caterpillar tractors for ripping and stripping, three Caterpillar 30-yard motor scrapers being push loaded with a set of 'quad nines', and two D-9 tractors leveling off overburden on the waste dump. Two eight-hour shifts were worked six days per week.

"This work was supported with related equipment such as a three-thousand gallon fuel truck, a grease truck, service trucks and mechanics. Fuel was obtained from Wilner Texaco in Fairbanks. In two weeks, three acres were stripped to gravel. About 12,000 cubic yards per shift were being moved. The weather warmed and stopped further stripping, but enough gravel was exposed to allow for a potential economical mining operation.

"As spring came, so did the surface runoff. Water accumulated near the new Steese Highway in such quantities that ponds of tremendous size were formed. These eventually broke through the waste disposal area and washed thousands upon thousands of gallons of water, along with tons of silt, into our newly-dug pit. Water was pumped for days around the clock at the rate of 1600 gallons per minute. After water was removed, it was found that silt covered the bottom of the pit to a depth of about five feet. Alaska Unlimited used two 641 Caterpillar scrapers, along with two D-9's, to remove the silt overburden that had been washed into the area.

"In the mining operation, Alaska Unlimited hauled gold bearing gravel from the pit with a 988 Cat six-yard loader. Initially, it was stockpiled and then fed into the hopper of the plant with a 966 Cat four-yard loader. This arrangement proved unsatisfactory because not only was the gravel handled twice, but gave an uneven feed to the sluice box. Tried next was dumping the feed into a hole dug next to the feed hopper for the trommels and feeding with a 510 half-yard John Deere backhoe. This seemed to work 100 percent better and was continued for the rest of the season.

"Mining continued in a normal way until the roofs of underground workings were encountered. Exposed were four vertical timbered shafts and the numerous drifts extending in various directions in the pit. Enough posts, caps, lagging and railroad ties from the mine were found to cause us to 'consider starting a saw mill.' Also, there were tons of rail, pipe, steam hose and turnsheets. It was very disappointing to encounter so much worked-out ground, but optimism must prevail and so maybe the next cut would not contain as much drifted ground. The early-day drift miners did not recover all of the gold -- that in the higher gravel and pillars remained to be recovered, which we did.

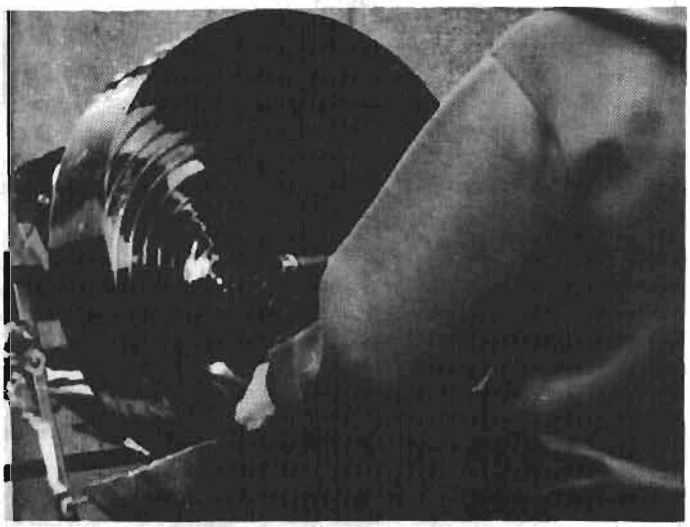
"Along in early April, EVECO moved the newly fabricated equipment from the lower 48 to Fairbanks. It took about six days to excavate an area to accomodate the new plant. The two trommels were set side by side, both being fed from a hopper that received gravel from a single four-yard loader. In the hopper was a four-inch diameter manifold that fed water to ten 1 1/2 inch nozzles to wash the material into the trommels. The trommels rotated at 11 RPM. Water pressure in the scrubber varied from 40 to 60 pounds per square inch. The scrubber consisted of four-inch diameter nozzles spaced at one foot intervals. The main line was supported by angle iron. Gravel was screened to 1 1/2 inch minus with all oversize discharged on a 30-inch rubber belt conveyor 24 feet long located at right angles to the length of the trommels and discharging onto a second 30-inch conveyor 60 feet long, which discharged the coarse gravel away from the plant from where it was stockpiled with a 966 Cat loader. The material passing through the trommel screens is laundered into a 40 foot long conventional three-unit sluice box in which gold is recovered. The center sluice is 24 inches wide and each of the two side sluices is 12 inches wide. Hungarian riffles, having a height of two inches and spacing of four to six inches, underlain by astroturf, were used in the center sluice. Number four expanded metal screens, underlain by astroturf, were used in the two side sluices. At the head of the sluice box unit, a punched screen having 5/16 inch diameter holes was installed. This allowed minus 5/16 inch material to enter the side sluices and minus 1 1/2 inch - plus 5/6 inch material to be sluiced in the center unit. The sluice box was set at a grade of 1 1/2 inches to the foot. The unit handled about 800 cubic yards in each nine hour shift. Water used in sluicing averaged 1600 gallons per minute. The majority of gold recovered was in the first four feet of the sluice box.

"After the screened material passed through the sluice, it discharged into a 36′ × 15′ Torgerson dewatering screw and, in turn, passed onto a 24 inch conveyor belt that carried the product to a stockpile. Since EVECO's operation is close to Fairbanks and outlying residential areas, much of the tailing products were marketed for individual access roads and leaching fields for sewer systems. In addition, a considerable amount of the tailings were used to lay over the waste disposal areas to make ground available for future use as building sites. Two products were developed from the tailings. Coarse rock, and 1 1/2 inch material from the trommel screen, are well suited for base courses for roads or are excellent for sewer leach areas and dry wells. The finer gravel, minus 1 1/2 inch tailings from the sluice box, is excellent for surfacing and grading of roads and for use on building sites. It will compact to 100 percent as determined by the testing laboratories.

The market proved to be excellent for these products and gave additional income to the mining operation.

"After sluicing began, a shortage of water developed. To remedy this, a deep pond was dug on Engineer Creek by use of a one and one-half yard drag line. This developed more water and the supply was further increased by pumping water with a six-inch pump from the mine pit into the fresh water pond. This allowed a two-shift operation to be initiated.

"Because drilling had shown that much of the mining section was low-grade material (some twenty feet) above the pay zone, it was desirable to have a daily check of the amount of gold recovered. This was accomplished by installing a unit in the four-foot diameter launder made by cutting an Alyeska pipe in half, lengthwise which carried the undersize material from the trommels to the sluice box. Required was a unit that could be cleaned quickly and easily. To make the recovery unit, a flat plate 16 inches wide and eight feet in length was welded in the bottom of the half-round pipe. Placed on this plate was astroturf carpet covered by two



Close-up view of goldhound used to produce a cleaned gold product.

16" × 4' number four pieces of expanded metal. When sluicing, the depth of gravel and water passing over the expanded metal varied from four inches to six inches. During every shift, the riffle section was cleaned and hence, twice a day the gold content of the gravel was determined. On occasions, when in the pay horizon and not in old drifts, as much as 20 troy ounces of gold was recovered from the sampling sluice.

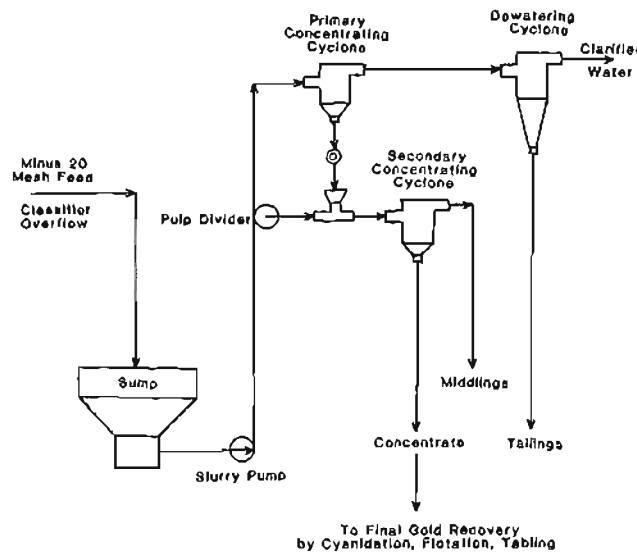
"The product made from cleanups was a gold-bearing black sand concentrate (gold, magnetite, ilmenite, scheelite) that was further concentrated on a small horizontally vibrating cleanup sluice having expanded metal riffles. This product was treated on a Gold Hound wheel to produce cleaned raw gold. Much of the average size of the gold is minus 30 mesh. Incidentally, the final cleanup processing is done by the wife of Bob Southwood, co-owner of Alaska Unlimited, and she has become most proficient at this work. Coincidentally, her name is 'Goldie' and this was her name before the mining program began.

A group of interested persons view operation of gold hound (James Watt, Secretary of Interior closely eyeing the gold hound and its product).

"The power plant used was a Caterpillar Diesel driven unit of 150 k.w. The recovery plant is powered by seven three-phase motors varying from five to fifteen horsepower. A 50 H.P. pump for dewatering the mine pit was run from the generator. We built the control panel comprised of: Voltmeter, Ohmmeter, Frequency meter, Safety Switches, Magnetic Starters and Push-button Controls.

"The first year, a 12 feet wide, 1200 feet long, 12 feet deep ditch was used to settle out solids. Periodically the ditch was cleaned with a 780 Case backhoe. In the coming year, it will be necessary to construct settling ponds which will be periodically cleaned by a drag line.

"This past year, several thousand tons of waste rock were placed on the overburden stripped in the previous spring. From this experience, our plant is not to place



Two-Stage Concentrating Cyclone System

gravel on the stripped overburden for a period of two years to allow the muck to more adequately drain and settle.

"EVECO personnel met with Alaska pipeline officials and reached an agreement as to the location for crossing the 48-inch oil line with our roads and waterways. The pipeline company designated the area and EVECO has cooperated completely and, in turn, we have received excellent cooperation. Probes were installed on the line to monitor the stability of the line, a procedure used by the pipeline company in other areas.

"The income from the recovered gold and the sale of gravel products was sufficient to justify continuing the operation during the 1983 mining season.

"Many things were learned and problems solved the first year. Perhaps the major point was that two companies combined their efforts to produce gold with a good working relationship leading to the decision to continue the operation for another year. It is nice to feel comfortable with such a relationship and to look forward to the future with the same people.

"Finally, this project would not have been possible without the cooperation of people like Dave Holland and Frank McGilvary with Alyeska; Dan Eagan, Vice President and Fairbanks Manager, Alaska Gold Company; John Reeves, Environmental Field Officer of the Alaska Conservation Office; and a host of other fine people who make up a segment of the Great State of Alaska."

Always of concern to the miner is recovering the maximum amount of fine gold from a sluicing operation. EVECO gave complete cooperation to the Mineral Industry Research Laboratory, School of Mineral Industry, University of Alaska-Fairbanks, in a research project designed to determine the amount of gold that was not recovered in the sluice box and to test a unit to recover such gold -- the project was supervised by Dr. P.D. Rao, who has described the research as follows:

"In recent years cyclones have been developed specifically for concentrating purposes. Their physical designs enhance the influence of particle specific gravity while suppressing the classification effects. MIRL has successfully tested a glass model for recovering gold from placer material. The results have been published as MIRL Report No. 55. To further investigate the application of this device, a pilot plant was built. It has an approximate capacity of one ton per hour solids with particle size smaller than 10 mesh. The system consists of two stage concentrating cyclones and one thickening cyclone fed by a 50 gallon sump and slurry pump system.

"The slurry feed is from the discharge of a sluice box after +20 mesh solids have been removed by the Torgeson dewatering screw, and is fed into the unit sump at a constant rate. This pulp is pumped into the primary concentrating cyclone. The overflow product is tailings and is fed directly into a conventional 4 inch dewatering cyclone from which dewatered waste is obtained. The overflow of the latter cyclone may be reused to supply water for dilution of the primary concentrating cyclone feed. The underflow is fed to a second concentrating cyclone. The overflow product of this cyclone is returned to the mixing tank as middlings, and the underflow, which is partially dewatered, is the concentrate.

"First trial field tests of the system were conducted at EVECO, Inc.'s mining operation during the summer of 1982. The feed to the cyclone was the waste water discharge from the plant (classifier overflow from sand recovery systems). The discharge had 7% solids. The feed assayed 0.002 troy ounces of gold per ton of solids. The concentration ratio for the tests completed were too low. After modification, additional tests with the cyclone system are planned for June 1983 in the Circle mining district with the hopes of developing a unit that will be practical in recovering additional fine gold values for the mine. The results of the testing will be available by fall."

The initial success of EVECO's operation is due to good creative planning, consideration of all problems existing in an area with considerable surrounding land use, cooperative working arrangements with others, based on the philosophy of multiple use, determination, initiative and good management. In this way 'TOO MUCH GOLD HILL' is a resource that allows further economic benefits to the Community and State.

Summary

Total area mined - Two acres plus.
Average depth of muck overburden stripped - 45 feet.
Average depth of gravel and bedrock - 27 feet.
Average cubic yards of muck stripped - Approximately 300,000 cubic yards.
Average cubic yards of gravel stripped - Approximately 150,000 cubic yards.

Heavy equipment used in mining:

Tractors	1 D-9
Loaders	1 988 Cat 1 966 Cat
Pumps	2 6" Morris 1 8" Crissifulli
Pipe	1600' - 8" steel
Power Plant	150 K.W. Cat
Other	780 Case Backhoe and 230 Cat on occasion

THE BUCKET WHEEL SUCTION DREDGE -- A MODERN ANSWER TO MARINE PLACER MINING

Richard Chilson
Field Sale Manager, Humphreys Mineral Industry, Inc.

It is a pleasure for me to have the opportunity to speak to you on the subject of Marine Placer Mining and Processing. My approach will be from the standpoint of the processor as well as from the dredge miner.

Marine placers can be defined as alluvial or eluvial deposits of free minerals in debris produced by weathering and disintegration of rock in an environment where a high water level precludes mining by dry bank methods. As a rule, these types of placers are coastal, River Delta and sand bars in current or ancient channels which remain flooded by surface water tables. Occasionally, high water levels exist in head water areas of inland rivers where uplifting takes place due to natural geological action, causing rivers to slow and deposit suspended solids.

Examples of marine placers are found in all parts of the world, from the gold bearing beach sands of Nome to the titaniferous beach sands of Florida and huge deposits of cassiterite in Malasia. Inland waterway deposits are exemplified by the Yukon Territory, Central California and the Salmon River area of Idaho. Upstream examples of marine placers can be found in the Amazon headwaters of Columbia and Peru, in Central Africa and, of course, in North America.

Since the release of price controls of gold in 1973, a renewed interest in precious metals has again become evident. Initially, the glamour brought out fortune hunters to dilute and discredit the ranks of real placer miners. I believe now that much of the dust has settled and though the stampede was cruel, those who have seen it through to this point can settle down to the business at hand, how to efficiently mine and process placers and profit from it.

In the past, numerous methods of handling marine placer were used. Attempts were made to remove the water by diversion channels and pumps, drag line fed floating screen and sluice plants were used also, but probably the most common method or approach has been the bucket line dredge. Yuba supplied 165 of these with bucket sizes from 3-18 cubic feet, Washington Iron Works built 17 units 1 1/2 to 6 cubic feet and some of these giants are beginning to operate again today.

Many are in extreme states of deterioration either from vandals, abuse or both. Generally, these dredges include mining, sizing and concentrating plants on single platforms. They utilize 2 methods of concentration: sluicing, or jigging, and combinations of the two. Sizing is almost without exception done by trommel scrubber. Digging capacity is generally from 18-40 feet. Larger versions like the Yuba 17 now owned by Placer Services, Yuba's gold fields and Marysville, California could dig to 105 feet. Today this unit has been modified at great expense to dig to a greater depth for modern large tonnage operations.

Smaller drag line fed floating plants, commonly known as doodle bugs, were built by Yuba, Bodason, Universal and Washington Iron Works, to name a few. These plants were lower capacity units designed to work streams and tributaries which larger plants could not address. Many remains of these plants can be found in Idaho, Colorado and in Alaska.

We are entering a new era as the economics of today prevail upon us. Not only the mines mart but the process mart, too. We have ecological restraints our fathers never imagined. Today, as never before, low cost production is the key to success. As we re-enter the marine placer, we must match the longevity of yesterday's production machinery with the innovative equipment which meets today's needs for low manpower, high maneuverability and reasonable upkeep and relatively low energy consumption.

I believe that one answer to low cost mining of marine placer is the bucket wheel suction dredge. Bucket wheel dredges are produced world-wide by 4 manufacturers today. Two manufacturers offer North American fabrication. Design characteristics tied to the philosophies of the individual manufacturers create significant variations in unit capacities and capabilities. One manufacturer with 26 bucket wheels in the field indicates that 14 are in mining applications. Salt harvesting, silica sand mining and sand and gravel are the bulk of these applications today. Bucket wheels are also used to mine fine gold bearing silts in the Amazon River in Central Brazil. An Australian group, Newman Equipment, has 2 bucket wheel dredges operating at Mt. Morgan reclaiming gold tailings for retreatment by a carbon and pulp plant. One of their larger units was recently purchased to mine rock salt in Saudi Arabia.

Bucket wheel dredges are compact but comfortable. They are highly maneuverable using high technology, movable spuds and hydraulically driven variable speed swing winches. They cut a broad deep swath quickly and cleanly utilizing full cutting capacity in both directions. Ladder mounted dredge pumps send more tonnage to the processing plant at higher densities than do comparably sized rotary cutter heads. Trees and roots present little or no difficulty for the bucket wheel dredge. Because of the high solids output the installed cost per ton of capacity is favorable. The bucket wheel cleans channel bottoms and can penetrate the upper weathered bedrock zones offering a near optimal solution for recovering precious values caught in the upper bedrock surfaces.

Bucket wheel dredges are being matched to separate dry bank or floating gravity process plants. This concept means that the recovery plant is not attached nor incorporated in the mining operation. Platform separation offers optimum operation of the mining dredge and undisturbed process operations. Using radio communications, the units can be operated independently with better response to each other's operating requirements. Both units are smaller and more manuverable. More efficient use of labor and energy are also strong arguments for the two unit operation.

About 30 years ago Newman entered into the suction dredge market. The primitive beginnings involved coupling a diesel engine directly to a slurry pump, supported on old oil drums and using hand ropes for swing lines. Later Newman designed and operated rotary cutterhead suction dredges. As long as the beach sands were free flowing, little motivation existed to improve upon the mining dredge.

More recent dredging operations, both mining and maintenance applications, encountered heavy clay content and indurated sands. Newman recognized that they would have to find a method of dredging which would deal with these difficult conditions. They developed their bucket wheel dredge design and commissioned the first unit in 1978. Eight dredges of similar design operate in Australia and Europe today. Newman Bucket Wheel Suction Dredges incorporate walking spuds, variable speed bucket wheel drive and swing winches driven by hydraulic motors. The hydraulic drive offers a factor of safety where load conditions exceed the ripping force of buckets. If an immovable object is encountered, the bucket wheel stops using a hydraulic pressure release system. The bucket spacing serves to pre-size feed to a suction line so that plugging is prevented. Buckets are designed as a straight face self-cleaning type without bottoms so that no clay build-up occurs.

As you probably know, Humphreys is in the business of building placer treatment plants and so the marriage of the bucket wheel to the Humphreys treatment plants gives us a full capability to provide a complete operation in a situation where there is marine placer.

LUNCHEON SPEECH

Terry Elder
Deputy Commissioner, ADCED

I have a very short and simple message for you today regarding the Administration. The name of our department is Commerce and Economic Development.

The Governor, as you probably know, would like to see 40,000 private jobs created during his term. Now in order to create 40,000 jobs the Governor is going to need to consider industry costs and industry will need to consider government goals and limitations. The creation of those jobs will mean that we have to discuss all industries, a job is a job and there is certainly nothing wrong with employment in the mining industry.

We have to look at the reality of opportunity. That is, when you look at the State of Alaska with a small number of people with a large land and resource base, the reality of opportunity is that you have to look towards industry. In the long run we may be able to develop industry based on technology. But in the short run, we obviously have to stress where our strengths lie, in mining, fishing and oil and gas. So we have to look at the deposits that are quartz filled, coal deposits and certain placer mines.

Placer mining and development of other mineral resources brings hope to the Interior. Quite a lot of our development in other industry is dependent on mining. Mining gives hope to interior development and Interior employment. The office of Mineral Development is an additive for this industry. This reflects what Dick Lyons wants to do with the Department. That is, he wants to create a number of offices that will be towards industrial development. In addition to this, we want to create a Division for Economic Research.

One thing which will kill any project is the lack of information. We want to increase the knowledge of industry and what it takes to make industry grow in this State. We also have a Governor who is a businessman, and there fore we understand that looking at industry are businessmen. We have to consider that there are costs and regulations. We have to have tax policies, but to accomplish certain objectives, without killing an industry.

The tax revenues from mining and any other individual industry are not going to replace the oil revenue that we get from Prudhoe Bay. That makes our job more important. We need mineral development for employment and income. We do not want to erect barriers for development and we want to work together to reduce those barriers. Placer mining is an important segment of the economy. Directly or indirectly we have found that placer mining contributes roughly $230 million and 3,000 jobs. This was recently published in an Office of Mineral Development publication.

We want to see growth and we want to help without ongoing subsidy of industry. We can be active in regulations but we can promise to work together to have sensible regulations. We can help within the structure if we

know where the mineral deposits are and what mineral resources there are. That is a legitimate job of government.

Again, we do not want to drive you out of business but we all have to realize that the objectives of government require certain revenues. We understand there are problems, and I have learned about more problems this morning. But we urge the industry to work cooperatively with the Department of Natural Resources and the Department of Environmental Conservation and resolve these types of issues. While we all have a different focus, we have a common goal, to create an economy which provides stable opportunities for employment and income. Let us move forward toward that goal in the spirit of reasonable cooperation.

If you have any questions for me or Commissioner Wunnike, we will be happy to address them.

Q. I was pleased to see the report completed on Placer Mining. Are you going to do a report on hard rock mining in Alaska?

A. Terry Elder: I understand that the Department of Natural Resources has funds for a study of hard rock mining. It is not all going to be used for the study (per Commissioner Wunnike). Let me say that the Department of Commerce and Economic Development wants to create a Division for Research within the Department and will be doing ongoing studies of mining, placer mining and hard rock mining. Whatever the resources are in Alaska, we want to have in-house mileage. The study on placer mining I think was very good and certainly the consultants worked very hard.

Q. I would like to ask if there is any move afoot to reconsider the classification of all waters in Alaska for drinking water.

A. Terry Elder: Well, certainly, the Department of Commerce and Economic Development wants the regulation for placer mining to continue to grow. The work that Commissioner Wunnike mentioned will work on those types of issues. I really do not want to comment on this as a Department of Conservation role, but I think that there are certain levels of cooperation that have existed for several years. I think that is industry works with them, then something can be done.

Esther Wunnike: I would like to announce, the formation of a Mining Review Team to advise me, and to advise the Governor only with respect to the Department of Natural Resources responsibilities and the processes within the Department as they have to do with all mineral activities in Alaska. I am sure you will be particularly interested in those having to do with placer mining. This team will also advise me with respect to the structure of the Department of Natural Resources as it relates to the mineral industry. I am looking forward very much to working with them and I hope that when you convene again at your next meeting that we will have some very positive results to report to you.

THE MARK-7 SPIRAL CONCENTRATOR FINE COAL RECOVERY USING REICHERT TECHNOLOGY

Thomas J. Ferree

Manager, Mineral Processing Services, N.L. Industries

The Reichert Mark-7 Spiral concentrator was introduced to the North American market at the Las Vegas AMC Mining Show in October of 1982. Since that time a number of placer and hard rock gold ores have been tested successfully with very significant recoveries and upgradings of free gold. At the present time two commercial size gold concentrator plants are under construction, using Mark-7 spirals as the method for gold recovery.

The design and operational characteristics of the Mark-7 spiral are completely different from a conventional spiral, as the pulp channel contains no concentrate ports and it does not require the addition of washwater to facilitate the mineral separation. These changes have resulted in easier operation, lower capital and operating costs per ton of throughput, and higher capacity per square foot of floor area occupied. The Mark-7 spiral has a practical application in the placer mining industry.

Design Data

•Capacity: 2-3 TPH (Solids) per start (pulp channel). Available in single-, twin-, and triple-start configurations.

•Pulp Density (w/w): Typically 40% solids (w/w) but can be operated between 20 to 60% solids (w/w).

•Size Range: Can handle material in the range of 2.00 -0.037 mm (9 - 400 mesh).

•Optimum Pulp Volume: 5.0 m^3/hr (22 USGPM) per pulp channel.

•Construction: Fiberglass, coated with polyurethane elastomer. Splitter assembly is cast polyurethane.

•Weight: Single = 43 Kgs (94.8 lbs.)
Triple = 105 Kgs (231.5 lbs.)

•Dimensions: Single = 2775 mm (109 inches) high × 3481 mm (540 inches) square
Triple = 3080 mm (121 inches) high × 3481 mm (540 inches) square

•Configuration: Six turn, ganged splitters and product hoses on multi-start spirals.

•Available in frames of 2, 4 and 6 units (single, twin or triple) complete with feed pulp distribution system.

Difference Between the Mark-7 Spiral and Conventional Spirals

A. No washwater addition required.
B. No concentrate take-off ports are in the turns of spiral trough. The only product splitters are located on bottom of last turn of the trough.
C. The spiral can operate at very high pulp densities (40 - 60% solids by weight).

D. Compound, computer designed trough profile with the inner section having a less acute slope than the outer section. The point of intersection of the inner and outer sections moves radially outwards from the centre column from the top to the bottom of the trough.

E. Much higher loadings can be achieved. The triple start configuration handle up to 9 TPH (solids) in one spiral.

F. The Mark-7 spiral can operate over a wide range of tonnage and density conditions.

G. Very high recoveries and concentration ratios can be achieved in one pass of material. (i.e. On free gold ore, recoveries of plus 90% with concentration ratios of 100:1 have been achieved.)

H. The metallurgical efficiency is extended to recover high specific gravity minerals at much finer size ranges. For gold, the omission of the washwater coupled with the newly designed compound profile has allowed excellent recoveries down to 325 mesh regardless of shape factor. This has not been possible using conventional spirals.

I. The Mark-7 spiral has the capability of producing a very high concentration of preclassified concentrates (i.e. reconcentration of a Reichert Cone concentrate).

J. The spiral has a water splitter for removing a "water fraction" from the tails product, with minimal solids content.

Equipment Choice Reichert Cone versus Reichert Mark-7 Spiral

The main criteria in regard to equipment choice between the Reichert Cone and the Reichert Mark-7 Spiral are as follows:

A. Size range of gold in ore. It has been our experience that the Reichert Cone gives better recoveries of gold below 325 mesh than the spiral.

B. Size of Production Plant. The cut-off point appears to be around 200 TPH. This is dictated, subject to condition (A) above, by the feed distribution systems required. At 200 TPH, a Cone plant would typically consist of the following:
- 3 Reichert Cones (3-way distribution)
- 4 Reichert Mark-7 Triple Spirals (12-way distribution)
- 1 Shaking Table

In comparison a 200 TPH spiral plant would typically consist of the following:
- 24 Reichert Mark-7 Triple-start Spirals (72-way distribution)
- 6 Reichert Mark-7 Twin-start Mids. Spirals (12-way distribution)
- 2 Reichert Mark-7 Twin-start Cleaner Spirals (4-way distribution)
- 1 Half Size Shaking Table

A rough equipment cost comparison of the two plants would work out slightly cheaper for the spiral plant.

The cost difference of the above two systems would be equalized by the extra cost of the more complex spiral feed distribution system. This, together with the more uniform feed pulp conditions desired in the cone plant feed distribution system, would warrant a close consideration of both systems. Above 200 TPH, the choice is clearly in favor of the cone plant.

N.B. The exception to the above would be in primitive areas where the technical competence of the plant operators is minimal. In these situations the Reichert Mark-7 spirals would be more likely to perform satisfactorily under the extreme conditions.

Results Obtained

A number of placer samples have been run on the Mark-7 spirals. The following results are typical.

(A) Tests Run by Boise Assayers & Metallurgy, Inc. - Boise, Idaho

(1) Snake River Gold - Southern Idaho

Test run on minus 20 mesh material deslimed with cyclones.

	% Weight Dist.	MG. of Gold	% Gold Dist.
Conc.	2.20	17.58	92.1
Tails	97.80	1.51	7.9
Heads	100.0	19.09	100.0

Concentration Ratio = 45.5:1

N.B. All the gold minus 100 mesh, with majority being minus 200 mesh.

(2) Snake River Gold - Southern Idaho

Test run on minus 20 mesh material (not cyclone deslimed).

	% Weight Dist.	MG. of gold	% Gold Dist.
Conc.	4.8	24.87	82.9
Tails	95.2	5.13	17.1
Heads	100.0	30.00	100.0

Concentration Ratio = 20.8:1

N.B. All the gold was minus 100 mesh, with majority minus 325 mesh and some minus 400 mesh.

(B) Test Run by the Colorado School of Mines Research Institute --Golden, Colorado

(1) Gravel from Jordon Valley, Oregon

Test run on minus 8 mesh material at approximately 2.5 TPH yielded a 99.8% gold recovery with 647.15 mgs of gold in the concentrate and 1.23 mgs of gold in the tailing.

(2) Gravel from Jordon Valley, Oregon

Test run on minus 20 mesh material at approximately 2.5 TPH yielded a 99.8% gold recovery with 515.20 mgs of gold in the concentrate and 1.08 mgs of gold in the tailing.

N.B. The gold in the above two tests was predominately plus 100 mesh.

(3) Crushed Gravel from Fresno, California

A test was run on crushed gravel from a site in Fresno, California at approximately 2 TPH.

	% Weight Dist.	Gold (oz/ton)	% Gold Dist.
Conc.	7.4	0.609	90.7
Mid	46.0	0.007	6.5
Tail	46.6	0.003	2.8
Head	100.0	0.050	100.0

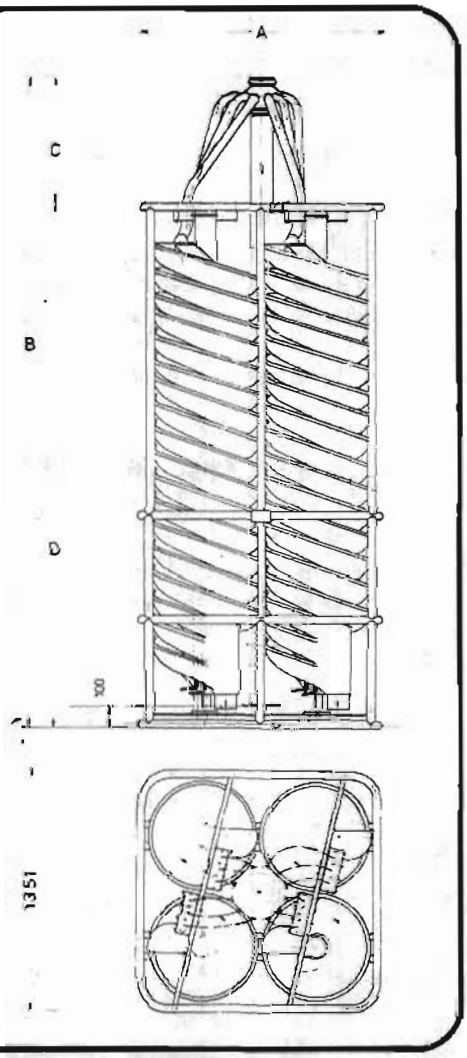
N.B. Microscopic examination of the middlings revealed some locked particles.

Reichert Mark VII Spiral Concentrator

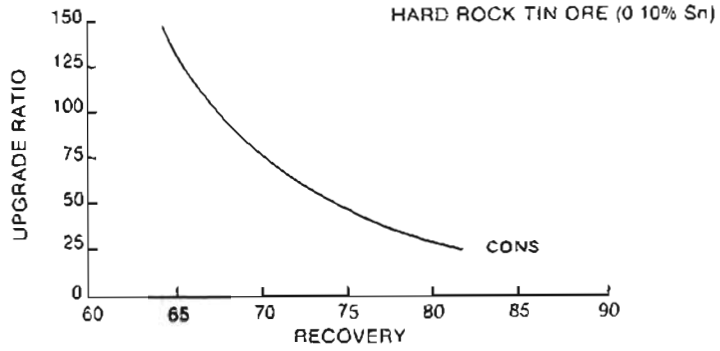
MINERAL DEPOSITS LIMITED

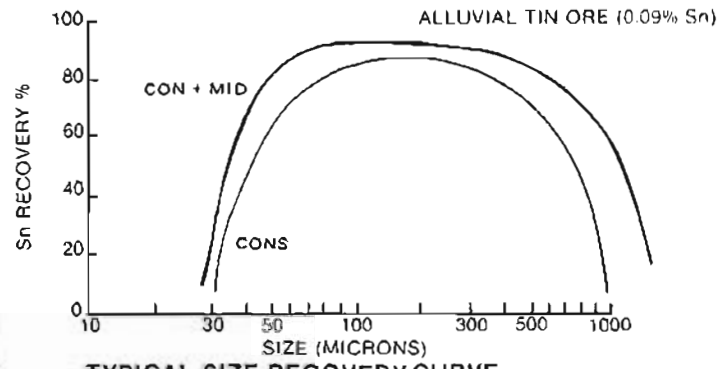
FEATURES

- excellent metallurgical performance without wash-water addition
- single, twin or triple starts per column
- simple operation with only one set of splitters per spiral start
- ganged splitters on multi-start spirals
- water splitter for removing water fraction with minimal solids contact as standard
- single set of product outlets for cons, mids, tails and water splits even on triple start spiral
- constructed in strong, lightweight fibreglass with polyurethane covering and castings for corrosion and abrasion resistance
- product launders available as accessories
- suitable for low grade ores including:
  - mineral sands
  - glass sands
  - tin ores
  - gold ores
  - tungsten ores
  - tantalum/niobium ores
  - chromite sands
- test facilities available throughout the world



TYPICAL UP-GRADE RATIO VERSUS RECOVERY CURVE





TYPICAL SIZE RECOVERY CURVE

DESIGN DATA

HEAD FEED (PER START)

Capacity:	up to 3TPH solids depending on application
Pulp Density (w/w):	up to 60% solids.
Size Range:	0 03 - 2mm.
Pulp Volume (max.):	5.0 m³/hr.

CONCENTRATE REMOVAL (PER START)

Rate:	up to 0 3TPH solids.
Pulp Density:	30-60% solids w/w.

NOTE: SINGLE, TWIN, TRIPLE STARTS AVAILABLE.

DIMENSIONS IN SPIRAL BANKS

(Refers to double row banks, single row available)

SPIRALS PER BANK	DIMENSIONS IN MILLIMETRES				INSTALLED WEIGHT (Kgs) (See note below)
	A	B	C	D	
2	740	3940	700	3240	290
4	1350	3940	700	3240	540
6	1975	4080	840	3240	820
8	2600	4080	840	3240	1035

NOTE: Weight refers to Triple Start Spirals.

DIMENSIONS: Use dimensions as guide only. Certified drawings will be provided on receipt of order. All dimensions in millimetres.

SHIPPING DETAILS: Spiral banks, except two spiral unit are packed for shipment mounted on a wooden pallet 100mm (4") high. Ancillary equipment is packed in separate containers. The two spiral unit with ancillaries is packed in a wooden crate. Single spirals are shipped in tri-wall containers.

(4) Black Sands - Grass Valley, California

A minus 1/4" fines product from an aggregate plant was concentrated in two stages of Pan American Jigs, further cleaned on a Deister Wet Shaking Table and then fed to the Mark-7 spiral. The spiral results were as follows:

	TPH	% Wt. Dist.	Gold Assay (oz/short ton)	% Gold Dist.
Conc.	0.015	0.9	117.0	76.0
Mid	0.998	59.2	0.475	20.3
Tail	0.672	39.9	0.129	3.7
Head	1.685	100.0	1.39	100.0

N.B. The spiral operating conditions were not optimized. Spiral middlings and tailings would both be recirculated in a commercial installation, and any gold contained therein would probably be recovered.

A similar test was run at 2.6 TPH per spiral trough to test the capacity of the spiral on heavy mineral concentrate. The material flowed freely in the pulp trough at the high tonnage condition, but metallurgical efficiency was reduced.

(5) Gravel from the Fairplay District, Colorado

A test was run at approximately 2.4 TPH at a feed pulp density of approximately 45% solids. The plus 6 mesh material was screened out prior to the spiral test.

Product	% Wt.	AU ASSAY oz/ton	AU ASSAY mg	AU DIST. Total Gold	AU DIST. Free Gold
Feed (Computed)	100.0	0.011	82.5	100.0	100.0
Tailing	94.6	—	—	(16.7)	—
Amalgam Conc.	—	—	6.44	7.8	8.7
Amalgam Tail	—	0.001	7.36	8.9	—
Concentrate	5.4	—	—	(83.3)	—
Amalgam Conc.	—	—	67.9	82.3	91.3
Amalgam Tail	—	0.002	0.841	1.0	—

The data shows that the Reichert Spiral recovered 83.3% of the total gold and 91.3% of the free gold into 5.4% of the feed weight. A microscopic examination of the feed material showed that the free gold was largely -65 +200 mesh.

Comparison with Other Gold Concentrators

An investigation to determine the relative performance of four gold concentrating devices was performed by the Colorado School of Mines Research Institute in October of 1982.

Approximately 1500 lb. of minus 1/8 inch prepared feed was provided by a sponsor for parallel testing on the Reichert Mark-7 Spiral, Knelsen, and Deister tables at the CSMRI facilities in Golden, Colorado. A CSMRI representative observed testing of a proprietary dry concentrator on material reported to be from the same sources as that tested at the CSMRI.

Results of the evaluation are shown below:

CONCENTRATING DEVICE	COMPUTED FEED GOLD CONTENT (oz/ton)	% WT. TAKEN INTO CONC.	MGS. TOTAL OF GOLD IN CONC.	FREE GOLD REC.	TOTAL GOLD REC.
Knelsen Hydrostatic Concentrator	0.013	4.2	90.60	95.0	88.7
Reichert Mark-7 Spiral	0.011	5.4	68.74	91.3	83.3
Deister Shaking Table (Slime Deck)	0.019	0.5	104.04	73.8	70.0
Proprietary Dry Concentrator	0.014	3.2	64.52	N/A	66.1

Other Applications

The Reichert Mark-7 Spiral Concentrator has proved itself in a number of other applications besides free gold recovery from placer deposits. Some of these are listed below:

(A) Free gold in hard rock deposits.

(B) Gold locked up in other minerals, such as sulphides.

(C) Secondary stage concentration of concentrates from large gravity units such as Reichert Cones.

(D) Both alluvial and hard rock tin ores.

(E) Concentrating titanium and zirconium bearing minerals from beach sand deposits.

(F) Upgrading of silica by removal of heavy mineral contaminants.

N.B. Test facilities are presently available in the following locations:

(1) Colorado School of Mines Research Institute, Golden, Colorado.
Contact: Erik Spiller (303) 279-2581.

(2) Boise Assayers and Metallurgy, Inc., Boise, Idaho.
Contact: Larry Mashburn (208) 345-6336.

(3) Bacon, Donaldson & Associates Ltd., Vancouver, B.C., Canada.
Contact: Gordon Bacon (604) 879-8461.

References

(1) Recent Developments and Applications of Spiral Concentrators -- G.F. Balderson. A Mineral Deposits Limited Publication.

(2) CSMRI Published Data -- D.E. Spiller.

(3) Data supplied by Boise Assayers and Metallurgy, Inc. -- L. Mashburn.

Footnote

•C.N. Robinson: Metallurgical Manager -- North America, Mineral Deposits Limited.

•T.J. Ferree: Manager, Mineral Processing Services, NL Industries, Inc.

ECONOMICS OF GOLD

Chuck Witlock
Delta Smelting & Refining

The good news that I want to share with you this afternoon is that precious metals, across the board, unequivocally, are going to go up. The bad news is that I do not know when. However, there are some strong indicators that professional traders use, day in and day out, and as most of you are familiar, there are 2 types of trading - fundamental trading and technical trading. Now, the fundamentalist is basically looking for some event in the world to change, some radical traumatic event that will force the price of metals up and the reason for that is that gold is the psychological indicator in the world. It is our anxiety indicator, and as we human beings become nervous about nations, about the economy, not only of the country in which we reside, but the world, we tend to lean toward hard money assets -- gold, silver, platinum, diamonds, semi-precious gems. The United States actually dictates to the world, which is a surprise to many people, the price of gold by its inflation index. I have used the inflation index in my fundamental trading activity for probably 10 years. The reason for that is the world economy. In the United States, I think we consume something like 52% of the world's goods, and because of that the entire world is dependent upon our output, our production and our foreign trade activities. As a consequence, I use that inflation index.

Because Volker is still in office in Washington, and it is likely that his position will be renewed next year; because we have a Presidential Campaign next year, and because Reagan is still in office, there is a high probability that the current administration will maintain its current philosophy. It is philosophy, if you will look back just one year, was to bring inflation down, bring interest rates down and bring the economy of the United States back on an even, stable keel. In fact, they were successful in bringing interest rates down. Those of you who have bought a home recently can appreciate that fact. They were also successful in bringing inflation rates down, but correspondingly, they brought unemployment up. Housing came to a screeching halt and our economy has suffered. It is going to take a long time for that recovery to occur. 100% of our plants in the United States are at 67% capacity. Even with a recovery and the drop of interest rates and the availability of availability of loans, what has happened in the United States is that as we recover, we are not going to be building new plants, we are not going to be buying additional equipment. As a consequence, we are not going to be the beneficiaries of this coming out of the recessionary period for probably 11-14 months. But we do predict, with some accuracy, I believe, that inflation is going to come back.

From a technical trading standpoint which is what we call the cartist, we look back at 44 years, 21 years, 7 years, and we try to cycle metals. We try to determine, by our computer analysis, where metals are going by phasing in certain indexes. Our indexes indicate an extremely strong bullish vertical market in 1984. We think there is a lot of support at $370 right now. A lot of the union fund people, the pension fund people, and the self-directed IRA people, are starting to put their money into gold mining shares. Vollack Fontaine, Ohmstead, Carlin Mines -- we are seeing an insurgence of fresh new investor money coming into the mining community that we have never seen before. The reason for that is because people want hard money assets. They would like to invest in gold but they cannot use self-directed IRA Funds to do that because we now know that this is prohibited. So, we see an increase in inflation. We see a soft market the next 2 months, it could conceivably drop to a low of $370. There is substantial buying direction at $370. We think this is the absolute bottom and we see an upward trend for the balance of this year and, surprisingly enough, not depending on what OPEC does.

We really do not care what OPEC does. The reason we do not care is because that is just another tax opportunity for the governments that sell the oil back to the people at the retail level. Those just increase the importation duty on oil. If oil drops $5 a barrel, and they increase the price to the refinery for an importation duty, what is the material effect on you and me, the consumer? Zero. It is just another form of taxation.

We all traditionally have thought in terms of the price of gold to the price of oil, the price of gold to the price of silver. How long have we all depended on a 35 to 1 ratio, a 30 to 1 ratio? Now gold and silver is at a 40 to 1 ratio, so regarding a lot of the rules that we traders have used in trying to determine the real value of metal, all bets are off.

We do not have a foundation on which to base our predictions other than taking the gross national product, the balance of payment, depreciation on the balance of payment between nations, the fundamental changes, and as I look at that, I will share it with you for just a moment, we have Russia thinking of turning Afghanistan back. We have peace and tranquility in most of the hot spots of the country, even in Lebanon. We have the United Nations maintaining peace. We do not have a fundamental threat in existence in the world of today. In some of the South African nations, there is still some unrest, in Central America we have problems with El Salvador, Nicaragua, and there is a high probability that Costa Rica could be attacked from the North and Venezuela has sent 40,000 tanks and 10,000 gas masks to Costa Rica in the event of a war. That could be a fundamental change. If Central America breaks loose, and we, in fact, have an insurgence or a war of some type, it would cause metals to run.

The advice that I share with the Delta clients is to have a strong metal position and I always urge the seven activities which I would like to share with you, and it is a piece of investment advice that I tell to all of our clients, basically, the eight T's for the 80's: safety of investment; liquidity is essential; tangibility, it must have a value in and of itself; stability, this refers not to the investment itself but to the safety and permanence of the investment; profitability, this is purposely ranked number 5 on my list because I think preservation of capital is most important; leveragability, this is simply

the use of margin and the borrowed money to take the fullest advantage of price changes; diversity, economic and financial common sense call for diversity in investment - and just one quick comment on that score, I recommend diversity of investment and I practice what I preach. I have gold shares in several companies, I own gold, silver and platinum, that is my definition of diversity.

Just a point of interest, have any of you thought why a savings and loan gives a higher interest rate than a bank? Why can you go to a savings and loan and make more money than at a bank? The reason for that is that your risk is greater. A savings and loan is limited to investments in real estate. A bank can lend money, commercial loans, real estate, any number of things, it can even fund a mining operation with proven reserves. With savings and loan you have a greater risk, so they pay a higher return. So the 8 T's for the 80's: suitability, diversity, leveragability, profitability, safety, liquidity, tangibility and stability.

Gold addresses all 8 of those items. The investment community is aware of this and because of it, supply and demand are increasing. We are holding one hundred times more gold in our bank vaults throughout the world than we can produce this year. The holders of the gold and the cartels are going to correct the market prices and we have seen that over and over again. We saw it through the run-up of 80 and we watched it through the run-down since 80. So, the bottom line is $370, the weak number for the next couple of months and we are looking for $550 to $570 prices by the end of the year. We see a corresponding analysis for silver.

I think that the lower silver price is a $9.20 range, that is the softest spot we can identify on our indexes, the highest silver this year is around $15. to $15.50. Through 1984, because of the supply and demand criteria, right now our silver mining production and salvage production is almost near our current demand rates, not withstanding the investment community's holdings. So as a consequence, everything that occurs from the manufacturing level from this date forward, is going to put the demand levels beyond the supply level, forcing silver up.

Gold is not in as enviable a position but we do believe that there are a lot of corresponding factors for both metals and as a consequence, 1984 is going to see a build-up in metal prices like we in the investment community have not seen for a long time. I have come very, very short of giving you our numbers but I can tell you that for 1984 we are in excess of $850 for gold so I would urge you not to use all your production. I would urge you to hold on to some of your metal because we do see a scenario that points to a very, very positive picture for the price of metals for 1984.

PREPARING PLACER SAMPLES FOR ASSAY

Milton A. Wiltse
Chemist, Alaska Division of Geological & Geophysical Survey

Introduction

There is a division of responsibility in the preparation of samples for assay shared by the miner or prospector, and the assayer. In a very real sense, the assay process begins with both the choice of the sample site and the sampling procedures used. The objective of today's talk is to emphasize the importance of these early steps in the assay process. That is, the part of the assay conducted by the miner or prospector before the sample gets to the laboratory.

It is the miner or prospector who defines the objective for collecting each sample and chooses the sample location. It is the miner or prospector who executes or supervises the procedures used in collecting and reducing the samples. It is also the miner who communicates the character of the sample and the sampling objective to the laboratory assayer so that the assayer in turn can choose the most appropriate laboratory techniques for the final analysis.

The laboratory must accept the responsibility for final reduction of samples in a manner that does not bias them from the miners' objective. He also must arrive at an accurate quantitative value for the sample material submitted so that the miner can determine a proper value to apply to the sample site.

The principles mentioned today apply equally well to 'hard-rock' assay sampling and sample preparation, and to various stages of mine development grade control. The examples used, however, will most closely approximate what you might encounter in a reconnaissance sampling to locate new placer ground. I will assume that the objective for sampling is to arrive at a meaningful though not necessarily exact estimate of placer gold value at an exploration sample site (Figure 1).

There are deceptively few requirements for sampling (Figure 2):

(1) The sample must be representative of the material sampled or if it is consciously not, the sampler must know in what way it is not.

(2) Field records must be kept which adequately describe the sample, site, and sampling procedure used.

(3) Laboratory analytical methods must be consistent with the objectives of the sampling program.

(4) The analysis of the samples taken must be accurate.

(5) The entire set of sample acquisition, reduction and analysis procedures must be consistent from sample to sample so that results from various sites can be evaluated on a common basis.

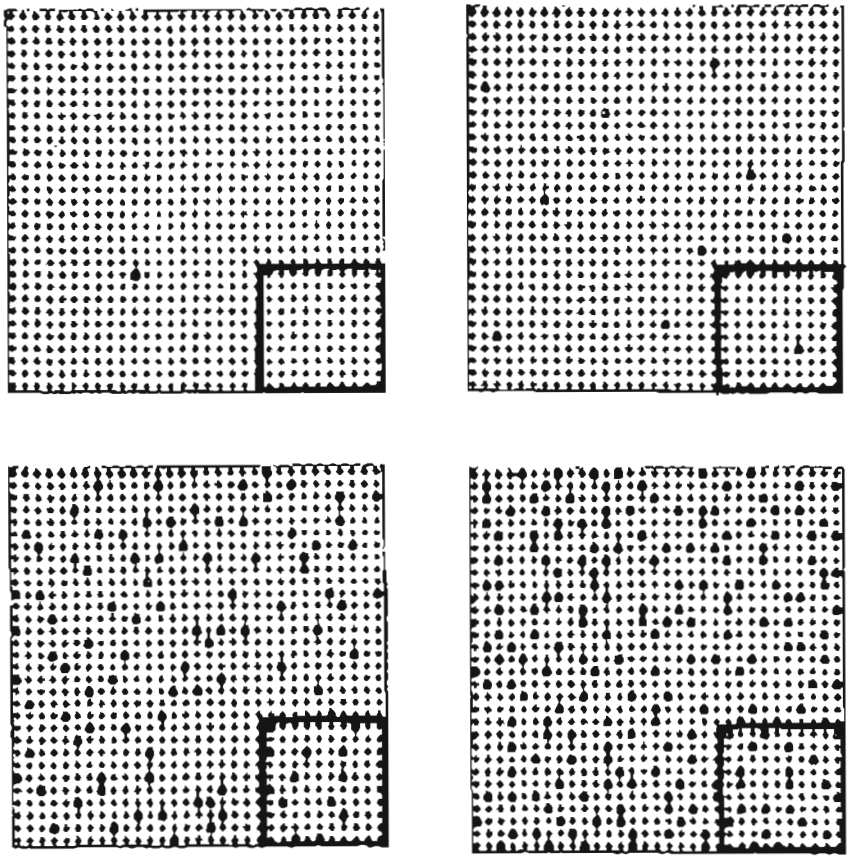


Figure 1. Graphical demonstration of particle sparsity effect. From J.F. Harris, 1982.

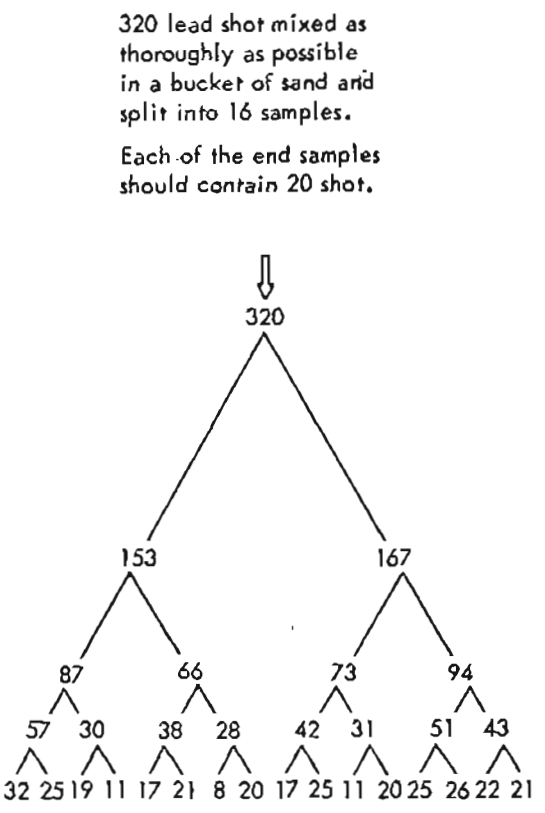


Figure 2. Diagram showing erratic distribution of metallic particles in successive splits of a placer-type sample. From J.H. Wells, BLM Technical Bulletin 4.

Sample validity and representation involves:

(1) Obtaining a sample large enough to provide a high probability that it will not be unduly influenced by the 'nugget effect', that is, the inclusion or exclusion of a single high-value particle.

(2) Taking a sample in such a way that it is not biased against the sampling objective.

(3) Reducing the sample for analysis in a manner which does not unconsciously bias it or introduce large random errors.

(1) We are attempting to take a small sample which ultimately allows us to arrive at a good estimate for the value of a grossly larger volume of material. We do not want to have to analyze everything in the pile or in our case, at the sample site, but we need to take enough material to average out high and low subsample values. If the material being sampled is homogeneous and consists of a uniform mixture of many small grains (each having a relatively low unit value), in a fine-grained waste material, then the sampling and sample-reduction problem is quite easy to deal with. Almost any sample will be representative of the whole, and thus give a good estimate of the value of the material sampled. If, on the other hand, we must deal with a high-value particle-ore material such as gold, which tends to be present as relatively few grains non-uniformly scattered throughout a high volume of waste material, we have a difficult sampling problem.

Consider these diagrams in Figure 1. The large area represents the 'area of influence' around a sample site. The small enclosed area represents the 'sample'. If the ore is high grade and particles of the ore minerals are uniformly distributed, the small sample approaches a good representation of the whole and the sample assay will be representative of the sample site.

As grade decreases for ores having a particulate nature, such as gold ore, the small sample becomes less and less representative of the site. The probability that the small sample contains a true average number of ore particles becomes very small. In the extreme case, one sample will show gold present and an adjacent sample will be blank. Neither sample will yield an accurate estimate of the sample site and the average of the two samples also would be incorrect. The diagrams of Figure 1 represent the nugget effect encountered in sampling gold deposits.

All else being equal, there are two sampling procedures that help to lessen the sample variability due to the nugget effect:

(1) Take large field samples.

(2) Take many small samples at a field site and combine them into one large sample.

Sampling potential ore material must have an objective. That objective might be to arrive at an accurate estimation of value for material known to contain valuable minerals so that development and production can be planned and executed. The objective might,

however, be more fundamentally directed toward discovering whether any valuable mineral at all is present at a site. The objective for the sample will influence the choice of sample site and many of the subsequent procedures followed in collecting and reducing the sample.

For example, if there are many random, uniformly distributed particles in high-grade ore, combining large samples from many random small ones would not necessarily increase the probability of getting a better representative sample. To determine the grade of a homogeneous ore one could take a relatively moderate sample and expect good results. This strategy, however, would not be the best on an untested creek where the objective might be to first determine whether any gold is present before doing more rigorous sampling work. In this case, we might choose to optimize or consciously structure the sample to increase the probability of detecting gold, for example, sites selected at heads of bars, boulder shadows, or upper end of natural riffles. Further, we would probably take a relatively large composite sample. In this case, although the sample would be badly biased with respect to a pure random sample which would give a good value estimate of all the gravel present, it is not biased with respect to the immediate objective of discovering if any gold at all is present on the creek.

In short, we must keep clearly in mind the purpose the sample and its assay are to serve.

Regardless of the size of the field samples taken, the amount of material finally subjected to chemical analysis consists of only a few grams. Since our interest is primarily the analysis of placer gold, the nugget effect due to the high-value, particulate nature of the ore can create serious errors if large field samples are not reduced properly.

Consider for a moment the results you would get if a 1-mg. particle of gold gets into an assay-ton sample split (approx. 34 grams) and that particle was the only gold particle in the entire sample. The assay of that split would report 1 ounce/ton of Au --- a grossly incorrect value. If the split had missed the gold particle, we would get 0 ounces/ton which is also incorrect. To get a true sample value using this 'split and assay' strategy we would have to eventually assay the entire sample. If the field sample is large - 10 to 100 lb. or more - this strategy is clearly unworkable.

Because so many samples which have been reduced by splitting are taken to laboratories, I would like to emphasize by one more example the dangers of this strategy for use with gold samples.

Figure 2 illustrates an experiment conducted by the U.S. Bureau of Land Management to simulate splitting a placer gold sample. Three hundred and twenty lead shot of uniform size were mixed in a bucket of sand and split through a riffle splitter into 16 uniform-sized samples.

Notice the range of shot occurring in each sample ---from 8 to 32 shot. If those shot were gold grains, any two samples would have a large spread of values, and a low probability of averaging to a true estimate of the sample value.

Splitting samples in this manner is often valid for ores, but in general it is not a good strategy for gold placer samples. To a large extent, splitting placer samples will negate the value of taking large samples.

A better procedure for reducing placer samples is to 'preconcentrate' the entire sample so that virtually all Au particles in the initial sample can be recovered.

To summarize for a moment, we have three fundamental points to consider when sampling high-value particulate ores (eg. placer gold):

(1) Obtaining an initial sample large enough to be representative.

(2) Collecting a representative sample consistent with the sampling objective.

(3) Reducing the sample in a way which minimizes the nugget effect on the assay results. This usually means preconcentration and recovery of metallic gold prior to final assay.

It is possible to estimate the minimum sample size necessary to achieve the objectives for which a given placer sample is collected. Clifton and others, (1962) derived a useful series of diagrams showing the relationship between gold particle size, sample size, ore grade, and accuracy of analysis.

The diagrams in Figures 3 and 4 are based on the premise that if a sample is large enough to contain 20 gold particles, it will give the true grade of the material sampled to within a relative accuracy of ±50% of the value reported 95% of the time. While this accuracy might not do for production control, it is sufficient for initial reconnaissance work.

Figure 3, modified from Clifton and others, (1962), provides some feel for the limits of the problem. Note that the x-axis is scaled in number of Au particles / kg = 2.2 lb. of sample and that the left hand y-axis is scaled in particle mass (weight) in micrograms. Since gold is uniform in density, its weight can be directly correlated with particle size. Therefore, on the right hand side of the diagram are two other 'y' axes scaled in:

(1) diameter of gold spheres

(2) diameter of gold flakes 1:10 t:D
where t = thickness of grain
D = diameter of grain

For a frame of reference I have indicated the approximate position of NBS & Tyler; 80-mesh screen sizes (0.177 mm) and have also marked 100 mesh (0.150 mm) on the right hand spherical-size scale. The diagonal lines plot the relationship between ore grade, particle size, and number of particles. For example, if you were working with an ore of 1 ppm =.03 troy ounces per ton, $12 - $15 per ton, and had 100-mesh gold, you would get 30 gold particles in a 2+1/4 pound sample. If the gold particles and sand were 80 mesh, a 2+1/4-lb. sample would yield only 20 gold grains. These estimates assume that the gold was evenly distributed and the waste material was also fine grained.

If the gold particle size approached 0.5 mm diam. (35 mesh), you would not be certain of having even 1 gold grain in a 2+1/4-lb. sample if ore grade was 1 ppm = $12 - $15/ton.

From this we can see that if we are looking for an economic gold deposit which has a common grain size of equal to 35 mesh, a 1 kg = 2+1/4-lb. field sample is

clearly not adequate in size for a representative sample even if the ideal conditions of uniform particle distribution are met.

The information shown in Figure 3 can be rearranged to be helpful in estimating the sample size required to obtain for 20 particles in a sample if grade and particle size are known.

Note that in Figure 4 the x-axis now is calibrated to read 'size of sample required to obtain 20 gold particles'. All other axes are the same as before. From this diagram we also can determine that we only need a representative 1 kg. = 2+1/4-lb. field sample of 100-mesh material to contain at least 20 grains of 100-mesh gold

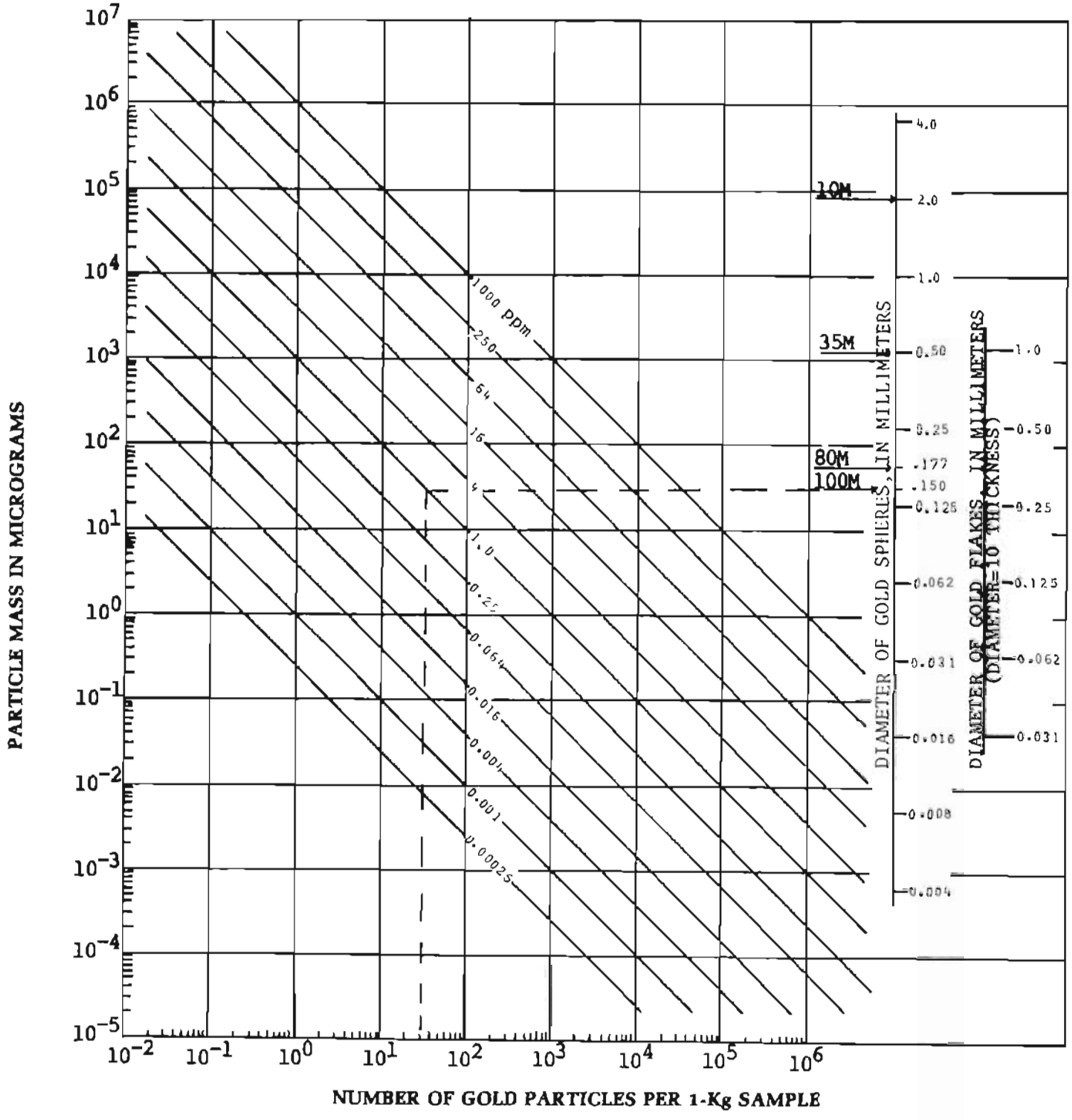


Figure 3. Relationship between number of particles per 1-Kg sample, particle mass (assuming all particles to be of uniform mass), and grade or tenure of the sample in parts per million. Scales to right relate grain size of gold spheres and flakes to particle mass. From Clifton et al., 1969.

if ore grade is 1 ppm. Keeping in mind the assumption under lying this diagram --- that is, even particle distribution and similar grain size between gold and gangue --- 80-mesh gold would require a 2+1/4 - 4+1/2-lb. sample, 35-mesh gold would require approximately 50-lb. sample to ensure obtaining 20 gold grains if ore grade was 1 ppm. Since gold is not usually evenly disseminated or uniform in size with its host gravel, the

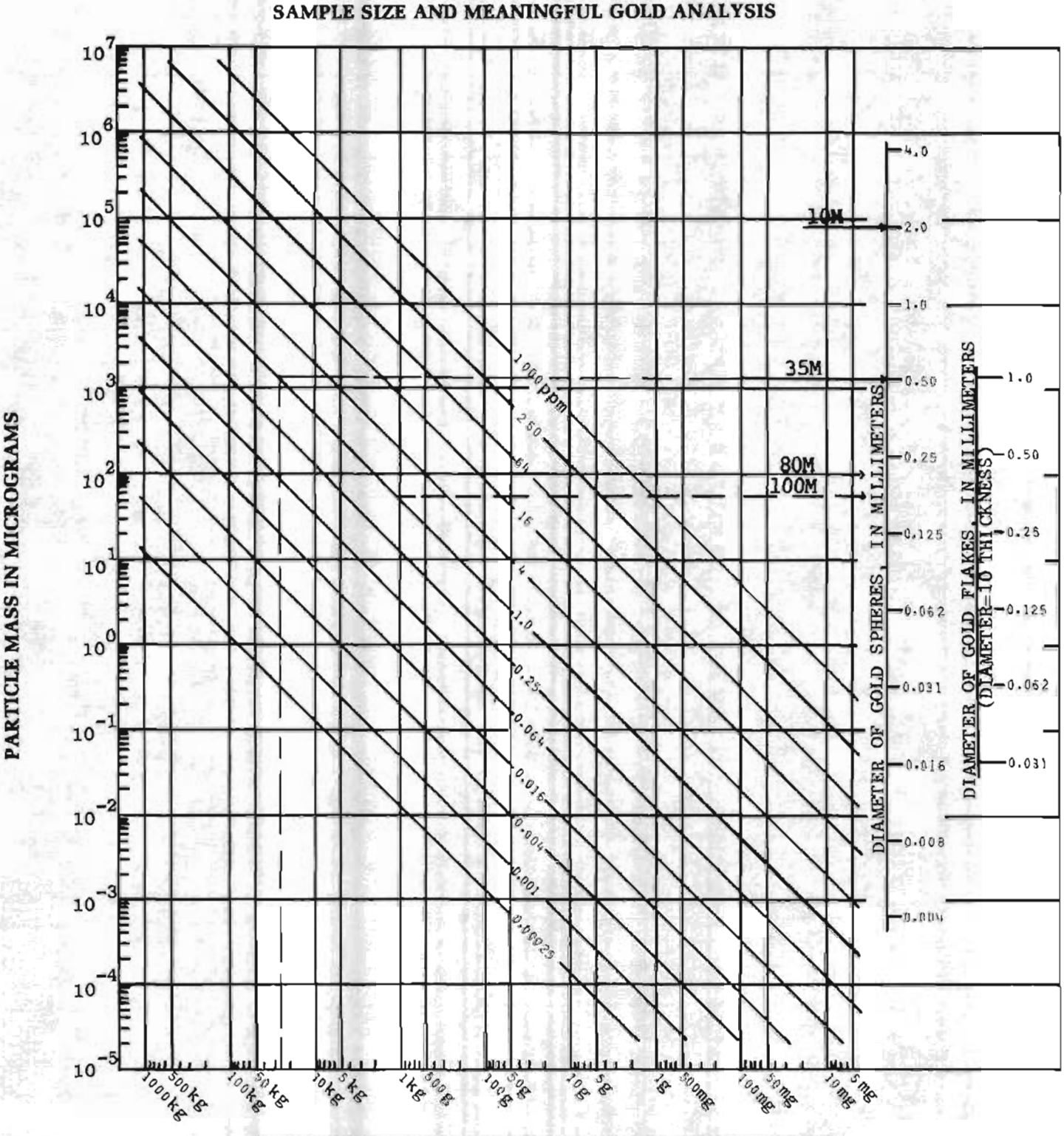


Figure 4. Size of sample required to contain an expected 20 particles of gold as a function of the combination of gold particle size and grade, assuming all gold particles to be of uniform size and randomly distributed in the deposit. From Clifton et al., 1969.

weights arrived at from this diagram must be considered absolute minimum weights for representative field samples required to have a 95 percent chance of achieving the relative accuracy of ±50 percent of the amount reported encompassing the true value of the sample location if grade is about 0.03 ounces per ton.

Let us consider further an example of 35-mesh gold. If 50 lb. is a minimum sample size for detecting a suspected grade of 0.03 oz/ton gravel, and we want to be somewhat within the limits of the assumptions made in constructing this diagram, then we must get a representative sample in which there is some chance the gold will be evenly distributed in a matrix of at least roughly similar size. Clearly, to achieve our objective it would not be wise to collect 50 lb. of the first random surface gravel encountered and expect it to be effective. What we need is at least 50 lb. of material close to 35-mesh size.

If the area contains cobbles or boulders, we can't physically get a representative sample of the site at all without the use of heavy equipment.

Any solution to this kind of sampling problem will be an approximation. How good the approximation is depends on how much time, effort, and equipment you can afford to devote to the sampling process. If you have minimal equipment and are working on a prospecting basis it is still possible to get reasonable results from some basic measurements and recorded field observations, provided you consistently:

(1) Make a good field-sample description,
(2) Follow a systematic sampling procedure,
(3) Reduce the sample by heavy mineral concentration.

For example, one could make visual estimates of percent of material over 2+1/2 in. in diameter and record the estimates. A portion of ground 1 yd. square might be staked out, and all material to a depth of 1 ft. removed and screened onto canvas to estimate material greater than 1 inch to 2 inch or whatever size one consistently uses in the sampling program. A few portable screens, tubs, and canvas are one possible working set up, but even this amount of equipment is awkward for true prospecting work. For rapid reconnaissance prospecting a standard 16-in.-diam. gold pan with or without a calibrated volume bucket, and a couple of small grizzlies sized to fit the gold pan can give surprisingly good results.

To take another hypothetical example, assume one estimates (visually or by a few small grizzlies or screens), that 30% of the gravel in the creek is less than 1/4 inch diameter. If you collected six level 16 inch pans of the 1/4 inch material you would have about 6/180 of an in-place yard of -1/4 inch material. With respect to our minimum sample-size graph, you would also have about 90 lb. of already partially reduced and sized sample. The six pans of 1/4 inch material represents about

$$\frac{6/180}{0.3} = \frac{20}{180} = \text{approx. } 1/9 \text{ yd}^3$$ of in-place raw gravel for our example or represents a 'raw' sample of about 1/9×3000 lb/yd in-place gravel = 333 lb.

The -1/4 inch material can easily be washed through a 10-mesh (2 mm) screen to further reduce and size the sample. The 10-mesh oversize is easily scanned for nuggets.

The -10 mesh material is now approaching a reasonable uniform matrix of size similar to the 35-mesh gold we anticipate. If we have something near 45 to 50 lb of minus 10-mesh material and the creek gravel is near 1 ppm = 0.03 troy oz/ton, theory says we should have 20 gold particles in that reduced sample.

In terms of preparing the sample for assay, it is evident that at this point much of the required work has been done:

(1) The sample has been described,
(2) A consistent sampling procedure has been followed,
(3) The sample is being reduced and sized to recover all its contained gold.

At this point, the sample should be panned down to 1 or 2 lb. All free gold which can be removed should be washed out and saved in a separate vial identified as belonging to the sample. The 1-2 lb. of tails remaining constitutes the material that goes to the laboratory assayer. In some respects, reducing the sample by concentration and extraction has already completed over half the assay. The amount of gold that the miner or prospector pans out will eventually be combined with the assay of the tails to determine the total weight of gold/initial sample.

Note that the sample was never split. It was reduced, first by size to remove the oversize material and then by panning to remove the lightweight material. It was always treated in a way that would retain virtually all the gold from the first large initial sample.

If a prospector consistently follows the principles outlined and works with the assayer, the assayer can then in turn help to get the best possible final estimate of the ground being evaluated. The prospector should be aware that the final laboratory assay results may provide the smallest value increment to be added to his panning results.

In summary, the prospector or miner should:

(1) Record the objective of the sample and describe the sample site and sample detail,
(2) Take large composite samples and be consistent in sampling procedures,
(3) Preconcentrate samples prior to final assay and remove the larger free gold grains.
(4) Do not split the samples.

References Cited

•Clifton, E., and others, 1969, Sample size and meaningful gold analysis: U.S. Geol. Survey Prof. Paper 625-C, p. C1-C17.

•Harris, J.F., 1982, Sampling and analytical requirements for effective use of geochemistry in exploration for gold, in Levison, A.A., ed., Cordillua, p. 53-67.

•Wells, J.H., 1969, Placer examination, principles and practice: U.S. BLM, Technical Bulletin 4, 209 p.

A NEW TROMMEL TYPE SCRUBBER

Joseph E. Vogler
Placer Miner

Every mine has some advantages and some disadvantages. Too many of them have too little water, too many big rocks, too much gravel and too little gold. I have not been able to do anything about putting gold in the ground, and it is pretty hard to change the amount of gravel, but we have tried to do something about two problems and they are both important. One is the amount of water it takes to wash your gravels and the other is what to do with big rocks that normally plug your sluice boxes.

I want to say one more thing about water. It is the most important solvent that we have on this earth. It makes all life possible and has influenced more civilizations, especially in their decline, than any other single element, so what we do with our water is important.

Now we will go to the pictures and I want you to take a look at a very simple thing. All it is is a dredge trommel that somebody forgot to drill holes in for the first 32 feet and then to make up for the lack of holes, they used a set of bars set 2 inches apart capped with a little AR plate so that there is a group of long openings, parallel with the length of the trommel. Dividers are set in these to keep too big a brush from going through and it gives you an inch and 3/4 minus.

The pipe at the upper left of Figure 1 is a 10 inch pipe leading from a little dam located probably 400-500 feet up stream. A valve permits us to direct water to a piece of 4 inch hydraulic pipe. The plant is operating on a gravity flow with approximately a 25-foot head on a 4-inch pipe of water.

I will digress just a moment. The Water Act amendment of 1972 mandated that the director shall conduct experiments to produce equipment or methods which will help to alleviate or reduce pollution caused by siltation from placer mining. About the only thing they have done is build a mud dam to impound tailings that wash out the next spring. It all goes in the same place, down the river, headed for the Bering Sea. This machine will wash, using 800 to 900 gallons of water, about 60 yards per hour because we have to shut down to take tailings. That will be corrected in the future. But this machine will reduce the water use considerably. For anyone here who is at all connected with the environmental movement, I think it is high time that the government carry this a step farther and see what can be done with the water washing discharge to take the silt out of it so it can be recirculated and reused. I think there is something possible, and with this machine, you will be able to mine on streams where otherwise you would spend most of your time waiting for the pond to fill up. This was our experience here, before we got this trommel in operation.

Figure 1

Figure 2

Those of you who have worked in a sluice box know what happens when you get a rock that is too big to go through. You are out there with a shovel or a pry bar and if you can get it out without shutting off the water, without getting a bath in cold water, you are a genius. Some of the rocks range over 42 inches long. We used a piece of Alyeska pipe to feed the material in out of the feed box, and if the rocks are 48 inches and bigger, we can't handle them.

Now, I'm going to turn this over to some of the men who did the work, John Howe and Sam Burger. They are the men who put this together out on the creek and made it work well enough that I'm having another one rolled at the Seattle Boiler right now. It will be up here within 2 weeks and we will put it together while the weight limits are on. This will be set up at Ketchum Creek and will be available by road so people can see it. The machine is such a pleasure and so satisfactory that I am going to put that Wobbler up for sale because it takes too much water. When I will take a machine out in which I've invested about $55,000 and set it aside, you must know that I think that this machine has answered some of the questions, I will explain a part of it here.

The trommel sits on 16 old truck tires and is made out of Alyeska pipe. The main scrubber section is 32 feet long, made out of inch plate, having 5 lifter bars that are made out of 2 × 6 bar iron with a 1/2 inch AR plate on top for wear. I am having some AR plate rolled, so there will be an extra 1/2 inch plate fit in and clamp under these bars. Actually this will be 1 1/2" thick, and have 5 lifter bars that will be 2 1/2" thick. You can watch the trommel bounce on the rubber tires but that is about all you know that is going on inside. It makes a bit of noise but you have to put up with that in a placer mine. Anybody who has listened to a dredge squeal and howl a couple of miles away is acquainted with those facts.

For the people who have small creeks with limited water supplies, and and rock problem, this machine, I believe, will begin to do a pretty fair job of solving some of your problems.

I want to emphasize again the importance of this large a group of people meeting who are interested in the placer mining industry. You have a power that can be exercised at the polls and at the City Council. If you leave here with that understanding and make your Legislators, City Council, and Borough Assembly, recognize that the placer mining industry has a definite impact upon the ringing of the cash registers in the City of Fairbanks, Alaska and other places in this State, this convention will be a whale of a success. I want to thank Mr. Sims for getting it started. Now, I'm going to call Sam Burger and John Howe up here.

[Both parties spoke on each slide. Names are indicated as SB (Sam Burger) and JH (John Howe)].

JH: The Creek we are actually mining is Mineral Creek, running east and west. The dredge tailings again extend down Woodchopper and the dredge would be off the slide.

SB: We are looking down right on top of Mineral Creek. The reservoir water is 150 yards or less above. We really have close to about 15 feet of head on that 4" pipe and the pipeline runs down along the left limit. Our tailings are visible, produced prior to the time when we had the trommel and last year when we used it.

JH: Our layout consists of our pond, a road built for the pipeline to run on, our trommel at the mining site and our tailing pile. Eventually we will be running a conveyor so that we will not have to move so much iron just for a little bit of rock.

SB: This is not a very big stream but it does supply all of the water requirements for the washing plant. Basically, I cannot recall a time last summer that we were forced to shut down due to lack of water and that is pretty important.

JH: All the materials brought in for this washing plant were in pieces and we were able to assemble it in camp. Of course, it came by barge. It consists of our engine which is a 3 cylinder, 40 horsepower dutz. We are running at about 30% throttle. It has a direct drive to a hydraulic pump and mounted in between the frame are the hydraulic valves so we can reverse direction. On the other side is a gear reducer which drives a small sprocket and that in turn drives the large sprocket which is around the trommel. That large sprocket we cut out just using a tracer torch because it saves us a little bit of money over buying one. There is a thrust wheel so that as the trommel sets on the incline, it keeps it from dropping off down hill (Figure 2).

SB: Our Cat is a D8 1H. It is our main stay out there right now. We are taking a 2U out this year and it will be our newest and best equipment there. Let me tell you that as far as economics go, that 1H runs an average of about 2 hours a day in order to push up enough material to run the plant. For that 2 hours it burns about 8 gallons of diesel. For the entire season, for the loader which uses the most - that is a Cat 966 we used less than 3,500 gallons of diesel. When you start looking at economics, sometimes you do not have to have the best and newest equipment. It just depends on the situation at your mining operation as to whether or not you can afford to run a D-9 or whether something smaller might work. In this situation, the steepness of the slopes and the general lay of the cut really make it hard to run larger equipment. The D-8 is capable of doing what we want it to do.

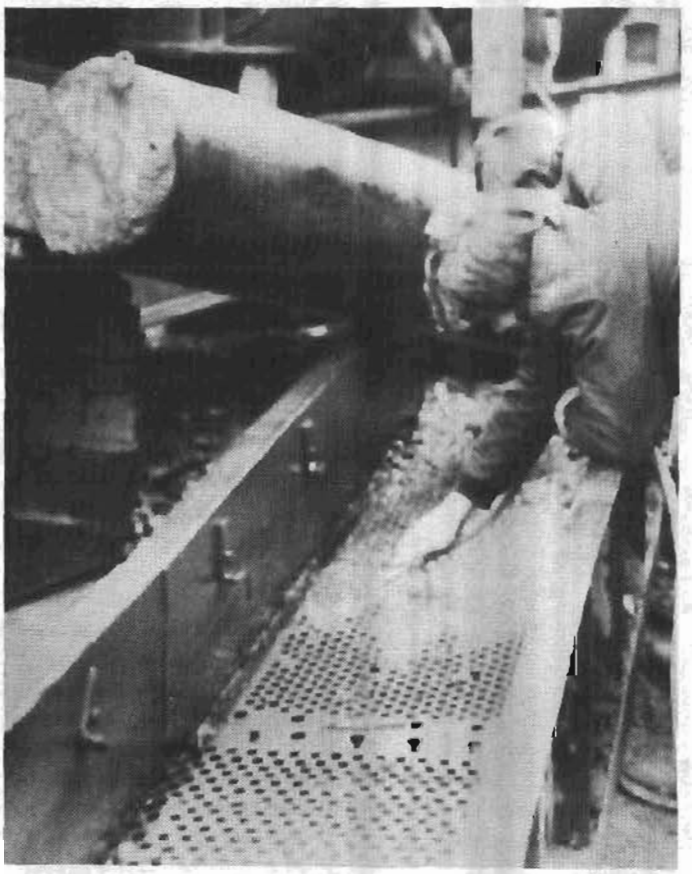


Figure 3

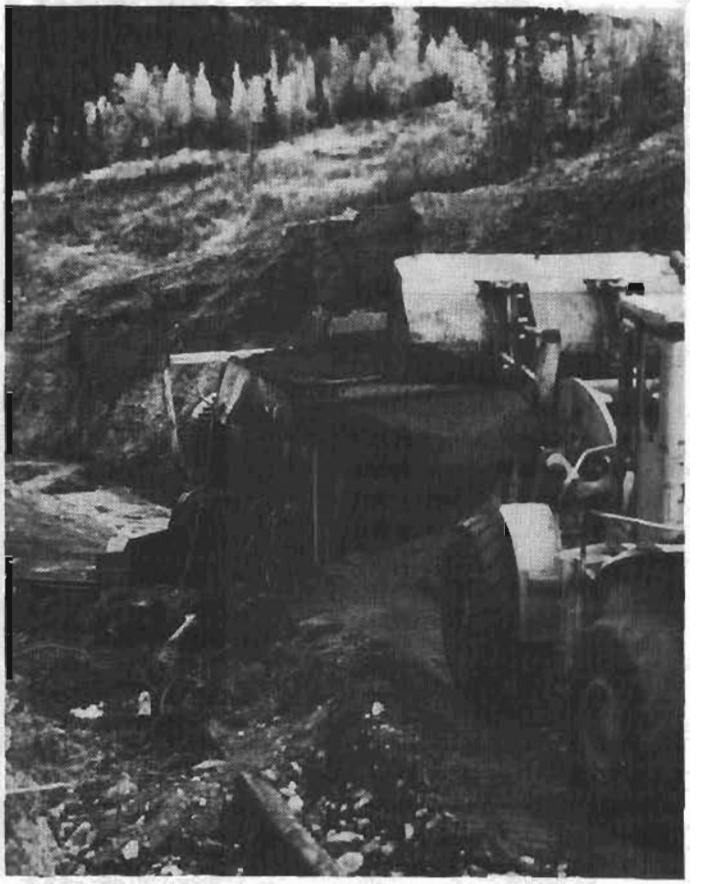


Figure 4

JH: The old sluice box we had previously used is still used this year. We capped the end off and fed through the same sluice box (Figure 3).

SB: Figure 4 shows a frontal view. This was the second location in the cut. We moved it just once last summer, but plan to move it more often so that we are not carrying material any further than we have to. Due to the depth of the cut and being right at the mouth of the Creek, it necessitates moving tailings a little further than we want to. We are now widening the cut as the overburden is less deep. The chute is made out of Alyeska pipe. Basically, we did not have any problems with the chute. About 4 or 5 times it clogged up because we dumped a rock that would not go through the 48" pipe into the chute. This year we are working on a feeder that will eliminate the chute and feed into a feeder which then will feed the trommel at a more even rate. We had to sit at the chute and maybe dump 1 yard out and then another yard out, taking about 2 minutes to dump the 3 yards. We were running about a yard a minute through it, and it took about 3 minutes to make a round trip. With the feeder, we plan on feeding it at about 3 yards a minute and it should improve the flow.

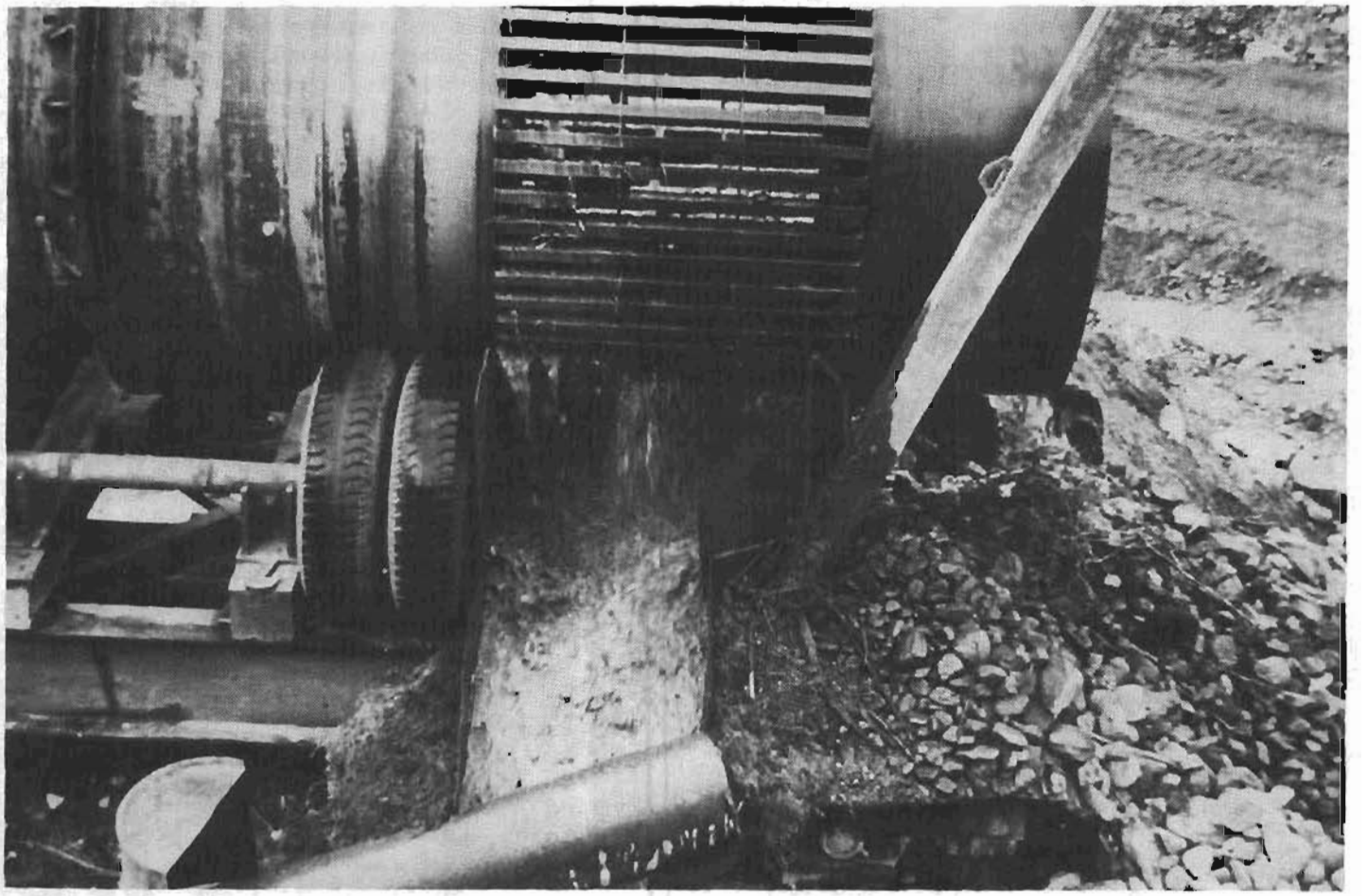


Figure 5

SB: Figure 5 shows the discharge in action. We set about 3 feet of riffles up in this short section of box, and recovered about 25-30% of our gold right in that first 3 feet. On the other hand, we certainly recovered enough in a 10 foot box added on to the end of this short box to make it pay. We know we are losing gold. We do not know exactly what we are going to use but will consider a combination of jigs and a sluice box to catch the larger stuff and reduce it and probably run the fines through another jig.

JH: Figure 5 also shows the discharge bars. You can see that this area is where most of the material is discharged and with this design it really does not take much length. Most of this water you see is not much water at all. Actually, it is from spray bars to make sure that the fines are washed off the discharge bars themselves. The main portion of the material comes out within the first 1/3 of the discharge bars.

SB: A thrust ring and thrust wheel right underneath keeps the trommel from working downhill when on an incline. The one thing that we discovered was that we should probably have made the thrust ring a little bit deeper. In other words, I believe it is 6 inches wide and we should have made it about 8-10 inches. Basically, with the trommel mounted on the rubber tires, you get some up and down movement. It stays pretty even except for maybe one or two big rocks bouncing down through, but there should be a little more clearance between the thrust wheel and the trommel. We like running on rubber tires. Originally, for economical reasons, we set up the axles with the rubber tires and figured that we would go to steel against steel or something a little more permanent later on. Now, we have made up our minds that the only change we are going to make is to put new tires on. As soon as we eliminated the old tires, we did not have a flat the rest of the season and everything ran beautifully. Really, the noise is not very substantial and it is easier on almost all of the components.

SB: Another good reason for not discharging the full length of the trommel is simply that you are protecting all of these moving parts from dirt and contamination and wear. Everything stays relatively clean. It just seems to be a really good system.

SB: The biggest problem with dumping into the trommel was that we had to feed it out a little bit at a time. The addition of a feeder should solve that problem.

JH: Approximately 75% of our tailings are the small 2" minus tailings which we can eventually send out on a stacker. Those small tailings should go right out on a belt and save us a lot of work.

SB: The spray bar inside the trommel is 5" in diameter. The first section of it is 4" and 5", which is what we had on hand. We have 3/4" pipe outlets every 18" on the bottom of the spray bar. The rear few we smash-

ed and cut into a nozzle shape so that they wash the large rocks off over the discharge bars before they tumble out the rear.

JH: The reason why we used 2 sizes of pipe on the discharge bar was because we took the 4" with us and the 5" up at the head was what we found in the dredge that we were scrapping out. We have decided that we need to turn our nozzles. We are going to turn the spray bar so that the spray is more directly on the material coming through.

JH: I will comment about our fuel efficiency again. A 50 gallon drum was carried up to run the Dutz and we did that 4 times throughout the season. Also, later on, like Sam had mentioned earlier, we will have a feeder. Our feeder will sit near the rear. This will feed a continuous flow of material rather than a dump every now and then out of the loader. We will have a conveyor running from it up into the chute. This will do two things. It will give us continuous flow and also the conveyor belt is just rotating around lifting only the weight of the rocks, not taking much energy at all. We will be saving fuel along with being more efficient in the number of yards we can get through in an hour. We will also gain more fuel savings on the tail end when we get our stacker.

SB: The clean-up is not very efficient. Again we are considering all the alternatives to change that. We want to clean up more often and take less time and effort doing it.

SB: We had astroturf on the bottom of the box, about a 1" space and then we had expanded metal with 1/8" screen on the bottom of that. Again, we had about a 1" space and then punch plate on top of that. We fed water into the bottom of the sluice box so that we had water constantly running over the astroturf. The small stuff filtered down through and was trapped in the astroturf beneath.

PRODUCTION TRENDS, PRICE TRENDS AND HEDGING METHODS

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Today I will be speaking primarily on how both users and suppliers of gold and silver can use the future market to increase the profitability of their business and how the freely fluctuating silver prices in evidence since May, 1967, and gold prices since March, 1968 have created a problem for users and suppliers alike.

Consumers can no longer determine upcoming raw material costs beyond the prevailing levels. Now, while producers never really know the price they might receive for their product in the months ahead, the various way stations along the pipeline face double risk. Broad public participation in the gold and silver markets suggests a likelihood of continued sharp price changes. For example, worsening in the inflation outlook could be accompanied by a sudden surge in silver and gold prices as public buying and seller rates, while the opposite could attract profit taking and lower prices. Because of price volatilities, some typical price risks now faced by both the consuming and supplying segments of the industry include situations such as, for example, the jewelry manufacturer whose catalog prices incorporate the current gold and silver price level. This firm would face the risk of reduced profit margins should prices move higher before all requirements needed in the production process are satisfied. Another example would be a producer who opens a new mine or reintroduces old workings that have suddenly become profitable because of higher values. The risk is simply that there is just no guarantee that prices will be at profitable levels or at a break even point when the metal is available for sale. Dealers holding unsold gold and silver in the troys face similar risk. Recognizing that there is little that can be done about silver and gold price volatility, many segments of the using and supply industry will probably be required to live with an unstable price structure for many years. However, although the forces underlying broad price swings cannot be changed, there is still a realistic answer to problems caused by adverse price changes, namely, silver and gold futures. Silver and gold futures will not prevent prices from fluctuating. Rather, like all other futures markets, they are simply a mechanism enabling the members of an industry to participate in forward pricing anywhere from a few weeks to more than a year into the future. This permits both users and suppliers to cope more realistically with the change in price levels.

The question some of you may be asking is, what are futures. The term futures or futures contracts refers to the unit of trading on commodity exchanges. By definition futures are an agreement to deliver or to receive a given quantity of a particular commodity during a certain time period. A buyer of futures agrees to deliver, or receive, the amount of metals stated in the contract when it matures. A Seller agrees to deliver the amounts stated during the maturity.

Futures are merely an additional step, a pricing mechanism, if you will. The principle role of silver and gold futures lies in providing a mechanism for forward pricing. This permits both users and suppliers to confront more realistically the problems caused by broad price changes.

The process of using futures to forward price is referred to as hedging. Basically, it involves an assumption of a futures market position, options to that held or anticipated to be held in the futures, or in actuals, rather. For example, a consumer needing silver or gold is in effect short the physical product. That is, the firm requires a certain amount of metal over a given time period. In these instances, hedging could involve the purchase of futures contracts in the equivalent to all or part of expected needs over a certain period of time up to about 18 months. This action establishes a firm price and thereby protects the user from the adverse impact of rising prices. Indeed, from a price protection viewpoint, a long position in futures is practically the same as tak-

ing in the comparable amount of inventories but without the added cost of logistical problems. The silver or gold supplier, which probably includes most of you, is considered to belong to physical product. Suppliers could hedge, that is protect the value of production of inventories by selling futures against part or all of holdings or anticipated production over a given period. This would protect the supplier from the adverse impact of falling prices. In both instances, the use of futures enables the hedger to establish a known price for silver or gold well in advance of the current date. The success of commodity futures as a pricing medium is because they are merely extensions of cash markets. Futures do not regulate the price of the cash commodity or move in a different price direction for an extended period of time, nor are they in direct competition with the cash markets. Instead, futures are influenced by the same forces that work in the physical or spot markets. Futures, therefore, tend to parallel physical price fluctuations, when the period of measurement is sufficiently long. Of course, hour by hour, day by day comparisons can reveal divergent behavior but in the long run parallel price movement is generally the rule. Meanwhile, the opportunity to close out a futures position by initiating an offsetting transaction prior to contract maturity and thus avoiding delivery remains a key feature in futures trading. Futures afford the flexibility of changing your mind, if you will, by offsetting, reinstating or a host of other strategies, which provide distinct pricing advantages over the cash or spot market transaction where rigidities often rule. Despite apparent advantages over solely physical market transactions, futures are not designed to replace or alter normal operations. In fact, futures were established to work side by side with the physical markets and both have their specific economic function. The physicals of cash markets are basically areas of product acquisition. There is no conflict between the two and in most instances, the introduction of futures by user or supplier does not require changes in normal market procedures. Consumers usually continue to acquire their metal through normal channels while suppliers will probably continue to sell to regular customers. The key difference is that prices for metal acquired or disposed of through normal sources can be priced well in advance via the futures market. Indeed, futures are merely an additional step in the marketing process. Despite the close relationship between gold and silver prices and futures, a differential can usually be detected. This difference between physicals and futures at a given time is called a basis. Those commodities where product rates vary considerably, basis relationships can be quite large. However, silver and gold are a fairly standard metal and under normal conditions it is unlikely that the basis relationships would not be much larger than shipping and storage fees plus the cost of holding money. That is, lost interest on funds tied up holding the metal. The cost of futures transactions is quite small. Purchase of sale of futures contracts requires an initial margin outlay or usually less than 15% of the total value of the futures contract, plus a small commission charge. The margin outlay is neither a down payment nor a fee and is returned if the futures position is closed out via an offsetting transaction. Of course, if the position hedger moved against them, additional funds would be required. Similarly, if the hedger's position were profitable, the firm could withdraw any excess margin. However, it must be remembered, the main purpose of futures is to establish price levels over an extended period of time to help protect the firm's profit margin and not necessarily to show a profit on futures.

Rising prices are a major problem for consumers. For example, a jewelry store. This is especially true if a high percentage of costs for their product involves raw materials. The two basic solutions to this difficulty: the consumer could acquire an inventory sufficient to cover many months production, or use the futures to price needed requirements for many months and keep inventories at normal levels. Both approaches enable the consumer to fix raw material costs over a given period. Futures have several economic advantages. In the first place, pricing via futures does not tie up large amounts of capital that would be necessary to immediate needs. Secondly, futures do not require the storage facility and security measures necessary when holding large inventories. Finally, the liquidity of futures enables the user to increase or decrease its position at virtually a moment's notice. Thus, for an example, a consumer confronted with the development with suggested higher silver or gold prices might cover needs for many months ahead via purchase of futures. If circumstances change, the user could merely liquidate the futures contracts via an offsetting sale. If the same user had increased inventories because of higher expected prices, it would be far more difficult to sell the excess inventories assuming market conditions changed. There are numerous other ways that a user can utilize silver and gold futures to improve product acquisition and marketing. I will mention a few strategies a little later.

Suppliers can also find many advantages in futures. Declining prices are a major concern of suppliers, namely metals dealers and producers. The big problem for dealers concerns the impact of falling prices on inventory valuation. For example, a supplier holding 10,000 ounces of unsold gold stands to lose $10,000 for every $1 per ounce declining gold prices. Moreover, during periods of broad price swings, free market prices can change by this amount in just a few minutes' time. If you have been watching gold prices, you can see how they have been fluctuating. For producers the problem is more serious since falling prices can change a profitable mine operation into a loss. Moreover, unlike consumers who can sometimes pass on these rising costs, miners cannot pass on the losses. It must be absorbed or the mine closes down. There are several approaches to the supplier's price problems. For the metal dealer it could involve carrying a very small inventory level. However, while this would minimize the risk of declining prices, it might also have a negative impact on business by limiting the amount of metal available for sale. The use of futures on the other hand would enable the supplier to protect inventory values without reducing stocks to levels that restrict business operations. The producer, on the other hand, could adjust to changing prices by

altering production. However, production process prevents flexibility to a degree. Here, too, the use of futures would permit the producer to forward price gold before it is taken from the ground. The use of futures as a pricing vehicle sometimes becomes clear via illustrations. There are, of course, various methods for using futures. Indeed, the same firm could use futures in many different ways, depending on prevailing market conditions and outlook. The theoretical illustrations I am going to give describe the application of silver and gold futures to a firm's pricing and marketing procedures.

In the first case I am going to illustrate how a consumer might initiate a buy hedge. The buy hedge against upcoming needs is often the approach used by consumers. That is, a gold or silver consumer might use futures to fix a percentage or even all of upcoming raw material costs for up to 1 year or longer. The procedure involves the purchase of futures in quantities that approximate the amount of metal intake expected over a given period of time. Then when the metal is delivered or priced, the comparable quantities of futures contracts could be liquidated. Let us assume an industrial manufacturing firm will purchase about 900 ounces of gold over the next 6 months. The metals are acquired from regular suppliers and will arrive every other month. The price will be based on free market levels prevailing at the time of the shipment. The transaction in the cash and futures market might work as follows: In January this firm might place an order for 900 ounces of gold for delivery every other month beginning in late February. Simultaneously, when he placed that order, he would buy 3 March gold futures contracts, 3 May gold futures contracts and 3 July gold futures contracts. When late February came around, he would accept the delivery of 300 ounces of gold from the regular suppliers and simultaneously sell his 3 March gold futures contracts. Late April he accepts another 300 ounces from the suppliers and sells his May gold futures and then in June, the same procedure, he receives 300 ounces of gold from his suppliers and sells out his July gold futures contract. The purchase of the gold futures enabled the industrial manufacturing firm to fix the price of gold in January for the next 6 months. That is, by establishing futures positions comparable in amount to the expected intake of metal, and selling the futures when the gold was priced, the firm would have avoided the added cost of gold price increases. If for example prices had advanced at an average of $50 per ounce during the period, the firm would have paid that much more for the physical gold. For 900 ounces this would have amounted to an additional $45,000. But, the increased physical cost would have been largely offset by comparable gains in the futures contracts which would have been liquidated at a higher level. If prices had fallen, the futures position would have shown a loss but the actual gold would have been acquired at lower levels and thus offset that loss. Remember, the main purpose of this transaction was to fix the price of gold for a given time period, not show a profit or a loss on the futures side of the transaction.

Silver and gold consumers can also utilize the futures market to protect the value of inventories, or scrap, generated in the production process via what is called a sell hedge. Let us assume that the same manufacturing firm I cited in the first case had acquired an excess inventory in anticipation of increased business. Now if desired, the consumer can protect the value of part or all of the inventories over a given period by selling futures as follows: In January the firm decided to protect the value of 50,000 ounces of silver holdings. In the futures market, he would simultaneously sell 5 March silver futures contracts, 5 May silver futures contracts. This example would work for gold, too. In late February when the excess inventories had been reduced by 25,000 ounces, he would buy back his March silver futures contracts. In late April when the inventories had been reduced an additional 25,000 ounces to normal levels, he would buy 5 May silver futures contracts. The above transaction enabled the firm to fix a value for excess inventories in January without actually selling the metal immediately. Then as inventories were reduced, the futures contracts were liquidated. Prices had declined, say an average of 50 cents an ounce on the average, and the firm would have had an inventory value reduced by $25,000. However, the losses would once again be offset by gains on the futures and if prices had advanced, the futures positions would have shown a loss and this would have been offset by the increased inventory values. This same procedure could have been followed if we were talking about scrap generated in the production process rather than inventories. In this instance the futures hedge would have been lifted when the scrap was sold to the refiner's scrap dealer. Like the prior example, the main purpose of the futures transaction was to protect the value of inventories until the metal was sold or priced.

If rising prices are a problem for consumers, then declining prices create problems for you, the supplier, especially producers who have large fixed costs. Silver and gold futures are a pricing medium for all segments of the industry including suppliers. A supplier could sell futures to protect the value of inventories against upcoming production or against a commitment to deliver metal at a price at the time of shipment. In the third case, let us assume that in January a supplier agreed to deliver 1,000 ounces of gold already held to a consumer in late March. The price would be based on the free market levels prevailing at the time of the shipment. In January, when he made this agreement to deliver the 1,000 ounces of gold, and March, with a price based on the price levels of gold at the time of shipment, he would buy 10 April gold futures contracts. Then in late March when he delivered those 1,000 ounces of gold to the customer at the prevailing prices, he would sell his 10 April gold futures contracts. The result of all this would be that the sale of the gold futures enabled the supplier to fix a value for the metal even though it would not be priced until delivery two months later. Now, if prices decline $10 an ounce, the supplier would be required to absorb the loss. That is, receive $10,000 less for the gold. The same principle would apply to producers who desire to fix the price of metal not yet even mined. Although the quantities of metal for producers would usually be much larger, the miner could

use the futures to fix the price of metals still in the ground and, thus, preserve his profit margins. In addition, because the silver and gold market structure is normally what they call a contango, whereby the distant months are higher than prevailing levels, the producer picks up the differential. For example, a miner forwarding pricing via futures typically establishes a selling price prevailing spot levels. If the supplier made a commitment to deliver metal not yet acquired, a buy hedge could be appropriate, as follows: In January, the firm agreed to deliver 1,000 ounces of gold to a consumer, or a customer, in late March and quotes a firm price. He would at that time buy 10 April gold futures contracts. In March when he delivered the 1,000 ounces of gold at the price quoted in January, he would sell his 10 April gold futures contracts. The purchase of futures enabled the supplier to quote a firm price for metal not yet acquired. If prices had advanced $10 an ounce, the supplier who failed to hedge would have been required to absorb the $10,000 loss. The supplier who hedged would have also received $10 an ounce less for the gold but would have offset these transactions with approximate gains in the futures market.

I mentioned earlier that futures are essentially a forward pricing medium that enables both users and suppliers to price a product or needs many months ahead. However, these remarks should not imply that once a future's position is placed, it should not be lifted until normal cash market action is taken. Indeed, also some well placed pricing actions in futures need little or no attention until liquidated. Others, sometimes, must be nursed through an adverse period, removed and reinstated later or removed all together. The key to a particular course of action lies in the unfolding circumstances at the given time. Remember, hedging is not a mechanical process, but rather, a sophisticated approach to pricing. It requires continuous thought. Timing in the initiation and removal of futures positions is also very important. It is recommended that a prospective hedger stay attuned to the prevailing gold and silver prices and currency market conditions and react accordingly, before and after establishing a position in futures. This could mean adding to one's position, closing it out, reversing a position or some other action. All hedging considerations should be thoroughly investigated.

The question sometimes arises regarding the percentage of requirements, the production that a firm should hedge. Unfortunately, there is neither a hard and fast rule or even rough guidelines that would be applicable to all. The ideal proportion can vary sharply from firm to firm. Therefore, it is recommended that members of the consuming or supply industry review the respective situations with a qualified commodity broker whenever contemplating a position in futures. Silver and gold futures are a management tool that can be used for forward pricing up to 1 year or longer. As with any tool, futures should be used under certain circumstances, or left alone all together. The decision to use futures often boils down to a judgment of whether futures prices and the market structure at a particular instance are attractive from a hedger's viewpoint and compatible with the firm's particular situation.

FORMATION OF MINING DISTRICTS

Donald Stein

Chairman, Fairbanks Branch, Alaska Miners Association

"Nothing is more destructive of respect for the Government and the law of the land than passing laws which cannot be enforced." This is the view of the great Albert Einstein when speaking about laws in relation to government.

My speech today essentially concerns mining districts and mining district formation. Within the State of Alaska, we have the Alaska Miners Association which was formed for social, educational, scientific and other purposes to promote the good of the mining industry; but we also have in the State of Alaska, the ability, from the 1866 mining law and later the 1872 mining law, to form mining districts within the state. The mining districts we can form within the State of Alaska are legal governmental entities. These mining districts do have the power to make local rules and regulations which affect mining conditions and also local rules and regulations which affect mining. I would like to cover some of the back history of the formation of the mining districts, why they were formed, the sources of the rules and regulations and that particular history as it concerns the mining district.

The system of acquiring mineral land within the Colonies of England was the Concession system which had its origin in the rights of Kings and feudatory awards to the mineral products in the ground. It prevails today in modified form in most civilizations. The claims system originated in the early days of mining in the United States. Prospectors rushed to the newly discovered gold fields of California and later to those of Australia. To preserve public order, some arrangement became necessary for determining the on-the-spot area of ground that each man was allowed to work and the conditions under which he could hold and deal with it. Hence arose the right of the discoverer to a claim, a term now in general use in legal parlance.

Two fundamental principles form the basis of all mining laws. One, the right of mine operators to secure an indefeasible title to their property so long as they fulfill certain specified conditions, the compliance to which is absolutely within their own power. Two, the right of the state or other landlord to certain rents, royalties or taxes on the profits of the capital, so that the capital, represented by property and labor, shall not be unduly idle. These principles are essentailly common to the laws of all countries, though in individual cases they are modified to suit climatic, ethnological and physical conditions as well as the histories and theories of land tenure of the particular mining region. Most of our mining laws came from the French and the Spanish systems. The principle of common law prevails in the United States in establishing the owner of the surface and prima facie title to minerals beneath it, until rebutted by evidence that ownership of the mines and

minerals had, from special cause, become severed from that of the soil and surface. Such separate and distinct title to minerals may arise through legislative acts of Congress or State or through a voluntary act of transfer by the individual who once owned both surface and minerals.

The first general act of mining was a law passed in 1849 and in 1866 a second act was passed. It was between 1849 and 1866 that mining claims in California were staked and miners formed mining districts, establishing their rules, customs and usages which became prevalent within the district. The law of 1866, passed July 26, 1866, was the first general statute by which title could be acquired to any public lands within what are now known as the mining states and territories. This act has been largely superseded or repealed by subsequent legislation but is said to have established at least three important and beneficial principles: (1) that all the mineral lands of the public domain should be free and open for exploration and occupation, (2) that rights which had been acquired in these lands under a system of local rules, with the apparent acquiescence and sanction of the government, should be recognized and confirmed, (3) that titles to at least certain classes of mineral deposits, or lands containing them, might be ultimately obtained. This particular law also dealt with the establishment and the recognition of the mining districts as they were set up.

When the law of 1872 was passed, it took into consideration a lot of the local rules and regulations already in effect in the mining districts. This law formalized some of these rules and regulations and made them more uniform and also decreased the number of them. But the law of 1872 did not limit the rules and customs that could be established by a mining district, as long as the rules and customs did not interfere with any of the laws set up by the Congress, the State or the local government.

The Mining Act of 1872, in referencing the law of 1866 declares all valuable mineral deposits and lands belonging to the United States, both surveyed and unsurveyed, shall be free and open to exploration, purchase and occupation by citizens of the United States, and those who have declared their intention to become such, under regulations prescribed by law, and according to the local customs and rules of miners in the several mining districts.

Mining Districts were recognized in the laws of 1866 and 1872 as legal government entities with the right to establish local rules and customs. These tenants of the law of 1872 are applicable and not inconsistent with the laws of the United States. Local mining districts established rules and regulations which varied on how a claim should be staked, the size of a claim, the amount of time and/or money to be expended in order to hold a claim, trespass, vested rights for using water, rights of way for canals, policing powers, local miners courts, claim adjudication, and many other situations which control mining within the district. Congress recognized the need to make uniform and place into formal law some of the varying rules and regulations of common law in the mining districts which dealt with the same subject. Section 28 of the law of 1872 was inserted to establish a more uniform code for the location, recording and assessment work requirements of mining claims, and still recognized the right of the local mining district to alter the formal law concept to fit the needs of the local mining district. Section 28 was established to fill a need for the mining industry, extracting from common law into formal law certain tenants peculiar to mining. Section 28 states in part, "The miners of each mining district may make regulations not in conflict with the laws of the United States or with the laws of the state or territory in which the district is situated, governing the location, the manner of recording, the amount of work necessary to hold possession of a mining claim subject to the following requirements: Section 28 does not preclude mining districts from establishing rules, regulations and customs concerning other phases of mining within the district nor was it intended to do so."

The rules and customs of miners are covered quite well by Wade in 1899 in his book "A Manual of American Mining Law." Chapter 1, included as Appendix A in this paper, has 10 sections such as the Origin of miners rules and customs; Rules and Customs recognized by the courts; Recognition by Congress Paramount authority of acts of Congress; Existence of custom, question of fact; Whether custom is in force; Conflict between rules and customs; Pleading; Construction of local customs; Rules and customs affected by state laws. According to Wade, once a rule or custom is made within a mining district, you must work at enforcing that rule and custom in order for it to be in force and effect. Rules do not obtain their force and power from mere enactment, but from the customary obedience and acquiescence of the miners within the district.

Wade states further in Section 9 of Appendix A, "In constructing these local regulations and usages, for the purpose of determining their validity, force, and application to particular cases, courts will not look narrowly into the regularity of the proceedings of the miners meetings by which they were adopted and promulgated. It is sufficient if it appears that the rule was agreed to by the miners, assembled on due notice, and they will only be disregarded for fraud, not on account of clumsiness of methods by which the expression was obtained. And even the alteration of one of several rules, after they have been passed and reduced to writing, does not affect the validity of the others. 2) Courts will examine and construe rules and customs for the purpose of obtaining their meaning, 3) and when their meaning is reasonable, and not in conflict with the law, such rules and customs must be strictly pursued. 4) For the reason that forfeitures are odious, they are construed strictly against such a conclusion. 5) Local rules have been sustained as reasonable, which provided for the amount of work to be done on a claim in order to hold it; 6) how claims are to be located; 7) requiring a notice of location to be posted on or near the claim;.8) and requiring a renewal of notice, under penalty of the claim being considered as abandoned. 9) Case References: 1. Gore vs. McBrayer, 18 Cal. 583; 2. T.M. Tunnel Co. vs. Stranahan, 31 Cal. 387; 3. Fairbanks vs. Woodhouse, 6 Cal. 434; 4.

Oreamuno vs. Uncle Sam M. Col, 1 Nev. 215; Gleeson vs. Martin White M. Co., 13 Nev. 443; St. John vs. Kidd, 26 Cal. 263; 5. Coleman vs. Clements, 23 Cal. 245; 6. Bradley vs. Lee, 38 Cal. 362; King vs. Edward, 1 Mont. 265; Leet vs. John Dare Silver M. Co., 6 Nev. 188; 7. Harvey vs. Ryan, 42 Cal. 626; 8. Strong vs. Ryan, 46 Cal. 33. Obviously common law in constructing rules and usages or customs by court is considered a potent force in the mining districts.

In Alaska the formation of a mining district is a simple procedure. U.S.B.M. Information Circular 7679 lists the Names of Regions, Districts and Subdistricts in Alaska including maps and a written description of the boundaries. Using these boundaries as a guideline, the miners within the district can call a meeting of those miners of the district; hold a meeting; adopt Revised Articles of Association; elect officers; elect trustees; adopt By-laws; and record the necessary paperwork with the Recorders Office. The Alaska Miners Association will send the necessary pertinent information to any eligible miner interested in reorganizing the mining district in which he mines. Eight mining districts have been completely formed in the state and a few are in various stages of formation. The formed mining districts will also be happy to forward information to eligible miners in other districts on how to establish a district.

The mining districts are legal entities and can have a great effect upon state law, state legislatures, Congress and many of the other political contingencies as they exist within the state and federal government. In other words, the mining districts can be a force to be reckoned with and we are just now starting to realize some of the force that the mining districts can generate. The Alaska Miners Association and the Circle Mining District, the Livengood-Tolovana Mining District and the Koyukuk Mining District have cooperated on several different projects including a Location-nonnegotiable lease system that could be set up in the White Mountain Recreation area, Wild and Scenic Rivers, Historic trails and RS 2477 access trails, stream reclassification for placer mining, safety and security of the mining operation in regards to overflights, unannounced visitors, and release of information on mining operations which should be kept confidential.

Mining Districts pass regulations or rules and establish customs pertaining to mining or mining related matters. Appendix B shows the revised Articles of Association of a typical mining district including the purpose, rights, and management of the district. Appendix C is a copy of the current regulations of the Livengood-Tolovana Mining District. The revised Articles of Association and the regulations or rules or customs may vary between mining districts because of different conditions existing in the different districts, but many of the Articles, rules and customs in the mining districts are similar. In an effort to promote the safety and security of its miners and to protect them from illegal, unannounced trespass, the Livengood-Tolovana mining district released a policy statement in 1982 as follows:

The Livengood-Tolovana Mining District has been reorganized to assist miners in recognizing the Rights guaranteed to them by the Constitution of the United States, the Constitution of Alaska and the Mining Act of May 10, 1872, as reaffirmed by the Mineral Policy Act of 1970, with full regard to Due Process of law under the Right of Eminent Domain.

The Livengood-Tolovana Mining District Regulations are not in any way to be construed as an obstruction, frustration, hinderance or denial to any Authorized State or Federal Agency.

However, precedent has been established under 30 U.S.C. 22 and 30 U.S.C. 28 for Mining Districts to govern themselves, protecting their members from violent acts and establishing civil order. We feel that the potential for a violent act exists when Regulatory Agencies and Miners, from their divergent positions are forced to deal together with no referee. The District is attempting to act as a buffer. The District requires 10 days notice of an inspection to enable us to provide a Trustee of the District to accompany the Agency Inspector in his assigned duties.

A basic Information Sheet is necessary for the District to properly identify the Inspector. Prior to adoption of our regulations, imposters could visit a miner's restricted area under guise of a legitimate Regulatory Agency.

Aerial photography must be curtailed. The miners in our District are striving for better technology and are working on devices that are not yet protected by patent. Their position must not be compromised by unauthorized overflights.

Our District has established a goal of being a model District. Therefore, if any complaints are received by any Agency of a violation occurring in our District, we wish to be notified. Thus we may be able to stem the violation before any action on the part of the State or Federal Agency is required.

The mining district can interface between the miner and the state or federal government and can help clear up a lot of the problems in the district without force or threat being applied.

Miners and claimholders should be encouraged to actively participate in their mining district activities. If they are mining in a district which has not been organized, they should seek assistance in procedures from either the Alaska Miners Association or other organized mining districts. All the mining districts in Alaska should organize. Each mining district is a separate legal entity, but the potential force of the mining districts working in concert through common law is sufficient to change the laws of the state and even the nation.

APPENDIX A

The Rules and Customs of Miners

Section 1: Origin of Miners' Rules and Customs

The Government of the United States, holding the only title to the public lands, is the paramount proprietor, and exclusive rights to occupy and explore any portion of the unoccupied domain of the general government, in the search for precious metals, must be derived either from the direct of tacit consent of such proprietor, we would naturally seek for the foundation of such rights as miners originally claimed to have acquired to portions of the public mineral lands, in antecedent acts of Congress. But long prior to any legislation upon the subject, the exploration and development of the mines were commenced, under circumstances which rendered impracticable an appeal to positive law, to determine the conflicting rights of those engaged in such enterprises. Aside from the fact that the rights asserted were of a nature so novel to our jurisprudence that the principles of the common law were found to apply but imperfectly, the scene of contention was in a locality unprovided with the judicial machinery necessary to a regular legal trial of the merits of conflicting claims. Necessity, therefore, compelled the miners to form voluntary associations, and adopt such rules as were necessary for the government of the camp or the district. These were, and still are, denominated District Rules. But even these rules, which were usually reduced to writing, and recorded in books kept for that purpose, were not always sufficiently comprehensive in their scope to meet the exigencies of every case. It therefore became necessary at times to appeal to the customary usages of a mining district to settle a question of disputed right. These usages thus received such sanction as could be given them at the time, by general acquiescence, and came to be regarded as of sufficient validity to furnish a rule of action at least for cases not comprehended in the body of written rules. These usages will be mentioned hereafter as Miners Customs. The rules and customs will be considered together, for the reason that it is difficult to tell which of the two rules or customs are of paramount authority.

Section 2: Rules and Customs Recognized by the Courts

As often as these rules and customs have been brought into question in the courts, they have been sustained by judicial authority, in so far, at least, as they were found reasonable and not in conflict with positive law, and when clearly established have been generally, if not universally, recognized as fixing the rights of all those within the district where the rule or custom in question was in force, as definitely as could be done by statute. [1] And it will be seen by consulting the authorities that this recognition of mining rules and customs is independent of any statutory provision acknowledging their validity. The reason of their recognition is well expressed in the opinion delivered in King vs. Edwards:[2] *The mining customs of any particular mining district have the force and effect of laws, or in other words are law *** as effectual as acts of Congress, for they are the American common law on mining for precious metals.*

[1] Hicks vs. Bell, 3 Cal. 219; Fairbanks vs. Woodbouse, 6 Cal. 434; Jenny Lind Co. vs. Bower, 11 Cal. 194; English vs. Johnson, 17 Cal. 106; Brown vs. '49 & '56, & c Co., 15 Cal. 152; Gore vs. McBrayer, 18 Cal. 583; Coleman vs. Clements, 23 Cal. 245; St. John vs. Kidd, 26 Cal. 263; Bradley vs. Lee, 38 Cal. 362; Strong vs. Ryan, 46 Cal. 33; Robertson vs. Smith, 1 Mont. 410; Belk vs. Meagher, 3 Mont. 65; Smith vs. North American M. Co., 1 Nev. 123; Leet vs. John Dare Silver M. Co., 6 Nev. 218; Golden Fleece vs. Cable Con. M. Co., 12 Nev. 312; Cases cited infra; Sparrow vs. Strong, 3 Wall. 104; Basey vs. Gallaghear, 20 Wall. 670; Atchison vs. Peterson, 20 Wall. 507.

[2] 1 Mont. 235.

[3] See remarks of Senator Stewart, of Nevada, on common law of miners and origin of rules and customs, 3 Wall. 100, 777.

Section 3: Recognition by Congress

Though no formal acknowledgement of the existence and force of these rules and customs was ever made by the national legislature until as late as the year 1866,[1] yet mineral lands had already been expressly reserved from sale, except as specially provided for by law.[2] And in the previous years there had been, if not a recognition of the prevailing rules and customs under which mining was carried on, at least a recognition by Congress of the fact that the public lands were occupied for such purposes, and a distinct acknowledgement of the possessory rights acquired by miners under these rules and customs.[3] When, in 1872, the first section of the act of July 26, 1866,[4] was repealed, by the substitution of a section of the revised Statutes of substantially the same import,[5] the recognition of these local rules and customs was not omitted. But it will be observed that, by the act of 1872, which embodies most of the congressional legislation upon the subject, and will be found fully set out in another place,[6] many provisions were made for the determination of miners' rights, with respect to matters theretofore left entirely to regulation by the miners themselves.

[1] Act of Congress July 20, 1866 – 1. *The mineral lands of the public domain, both surveyed and unsurveyed, are hereby declared to be free and open to exploration and occupation by all citizens of the United States, and those who have declared their intentions to become citizens, subject to such regulations as may be prescribed by law, and subject also to the local customs or rules of miners in the several mining districts, so far as the same may not be on conflict with the laws of the United States.*

[2] Act of Congress July 4, 1866 – Rev. Stat. U.S. 2318; post, p.13.

[3] Act of Congress February 27, 1865 – *9. No possessory action between persons, in any court of the United States, for the recovery of any mining title, or for damages to any such title, shall be affected by the fact that the paramount title to the land in which such mines lie is in the United States; but each case shall be adjudged by the law of possessions.* Rev. Stat. U.S. 910.

[4] Supra.

[5] Rev. Stat. U.S. 2319; post, 12 et seq., p.13.

[6] Title xxxii, Chapter 6, Rev. Stat. U.S.; post 12, p.12.

Section 4: Paramount authority of acts of Congress

In so far as these provisions extend, they entirely supersede all mere local regulations upon the same subject, and abrogate all those in conflict. The ownership of the property, with respect to which the license to occupy is given, necessarily gives the federal government the paramount right to fix the terms upon which it shall be occupied and appropriated, and but for the provision which occurs in several places in the federal statute, subjecting the rights of miners upon the public domain to the local law of the state or territory in which the

public lands lie,[1] it would be doubtful whether they could be affected by other than congressional legislation, except as they might be indirectly operated upon by the state legislature in the exercise of the police and taxing powers of the state. The statutory recognition of these rules and customs, it will be observed, is, in every instance, qualified by substantially the same proviso, by which the courts have from the first reserved the right to declare them void -- that they should not be contrary to positive law. Therefore, when a local mining rule is invoked to defeat the title of the United States, or of one holding under a patent granted in pursuance of the laws of the general government, it will be held ineffectual.[2]

[1]***Under regulations prescribed by law, and according to the local customs, etc. Rev. Stat. U.S. 2319. ***Shall be governed as to length along the vein or lode by the customs, regulations and laws in force, etc. Rev. Stat. U.S. 2320. ***So long as they comply with the laws of the United States, and with State, territorial and local regulations, not in conflict with the laws of the United States governing their possessory title, etc. Rev. Stat. U.S. 2322. Basey vs. Gallaghear 20 Wall. 670; Golden Fleece Co. vs. Cable Co., 12 Nev. 312.

[2]Fremont vs. Seals, 18 Val. 433; Yosemite Valley Case, 15 Wall. 77; Prosser vs. Parks, 18 Cal. 47.

Section 5: Existence of Custom, Question of Fact, Evidence

Whether there is a custom, or a distinct rule, is a fact, like any other to be established by the best evidence.[1] And in one case, at least, it has been held that a transcript from the record books in which the rules were copied by a designated officer, could not be offered in evidence upon the strength of such authentication as it might receive from a certificate of the custodian. It was decided that the correctness of the transcript must be established by evidence aliende.[2] The book of rules itself, however, is competent evidence to prove that the rule had been adopted,[3] though this proposition was, in one case, qualified by the statement that it was good secondary evidence of a sale.[4] It is probable that the book of rules, when properly identified, would be the best evidence; but where parol evidence had gone in without objection that it was not the best evidence, and the written rule was subsequently introduced, it was held no error to allow both to go to the jury.[5] The evidence of customs is the same as is requisite to establish any kind of custom. The custom to be primarily established is a local one; but in the absence of any local custom controlling the matter in controversy, a general custom may be proven. It is held, however, that a general custom cannot be established by proof of local customs in other districts,[6] by a court of high authority in mining matters.

[1]Sullivan vs. Ileuse, 2 Col. 424; King vs. Edwards, 1 Mont. 235.

[2]Roberts vs. Wilson, 1 Utah 292.

[3]Orr vs. Haskell, 2 Mont. 225; Harvey vs. Ryan, 42 Cal. 626.

[4]St. John vs. Kidd, 26 Cal. 263.

[5]Coleman vs. Clements, 23 Cal. 245.

[6]T.M. Tunnel Co. vs. Stranahan, 31 Cal. 387.

Section 6: Whether Custom is in Force

It is not sufficient to show that a custom had prevailed, or that a certain rule was adopted. It devolves upon any one invoking the aid of either custom or written rule, to show that it is still in force, if such an issue is made.[1] The rule to affect the right must have been in force at the time the right was acquired or the acts done by virtue of which it is claimed, as these rules cannot have retroactive operation;[2] though it was held, in one case, that a subsequent rule might be given in evidence to show by what right the party claimed, the effect of such evidence being properly guarded by instructions to the jury.[3] For obvious reasons the force and effect of a mining custom does not depend upon its antiquity any further than that it shall cover the time when the location was made, or other act done which it is intended to control.[4]

[1]Pralus vs. Jefferson, G. & S. M. Co., 34 Cal. 558; Harvey vs. Ryan, 42 Cal. 626.

[2]T.M. Tunnel Co. vs. Stranahan, 31 Cal. 387.

[3]Roach vs. Gray, 18 Cal. 383.

[4]Smith vs. North American M. Co., 1 Nev. 123.

Section 7: Same - Conflict between Rules and Customs

In this connection the relative value of rules and customs come up for consideration, as they operate to abrogate each other. Under a state statute[1] authorizing proof of the customs, usages, or regulations, established and in force at the bar or diggings, embracing such claims, and declaring that such customs, usages and regulations *** shall govern the decision of the action, it was held that no distinction was made between the effect of a custom or usage the proof of which rested in parol, and a regulation adopted at a miners' meeting and embodied in a written local law.[2] The reason assigned for this ruling is that the district laws acquire their force not from mere enactment, but from the customary obedience and acquiescence of the miners within the district. It is further laid down in the same case that mining customs will prevail over prior conflicting rules that have fallen into disuse and are disregarded by the miners.[3] The only advantages a written rule has over a custom of this kind seems to be the facility with which it may be proved, and a sort of presumption in favor of its remaining in force. Thus it is said in another case: The written laws of the district which presumptively were in force, required work in the district. *** If any other custom had grown up in that district *** it developed upon the appellant to show it, as this would be considered an amendment to, or modification of, the former custom.[4] This places both upon the common footing of recognized usages, and gives effect to the latest. This being the case, it would be safe to say that a written rule adopted at the miners' meeting, as an expression of their acquiescence, would abrogate a previous custom among the miners of the district. It has also been held that general recognition of a miner's right to a claim will give him a good title where the location was not made in strict accordance with local rules.[5]

[1]California Practice Act, 3, p.621.

[2]Harvey vs. Ryan, 42 Cal. 626.

[3]Ibid.

[4]King vs. Edwards, 1 Mont. 235.

[5]Kinney vs. Consolidated Va. M. Co., 4 Sawyer, 382; Harris vs. Equator M. & S. Co., 2 Col. Law Rep. 63.

Section 8: Pleading

Whether the rule or custom must be specially pleaded, depends, in a great measure, upon the code provisions, or the practice of the different states and territories. But, in general, it is deemed sufficient under the code to allege that the property is claimed by virtue of full compliance with the local laws and rules of miners, etc. And in California it has been decided that rules and customs may be shown when not specially pleaded, in support of an allegation of ownership.[1] This however, is somewhat modified as a rule of decision by a much later case in the same court. The modification or qualification, goes to the object for which the mining rule is invoked. Where the custom is relied upon by defendant for the purpose of showing a forfeiture by palintiff, it is held that it should be specially pleaded.[2] It is admitted in this case that abandonment, having the effect to leave the land entirely unoccupied, might be shown under the general denial. But, says Niles, J., in delivering the opinion of the court, *the occupant of a mining claim does not lose his right of possession absolutely by a failure to comply with one or more of the local mining laws, although these laws declare a forfeiture as the result of such non-compliance. He may still remain in possession, under his original location, and is entitled to possession until such time as another shall enter and locate the ground in the manner prescribed by the mining laws, and avail himself of the default of the prior occupant. A defense based merely upon forfeiture does not involve a denial of the plaintiff's possession or right of possession, at the date of defendant's entry.*[3]

[1]Coleman vs. Clements, 23 Cal. 245.

[2]Morenhaut vs. Wilson, 52 Cal. 263.

[3]In this case the contrary views expressed in Bell vs. Brown, 22 Cal. 661, are expressly noticed and overruled.

Section 9: Construction of Local Customs

In construing these local regulations and usages, for the purposes of determining their validity, force, and application to particular cases, courts will not look narrowly into the regularity of the proceedings of the miners' meeting by which they were adopted and promulgated. It is sufficient if it appears that the rule was agreed to by the miners, assembled on due notice, and they will only be disregarded for fraud, not on account of clumsiness of methods by which the expression was obtained.[1] And even the alteration of one of several rules, after they have been passed and reduced to writing, does not affect the validity of the others.[2] Courts will examine and construe rules and customs for the purpose of ascertaining their meaning,[3] and when their meaning is reasonable, and not in conflict with the law, such rules and customs must be strictly pursued.[4] For the reason that forfeitures are odious, they are construed strictly against such a conclusion.[5] Local rules have been sustained as reasonable, which provided for the amount of work to be done on a claim in order to hold it;[6] how claims are to be located;[7] requiring a notice of location to be posted on or near the claim,[8] and requiring a renewal of notice, under penalty of the claim being considered as abandoned.[9]

[1]Gore vs. McBrayer, 18 Cal. 583.

[2]T.M. Tunnel Co. vs. Stranahan, 31 Cal. 387.

[3]Fairbanks vs. Woodhouse, 6 Cal. 434.

[4]Oreamuno vs. Uncle Sam M. Co., 1 Nev. 215; Gleeson vs. Martin White M. Co., 13 Nev. 443; St. John vs. Kidd, 26 Cal. 263.

[5]Coleman vs. Clements, 23 Cal. 245.

[6]Bradley vs. Lee, 38 Cal. 362; King vs. Edwards, 1 Mont. 235; Leet vs. John Dare Silver M. Co., 6 Nev. 218.

[7]Maliet vs. Uncle Sam M. Co., 1 Nev. 188.

[8]Harvey vs. Ryan, 42 Cal. 626.

[9]Strong vs. Ryan, 46 Cal. 33.

Section 10: Rules and Customs affected by State Laws

In many of the details for carrying into execution the laws in regard to mining upon the public domain, Congress has delegated the power to legislate to the law making powers of the states and territories in which the mineral land is situated. So far as this power is exercised it superseded or abrogates the district rules, saving all rights previously acquired. But these district rules and customs have been recognized by local legislatures.[1] The construction of state and territorial legislation will receive attention in subsequent chapters, where a large part of the mining laws now in force of the several mining states and territories will be found compiled and arranged.[2]

[1]Laws of Nev. Ter. p.16, 4, and p.21, 74, 77.

[2]Post, Ch. xv.

APPENDIX B

Revised Articles of Association
of

KNOW ALL MEN BY THESE PRESENTS that we, the undersigned miners of this Mining District, pursuant to the Acts of Congress which delegate to miners of the several mining districts the right to organize and to make and promulgate rules and regulations according to the local customs or rules of miners, 30 USC §22 and 30 USC §28, hereby do promulgate these Revised Articles of Association.

ARTICLE I

This Mining District has been long and regularly established and organized as a mining district.

ARTICLE II

The boundaries of this Mining District have long been known, historically established, and shall continue to be the area within the boundaries shown on the map of the district in the custody of the Recorder of the district.

ARTICLE III

The purpose of the District are as follows:

(1) To preserve the rights and privileges granted under the Constitution of the United States and the Con-

stitution of the State of Alaska and the Mining Act of May 10, 1872, as reaffirmed by the Mineral Policy Act of 1970.

(2) To encourage and aid the intelligent and progressive development of the district's mineral resources.

(3) To make and promulgate rules and regulations for the government of the district to the extent authorized by the Congress of the United States.

(4) To define local customs and mining practices and local mining terms applicable to mining in the district, and to encourage the filing of claim maps of claims in the district with the Recorder.

(5) To accept funds, property, and services to further the interests of the district.

(6) To create from among the district's members or honorary members such standing committees as the miners of the district may determine.

(7) To cooperate with federal and state agencies in encouraging the development of mining in the district.

(8) To disseminate mining literature, information and educational materials to the miners of the district and to the public.

(9) To affiliate with the Western Mining Council and to cooperate with and encourage the organizations and associations of miners whose objects and purposes are similar to those of this district.

(10) To adopt by-laws pertaining to the management and organization of the district, its trustees, officers and standing committees and their terms of office.

ARTICLE IV

Each miner of the district is entitled to one vote. A certificate of membership shall be issued to each miner, certifying his membership. Persons who are not miners of the district who contribute to the funds or to the work of the association may be granted sustaining or technical or honorary memberships, but unless they are also miners of the district, they shall not have the right to vote.

ARTICLE V

This Mining District shall be managed by a Board of Trustees not less than three or more than nine in number, to be elected at the annual meeting of the membership and to serve until their successors are elected and qualified. The trustees shall elect from among their number a President, Vice-President, Secretary, Treasurer and a Recorder and such other officers as they may deem necessary for such terms and in such manner as provided in the By-Laws.

ARTICLE VI

Notice of the time and a place of stated and special meetings of the trustees and of the members shall be given orally, by mail, or by publication in a newspaper of general circulation in the District at least _____ days prior to the date of any such meeting. Notice of the annual meeting for the election of Trustees shall be given at least seven days prior to the date of such meeting.

ARTICLE VII

These revised Articles of Associalton or the By-Laws of the Association may be further revised or amended by a majority vote of the members.

IN WITNESS WHEREOF, pursuant to resolution of a meeting of the miners of the district, duly and regularly called and held, we, the duly elected President and Secretary of said mining district, have hereunto set our signatures this _____ day of _____, 19_____.

_____

President

Residing at _____

_____

_____

Secretary

Residing at _____

_____

_____

County of

On this _____ day of _____, 19_____, before me, the undersigned Notary Public of said State, duly commissioned and sworn, personally

appeared _____, known to me to be the President of the Mining District that executed the within Revised Articles of Association and acknowledged to me that such Mining District executed the same.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal the day and year in this certificate first above written.

_____

Notary Public in and for said State

APPENDIX C

Regulations of the Livengood-Tolovana Mining District

REGULATIONS

Livengood-Tolovana Mining District

Section I, Article 1: Valid Mining Claims

All mining claims in the District must be properly located and staked pursuant to either Federal or State laws governing claim staking. A map of such claims must be filed with the District within one (1) year of Recording said mining claim with the State Recorders Office.

Section I, Article 2: Miners

Any miner operating in the District must comply with State and Federal laws to the best of his ability. All miners operating in the District shall be given the option of settling disputes by a jury of his peers.

Section II, Article 1: State and Federal Agencies

All State and Federal agencies, when making routine inspections of any or all mines in the District must comply with current mining laws with full regard to due process of law under the right of eminent domain, and must comply with the following:

A. A ten (10) day notification of such inspection must be made to the District.

B. As a prerequisite to any inspection, the agency inspector must complete and sign the Basic Information Sheet provided by the District.

C. The agency inspector must be accompanied in his inspection by an uninterested member of the Board of Trustees of the District.

D. Aerial photography for the purpose of routine inspections will not be recognized in the District as valid surveillance techniques, but will be construed as trespass and a violation of rights to privacy and developing mining technology.

Section II, Article 2: Complaints

In case of Complaints to State and Federal agencies, the following rules shall apply:

A. A written and signed copy of the complaint must be filed with the District.

B. The agency inspector answering the complaint must be accompanied in his inspection by an uninterested member of the Board of Trustees of the District.

C. "Overflights" for the purpose of confirming the validity of the complaint will be allowed only if the following provisions are met:

1. The aircraft to be used must be registered with the District, giving the following information: Registered owner of aircraft; Make and Type of aircraft; Name and mailing address of pilot: Identifying numbers of aircraft; color of aircraft; Date, time and place of overflight; Names and addresses of all passengers; List of all surveillance equipment used.

2. Aircraft must comply with FAA Residential Regulations.

Section II, Article 3: Other Organizations in the District

Any group or organization attempting to collect data on any mining claim in the District must first comply with Section II, Article 1 above.

Section II, Article 4: Failure to Comply

Any individual, Government Agency or private organization found to be in violation of these Regulations by the District shall be issued a warning. Finding of a Second Violation shall be subject to the posting of a Bond, amount to be determined by the District.

Section II, Article 5: Exemptions

A patent application is considered as an agreement between the miner and t BLM Patent processing department or mineral geologists and is exempt from the requirements of these regulations while operating under regulations pursuant to patenting.

Section II, Article 6: Definition, Sections I & II

Miner as used in these regulations is defined as a Mine owner or lessee in good standing in the Livengood-Tolovana Mining District according to the By-Laws of the District.

District as used in these regulations is defined as the Livengood-Tolovana Mining District as outlined in its historic charter.

Mining Claims as used in these regulations are defined as any claim belonging to a Miner in good standing in the District.

Board of Trustees as used in these regulations is defined as provided in the By-Laws of the Livengood-Tolovana Mining District.

Jury of his Peers as used in these regulations is defined as being the same definition as that used in the Constitution of the United States.

Due Process of Law under Right of Eminent Domain as used in these regulations is defined as being the same definition as that used in the Constitution of the United States.

Complaints as used in these regulations are any complaints filed by an individual, agency or organization to a State or Federal agency.

Authority: USC 30, Sec. 22
USC 30, Sec. 28

BANQUET SPEECH

Bettye Fahrenkamp
Alaska State Senate

I have learned a lot about mining and especially the search for gold in this part of the country in my twenty-five years here. I guess most of it I have learned while listening to Placer miners and their problems.

I would like to tell you how proud I am of what I have seen in traveling around the creeks looking at your efforts, to improve the extraction of the gold, the working on the creeks, and the way you are striving hard to try to work within the environment and to handle the sedimentation and things in the proper way. And working with a job that is hard enough by itself. I know and you know that you are working most of the time with burdensome regulations, some that fit and some that do not, with government often looking over your shoulder.

Since I work with that government or sometimes fight with it, I just thought I would bring you up to date about what we have been doing so far to try to improve things.

This morning I attended another meeting of a task force that was put together by the new commissioner of the Department of the Environmental Conservation, Dick Neve'. He is looking into the water quality problems, and I know none of you have mentioned that since you have been here, probably you will mention it tomorrow, or in the next year. You all know what those problems are. This group includes miners, agency people from DEC, EPA, conservationists government people, and we are really trying to sit down at one table and talk together, which in itself is a miracle. But to try to really solve some of the problems I think is a real step in the right direction. As most of you know, the water quality standards for turbidity is simply too low now, and under the technology we have out on the creeks and the economic way things are in most of them, we just cannot meet the turbidity standards. I am very happy to say that Commissioner Neve', and our new commissioner of DNR are seriously taking a look at this. The commissioner of DEC has decided to take another look at these standards and he admits that some of them need upward adjustment. I think that is a step in the right direction. Even a significant upward movement of some of the regulations. As you hear of the ways we are trying to solve these, let us know what you think about it, but remember that we are all trying to reach a state of thinking which will satisfy those people who want to use conflicting interests on the same creeks.

When we start looking at these conflicting interests, we have got to look at the classification of the streams that can run anywhere from drinking water to industrial, which lessens the standards as you are well aware. Except for the Chena River, right here in part of Fairbanks, there is not one stream that is now classified other than drinking water quality. That means that we need to work. Another approach is to reclassify these streams where mining is the most important, and use the classification such as the industrial classification which has the lower standards. This is what we need to take a good look at now.

DEC has agreed to review the classification procedure and regulations and make some changes in the time patterns in the reclassification process. I know you will not be happy with all that comes out of it and they will not be happy and neither will the others, but at least it is another step in the right direction. The stream classification is not the entire answer. On some streams, other competing uses, such as recreational boating, fishing, drinking water supplies, will prevent the streams from being reclassified as industrial. In these cases, we are looking at research, alternative technology to try to help solve the problem. Settling ponds have shown, as you know, a great improvement, but we all know that is not the answer. There have been some successes using recycling, and I am glad to hear that more of you are trying it. But using new techniques means that before we require miners to try to meet standards, we ought to at least know how it can be done and what it is going to cost, which means research. I guess that my part of it in working with the group, at the request of Commissioner Neve', is to find the funding to do some research. I was happy today to learn that the miners are interested in helping with that, EPA's interested and there may be some funds that we can use there. Any work that we can do, whether it be on one of your mines, or whether it be indepth scientific studies, will help us to resolve some of these problems. I hope that if we get some of these studies started you will not think it is the state or the federal government, or somebody else trying to shove something else down your throat. What we are trying to do is help you and help all of us keep your business going because it is vital to us all.

The problems on Birch Creek, is another one that we have been working with along with the mining and federal conservation systems. Access to claims, claims staking regulations, instream flow and navigability; the one particular stream that has it all is Birch Creek. In working with the Citizens Advisory Commission, we did respond to the Birch Creek plan and addressed it thoroughly. I know some of you have been working with the commission office and we will continue to work with you as hard as we can on that. Birch Creek represents a situation where the Placer mining operations are in violation of state water quality, where parts of the river have been labeled non-navigable, by the federal government, where along the wild rivers access to adjacent claims is blocked or can be, where a huge view shed is recommended to protect either side of the river, where state regulations prohibit stream reclassification, and where historic mining activities in the water shed have been ignored or not considered legitimate although they have been there for over eighty years. These are some of the things that we are working with now. I intend to meet again with BLM and to follow up on the commissions' comments on the draft plan to see if we can ease the situation.

I have also talked with Esther Wunnike, the Commissioner of the Department of Natural Resources, on this navigability question. Under the Statehood Act, the state owns the submerged land under all navigable rivers. By declaring a river like Birch Creek non-navigable, the BLM is retaining the bed and the bank

and the river under federal ownership. Esther agrees with me that the federal government is not following the guidelines in the case of Birch Creek. DNR has filed an appeal with them and is prepared to pursue it in court, if need be, and I think we all should thank her for that.

The state has already taken a similar case to court, the Gulkana River case, which will be used as a test case. A decision is expected this spring and we will be following that very closely.

I have also asked DOT if they would look into the access problem on Birch Creek to see if the historic use of trails and access corridor along the river could substantiate the historic right of way in the area. Birch Creek's a battle field and all of us know that we have the same types of problems, more or less in degrees, in many of our streams. So what is very important for us to do is watch these questions about navigability determinations and watch them closely, fight them hard, so that we do not set precedence in these instances against the rights of the state.

A lot of you have expressed concerns to me lately about some appointments in DNR. I would like to say that Commissioner Wunnike is one of the best qualified people that I have seen. She is working very, very hard and I am very proud of the job she has started.

I know a lot of you would like to have a separate division in the department for mining. Frankly, that is just not going to happen this session. The budgetary problems will not allow it and there is really not time to work it through. The department has agreed to create a mining review team composed of Dave Heatwole, Roger Burggraf, and Ron Rosander, and they are going to report to the commission their recommendation on DNR organization, personnel policies and operating procedures. Based on these recommendations, DNR will hopefully make some changes in the department which will be helpful to mining.

Frankly, I am very, very encouraged. I see us with a chance either through changes in regulations or by incorporating together, in trying to solve the problems.

BEDROCK SOURCES OF PLACER GOLD

Don Stevens
President, Stevens Exploration Management Corp.

My subject this morning, bedrock sources of placer gold, is a bit different approach than the typical approach to the placer business. As kind of a chemist by nature, I think of placer as an unusual type of geochemical anomaly. It is useful then to help discover lode sources of gold. A great many mines have been found this way. Some of the biggest in the world were discovered through the followup of placer gold appearances. Right now, much of the mining industry is looking through the literature on Alaska, looking at placer districts, trying to learn as much as they can about placer gold, hoping that it will lead them to important new lode discoveries.

When looking at placer gold, there are a number of things that should be looked at, one the trace element geochemistry of the gold. Another is the fineness and the silver-to-gold ratio. Look at the heavy minerals that are associated with the placer gold and the geologic setting. This information is useful in helping to decide what type of deposit the placer gold was derived from. There is a lot of interest now in Carlon type lode gold occurrences, hot springs type gold, and by looking at the chemistry of placer gold I think more discoveries of this type of lode gold occurrence will be found in the state. I think that it is quite likely that this research will lead to the discovery of world class lode gold deposits in Alaska. If I had to pick a region, I would probably have to say the Seward Peninsula.

As we look at the main subject, bedrock sources of placer gold, we see that it helps provide a framework to think from. To do that I will review the classification system proposed by Boyle in his book, Geochemistry and Geology of Gold Deposits. With this framework, I will look at a couple of the categories and then apply that to exploration in Alaska and focus on where we should be looking for new gold deposits.

The important type of gold deposits are those that occur in auriferous porphyry dikes, sills, and stocks or auriferous coarse grain granitic bodies, aplites and pegmatites. This type is not too common in Alaska but there are deposits in southwest Africa and in Idaho.

Another type of lode gold deposit, is the auriferous skarn type deposit. The Nabesna mine here in Alaska is of this type.

A third type of lode deposit would exist where gold and silver occur in veins stockworks, lodes, pipes, and silicified zones in faults, shears, sheeted zones and breccia zones located in volcanic terrain. The big gold producers in the Canadian shield are predominately of this type. The Red Lake district in Ontario, Kirkland Lake, and Yellowknife, also have this type of gold occurrence.

Other types include auriferous veins loads, sheeted zones, saddle reefs and faults, shear zones, drag folds, crush zones and openings on anticlines essentially in sedimentary terrain. Development of replacement bodies near faults and fractures in chemically favorable beds in the sedimentary sequence. Examples of this type of deposit include the Telfer Mine in Australia, Numont's very profitable New Venture and the Caribou Mine and Kemler Mine in Canada.

Other type of deposits are the gold and silver veins, loads, stockworks, silicified zones in complex geologic environments with sediments, volcanics, and various intrusive and granitized rocks in the section. Examples of this type of deposit are Grass Valley, California, Rossilyn, B.C. and the Alaskan Juneau Mine, here in Alaska. Many of you heard Tom Turner's talk at the Alaska Miners Convention last fall where Tom suggested a volcanogenic mechanism which serves as the source of the gold. It is reconcentrated in the quartz veins at the Alaska Juneau and the Tredwell mines.

Another type of deposit which is becoming more important is the disseminated and stockwork gold-silver

deposit in igneous intrusives, volcanic and sedimentary rocks. The main point is that the gold is disseminated: examples of this type are the Kemflow Mine in Quebec and the Carlin Mine in Nevada. At Carlin, the gold runs along the horizons that are chemically reactive. Later we will discuss this type deposition in a little more detail.

Lastly, gold deposits in quartz pebble conglomerates in quartzites; examples of this type are Witwatersrand in South Africa, Tarqua in Argentina, the Jacobina conglomerate in Brazil, Elliott Lake in Ontario.

The annual world gold production is about 50 million ounces. Twelve percent of that is produced as byproducts of other mining operations such as porphyry coppers and volcanogenic massive sulfides. Sixty percent of the world's total production comes from quartz pebble conglomerates and associated quartzites. In essence then, sixty percent of the world's gold production comes from fossil placers. Let us look a bit then at the characteristics of quartz pebble conglomerates and the quartzites that are associated with them. The best and most productive are of Precambrian Age. The gold occurs in units which are thin beds in elongated lenses in thick sedimentary sequences. Looking around Alaska, can we find any gold deposits of that type? The answer is yes and I would like to discuss a few of those.

First in the very productive Miller Gulch of the Slate Creek area, gold was derived from a unit known by the miners as the Round Wash, which is a conglomerate. It was up on a hillside and was eroded and provided the gold that was later mined. This is not Precambrian, it is much younger and probably does not contain economic concentrations of gold within the conglomerate itself but through the placer process, gold is upgraded to where it can be mined at a profit. Another conglomerate which has provided gold for placer deposits is near Alfred Creek in the Nelchina District. At present the conglomerate is not of very large extent. However previously it was much more expansive and probably provided a lot of the gold in the Alfred Creek area.

The other unit is the York Slate. It is the most extensive formation on the Seward Peninsula. It is actually a carbonaceous quartzite. Most of the individual clasts that make up the quartzite are siltsized with abundant carbonaceous material. Inner beds of graywacke, phyllites, and phyllitic limestone are all carbonaceous. Of real interest in the York Slate is the fact that algalmatts have been discovered very similar to what is known in the Witwatersrand. To date, no one has found a Witwatersrand type gold occurrence in the York Slate, but the scale of prospecting needed to make that type of discovery probably has not been attempted on the Seward Peninsula. It is difficult with the tundra cover and frost derived rubble blanketing so much of the terrain. Although there is some discussion about it, the York Slate is probably Precambrian. Seemingly it is of the proper age. Exploration of the York Slate should focus on several different aspects of the sedimentary section. One aspect would be to look for Witwatersrand type gold occurrences, by mapping the York Slate looking for the coarser grain portions of the unit. That is where the gold would be found. Since the formation is predominately silt sized particles, one can imagine that the gold associated with the silt is very fine grained. This is probably why the York Slate serves as a good source rock for gold deposits. In other words, any mechanism which induces the hydrothermal system to leach this low grade gold from the York Slate into a quartz vein or a chemically receptive bed is likely to make ore. This is a model being pursued on the Seward Peninsula. Parts of the York Slate have abundant strata bound sulfides, chalcopyrite, galena and iron pyrite. Where sulfide rich sections occur is also the most likely place to prospect for gold deposits.

In the Nome area, near a sequence of northeast trending faults, there is a high concentration of placer occurrences. The thinking is that these steeply dipping northeast trending faults were probably permeable. Underlying intrusives allowed a hydrothermal convection cell to be set up into the York Slate which mobilized gold from the low grade source rock and reconcentrated it along these faults and shear zones. The occurrence of a chemically reactive rock unit near the fault could produce a replacement, possibly of the Carlin type. Looking at the occurrences of metals associated with the Carlin type mineralizations such as mercury, antimony and so on, it is likely that this has happened.

A possible fourth type of gold occurrence in the York Slate exists near the top of the section, where units are very possibly exhalite formations. These could carry gold as well.

The other type of deposit is the Carlin type, which occurs in carbonate bearing rocks. This deposit is characterized by replacement of the host rock by silica, pyrite, arsenopyrite, trace amounts of mercury, tungsten and antimony. Because the gold is microscopic one can mine a Carlin type deposit for years and never see any gold in out crop or hand specimen. But the gold is there and in economic quantities. The associated metals again are arsenic, antimony and mercury, all typical indicators of that particular type of mineralization. As we look around Alaska then, where should we be prospecting? A good place to examine right now would be the carbonate terrain in the mercury province of Alaska. By looking at the physical chemistry of hydrothermal systems, one learns that the first mineral that might be encountered in the zonation pattern would be cinnabar. With that in mind then, the Kuskokwim area should be prospected for cinnabar which occurs in carbonate bearing rocks. By drilling deeper the Carlin type mineralization will be encountered if that model is correct.

Are there any Carlin type occurrences known now? Knaebel Mining Ventures has a proposal out on a property near Livengood. The model they have developed suggests a Carlin type gold occurrence which was the source of the placer gold currently being mined by the placer miners at Livengood. Using the Carlin model to prospect the York Slate one would look at the carbonate bearing portions of the unit. The northeast trending faults are likely areas where Carlin type mineralization may have developed. When we look at the Seward Peninsula, and the special relationship between the York Slate and Placer gold deposits it is an outstanding correlation. Look at Solomon, Candle, the Nome area and

Iron Creek and it becomes clear that the principle producing areas on the Seward Peninsula are those with York Slate as the bedrock.

I think the future is very bright for the discovery of major lode gold deposits in Alaska. I think the Seward Peninsula will be the site for a lot of exploration and big discoveries in the near future.

PLACER GOLD EXPLORATION

Edward J. Armstrong
Vice President of Exploration and Development,
Tri-Con Mining Company

I believe that the Alaskan placer industry is running at about 10% of its full potential. I think that many properties are sitting idle because they were tried and failed due to insufficient criteria for systematic development. Many other inaccessible properties are as yet undiscovered.

There is a tendency in placer mining to move directly into production because of the quick return of gold from gravels. Once a property is acquired, the operator begins to direct his attention to getting into production. Fuel and equipment must be acquired and moved onto the property before breakup. This scenario becomes proportionately dramatic the less accessible the property. If the operator has tied up all his capital, or a substantial part of it, he is anxious for the first cleanup, which can be one of these three: 1) better than expected, 2) Okay, 3) much less than expected. If the third case occurs, why did it happen? Did the operator have the wrong type of equipment for his type of creek? Was the ground frozen while he expected it to be thawed? Did he get a box that required 4,000 GPM of water while the creek only produced 250 GPM? Was the paystreak that was supposed to be there, in fact, not there? Now that all of his capital is tied up in the mine, does he continue to operate and hope it gets better?

In the hardrock mining industry, there is an average lead time of five to ten years before a mine is actually producing profitably. I suggest in the placer industry, for undeveloped ground, a lead time of one to three years to precede profitable production. Of course, there are exceptions to every rule.

*A knowledge of local geology, regional geologic history, and physiographic development is a distinct aid in placer mining, it furnishes a hypothesis on which to base prospecting, exploration, and mining.

The characteristics of the gravel, including size, shape, cementing material, and depth affects the applicability of different methods of mining.

The character of the bedrock, whether soft or hard, smooth or creviced, will affect mining methods.

The character of the gold, flattened or rounded, fine or coarse, fineness and its distribution may be the determining factor in choosing a mining method. All the gold in a deposit 75 feet deep may be concentrated on bedrock in a four or five foot paystreak. A high cost method like drifting may be more profitable than a lower cost method like open cutting 70 feet of barren material.

Surface exploration work which should be conducted includes surveying and mapping topography and geologic and surface features, in order to provide a reliable map from which to work.

The magnetometer is an excellent tool for deposits which contain minerals affecting magnetic intensities, such as magnetite. This tool is especially useful where the character of the ground makes exploration by shafts impossible. A contour map of varying intensities will show areas of relative concentration. Thus, one can determine the best area for prospecting or exploration. In the case of abandoned courses hidden by overburden, one can readily lay out the trend of the buried channel and minimize the amount of time and money expended on exploring for, and testing, the deposit.

Seismic surveys, likewise, can be used to map bedrock topography, thus detecting deep channels. In frozen ground, an EM-31 electro magnetic resistivity survey may be more effective if there exists sufficient resistivity contrast between the overburden and bedrock.

For frozen deposits, much information can be gained by sinking a shaft, driving a tunnel, or drifting. This method provides a firsthand look and detailed measurements while providing bulk samples from which to gain knowledge.

Drilling is effective in frozen or thawed deposits. For best results, the holes should be cased to prevent runins. If drilling is carried out along a grid pattern, values can be calculated and charted, allowing the paystreak, if one exists, to be mapped, thus allowing a proper mining method to be developed.

Sampling can also be accomplished by mechanically excavated open pits. This is most reliable in shallow ground, less than 25 feet deep. By measuring the pit, and washing the material excavated from it, values per cubic yard can be determined using the gross content method. A pattern of pits will give very reliable information.

When processing the various samples, they should each be processed and recorded separately. Results should be categorized according to lithologies, characteristics, gold content and character, and location - to arrive at a compiled picture of the sampling program. In a property evaluation, a final judgment of the results takes into account all of the hard numbers, as well as operating factors which influence the development of a mine, such as water supply, transportation, labor, climate, and applicable laws and regulations.

In conclusion, placer mining is inherently risky. We are at the basics of making money when we can dig gold out of the ground and readily sell it on the open market. We are also in a business which offers significant financial rewards and freedom. The success to failure ratio of a placer project is significantly greater when exploration and development precedes production. Exploration costs can be paid back many times over throughout the life of the mine. If exploration proves an uneconomic deposit, a much greater investment in equipment and operating costs will have been avoided. Environmental damage is kept to a minimum when an area is evaluated

prior to production. First, the area explored may be uneconomic to mine profitably. Secondly, if a pay streak exists, then the limits are known, and minimal ground disturbance is required. Because production limits are present, significant cost savings can be realized by moving only the dirt which has shown economic quantities of gold. Once a deposit has been thoroughly tested, it is truly like money in the bank, as financing the production becomes much easier. Perhaps best of all, the operator isn't scratching his head and wondering what to do after his first clean up.

As I said earlier, I think 90% of the potential of the Alaskan placer mining lies in the future. I wish each of you success in your ventures.

*Peele, Mining Engineers Handbook, Third Edition, V. 1 10-533

BLACK SAND SURVEY ALONG THE PACIFIC COAST

John Gomes
Metallurgist, U.S. Bureau of Mines

Recently, the U.S. Bureau of Mines completed an investigation for the recovery of byproduct heavy minerals from Pacific Coast sand and gravel and placer gold operations. The objective of these investigations was to determine feasibility of recovering heavy mineral concentrates from these operations and to study methods for preparing individual mineral products from the heavy mineral concentrates. This work was performed at the Reno Research Center which is located on the University of Nevada, Reno Campus.

A great deal of responsibility for this project goes to those Alaskans who came into the bureau about twelve years ago, and wanted to know what to do about the black sands that filled up the riffles and decreased their gold recovery. We talked a little bit about it and they happened to have a sample of the black sands. They left the sample and we analyzed it and also did microscopic examination and found out that one of the major minerals in the black sand was cassiterite. I think the sample ran about ten or twelve percent tin.

When they came back a week or so later, we told them what was in the black sand. They wanted to know what to do about it. It was still a problem. We asked them how much of the cassiterite they would recover, figuring it was ten or twelve percent. They made some ball park calculations and said probably six or eight pounds per yard of gravel. Then they said how much is the tin worth? We said around six dollars per pound. They made another calculation and said the tin's worth more than the gold. I have never heard from them since, so they may be responsible for this project.

The recovery of gold from Pacific coast alluvial deposits has been practiced for decades. The recovery of other heavy minerals has been neglected. The heavy mineral concentrates referred to as black sands has intrigued miners since biblical times.

A study of the mineral composition of California or Pacific coast black sands indicated the largest portion was magnetite. The next two most prevalent minerals were hematite and ilmenite. Then in certain areas we have those of limited economic value, including such heavy silicate minerals as olivine, sphene and amphibole. Our definition of heavy minerals: Minerals having a specific gravity over 3.3. These silicates usually find their way into the concentrates. In addition, there are the industrial minerals, chromite, garnet and zircon which usually vary from a fraction of a percent to sometimes seven or eight percent. Also there are the radioactive minerals which range around a fraction of a percent. In the Pacific coast area, these were mainly thorium minerals such as thorite which is a silicate mineral. Finally there are the two that everyone would like to find more of, in concentrations ranging from a fraction of an ounce on up to hopefully several ounces, and that is gold and the platinum group metals.

I know in Alaska that cassiterite is present in these concentrates. Also sometimes if the source is nearby, scheelite and cinnabar, but both of these minerals are very friable and break up very easily and consequently are not generally found in concentrates very far from their source. At the Pine Creek scheelite mine, which is probably the biggest in North America, we sampled a sand and gravel plant eight miles below and did not find a bit of scheelite. Also minerals such as monazite and the columbium tantalum minerals such as columbite have been recovered by placer methods in the United States and we were hoping to find more of these exotic minerals but the study only revealed traces.

We need justification for doing everything. The justification for this project is that a high percentage of the ore minerals found in black sands are obtained, in this country, by importation. We see that rutile, ore of titanium, chromite, ore of chromium and platinum group metals are over 90 percent imported. In addition, iron ore and ilmenite are about 40 percent imported.

The Pacific coast alluvial deposits represent a large resource in excess of several billion tons. In addition, over a hundred and ninty million tons of aggregate are extracted annually.

I will describe the results of laboratory research concerned with the recovery of heavy mineral concentrates and the beneficiation of individual mineral products from four different operations. The present state of the art of recovering byproduct minerals from sand and gravel operations is the recovery of gold. At a plant on the American River near Sacramento, riffles were added in the sand washing circuit to recover gold. This has been practiced for years. Before the seventies when the price of gold increased, it was usually done as sort of a hobby or contractors did it and then split the gold with the sand and gravel operators. Now with the price of gold increasing, they've gotten real serious about it. It is a simple operation, wash sand passes over the riffles and the barren material or the tails go through a classifier where the water is reclaimed and you end up with a tailing product or a sand product which is sold for concrete sand. The concentrates are cleaned out of the riffles once a week and then they are processed dur-

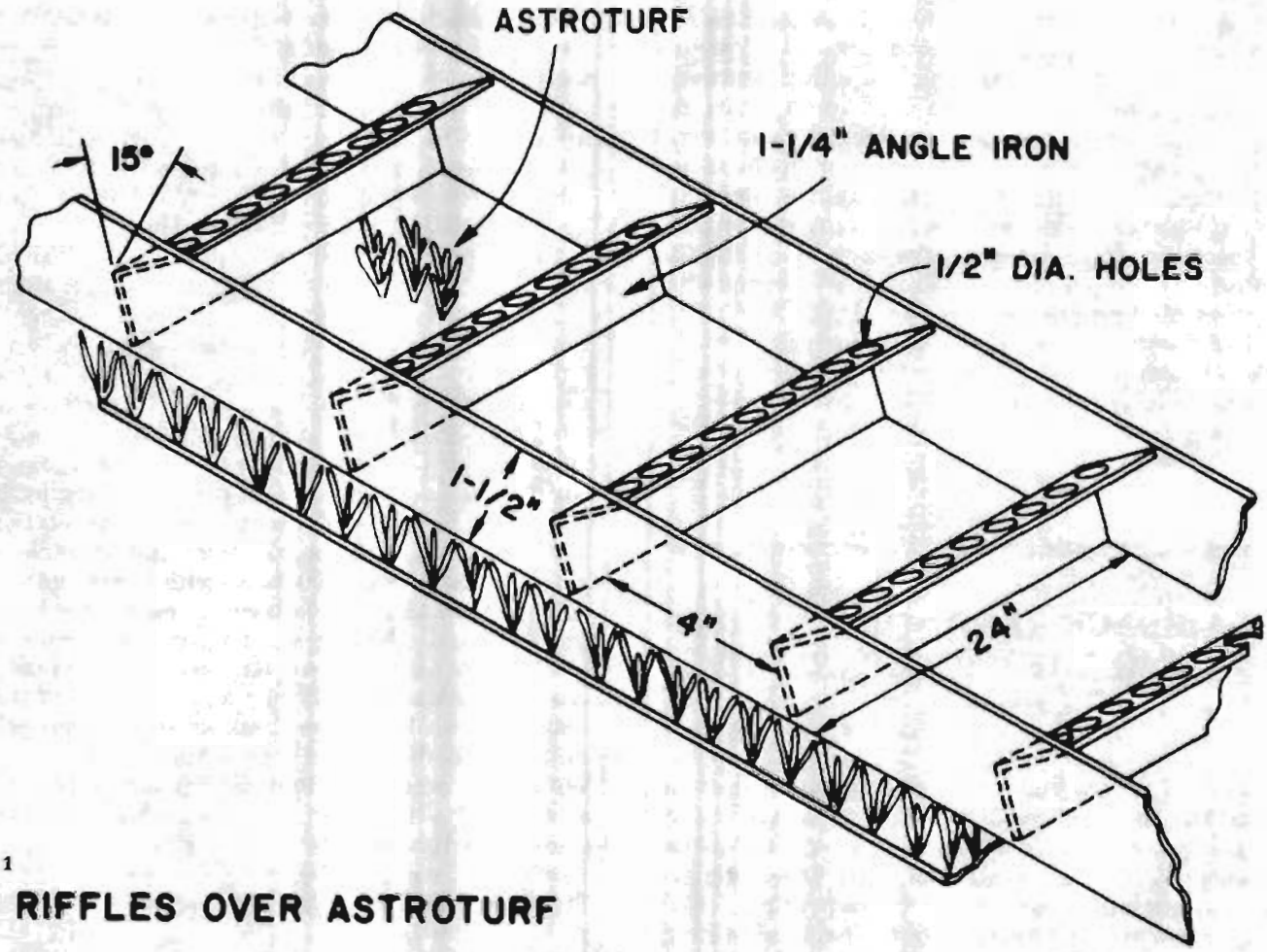

Figure 1

RIFFLES OVER ASTROTURF

ing the next week on a concentrating table, to recover a higher grade concentrate, which is then treated by amalgamation for the recovery of gold.

The sand washing circuit at the American River Operation has eighteen hundred square feet of riffles. This was enlarged a few years ago from 300 feet and the recovery of gold was doubled. They still feel that they are losing about 1/3 of their fine gold. The astroturf riffle was developed to recover their finer gold (Figure 1).

From now on I will discuss our laboratory work and what we found in the study. I will discuss heavy mineral concentration from three locations, the American River, the Yuba gold dredge field and the Ion which is a waste from a silica sand operation. The two conventional black sand products are from the American River plant I just described where they are recovering gold, and the other one is from a dredge in the Uba gold fields area which is presently being operated by Placer Development. Here heavy minerals are usually magnetite with some titanium minerals. In the Uba there was 2 1/2 percent chrome oxide which is equated to about 4 percent chromite. In the American River sample, we did happen to get lucky and get a high platinum group metal content that varied from 0.4% up to 1.5%. We never did get another sample that ran anywhere near that. Figure 2 is a flow sheet that we worked out for the recovery of other heavy minerals from the American River sand. We prepared a concentrate by a two-stage spiral technique. The concentrate would run about 90 percent total heavy minerals and the recoveries were generally over 90 percent. The concentrate was first treated by amalgamation for the recovery of gold, and then by wet low intensity magnetic separation to recover a magnetite concentrate. In the case of the American River, 75 percent of the material ended up in this concentrate which contained around 93-94 percent iron oxide, so it was a fairly high grade magnetite. The nonmagnetic fraction then went into flotation in preparation for a platinum group metal concentrate. The tailings from the platinum flotation were transferred to fatty acid flotation for the preparation of a thoria concentrate. This concentrate was scalped for the removal of ilmenite, garnet and other magnetic minerals. The analysis and distribution of products from the platinum group metal flotation includes the heads which ran about 1 1/2% platinum and 8/10 of each iridium and osmium. Recoveries ranged from 91 - 93%. The platinum as ferroplatinum, which is quite common over most of California and in general, is the major platinum mineral. The osmium and iridium occurred as an alloy. We did a study later with the scanning electron microscope on concentrates from eleven different areas of California and identified over thirty platinum group minerals. In the Southern Sierras, instead of ferroplatinum, the major platinum mineral was speriate which is platinum arsenide.

The results of the flotation of the radioactive minerals, starting with .68 thoria and .03 uranium ox-

ide, resulted in a flotation concentrate containing 3.3% thoria and .15% uranium oxide. After scalping out some of the magnetic minerals, we upgraded it to near 9% thoria and .4% uranium oxide. The overall recovery was nearly 60%.

Figure 3 shows the Uba dredge which is, as I said before, being operated by Placer Development near Marysville, California. This is the largest placer gold dredge field in the world and at the old price of gold produced over 120 million dollars. This dredge used to dig to a depth around a hundred feet. There have been thirty feet added to the digging ladder so now they are getting about thirty feet of virgin material.

The recovery of heavy minerals was performed on the dredge where we received the concentrates. These concentrates were over 90% heavy minerals. The first step was low intensity wet magnetic separation to recover a magnetite concentrate. About 2/3 of the material went into this magnetite concentrate which again was around 90% iron oxide with a major impurity consisting of titanium because some of the magnetite was titaniferous. In the second step we attempted to prepare an ilmenite and a separate magnetite product but both of these minerals have very similar magnetic and electrostatic properties. Consequently we could not get an efficient separation and we ended up with a low grade titanium chrome fraction. However, the zircon in this concentrate only ran 1/2% to start with and we managed to recover a zirconium product containing 63% zircon.

We worked out a flowsheet for the recovery of the zircon and ilmenite from the waste ponds of Ion. As I mentioned before, this is a silica sand operation and they throw away the heavy minerals. The light minerals are the commercial minerals. This plant has been operating for almost 30 years, consequently there are millions of tons of concentrate accumulated here. The ponds run about 27% heavy minerals and again we used the two stage spiral concentration technique as shown in Figure 2 to recover a concentrate which was over 90% heavy minerals. We did not need any low intensity magnetic separation because there is not any magnetite in the Ion formation. We went into high intensity magnetic separation to recover a titania fraction that contains 63% TiO_2 and then into heavy media separation to recover a zircon product that was near 90% zircon. We also recovered an ilmenite product of 63%. This could be comparable to the beach ilmenites of the world.

In summary, the distribution of heavy minerals in alluvial deposits of the Pacific coast is widespread. Major industrial minerals present were magnetite and ilmenite. In some areas significant quantities of gold and platinum group metals and zircon were present. Recovery of 90 weight % of the heavy minerals in concentrates containing 90% minerals was achieved using conventional gravity techniques. Individual magnetite, ilmenite, chromite, zircon, and rutile products were prepared by magnetic and high tension separation techniques. Platinum group metals and radio active

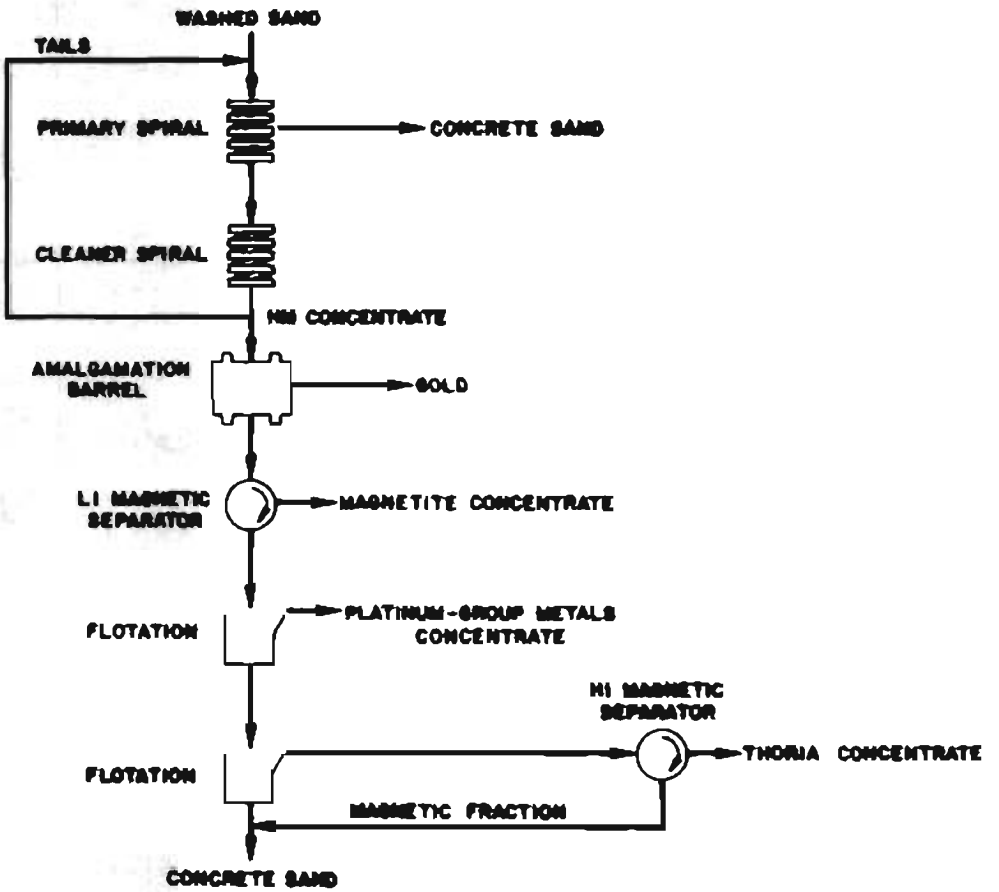

Figure 2

Figure 3

minerals were recovered by flotation techniques. Successful recovery of byproduct minerals will depend on the markets for mineral concentrates and the incorporation of high capacity concentrating equipment into the sand washing circuits of the individual plants. Equipment such as the Reichert Cone or the Cleveland Jig with low initial and operating costs could be utilized. A plant utilizing relatively high cost magnetic and high tension equipment could be built in a central location to treat heavy mineral concentrates obtained from several individual sand and gravel operations.

Twenty-five years ago, who would have predicted that a sand and gravel operation in the city limits of Sacramento would be California's largest gold producer four out of the last five years? Such an operation is Tigart Aggregate Operation on the American River.

MINERAL SAND DEPOSITS

LOCATION	TOTAL HM, WT-PCT	HM FRACTION
E. AUSTRALIA	0.5	RUTILE, ZIRCON, CHROMIFERROUS ILMENITE
W. AUSTRALIA	4.0	ILMENITE, ZIRCON, 10 RUTILE
FLORIDA	<5.0	50 ILMENITE, 15 ZIRCON, MINOR RUTILE
NEW JERSEY	~3.0	80 ILMENITE, 3 RUTILE
S. AFRICA	~2.0	85 ILMENITE, 10 ZIRCON, 5 RUTILE

Figure 4

PLACER MINING AND WATER QUALITY

John Reeves
Field Office, ADEC

Ladies and gentlemen our department appreciates the opportunity to participate in the Fifth Annual Placer Mining Conference. There are quite a few agencies interested in what miners are doing. I have compiled probably an incomplete listing, but I do have some of them listed:

The EPA, National Park Service, U.S. Forest Service, BLM, U.S. Fish and Wildlife Service, Mining Safety and Health Administration, IRS, Bureau of Indian Affairs, U.S.G.S., U.S. Bureau of Mines, Army Corp of Engineers, most of the native corporations, Department of Defense, Alaska Department of Fish and Game, Department of Environmental Conservation, Department of Revenue, Department of Transportation, Department of Natural Resources with the Divisions of Parks, Division of Forestry, Division of Land and Water Management, Division of Research and Development, Division of Minerals and Energy Management, Division of Geological and Geophysical Surveys; the special interest groups like the Friends of the Earth, Sierra Club, National Wildlife Federation, Audubon Society; Federal, State, and Local Councils on the Environment, Northern Alaska Environmental Center, Interior River Users Association and the Alaska Conservation Society. So you are not alone. You have a lot of interested people out there with you.

At the close of the 1979 mining season, the state regulatory agencies had not developed a cohesive program for monitoring placer mining waste water discharges or the subsequent enforcement of water quality standards. By 1980, the number of active placer mines in the northern region had increased by the rate of 60% annually over the preceding five years. By 1981, there were an estimated 500 active placer mines in the northern region and a total of 337 applications for waste water discharge permits were received. In 1982, 382 applications were made. All of these operations have the potential to cause adverse affects on the environment and water quality and generate other water pollution problems.

As defined in Title 46, Chapter 3 of the Alaska Statues, pollution means the contamination or altering of waters, land, or subsurface land of the state in a matter which creates a nuisance or makes waters, land or subsurface land unclean or noxious or impure or unfit so that they are actually or potentially harmful or detrimental or injurious to public health, safety or welfare to domestic commercial, industrial, or recreational use, or to livestock, wild animals, bird, fish or other aquatic life.

Settleable solids and turbidity are the two water quality parameters affected by placer mining used to determine the level of pollution. Settleable solids are the soil particles suspended in water that will settle out if the water is calm. This generally does not include silt or clay sized particles.

The state waste water discharge permit stipulation is .2 milliliters per liter at the pond effluent. Turbidity is a measure of light scattered and absorbed by any particles in water rather than passing in straight lines through it. This is measured in NTU's which are nephelometric turbidity units and do or do not include clay and silt sized particles that remain in suspension.

The statutes also state under Article 1, Declaration of Policy in Alaska Statute 46 of our department, it is the policy of the state to conserve, improve and protect its natural resources and control water and land and air pollution in order to enhance the health, safety and welfare of the people of the state in their overall economic and social well being. Under AS 46.03.020, Powers of the Department, The department may at reasonable times, enter and inspect, with the consent of the owner or occupier of property or premises, to investigate either actual or suspected sources of pollution or contamination or to ascertain compliance or noncompliance with the regulation which may be promulgated in Sections 20-40 of the same chapter. Information relating to secret processes or methods discovered during investigation is confidential.

Also the department may develop regulations necessary to effectuate the purpose of this chapter, including by way of example, regulations providing for control, prevention or abatement of air, water, land, or subsurface land pollution.

Now, AS 46.03.070 Pollution Standards states after public hearing, the department may adopt standards and make them public and determine what qualities and properties of water indicate a polluted condition actually or potentially deleterious, harmful, detrimental, or injurious to the public health, safety, or welfare to terrestrial and aquatic life or their growth, propagation, or to the use of waters for domestic, commercial, industrial, agricultural, recreational or other reasonable purposes.

AS 46.03.080, Quality and Purity Standards states 'After studying public hearings, held upon due notice, the department may establish standards of quality and purity or group the designated waters of the state into classes as to minimal quality and purity or both. The department shall classify waters in accordance with consideration of best usage in the interest of the public. The department may alter and modify classifications after hearings.

So in the Alaska Statues, Title 46, Chapter 3, we find the implementing authority given ADEC by the Alaska State Legislature in order to adopt water quality standards which provide for the protection of identified uses of Alaska's waters. Water quality standards are established in Title 18, Chapter 70 of Alaska's Administrative Code. The water quality standards are used primarily for the basis of 1) establishing conditions for waste water discharge permits issued by the department, 2) developing best management practices to control nonpoint sources of pollution, 3) determining the effect of man's activities on identified uses of the water,

and 4) enforcement actions against operations adversely affecting water quality. The water quality standards are revised and reviewed as necessary at least once every three years.

Currently they are under review to insure that they reflect new information on criteria limitations and that existing or potential water uses are accurately identified. The uses for water supply are 1) drinking, 2) agriculture, 3) aquaculture, 4) industrial, including any water supply used in association with the manufacturing or production enterprise, including mining, placer mining, energy production or development, 5 & 6) water recreation, contact and secondary, 7) growth and propagation of fish, shellfish, other aquatic life, wildlife, including water fowl and fur bearers. Those are the protected uses.

The water quality parameters as listed in that chapter are 1) fecal coliform bacteria, 2) dissolved gas, 3) pH, 4) turbidity, 5) temperature, 6) dissolved inorganic substances, 7) sediment, 8) toxic organic and inorganic substances, 9) color, 10) petroleum hydrocarbons, 11) radioactivity, 12) total residual chlorine, 13) residues, floating solids, scum, etc. In the field, DEC concentrates its efforts on monitoring pH, turbidity, settleable solids, and on some drainages, arsenic and mercury. The standard for each parameter is determined by the identified use or stream classification.

Title 18, Chapter 70.030, procedures for applying water quality criteria. In applying the appropriate water quality criteria for any waters or portions of waters, the department will use the following procedures: 1) if a water is classified for more than one use, the most stringent water quality criteria of all the uses will apply. This means that unless otherwise classified, the water quality should meet drinking water quality supply criteria. At this time, there is only one water body in Alaska that is classified for a particular identified use and that's the Chena River, classified to exclude drinking water supply use, which flows through Fairbanks.

The situation is therefore obvious unless reclassified. All streams in the state, by regulation, are required to meet drinking water supply standards, as that is the most stringent water quality supply criteria. In regards to turbidity the standards state turbidity shall not exceed 5 NTU's above background conditions when the natural turbidity is 50 NTU's or less and when the natural condition is more than 50 NTU's or less and when the natural condition is more than 50 NTU's not to exceed the maximum increase of 25 NTU's. For sediment, no measurable increase in concentrations of sediment above natural conditions.

Section 18, 70.010 states, no person may conduct an operation which causes or contributes to a violation of the water quality standards established by this chapter. The water quality standards established in Chapter 70, apply to man made alterations to waters of the state. The water quality standards established by Chapter 70, constitute the degree of degradation which may not be exceeded in a water body. Waters having natural characteristics which are of a higher quality than the water quality criterion for protected uses established in that chapter must be maintained at the existing quality except where 1) under 18AAC70.015 or 18AAC70.055, it is demonstrated to the satisfaction of the department that limited degradation of the water body may be allowed, 2) it has been demonstrated to the department that the reduction of water quality is justifiable as a result of necessary economic or social development, 3) the reduction of water quality will not injure present or potential uses of the water, 4) all wastes and substances proposed for discharge into the waters, are provided with all known available and feasible methods of treatment as determined by the department before discharge.

Chapter 70 also details the reclassification procedures for identifying specific uses of streams. The Livengood Tolovana Mining district has initiated this procedure for reclassification of streams within their district in industrial use. There are several others that have turned these reclassification requests in. The Circle mining district has expressed the same desire for the Birch Creek wild and scenic river system and its tributaries.

Data regarding the effects of placer mining on recreational fishing is scant but according to an Alaskan Department of Fish and Game five year study in 1977, 9,925 man days were fished on the Chatanika River. In 1978, 10,835 man days were fished. In 1979, gold went up, 4,453 man days were fished. That is a cut by more than 50%. In 1980, 5,576 man days were fished. In 1981, 4,691 man days were fished. I have an idea that more man days were fished last summer because the miners on the Chatanika drainage greatly improved their wastewater treatment over previous years.

There is a dire need for research on sport and commercial fishing as impacted by placer mining so that a data base can be constructed. This will enable regulators to draw from a valuable source of information thus avoiding knee jerk reactionary legislation that benefits no one and is a disservice to government, industry and the general public.

If there was only one placer mining operation in the state there would be very little concern for its impact on the environment. This individual miner would view that impact in the same light as those who regulated him, if in fact there were any.

There are however, an estimated 500 placer mining operations in the interior. Many of these operations view the environmental impact of their mine from that individualistic perspective rather than from the angle that there are many more miners causing large enough impacts on the environment to warrant some regulations to protect against unnecessary environmental degradation.

There has been a rapid transition from an industry that lay dormant for the past 40 years to one bristling with activity and socio-economic impacts. In the 60's and 70's the United States set a new course. This direction was a dramatic commitment to environmental restoration backed by the enactment of some 20 major environmental statutes at the federal level. The first half of the 70's was spent in feverish debate over global growth limits, rapid resource depletion and world doom. The last half was spent in offering generally intelligent alternatives to measures deemed unacceptable by industry.

Because placer mining was a relatively inconspicuous activity in Alaska in the late 60's and early 70's, not much research was conducted or data collected on the industry. After President Ford released price restrictions on gold, it followed naturally that the upward escalating price per ounce would greatly impact and accelerate mining activity within the state.

It was inevitable that this gold rush and the still new environmental consciousness that had swept the land would clash, unable to share the same point in time and space. Environmental groups were caught quite unprepared for the almost unbelievable flurry of activity generated by the new interests in Alaska's lode and placer potential. Such unpreparedness tends to cause a reactionary mentality and communications or dialogue between industry and these agencies floundered or broke down completely. The Alaskan gold rush of the latter 70's and early 80's, like no gold rush before, pitted individualistic miners against policy makers. Towards the end of the 70's, the media had begun shifting its attention toward environmental abuses by regulators with business leaders in particular assailing environmental regulations as a major contribution to the country's economic woes.

Placer miners in Alaska felt overwhelmed. Miners historically had had no real regulatory directives and considered environmental regulations too restrictive. The regulatory agencies on the other hand who implement state and/or federal policy, were mandated to enact tougher restrictions because of multiple use concepts brought on by increased competition for the resource base. Hard line preservationists throughout the United States viewed Alaska as the ultimate battle ground and were staunch supporters of a program that included no resource development whatsoever.

Placer mining is an important element of Alaska's history and economy that utilitizes state lands and water resources. The Alaska constitution and statutes require management of land and water resources as important to the general public in a manner not only simplified in its regulatory programs, but reasonable, consistent, timely, and in the best interest of government and the general public that it serves. The state's presence, whether for consultation, technical assistance, gathering data, or for enforcement purposes is necessary. The agency personnel, however, shall coordinate their visits with other agencies and with the mining operators so as to minimize interference with work schedules and get the best technical effects for all interested parties.

Representatives for the Alaska Department of Fish and Game, Department of Environmental Conservation, Department of Natural Resources, the Division of Economic Enterprises, the Governor's office, the Alaska Miners Association, and the staff advisory to the House Resources Committee, comprised the working group that convened in 1980 to discuss methods to resolve the apparent conflicts between management and various resource interest groups. Studies of placer mining and water quality prior to the formulation of this group concluded that various problems associated with operating conditions encountered by miners may require site specific solutions. Technical assistance to placer miners attempting to meet water quality parameters can be provided by field people who are familiar with the mining process, field operating conditions, and available technology.

The Departments of Environmental Conservation, Fish and Game, and Natural Resources in order to achieve a better working relationship within their own regulatory frameworks have joined together establishing a team concept to implement the permitting and resource management responsibilities of the state. Members coordinate the review of the state placer mining applications dubbed Tri-agency applications. It is now called the multiagency form because there are about seven involved. These applications are dealt with by these groups on a statewide basis.

In light of this increased mining activity, increased environmental degradation has occurred. To best achieve compliance from miners in waste water treatment, the Department of Environmental Conservation worked closely with other involved agencies and sponsored an active field program during 1982. Last summer it was demonstrated that it is extremely difficult, if not impossible to maintain a multiple water use program through cooperation between user groups without an active field compliance program. Detailed regulations or even new laws are not the answer. Regulations historically beget regulations and unenforceable regulations are just that.

The amount of effort put forth by miners to upgrade waste water quality depends on their ability to realistically attain compliance of industry regulations. The miners creating conflicts between water user groups will be required to use well designed and maintained settling ponds. Additional treatment in order to eliminate these conflicts might be one solution to this problem, however, the economics of such actions should be analyzed prior to formulation of additional regulations. Technical assistance will be provided to miners in the field. Miners will be advised of proper methods of settling pond construction and told how to best achieve compliance, obtain permits, etc.

Samples were taken in the field in 1982 and will be again in 1983. The purpose of this sampling program is to determine pond efficiency and whether or not the operation is in compliance. The northern region office exercises one basic enforcement strategy aimed at high priority streams that contain anadromous fish, recreational use of the stream and drinking water supplies. It is our department's intention to focus field monitoring activities on those high priority streams such as the Chatanika, Chena, Salcha, and Forty Mile River areas where multiple use conflicts exists. On streams where there is heavy mining impact it is our goal to encourage constructing and maintaining settling ponds or other techniques to settle out solids.

It is felt that all operators can meet the EPA settleable solids limit of .2 mL if they maximize the use of settling ponds. We recognize there are many operations, many sites, where you just will not be able to build a pond large enough. The state turbidity standard is the most difficult water quality parameter to meet and ongoing research will shed needed light on what environmental effects these suspended solids actually have.

Field compliance to water quality regulations is recognized by our department to be difficult at times and some sites may require a tailored approach to meeting the standards. In many situations, economics and practicality play a role in determining best sediment control methods. As long as the miner demonstrates a willingness to comply and engages in cooperative efforts to meet the standards, the state will pursue every avenue in achieving its own mandate to offer technical assistance and allowing a reasonable amount of time to solve the problems associated with water quality as affected by placer mining. In the meantime regulatory agencies, miners, recreational users, and the general public, should display a willingness to understand each other's views and problems so that meaningful and well balanced programs of environmental quality and economic growth can be effectively constructed and maintained.

Responsible and effective leadership is the essential ingredient to addressing these issues. In the 80's, government and industry must provide more than useless lip service to each other. With increased effort by placer miners to clean up waste water discharges and other land use practices, the industry will promote alliances with other user groups rather than be forced to continue in a role of adversary year after year after year, a role many do not deserve or desire, but one that has been cast upon them like the net of regulations that catches all because of the irresponsible actions of a few.

Recognizing that, the Department of Environmental Conservation set up a Placer Mining Issues Task Force three weeks ago to smoke out the issues and get them in the open.

Our commissioner appointed five subcommittees and assigned various people to them. We had representatives from our department plus our commissioner, representatives from Fish and Game, representatives from DNR plus their commissioner. Miners, engineers, consultants, the EPA, environmentalists, Senator Fahrenkamp, Pat Porcheau, Department of Commerce and scientists were involved. The task force had five subcommittees.

The first one was water quality standards, classification, settling ponds, and recycling. The second was multiple use conflicts - what are the problems? Third, permits and permitting, fourth was research and pollution control funding, and the fifth group was proposed legislative changes. It is the first time in many people's memory, and maybe the first time ever, that all of these people have gotten together around a table and talked about the issues. We have two groups zeroing in on the most important issues: turbidity and settleable solids, and funding for research. Funding is a problem. We are trying to see what kind of research we can get, hopefully applied research and it would be nice if we could find a source that would provide the funding.

In the meantime, we ask for your patience and indulgence. It looks like we are at least getting somewhere this time.

PLACER MINING ADVISORY COMMISSION

Robin Foster

Director, Citizens Advisory Commission on Federal Areas (CACFA)

Those of you who were living here in December of 1980 should remember what happened with the passage of ANILCA, Alaska Natural Interest Lands Conservation Act. About 124 million acres were placed by the Federal Government into conservation system units such as parks, wild and scenic rivers, additions to the national forests, and additional recreational lands. With the land in those conservation units we have certain rules and laws that we have to abide by. We also have certain guaranteed rights including the right of access, the right of continued use or develop ment of our valid mineral rights, and so on.

In 1981, the Alaska State Legislature passed a law that created the Citizens Advisory Commission on Federal Lands. Our sole purpose is to ensure that the federal agencies such as the Park Service, the Forest Service, the Bureau of Land Management, and the Fish and Wildlife Service follow congressional content and also stick with the statutes when they are implementing ANILCA in Alaska. It sounds complicated, but it is really important. If you are having problems getting access to your claim, if you are being denied maybe air access where you have had it in the past, if you are getting hassled with some of your validity determinations and that sort of thing, there may be an opportunity for us to help.

We are located in Fairbanks and Bettye Fahrenkamp is the chairman. One of the members and one of your very interested miners, James Williams, is our vice chairman. We are sixteen members, eight appointed by the governor, four by the legislature and we have four legislative members. We have state wide interests. We are dealing in Southeast, Northwest, Southcentral, and the Interior of Alaska and trying to keep a handle on what the federal agencies are doing. We spend a lot of time reviewing the plans.

The commission has been involved very heavily in the Kantishna-Dunkle Mines area, the study that is currently going on and being sponsored by the Alaska Land Use Council. We have recently completed a review and sent in formal comments for the Birch and Beaver Creeks. We are very much aware of the concerns that the miners have in those two areas. We have worked with a lot of miners on that particular problem and I think that we have represented your interests well. It also happens that your interests are the same as those involved with ANILCA and some of those guarantees that were put through were not considered in Birch and Beaver Creeks. We have tried to make certain that these will be considered in their long term management plans.

For any of you who have claims in the Gulkana, Unalakleet, or Delta River areas, I would mention that April 8, 1983 is the deadline for the comments on their draft river management plans. If you are not aware of

those plans, or that planning activity, I suggest that you contact the Bureau of Land Management and get a copy of those plans immediately and review them to see what problems might exist in the statements and policies they have written and determine how they might affect you. We would be happy to take your comments into consideration and use them when we are doing our review of the plans.

I think that you, as inholders and as people with valid interests in federal areas, need us. I think that there are other people in the state that need us as well. By the same token, we need you and we need your help, we need your input. We need your information on particular areas, and particular problems, and particular places where we might be able to more readily weave our way through the federal bureaucracy to get some message to the people who are doing the managing in the area. I really appreciate the time to let you know about us. If you have any questions or any comments please keep us in mind and remember there are some bureaucrats that are on your side.

ECONOMIC IMPACT OF PLACER MINING

Derek Sherman
Chief Engineer, Louis Berger and Associates, Inc.

Although placer mining has played a major role in the exploration and development of Alaska, it is only recently, since 1978, that this industry has seen a partial revival due to the higher prices of gold. To determine the effect of this activity, the office of Mineral Development contracted LewisBerger and Associates, engineering and economic planning consultants, to measure the economic impact of placer mining on different communities in Alaska and on the state's economy as a whole.

We measured the economic impact of this industry by determining two variables. 1) expenditures made by the industry and 2) employment generated by placer mining activity. By using the input/output analysis, the overall impact of the placer mining on the state's economy could be estimated from these two basic variables, expenditures and employment.

The data needed to determine these variables was gathered through two surveys of placer miners throughout the state. It should be noted that we decided not to gather data on the production of gold by individual miners since this information has historically been given with great reluctance. A survey of local business in three communities, Fairbanks, Anchorage, and Nome, which supply to placer mines, was also conducted. A census of all placer miners in Alaska was also made using available data provided by the Department of Natural Resources, DNR, and contained on the tri-agency form.

The conclusions of our analysis show that the expenditures by placer miners for labor, goods and services, were between 80 and 83 million dollars in 1982. These expenditures are approximately 1.5% of the states 1981 gross personal income, and roughly 2,350 persons worked in the industry or about 1.2% of the persons employed in Alaska.

Comparing gross expenditures with gross personal income is somewhat like comparing apples and plums. You cannot really compare them, they are quite different things, however, it does give some indication of relative importance of placer mining on the state's economy as a whole. Regionally, 39% of these expenditures were in Fairbanks and 40% of the workers reside here. Anchorage was found to play a less important role in the placer mining industry, accounting for 12% of the expenditures and 20% of the workers. As expected, the lower 48 states are important sources of supplies and of labor, originating 33% of the expenditures and 24% of the labor force.

The placer mining industry has a ripple effect upon the state's economy. In the three communities which we surveyed, it was estimated that 360 persons are employed as a direct consequence of this activity by the various suppliers of the industry. The multiplier effect can add considerably to the income and to the employment of the economy. Thus, the overall impact on the state's economy can be estimated to be between 230 and 240 million dollars, or about 4.3% of the 1983 gross personal income for the state and a total of 2,940 jobs dependent upon the industry.

I will now briefly review the surveys which were used to obtain the basic data in order to determine the impact of placer mining on the industry. Our approach was designed to achieve maximum results within a limited time frame. First of all, general data on the placer mining industry was obtained from a response to a short questionnaire mailed out to 600 miners, and I imagine most of you received our questionnaire. Then a follow-up survey was conducted to obtain more specific data on the employment, expenditures and the size of your mining operations. Simultaneously a third survey of different enterprises that supplied the placer mining industry with fuel, equipment and supply services was also carried out. Data from this last survey was used to cross check the information obtained from the first two surveys of the placer miners.

In order to do all the surveys it was very necessary to obtain the cooperation of the members of the mining community and to assure the confidentiality of the data which we collected. Our short survey which was one page in length was mailed to miners based on a list of current mining licenses issued by the Alaska Department of Revenue and on applications submitted on the tri-agency form. In conducting this survey we received considerable assistance from the Alaska Miners Association and its regional branches.

The one page survey form asked miners for general location of their mines, daily production in terms of cubic yards of material handled, where fuel equipment and supplies are purchased, average number of persons working the mines and where they reside, the duration of the mining season and the estimated expenditures which the miners made during the 1982 season. Over 600 questionnaires were sent out and a total of 127

replies were received. So we received slightly more than a 20% response to our survey. The questionnaires also asked the miners to indicate if they were interested in receiving a second more detailed questionnaire.

The detailed or follow-up survey was done by mail and by telephone with the help of Doug Colp and Earl Beistline and asked more specific information about where the goods and services were purchased and the amount acquired in dollar terms of each. Expenditures were classified into a number of categories, for example: fuel, labor, equipment, supplies and technical services. From this data the dollar purchases in a community could be estimated. Forty of these surveys were completed, a little over 30% response.

We also did a survey of the support industry. Suppliers supporting the placer miners were interviewed in Nome, Fairbanks, and Anchorage. We received considerable cooperation from the various companies.

Next I will point out how we used this information to arrive at the results of our study. In order to estimate the impact of placer mining on the state's economy it was necessary to determine the number of companies and individuals actually mining and the relative size of these activities. We tried to do a census of placer miners. Unfortunately there is no single source of data which provides a census of all the placer miners in Alaska. The most current tabulation is the tri-agency form which is sent to the Department of Natural Resources by all miners in order to receive the required approval by regulatory agencies. These agencies include the Alaska Department of Natural Resources, the Department of Environmental Conservation and Department of Fish & Game. This source of information has had two problems, it gives the miners' intentions but it does not necessarily give data on actual mining activities. This factor could result in an overestimation of activities by placer miners. Furthermore, a number of recreational and smaller miners including a few medium sized operations do not always observe these formalities. Alaskans are noted for their independent attitudes, therefore some are not included in this source of data. Thus, the census would underestimate the number of active miners. These two factors tend to offset each other so one of our assumptions was that the tri-agency forms represent a pretty good idea of the mining activity within the state. A number of miners submitted more than one form in some cases for adjacent claims. These cases were considered as a single unit.

Based upon the analysis of the 127 short questionnaires which we received and discussions with a number of individuals connected with the industry, placer mining operations were divided into four sizes. The four categories include, 1) Recreational and assessment work with expenditures of less than $10,000, a very low level of expenditures, 2) Small mining operations were defined as having expenditures between $10,000 and $125,000, and 3) Medium and large scale mining operations are divided at $800,000. Data obtained from the 507 miners who submitted tri-agency forms, such as employment, equipment and type were used to classify each operation into compatible groups. It follows that each one of the 507 tri-agency forms was put into one of the four categories. We had a pretty good coverage of small, medium and large categories. However, the recreational and assessment activity was rather weak. A cross-check on the census of placer miners was made by comparing these results with an independent survey conducted by the Division of Geological & Geophysical Surveys. The figures compare favorably. So, we did have a way of cross-checking results.

Expenditures made by the industry for the purchase of goods and services and the number of persons employed are the two main variables which determine the direct economic impact of the industry on the Alaska economy. The statistical information obtained from the analysis of the survey is then adjusted upward to match the total number of placer miners in the state as identified in the census. Expenditures made for different categories of goods and services in Fairbanks, Anchorage, and other Alaska communities and outside the state were determined on the basis of the detailed survey. These figures were expanded by size of operation to determine statewide totals. This helps explain why the determination of number and size of placer mining was an important element in the study.

I will now summarize, briefly, the results of the analysis of the direct impact of the placer mining industry. The total expenditure including labor made by the placer mining industry is estimated to be at least $80,000,000 in 1982.

Expenditures made in Fairbanks are considerably larger than elsewhere in the state and reflect a large proportion of placer mining activity which is located in the Fairbanks area. Although there are a large number of people involved in it, many more than actually submit tri-agency forms, the overall impact of recreational mining is very small (About 1%).

In Fairbanks total expenditures are about $31,000,000, a good portion of which goes to labor, equipment and fuel. Anchorage has a total expenditure estimated at slightly less than $10,000,000. Labor (29%) is a more important factor there, fuel is a very small factor and possibly the reason is that some of the miners buy their fuel directly from the refiner rather than through distributors. Equipment is also very important in Anchorage. Other locations in Alaska reflect the fact that a lot of fuel is bought directly from the refiners rather than through distributors. Labor is around 20%, supplies are 15% and as one would expect, equipment is relatively less important elsewhere in Alaska. These figures represent around $12,000,000, the largest proportion of those expenditures occurring around Nome, however, similar expenditures occur in Glennallen, Juneau, Talkeetna, Nenana, Kenai, Ruby, Circle and Manley Hot Springs.

Outside Alaska expenditures amount to $26,000,000. 24% of labor expenditures go outside the state. Some fuel is bought outside the state, mainly for placer mining operations along the coast. Also quite a bit of equipment is bought outside the state. Seattle is probably the most important source of supplies and labor.

We made an adjustment to the labor cost and I will explain why we made this adjustment. Total placer mining costs are estimated to be around $20,000,000. This figure is understated since small and medium size

miners generally pay part of their employees wages in gold. The larger placer miner operators in comparison usually pay their employees by check or cash with bonuses paid in gold. Based upon the survey results about 31% of the expenses of large operators are for wages, 25% for the medium size mine and 17% for the smaller operators with an average of about 25%.

General micro economic theory would indicate that the smaller operators should be more labor intensive, and the larger ones more capital intensive. Upon reviewing the results of the survey the opposite is found to be true, and this is because the smaller miners pay in gold and the medium size miners pay part of their expenses for labor in the form of gold and part in cash. However when comparing the large operators, the percentage of labor costs is considerably lower than average. We made some comparisons and basically micro-economic theory was borne out.

The labor intensiveness of small mines is further shown by comparing the number of persons working the mines per $1,000 of expenditures. This ratio decreases with the size of the mines. To reflect the value of payment made in gold, it was assumed that total payments for labor, in kind, and cash for all operators was 31%. 31% is the average of all mines in the large category except the largest which is located at Nome. The actual expenditure on labor in economic terms would then increase from 19.6 million to about 22.6 million. It is just a minor adjustment. The direct impact on the mining industry would increase to an upper value of $83,000,000. The increase in labor costs to $22.6 million would be even higher if the labor cost were larger than the 31% assumption we used for the small and medium mines. Thus, the 81.3 million given in our study as the upper value is rather a conservative value and it should probably be a higher value, which will be difficult to determine since there would be no data on which to base it. Approximately 2,000 persons are employed by the mining industry over the three to four month period, per year, when the mines are in operation. Based on the survey the total direct employment including recreational mining and assessment work is 2,350, so the numbers are relatively close. Regionally mining is more than twice as important in the area north of the Alaska range with Fairbanks acting as the center of placer mining activity. About 1/4 of the labor force comes from outside this state. Other centers of activity include Palmer, Ruby, Circle, Manley Hot Springs, and Juneau.

Initially it was hoped that statistically valid samples for the two regions, one north and one south of the Alaska range, could be obtained. Samples obtained for the region north of the Alaska range are much larger, about four times more than the data we received for the southern region. For this reason an average of both regions was employed in the study. Using these values the total expenditures by mine type and region were computed. The average recreational mine spent about $5,000, the small mine spent about $51,000, the medium mine spent five times as much at $287,000 and then the large mine 10 times as great which is 2.7 million.

Although the major economic impact of placer mining is measured through data collected on expenditures and employment, other information obtained provides additional insight into the industry. For instance data collected on annual duration of mining activities can be used to analyze the seasonal impacts of employment. Some of the additional data that we collected, the average employment by mine type, is 2.5 persons in the recreational, 3.6 for the small mines, 6.5 for the medium mines and 19.2 for the large mines. As I mentioned before, the expenditures between the medium and the large size mines increases 10 fold and the employment increases only 3 fold. This is what I mean by less labor intensive activity for larger scale mines.

We also looked at the support industry. Miners buy supplies, fuel and equipment from a number of suppliers, some in Alaska and some in the lower 48. We interviewed a number of firms, 57 in Fairbanks, 71 in Anchorage and 34 in Nome. And these expenditures obviously do not include the labor that the miners use, $34 million in Fairbanks, between $18 and $21 million in Anchorage and about $2.7 million in Nome. I would like to point out that the data for Anchorage probably includes types of mining activity other than placer mining. It was difficult for the suppliers in Anchorage to distinguish between placer mining and hard rock activity related to gold or other minerals. That is why the information for Anchorage is a little more doubtful than that from Fairbanks. Most of the suppliers in Fairbanks know what type of mining activity the different miners are involved in, and actually could give some very good information regarding the importance of placer mining on their business operations.

We measured the overall impact of placer mining on the Alaskan economy. To do this, we had to draw on information prepared by other studies. We used an input/output model, which describes the flow of goods and services in the Alaskan economy, and allows the examination of potential impacts on the over all state economy, due to changes in level of activity in any given industry. This is a tool that economists use to measure small changes in different industries. In using multipliers that were developed from a 1972 study referred to as input/output tables for Alaska's economy, we got an employment multiplier of 1.25 and an income of 2.93. It is very important that when multiplying direct expenditures by these multipliers, which measure the ripple effect of mining activity on the overall economy, there are certain provisions that must be considered. The results are only approximate. First, multipliers are developed to measure small changes in a sector's income or employment. To determine the overall impact on the state's economy of an entire sector or subsector is a misuse of the multipliers, so you must understand that this is a very approximate look. Mining expenditures are used rather than mining income, so again, there is this distinction between expenditures and income. What is expended is not necessarily what is returned in terms of income.

The input/output model was computed using pre-pipeline data, and, as I mentioned, it was prepared in 1972. The mining sector includes all types of mining activity, exploration, coal, and hard rock mining, as well as sand and gravel operations. Thus a multiplier for a subsector, which in this case is placer mining, is likely

to be somewhat different than the sector as a whole. Even so, these values do show that placer mining has a snow balling effect on the state's economy, far greater than its direct impact. The effect on communities within the state is difficult to determine using input/output analysis. However, the survey results discussed above do give indications of the direct economic impact on Fairbanks, Anchorage, and other communities in Alaska, and you could probably apply the same ratios to the indirect impacts. For example, Fairbanks would be expected to receive about 39% of the overall economic benefits from placer mining, which is thought to be about $240 million a year.

TIN MINING IN MALAYSIA

Del Ackles
President, Circle Mining District

There were two main objectives for making this particular trip to Malaysia. One was for enjoyment and the other was to find a source of better recovery machines which would use less water. We researched several of the different types of jigs and other methods of recovery.

Our trip was arranged through the MTE and ICH people who build, and have been building dredges for the last 100 years, especially for South East Asia. Their jigs are very well known, and they have many years of technology behind them. The area we went to is on the Malai Peninsula. We covered two or three areas there. To give you a reference, Singapore sits right on the corner of the peninsula. We went to Singapore first, and spent a couple of days. From Singapore, we continued up into Malaysia, to the border of Thailand. We stopped first at Penang, and then stopped at Hatchai, which is on the border, and from there we went into Thailand to the town of Pukette. Currently, the area around Pukette has many world class dredges working large off shore deposits. We were invited for a short four hour visit on one of the dredges. We had a lot of cooperation and were permitted to examine most of their recovery systems. From there we made arrangements through the Belaton people, who had some of the contracts for the Thai government, to examine an on shore plant where the product is upgraded.

They have achieved a very high recovery rate on a mineral with specific gravity of 7. Their recovery rate potential on the dredges themselves can be as high as 96%, but because of security reasons and thievery they only upgrade to 30%. The concentrate is upgraded on shore, where it can be monitored by tighter security. The final step is at the refinery which is operated by the Thai Government.

Now to give you a breakdown on what one of these jigs looked like. The largest is 25 feet in diameter. On their dredges they were processing 1/2 inch minus material across these jigs which could handle up to 550 cubic yards an hour. They were using a series of jigs for concentration - first the roughing jigs for separating the main product from the oversize, then recycling. Both the tails and the middlings from the jigs were circulated back through the system again.

The jigs are fairly simple in operation and theory. There is a hutch area that has screen bedding in it. On top of the screen material is a shot material, and on this particular dredge, and in these jigs, they use rough cassiterite for their shot, about two inches long by about an inch in diameter. This worked better than round jigging material. As water is directed across the cell, a rubber skirt or band near the bottom allows the bottom of the jig cell to move up and down, causing a suction or drawing effect which actually pulls the material down through the cassiterite bedding. The coarser material remains on top of the bedding, depending upon the screen size, and the finer material is recovered when it passes through the screen into the cell beneath the bedding.

The pulsation stroke on this particular type of jig has product versatility because it is adjustable. They feature a cycle adjustment, plus a throw adjustment, and it is possible to increase and decrease the relationship or ratio between the upstroke and downstroke, which is critical. Jigs such as the Pan Ams and others we looked at were mechanical and all pulsation features were set. A lot of the downstroking or drawing effect across the jig table, and the upstroke, when the water was pushed back through the table, were the same. We found this to be inferior.

They manufacture the jigs in various forms and configurations. Capacities for the different sizes range from 7.5 to 500 cubic yards per hour. These yardages are based on 1 inch minus material.

The operating cost on these jigs including maintenance is extremely low. One of the larger units has an operating cost of about $1.30 to $1.35 an hour, which is fairly inexpensive considering the job that they do. Furthermore, they operate from year to year with very little maintenance problems, an occasional seal or something of that nature but otherwise they are maintenance free.

Because of their sharper upstroke, slower downstroke and stroke adjustability, these jigs have an advantage over certain other jig types. The type of minerals that are being processed might give problems which can be corrected if the sensitivity ranges are available.

Tests run on cassiterite, which has a specific gravity of about 7 compared to gold with a specific gravity of approximately 17, suggests a high level of recovery. They ran a known amount of cassiterite of different sizes along with measured amounts of gravel material in order to determine recovery potential. Their spectrum ran from 300 mesh on the lower end up to a coarseness of about 35 mesh. This was a very fine cross section and because most Alaskan placer miners are dealing with fine gold, in a standard sluice box, they start suffering recovery losses after about 40 mesh. These tests showed that from a known cassiterite input a recovery of 96.21% can be obtained. Furthermore, if these high recovery percentages can be achieved on something which has a specific gravity of 7, it is clear how efficiently these jigs would process gold.

In addition to cassiterite, these jigs have also been used on gold. Several of them are operating in Russia and China. They have also been designed for use on diamonds, which have a specific gravity of about 3.5. The jigs have been very efficient in recovering even the smaller pieces ranging from 35 mesh through coarser material of 16 mesh. They were running a 92% recovery rate on diamonds and a 94.6% recovery on gold from 300 mesh up to about 75 to 80 mesh.

Now, how to produce a machine that would apply to our industry without requiring that we purchase a large dredge. They do have an on shore plant which has been used successfully. It has a lot of faults, so we were contacted about possibly trying to improve the design. This plant, which is a dry land plant, is simply a unit that was taken off a floating dredge. They removed the bucket ladder chain going to the feed system and installed a hopper which was very inadequate. It limits the mine operator to the type equipment needed to feed the system, which is a bad feature on most of the recovery type equipment we have available on the market today. The versatility has to be there so that the operation is not limited to a loader, drag line or backhoe. As you know, if a piece of equipment broke down the entire operation shut down because the dozer could not feed the plant.

The larger models are close to 500 yard capacity plants which are too large for the average mine here in Alaska. Consequently, we have attempted to design something that will range between 200 and 300 yards per hour. The plant will have a base work of ten feet. A trommel will sit on top of the 10 foot portion. We have also incorporated a staking conveyor off the trailings chute. Also we are planning a Texas type track feeder, of 20 to 50 feet in length that will have adjustable tilt for the feed. With these additions, on the smaller unit, I think we will have a very efficient, very versatile type washing plant that can be moved easily, broken down and trucked without being overweight or oversized, and will have a very high recovery rate.

Now, let me explain how these dredges actually operate offshore. For the people who do not understand how a dredge is anchored, they generally use a spud shaft system for anchoring which permits movement and the preciseness necessary for a thorough cleanup of bedrock. Being in the ocean they have problems with not only the tides, but the waves. They have designed a unique anchoring system which permits them to move the dredge forward by increasing and decreasing the tension on the anchor lines. By using this anchor system they are able to position the dredge quite precisely. In addition, they use lasers on shore to make certain that their cuts are kept very precise. This allows them to move about 50 meters ahead before the anchors have to be reset again. There is down time while resetting the anchors, but basically it is a very efficient way of anchoring something this large in a sea that is continuously moving.

The jig plant on the dredge had a delivered cost of $800,000.00, which for its size and capacity was not expensive. One thing that should be pointed out is that the system had three different jigs on it, a main roughing jig, a secondary jig mounted above for additional concentration, and a tertiary jig for final concentration. It was a very well set up piece of equipment for the cost.

The dredge we visited was the Watina which has been operating at half capacity because of problems. Basically, what they were trying to do is just like any miner in Alaska, get through the season without any big expenses so they could make repairs. But even though they were operating at half capacity, they were doing very well. The main separation of the water, since this is a suction dredge, is through a large cyclone, then ejected straight out the bottom of the dredge in back. This was done for two reasons. The flow ejected under the water keeps all of this tailing buildup moved in behind the dredge so it would not come back onto the dredge itself. One thing pointed out to us concerning recovery was that it was important to use clean water. In Alaska this is something which has been a sore spot as far as recycling is concerned but we have to remember, even if the jigs do require clean water the type of apparatus we are trying to build only requires about 270 to 300 gallons a minute for a 250 yard per hour recovery, which is quite high. At the back of the dredge are the spud shafts, which are two big poles used to anchor the dredges. During our visit they were not using the spuds but a series of anchors called the "christmas tree" to stabilize and direct the dredge.

The control room is nothing but a control house from a boat, which they have modified and installed on this dredge. They are not very sophisticated in their methods of digging this material out. In the control room the operator sits and looks at meters. When he has a certain amperage load on the cutter head he knows it is cutting, and then the depth is controlled by a fellow standing on the back looking into the trommel who yells when he hits bedrock. I am glad to see that their technology is on par with ours.

The engine room was basically antiquated in a lot of ways. They had set this particular dredge up with two engines, one as a spare in case something went wrong. The engines are old Hitachi engines, about 3,000 horse power. These engines directly turn the pump shafts, and also supplyed power to the forward end of the cutter head. Another engine supplied the electrical power required on the dredge for the motors, jigs and various other electrical equipment. This had a 400 kilowat capacity. Also they had one spare generator and one spare main drive mechanism. The main hydraulic pressure supplied to all the jigs comes from one distribution center. There is a cam inside which turns around and distributes the pressure through the system. Their main hydraulic pump is a big double shell model.

The components that lead to the digging end consists of a suction tube 40 inches in diameter, a shaft driven by the gear boxes which turns the cutter head. Because they were at reduced production the cutter head was only turning 12 RPM, but normally it turns between 30 to 35 RPM. The cutter head itself is pretty substantial. They went to the trouble of lifting the assembly out of the water for us. This took about an hour to cycle up and back down. The cutter head is attached to a ring, and the head is pointing forward. It is about six feet in diameter

and about five feet across. The material they are working is so soft that these cutter heads will last for about three to five months without having to be replaced. The maintenance on the cutter heads is basically just hard surfacing.

From the suction tube the product is directed into the trommels which were driven by hydraulic motor packages. They were quite simple in design. There were no chains, cables, or anything else. It was more of a dead weight system drive.

The bedrock coming into the trommels is very soft. Large chunks can be broken apart like clay. In some of this, seashells were visible in the sediment layer. Also, one can actually see the cassiterite in some of these pieces. The way the operator tells that he is in bedrock is by the coloration change. Bedrock to me is something that is a little more firm or hard. However, the muck layer above bedrock here is basically a decomposed organic and is black. Once they get through this and see the lighter material coming through they know that they are deep enough. The tin does not seem to penetrate much more than a meter of the bedrock.

The trommeled material enters a distribution center beneath the trommel, then pumped to the different bays where the jigs are set up.

They had six of the twenty four foot jigs which we examined. They had done some modifications by adding little barriers on the racks themselves to retain the material a little longer. They felt this improved their recovery. Water requirements on these units are about 760 gallons per minute, which considering they are processing 550 yards per hour of half inch minus, is a very respectable conservation of water.

At the jig bottom are the cells and hydraulic packages which pulse at different times. The pulse on these is set at about 3/4 of an inch stroke, and they were running them at a reduced rate because of the reduced production, so they were running them right around forty cycles per minute. Again, the upstroke was the more rapid force and the downstroke the slower force. The advantage these jigs have is that because they are run by hydraulics, they can be adjusted.

The tailings are recycled and also the middlings which come off are pumped upstairs to a half cell jig. These half cell jigs are the larger jigs simply cut in half. The concentrated product will go to these particular jigs. The tailings which come off will be pumped straight out through the side, and the middlings will then be pumped back downstairs to a mechanical jig. Out of this jig they obtained their 30% upgrading. The tin product is very fine in consistency, ranging from about 60 mesh to about 400 mesh. Finally several employees pack the material for shipment to shore. The dredging operations in the area varied from drag line buckets to suction to actual scuba outfits with suction. It was quite a range of different operations.

We were lucky to be permitted a visit to the on shore plant where we could see where the final product was broken down to the purity required by the smelter. They brought the product in by tender ships, and it was pumped ashore in pipelines and put into storage vats. Each vat would have that particular dredge's name on it. They have a little hydraulic elevator that pumps the material to the top, where it is split and directed to the processing plants.

Their processing plants are actually very basic, and I was surprised at the efficiency at which they operate. A 1/8 inch vibrating screen scalps the rough tin off. At the end of the screen is a demagnetizing drum which pulls the magnetite off. They wipe the magnetite from the drum and it falls into a tray. The 30% product coming off the ships is then processed across a home made mechanical jig which can achieve 94% recovery on the first pass. That 94% goes directly to melt.

Five percent of the tailings have ilmenite, monzonite and various other minerals in it. These are directed to a hydraulic classifier. The hydraulic classifier is a standard classifier; basically there are cells that have water circulated through them at different velocities. Each successive cell has one half the water velocity of the previous cell which immediately leaves the heaviest material in the first cell, the next heaviest in the next cell, and so on. Thereby the product is classified by size. They pump this material out of this hydraulic classifier into a separator for dewatering. They pull the water back off and the material goes to a standard type separating table. Off these tables, they will recover another 3^{1}1/2 to 4%.

One thing which was not discussed very much was the amount of gold and silver they recovered. The final product that comes off the tables contain ilmenite, magnetite and monzonite which goes into drier bins. The material is dried then transfered through a gravity classifier to an electrostatic separator. From here the monzonite sand is separated and goes into barrels. This is also very high in autonite and carnotite, which are radioactive ores. They try to keep this separated. The rest of the low grade products, mostly ilmenite, are stacked and stored for later use.

The cassiterite leaves this plant and goes next door to the refinery operated by the Thailand government. We were not permitted a visit but we did see a five and a half ton load of tin on a truck that left the refiner.

At the time of our visit they were contributing about 20% of the world's total tin production from this refiner; now it is down to about 11%.

THE CONCEPT OF DISCOVERY

George Reeves
Consultant

This paper is entitled 'The Concept of Discovery'. The time honored rule of discovery is the prudent man rule, laid down by the Secretary of the Interior in 1894 in the landmark case of Castle vs. Womble. In that case the Secretary said, 'after a careful consideration of the subject, it is my opinion that where minerals have been found, and the evidence is of such a character that a person of ordinary prudence would be justified in the further expenditure of his labor and means, with the reasonable prospect of success in developing a valuable mine, the requirements of the statute have been met.' Now, we have all heard that part of it. Let me quote to you the part that you do not hear very much in the decisions of the Board of Land Appeals. The Secretary continued to say 'to hold otherwise would tend to make of little avail, if not entirely negatory that provision of the law whereby all valuable mineral deposits in lands belonging to the United States are declared to be free and open to exploration and purchase. For if, as soon as minerals are shown to exist at any time during exploration, before the returns have become remunerative, the lands are to be subject to other disposition, few would be found willing to risk time and capital in the attempt to bring to light and make available the mineral wealth which lies concealed in the bowels of the earth, as Congress obviously must have intended the explorers should have proper opportunity to do.'

Discovery is the all important fact on which title to a mining claim depends. Moreover, as the Supreme Court has said, it is the initial fact, the first step in acquiring title to an unpatented mining claim. In the mining laws, Congress has set out a legal system by which a miner can acquire title and eventually a patent to a mining claim on the public lands. The first step in this process is discovery, for the law provides that no location of a mining claim shall be made until the discovery of the vein or lode within the limits of the claim located.

In recent years, however, the Department of the Interior has stopped viewing discovery as the initial fact, or the first step in acquiring title to a mining claim, and now views it as something that can occur only after exhaustive engineering and economic studies have been made. It has stopped viewing discovery as something which can occur as soon as minerals are shown to exist at any time during exploration, and now views discovery as something which can occur only when mining operations are about to commence.

Let me refer you to a decision of the Department of the Interior's Board of Land Appeals entitled United States versus Pittsburgh Pacific Company. In this case, in order to show the existence of a discovery, the claimant was required to show (1) that the requisite water supply could be obtained and delivered at a feasible cost, (2) that the requisite acreage for the anticipated construction could be acquired in a feasible configuration and at a price harmonious with a profitable mining operation, and (3) that financing in the amount of 28 million dollars was available at a feasible interest cost. Claimant was also required to provide additional information regarding labor and environmental costs. It appears that in the case of the labor costs, the claimant was required to describe each operation and detail why the given number of men at a given wage cost was needed. In the case of environmental costs, the claimant was required to establish the environmental protection majors which would be required and the cost of these majors. All of this was required before the Department of the Interior would recognize that the claimant had made a discovery on its claims.

Reading decisions such as Pittsburgh Pacific, and there are others, makes it clear that the Department of the Interior has lost sight of the fact that discovery is but the beginning of the effort to develop a valuable mine. The department seems to be unaware of the fact that the prudent man's expenditure of his labor and means is an investment of risk capital. The Department is judging the prudence of such expenditures by the same standards which the Courts would apply in judging the legality of investments made by trustees acting on behalf of widows and orphans. As the Board of Land Appeals said in the Pittsburgh Pacific case, and I quote 'the Department, of course, is most anxious that it not patent the land, only to have the project fail.' Thus, the prudent man of Castle vs. Womble, whose mining claim is valid, if the evidence shows merely that he has a reasonable prospect of success, has become the super prudent man of Pittsburgh Pacific whose mining claim is valid only if the Department of the Interior determines that his project will not fail.

It seems quite obvious that the law of discovery has taken a wrong turn somewhere, or perhaps several wrong turns. Before we can come to any realistic conclusions about how to get it back on the track, we must find out where it went wrong and why.

It is my view that there are three major problems in the law of discovery, areas in which fundamental errors have been allowed to creep into the prudent man rule of Castle vs. Womble. For convenience, I will refer to these problems as the marketability problem, the development problem, and for want of a better term, the Carlile problem.

Before turning to the marketability problem, I should mention one very important aspect of the prudent man rule, which is that the rule contains two separate requirements. The first requirement is that minerals, whether in a vein or lode or in a placer deposit, must be found within the limits of the claim. The second requirement is that the evidence must be of such character that a person of ordinary prudence would be justified in further expenditure of his labor and means with the reasonable prospect of success in developing a valuable mine. It is the first requirement that minerals be found within the limits of the claim that gave birth to what is now called the marketability rule.

Shortly after the enactment of the general mining law of 1872, the Commissioner of the General Land Office

was called upon to determine whether substances such as borax, sulfur, alum and asphalt were minerals subject to location and patent. He concluded that whatever is recognized as a mineral by the standard authorities on the subject comes within the purview of the mining laws. The metallic minerals in certain crystalline nonmetallic minerals came well within the scope of the recognized by standard authorities test. For substances lacking a definite composition or a crystalline structure or both, there were developed two additional tests. The first was whether the substance was classified as a mineral product in trade or commerce. The second was whether the substance has a special or peculiar value in trade, commerce, manufacture, science, or the arts. This latter test focuses directly upon the commercial value of the substance to the user. The value to the user, and hence the classification of the substance, as a locatable mineral was measured by the user's desire to purchase the substance, or, looking at the matter from the standpoint of the seller, by the merchantability or salability, marketability, if you will, of the substance. In a number of decisions, the Secretary of the Interior held that the fact that material extracted from the mining claim had actually been marketed was indicative of the mineral character of the land.

These decisions applied to what I called the affirmative aspect of market ability, which is the concept of marketability, whether or not it had a profit. The marketability of a particular substance is sufficient to establish that it is a mineral subject to location under the mining laws. And if in addition to showing the salability of the substance, the miner can also show that it has been sold at a profit, then he has established not only that the substance is a mineral subject to location under the mining laws, but also that he has made a valid discovery, for by showing that he has sold the mineral at a profit, he shows not merely that he has the reasonable prospect of success in developing a valuable mine, but rather that he has a valuable mine in hand. Thus, market ability at a profit is sufficient to establish the existence of a valid mining claim. But, and this is very important, market ability at a profit, although sufficient, was not always necessary to establish the existence of a valid mining claim. As late as 1944, the Department of the Interior recognized that if marketability at a profit could not be shown, the validity of the claim could still be established by application of the prudent man rule. In 1958, however, the Secretary of the Interior made present marketability at a profit necessary to establish the validity of a mining claim for non-metaliferous minerals of widespread occurrence. After this the marketability rule quickly became the overriding standard of discovery in the case of claims located for such minerals.

Let me give you an example of how, through the wooden logic of the Department of the Interior, the marketability rule is being carried to its ultimate conclusion. In a case involving lime bearing materials, the Bureau of Land Management held, and I am quoting, 'the mineral materials exposed when the mining claim and issue have had no present market at any time because there has never been a processing plant available, and in the absence of such a plant, the mineral materials on the claims have no commercial value.'

Since direct shipping ore is virtually unknown today, this decision would apply to deposits of metallic minerals, such as lead, copper or zinc, and make the construction of a mill a prerequisite to the valid location of a mining claim.

I submit that any interpretation of the mining laws which requires the prospector to build his mill before he can make a discovery, before he takes that first step toward acquiring title to an unpatented mining claim has certainly placed the cart far, far in front of the horse.

Let us turn now to the second problem, which I referred to as the development problem.

The early Court, in administrative decisions, was virtually unanimous in agreeing that a considerable amount of exploration might take place after discovery. And that indeed, the security of tenure guaranteed by recognizing discovery at an early date was essential to enable the locater to continue his exploration without fear that the land would be claimed by another or disposed of by the United States. In Castle vs. Womble, for example, the Secretary recognized that a discovery could be made at anytime during exploration before the returns become remunerative.

In one early court case, one of the expert witnesses testified that, in his opinion, there could be no discovery of a vein or lode unless the formation contained gold and silver in sufficient quantities to pay for mining, milling, smelting, and transportation, and the property was developed by means of tunnel shafts or other workings to the point where it would pay such expenses. The Court rejected the theory advanced by the witness and held that it was sufficient if the mineral discovered was sufficient to justify the locaters in expending their time and money in prospecting and developing the ground located.

The same view was expressed in an Alaska case where a discovery was held to exist where the facts were sufficient to justify the expenditure of money for the purpose of exploration, with a reasonable expectation that when developed, the claims would be found valuable as placer claims.

Cases such as these make it clear that a discovery may exist if further exploration is necessary to determine whether actual mining operations are ultimately justified. The fact that actual mining operations may not yet be justified does not necessarily negate the possibility that exploration itself may be justified by the existence of a reasonable prospect of success in ultimately developing a valuable mine.

Nevertheless, the Department of the Interior in the line of cases commencing in 1961 with the United States vs. Altman, has held that mineralization which only warrants further exploration does not satisfy the prudent man rule, that to satisfy the prudent man rule, valuable minerals must be exposed in sufficient quantities to justify development of the claim through actual mining operations.

In other words, the miner must be ready to commence actual mining operations before he can take the first step, discovery, for the acquisition of an unpatented

mining claim. In my opinion, this interpretation is a product of a basic misunderstanding of both the history and the purpose of the mining laws.

The final problem area, and, in my opinion, the most important one, is what I refer to as the Carlile problem.

In the United States vs. Carlile, the Secretary of the Interior held that the same amount of mineralization required to support the issuance of a mineral patent is also required to support a valid location. As a result, if the showing of mineralization is insufficient to support the issuance of a patent, not only will the patent application be rejected, but, in addition, the claim will be declared invalid.

In order to understand how this interpretation could arise, it is necessary to understand that the amount of mineralization required to establish the existence of a discovery on one hand, and that required to establish the mineral character of land on the other, do not stand in the same relative positions today that they occupied in 1872.

In the years immediately following the enactment of the General Mining Law of 1872, discovery meant merely the physical act of finding a vein or lode or mineral in the ground in question. Commercial value, either in quantity or quality, was not required. Mineral character of the land, on the other hand, could be shown only by showing the existence of known mines or paying mines. To obtain a mineral patent, a claimant was required to show not merely that he had made a discovery, but in addition, that the land was mineral in character. Today, however, the situation is reversed. The mineral character of land can be established by its geological inference. It is not even necessary that minerals be found in the land. To obtain a mineral patent it is no longer sufficient for the claimant to show that the land is mineral in character, but rather, he must show in addition the existence of a discovery.

Since the existence of a valid mining claim is based upon a showing of discovery, not a showing of mineral character, it was at an early date recognized that the showing required to establish the existence of a valid mining claim was not as great as that required to establish the claimant's right to a patent.

The distinction between the showing required for a valid location, and that required for a patent was recognized by the United States Supreme Court in one of a series of administrative and judicial decisions usually referred to as the Clipper cases. History and outcome of the Clipper cases may be briefly summarized as follows. The placer claimant filed an application for mineral patent to a placer mining claim. This application was rejected on the ground that the land was not distinctly valuable for placer mining, and that the same had not been improved as required by law. Subsequently, the Clipper Mining Company filed an application for a mineral patent to certain lode claims, which conflicted with the placer claim. The placer claimant filed an adverse claim and instituted an adverse suit. Clipper contended that the decision rejecting the patent claimant's application for patent was a complete and final adjudication that the ground was not placer ground. The case finally made its way to the United States Supreme Court, which said that although the department had rejected the application for patent, it did not thereby declare the claim invalid.

The rule of the Clipper Cases was recognized in a number of subsequent decisions of the Secretary of the Interior, and as recently as 1959, the Secretary rejected patent applications without invalidating the claims. In one such case the Secretary said, and I quote, 'denial of the patent application that should be emphasized again does not constitute a ruling that the claims are null and void.' The applicant's rights in the claims remain as they were before the application for patent was filed, and as they would be if no application for patent had ever been filed.

In 1960, however, the very next year, in United States vs. Carlile, the Secretary reviewed the entire history of the Clipper Cases, and after recognizing that until discovery a mining claimant has no rights against the United States, concluded that a claimant cannot rely upon lesser discovery to sustain the validity of his claim than is necessary to entitle him to patent.

The fundamental error in Carlile is the Secretary's failure to recognize that in the Clipper Cases, the rejection of the patent application was not based upon the lack of discovery, but on the failure of the applicant to establish the mineral character of the land, as was then required. The Secretary's error, no doubt, resulted from his failure to realize that at the time of the Clipper Cases, a greater showing of mineralization was required to establish the mineral character of land and was required to establish the existence of a discovery. The Secretary's assumption that Clipper was a discovery case, in other words, a location validity case, when it was, in fact, a mineral character case, namely a patent case, assumes the very question in issue, which is whether a discovery, and hence a valid mining claim, can exist even though the ground is not shown to contain sufficient mineral to support the issuance of a patent. The Supreme Court decision in Clipper clearly says that it can.

The reason that Carlile is so important is that now, every time an adjudicator within the Department of the Interior undertakes to determine whether a mining claim is valid, he knows that he will also be determining whether a patent can be issued for that claim. Every decision regarding the validity of a mining claim automatically becomes a decision on the patent ability of the claim. Now, this is how the law of discovery got to where it is. What can be done about it? I would like to refer to correcting the law of discovery, and when I talk about correcting the law of discovery, I think we have to get back on the track on three different areas, and they are the three areas that I mentioned. I think we have to get back to the point where marketability determines the locatability of a mineral and not whether or not you have a valid mining claim, and as for the question of development, I think we have to get back to the point where a discovery can occur during exploration, and you do not have to be ready to go immediately into development. And most importantly, under Carlile, I think we have to get back to the point where it is recognized that, in order to have a valid claim, you do

not have to show the same showing that you have to show to get a patent.

As I see it, theoretically there are four ways in which the law of discovery could be corrected. Legislative, by amending the mining laws in Congress; Administrative, by getting the adjudicators within the Department of the Interior, which means ultimately the Board of Land Appeals, to revise their interpretation of the mining law; Judicial, by getting the Courts, which ultimately means the United States Supreme Court, to reinterpret the law of discovery; and finally, Executive, by obtaining within the Department of the Interior a reinterpretation of the law of discovery by means other than a case by case adjudication.

First, let us look at the possibility of getting Congress to amend the mining law. Many opinions have been expressed pro and con on the advisability of amending the mining laws. I tend to side with those who take the Pandora's box position and say that once the mining laws are opened up for amendment, it will be impossible to say what the end result will be, except that it will be quite different from the mining laws we now know. But there is a more fundamental reason, I believe that we should not attempt to correct the law of discovery by Congressional Action, and that is that it is not the statute that has caused the problem but rather the interpretation of the statute by the Department of the Interior in recent years. From 1872 to the mid 1950's there was no problem with the law of discovery. But starting in about 1958, the Department's interpretation of the law of discovery changed drastically. Marketability rule came into full fruitation. The requirement that a mining claimant must be ready to commence mining operations before he could be said to have a discovery was imposed. And the amount of mineralization required for a valid location was made equal to that required for the issuance of a mineral patent, all within the space of about three years. There is where I believe it is necessary to focus our efforts upon changing the administrative interpretation of the law of discovery rather than upon changing the statute itself.

The administrative interpretation of the law of discovery can be changed either directly, by convincing the adjudicators within the department of the Interior, and particularly the Board of Land Appeals that their past interpretations were erroneous. Or, indirectly, either by Judicial decisions which provide the proper interpretation of the law of discovery or by regulation or other executive action within the Department which gives the adjudicators proper guidelines for interpreting the law of discovery.

I hold out little hope for convincing the adjudicators within the department, particularly the Board of Land Appeals that their past decisions have been in error. Nevertheless, I do believe that an attempt to do so must be made at every opportunity. If for no other reason, than to keep constantly before them the proper interpretation of the law of discovery.

Similarly, I see little hope that the courts will provide any relief. The lower federal courts are caught in a vice, the lower jaw of which is the body of administrative interpretation of the law of discovery which exists in the Department of the Interior, fortified by the doctrine that the Department of the Interior has special expertise in land matters, and its decisions are entitled to great weight, and the upper jaw of which is the decision of the United States Supreme Court in United States vs. Coleman, in which the Court approved what he had understood to be the Department's interpretation of the law of discovery. Nevertheless, I believe that proper interpretation of the law of discovery should be urged in the Courts at every opportunity on the off chance that an astute and courageous judge would examine the subject of discovery independently and in some depth rather than accept the Department of the Interior's interpretation of the law.

The most likely means, in my opinion, by which the law of discovery may be corrected is by executive action; either the promulgation of regulations on the subject of discovery, or perhaps the issuance of a solicitor's opinion on the law of discovery, or both.

In considering the possibility of the Secretary's promulgating regulations on discovery, the first question to be raised is whether the Secretary has authority to do so in light of the Supreme Court decision in the Coleman case. In my opinion, there is no question but that the Secretary has the authority to issue such regulations. It is important to note that in Coleman, the Supreme Court did not undertake to make an independent interpretation of the law of discovery, but merely approved what it understood to be the Department's interpretation. This is made quite clear in the subsequent decision of the Supreme Court in Andrews vs. Shell Oil Company, where the Courts said that in Coleman it concluded that the marketability rule was 'a permissable interpretation of the law of discovery.' Therefore, it appears that the Supreme Court has left the Secretary of the Interior ample room for other permissable interpretations of the law of discovery. The most expedient method of implementing such an interpretation would be the promulgations of regulations on the subject of discovery.

In May, 1982, several representatives, including myself, of minerals exploration coalition, a Denver based organization comprised primarily of exploration Geologists met with representatives of the Department of the Interior on the subjects of discovery and valid existing rights. I attended a similar meeting in November of 1982 between representatives of the American Mining Congress in the Department of the Interior. As a result of the latter meeting, I drafted a set of proposed regulations on the subject of discovery. In December 27th, 1982, the Department of the Interior published a notice of intent to propose rule making which invited comment on a number of matters, including the definition of discovery.

In February, 1983, minerals exploration coalition submitted the proposed regulations, which I had drafted, to the Department of the Interior. Finally, I would caution you that even if regulations on the subject of discovery are promulgated, in a form favorable to the mining claimant, this does not mean that the adjudicators within the Department of the Interior will not find new ways to misinterpret the law, and to reintroduce the old errors, which we are seeking to eliminate. In the

late 1950's and the early 1960's, the Department of the Interior seems to have encountered little opposition from mining claimants to the drastic changes it was making in its interpretation of the law of discovery. To prevent the same thing from happening again, mining claimants must look upon every mining claim contest proceeding as a potential vehicle for Departmental mischief, and should ever be on the alter to refute any erroneous interpretations in the law of discovery, which the adjudicators would impose upon them.

Someone said it once before, but I believe that it is appropriate in present context to say again, that eternal vigilance is the price of liberty.

A TALE OF TWO MINES

Tom Albanese
Nerco Minerals, Inc.

Over the past year, Nerco Minerals has undertaken an extensive review of precious metal deposits and mines in the United States. This resulted on December first of last year in the signing of a letter of intent between Nerco Minerals and Occidental Petroleum for Nerco Minerals to purchase all the outstanding common stock in Oxy Min, a subsidiary of Occidental Petroleum. This resulted in the acquisition by Nerco Minerals of interests in two mines in Nevada. One of these is a silver mine, the Candelaria Mine, with a 92% effective interest*. The other is a 50% interest in Alligator Ridge, a gold mine in Nevada, which is operated by Amselco, a subsidiary of Selection Trust in London. This culminated, the transaction closed in February 2nd. We brought in a crew to Candelaria. We are starting up the mine production there now. We will have full production before the end of the year.

Candelaria is an old silver camp in Nevada. It was originally discovered and first produced silver in the mid 1800's. It is an exceptionally rich producer, with the same type of silver grade being taken out of Virginia City. Mining pretty much subsided toward the end of the 1800's when the high grade veins near the surface became worked out. Prospecting started up again during the 1970's and Occidental Petroleum became interested in a large scale mining operation on the entire mineralized formation, minus the earlier mined high

Figure 1. Mine plant at Candelaria Mine with Mount Diablo in the background and Lucky Hill in the foreground.

*In October, 1983 Nerco Minerals purchased the outstanding interest to become the 100% owner of the Candelaria mine.

grade. Figure 1 is a general view of the mine plant at the Candelaria mine.

Candelaria is a heap leach operation and since one of the next speakers will discuss the theoretical background of heap leaching, I will stick to the operation process. The total haul from the pit is less than 1/2 mile from the plant. At the plant the ore undergoes primary crushing, secondary crushing and agglomeration. Trucks then load the ore onto leach pads. The pads are each 1,000 by 400 feet in area. Heap leaching and cyanidation take place here. Pregnant solution ponds at the bottom of the heap pads are for drainage and collection of the solution. The pregnant solution is pumped up to a facility building and desorption of the pregnant solution and final recovery of the silver and gold takes place at this point.

Figure 2. Leach pads and pregnant solution ponds.

The deposit is a massive sulfide -- the oxidized cap on a subvolcanic massive sulfide hosted in shales. The Candelaria mine is actually two adjacent pits (Figure 1). Mount Diablo is in the background and Lucky Hill is in the foreground. Originally this was all honeycombed with underground mining, but now the entire mineralized formation is being mined. Mining is done on 20 foot benches and drill holes are spaced. Blast hole spacing is about 14 by 14 feet. Because of the nature of the ore and the microscopic type gold and silver mineralogy, each of these blast holes will be sampled on a day to day basis, with the cutting being assayed. The blasthole assays are then entered into a computer, which tabulates all the information with the existing mine plan for a day-to-day plotting of a bench map which the mining engineers use during mining. This is a novel technique, and Candelaria was one of the first mines in the nation to use it.

Mining takes place with Cat 992 loaders loading into 85 ton Cat trucks. Mining is at a rate of 10,000 tons a day of ore and about 20,000 tons a day of waste. Total mine production per year is about 2 1/2 million tons of ore and over 5 million tons of waste. This material is then run through primary and secondary crushers to about 1.5 inch size.

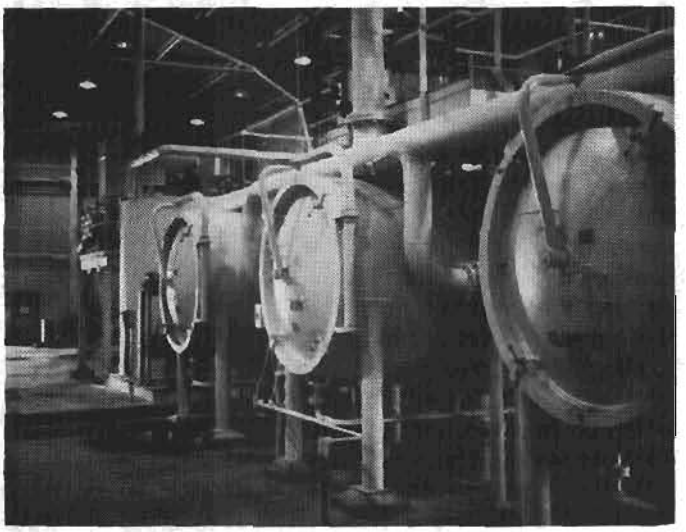

Figure 3. Clarifying tanks.

Candelaria and the Alligator Ridge mines have used agglomeration techniques where all the material will be sprayed with a cyanide solution to allow the fine particles to adhere to the larger size particles. This allows for even permeability and percolation in the pads. The initial cyanide shot also increases the silver and gold recovery. The pads are quite expensive, and production from them is high. By all accounts this mine is one of the largest heap leach operations in the world. After a dilute cyanide solution has been sprayed, the solution will drain through the pads, and drain off an impermeable pad, which will be built underneath the pads themselves. Runoff solution will drain down into pregnant solution ponds (Figure 2). This material then is pumped up to the processing facility. Figure 3 is the processing facility where the solution initially goes through a series of clarifying tanks. At this point zinc powder will be added, using a standard Merrell-Crow zinc desorption technique. The zinc will be absorbed by the cyanide, causing the silver and gold to drop out. The precipitate will then be recovered by filter press (Figure 4). This precipitate will be over 50% silver with some gold.

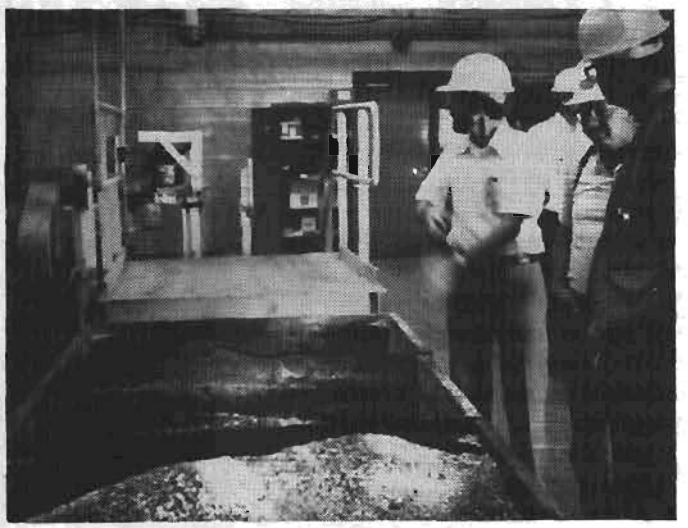

Figure 4. Precipitate.

The furnace is a large propane fired furnace in which the precipitate is melted down on a weekly basis. Just like in placer gold mining, the precipitate is mixed with fluxes which will melt as a dore' button and slag. A Dore' Button is the final product (Figure 5). To give an idea of the size of the Candelaria mine, one of these bars will be produced every two and a half hours, 24 hours a day, seven days a week during full production.

Figure 5. A Dore' Button, the final product.

The Alligator Ridge deposit was discovered by a grubstake prospector in 1975. In 1976 drilling began which started to deliniate some of the ore bodies. In 1977-78, additional drilling was undertaken. In 1979 a feasibility study was undertaken and the decision was made to go ahead with building the mine. Bechtel was contracted for the job, and within 9 months the joint venture was pouring metal. Figure 6 is a view of the leach pads at Alligator Ridge. Mining is at a rate of about 3,000 tons a day of ore and about 12,000 tons per day of waste. About 750,000 tons per year of ore is mined from this deposit. Notice the uniform nature of the leach pads and also the slightly different color. There are different variations of ore and different carbon contents. The pads segregate the different ores so that different cyanide rates, etc. can be accounted for.

Alligator Ridge has lower mining rates than Candelaria, so 35 ton Cat trucks are employed. Alligator Ridge is currently made up of three ore bodies; Vantage I, II and III. Vantage I is nearly mined out, with only about one year left. The geology at Alligator Ridge is generally similar to the Carlin-type ore bodies. Generally oxidized, there are a few places where carbonaceous ores exist. Figure 7 shows the Vantage II ore body. Note that some of the carbon sections are visible in the photo. Since carbon tends to be a preg-robber for cyanide, the

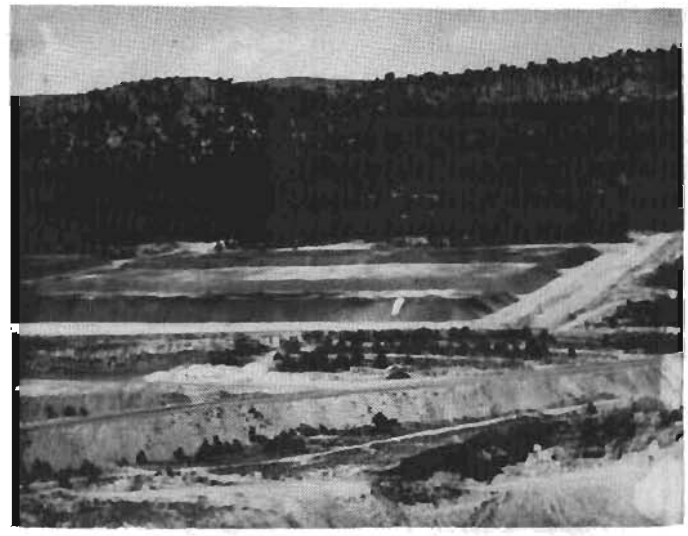

Figure 6. Leach pads at Alligator Ridge.

carbonaceous ores are not amenable to heap leaching so this material is stockpiled for the future. Perhaps someone will soon develop a system to extract the gold from the carbon-rich ores. Figure 8 shows the crushing and agglomerating facilities at Alligator Ridge. It is similar to what they have at Candelaria, except that the mine has a course stock pile draw on the side. The ore material is crushed down to 3/4 inch. This crushed ore is then agglomerated with a very diluted cyanide solution. This has increased the initial gold production from the pads. Figure 9 shows a truck and dozer building a new pad with the crushed, agglomerated material. Figure 10 shows the drain between two of the pads. The solution percolates through the leach pad, runs off an impermeable clay barrier and collects in the drain. The drain collects all the pregnant solution and transfers it to a pond, which is located close to the processing facility. The processing facilities utilize a C-C-D process to separate the gold, which is shipped from the mine as Dore' Bars. Total production at Alligator Ridge is about 60,000 ounces of gold per year.

As a result of this acquisition, Nerco Minerals, which is headquartered in Fairbanks, has the potential capaci-

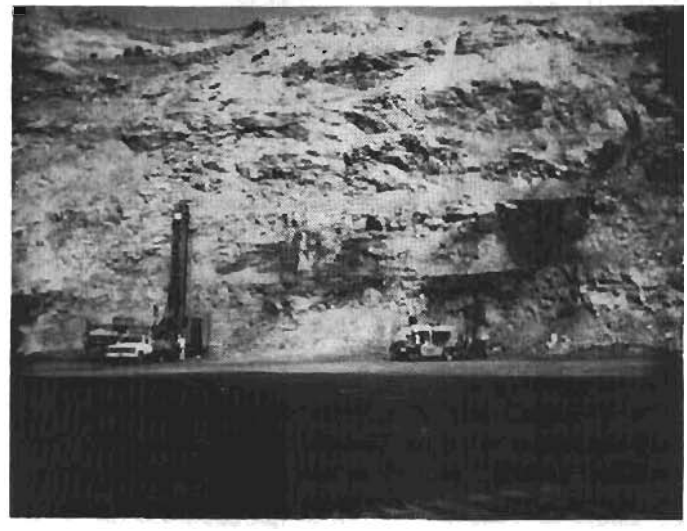

Figure 7. The Vantage II Ore Body.

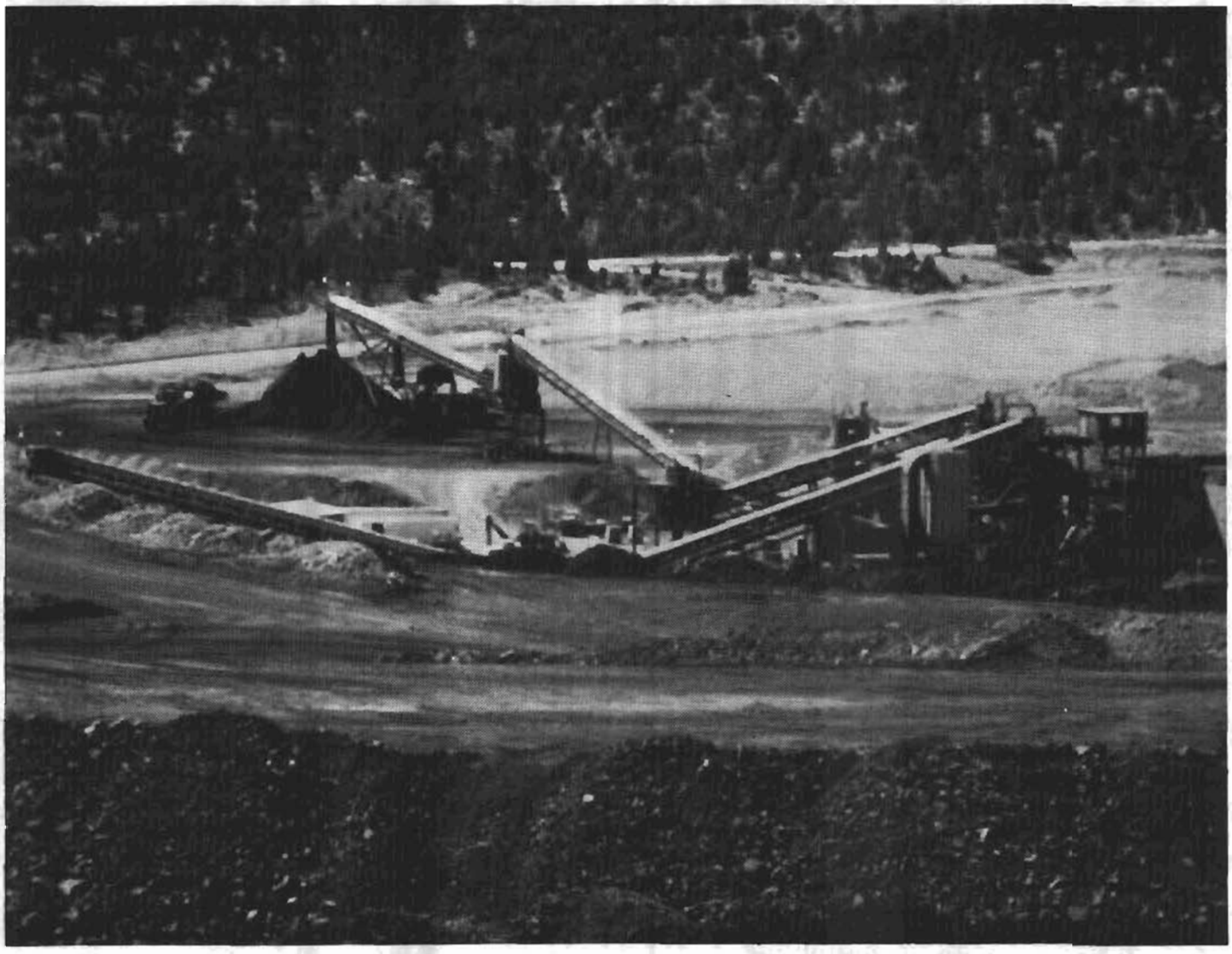

Figure 8. Crushing and Agglomerating Facilities at Alligator Ridge.

Figure 9. Building a new pad at Alligator Ridge.

ty of becoming one of the largest precious metal producers in the United States. That should be of interest to the Alaskan Mining Community particularly the placer mining industry.

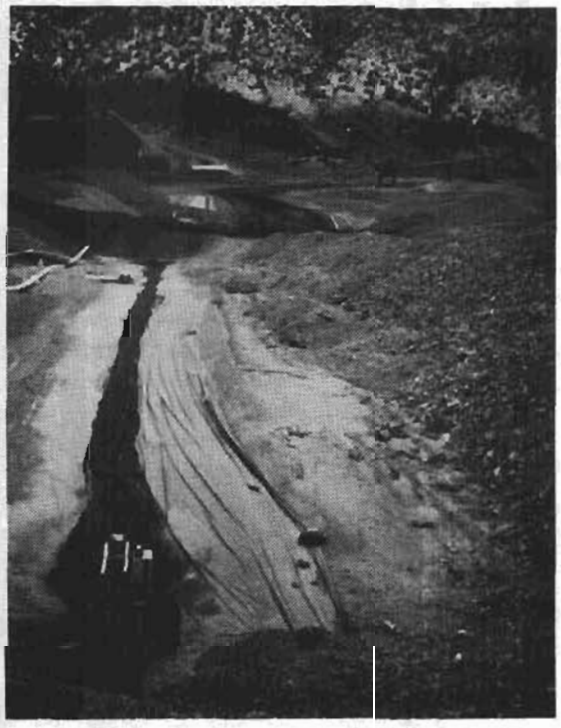

Figure 10. Drain between two pads at Alligator Ridge.

IMPACT OF PERMAFROST ON PLACER MINING

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School of Mineral Engineering, UAF Introduction

Mining in modern days is not as limited by the climatic and geological conditions nor by the depth of the deposits as in past times. The industry has developed economical methods which can be successfully employed in 10,000 ft. deep South African gold mines, in prone to rock bursting and highly gaseous deep coal seams in Western and Central Europe, mining coal under the sea in Scotland, extracting polymetallic ore buried under 2,500 ft. of running sands in Central Europe; and the Polaris project in Canadian far North. Mining placer deposits in permafrost is a similar challenge. Placer operations at the beginning of this century, employing dredges and giants as well as extensive permafrost drift mining, have to be recognized as being up-to-date in technology for their times.

The mining community, through its professional and research organizations, has the ability to design, test and implement modern mining methods which would be economically, technologically and environmentally suitable to mine deposits in permafrost given its climatic and geological restrictions.

With the ever increasing public pressure to protect the unique environment of Alaska, with shallow and rich placer deposits being exhausted, we are facing a challenge to modify our placer mining methods. This is a major effort for all of us in mining, since it can not be handled by individual or small organizations. Most of you who are in this business are trying to modify existing or develop new mining methods, or are coping with problems frequently too large and complex when compared with the available resources and size of your operation.

We need to combine our efforts and organize all parties involved, the Alaska Miners Association, and specifically, its local chapter in Fairbanks, the U.S. Bureau of Mines and the Mining Engineering Department of the University, and work towards the development of safe and efficient mining methods for small operations in placer deposits.

In this paper, I am going to discuss some of the basic properties of the placer deposit material as related to the below freezing point conditions and specifically address the need to develop an underground mining system for the placer deposits in permafrost.

Permafrost has a very special effect on both surface and underground mining of placer deposits. From the technical point of view:

- it changes the mechanical properties of the ground from low cohesion silt and loose gravel to rock-like material,
- it is associated with lower temperatures both underground and especially on the surface during the wintertime,
- it is characterized by lack of water and low air humidity level during the wintertime.

From the technological point of view the above mentioned characteristics require special mining methods. They cause difficulties in stripping and create additional problems related to surface reclamation, ground control, environmental protection, etc.

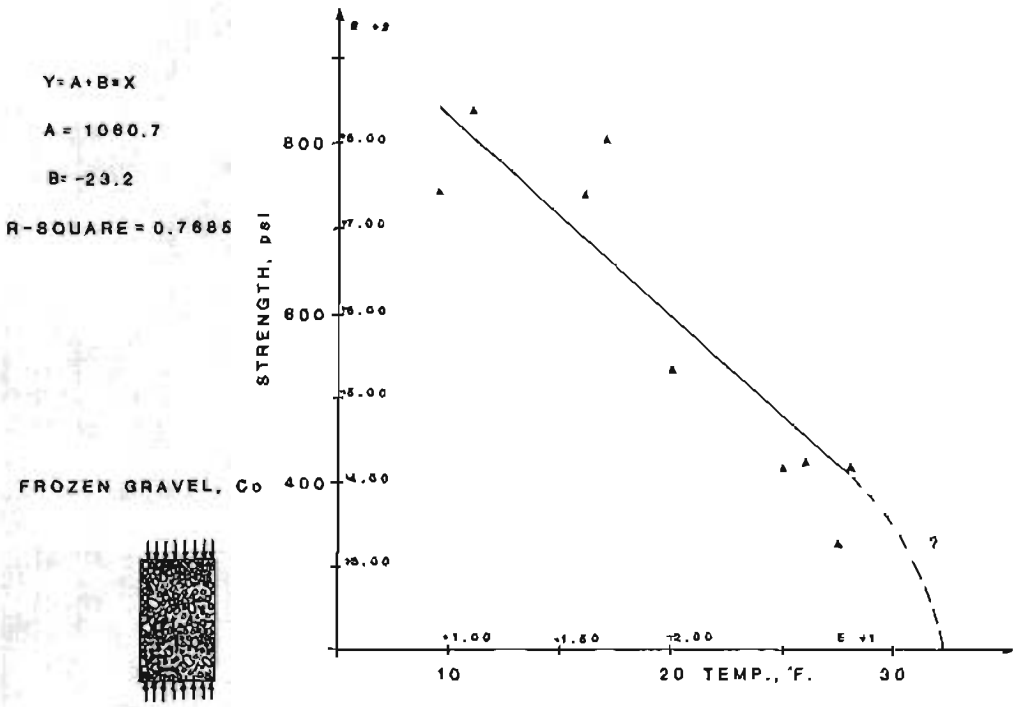

Figure 2. Uniaxial Strength of Frozen Gravel.

- **(Figure 2)** uniaxial strength of frozen gravel (2 in. max. dia. for gravel) varies from about 800 psi at 10°F to about 400 psi at 30°F. It is quite obvious that the strength would drop from about 400 psi to 0 at freezing point showing great influence of temperature on strength at close to freezing point temperatures.

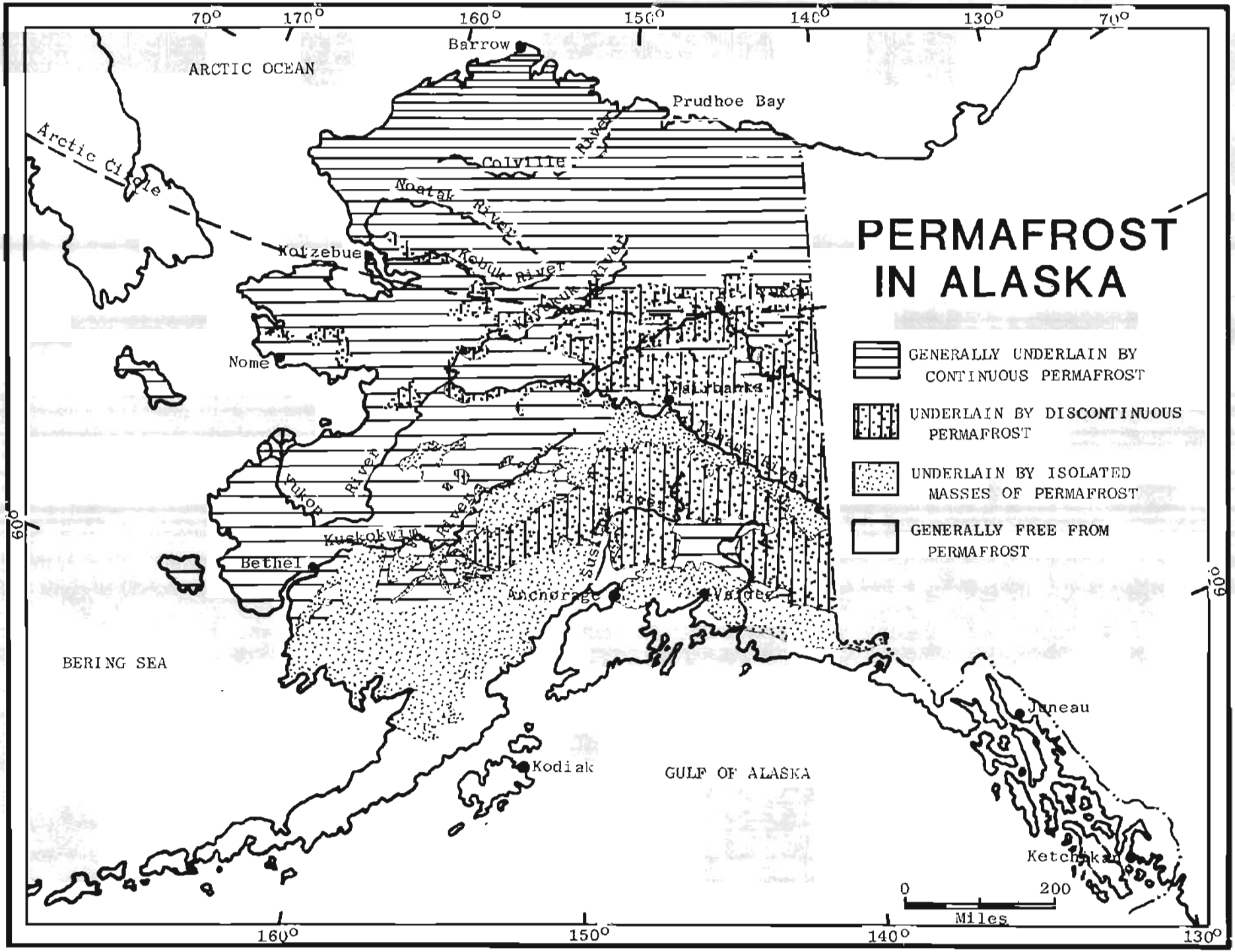

Figure 1. Permafrost Distribution in Alaska.

Permafrost and Its Properties

- **(Figure 1)** shows the permafrost distribution in Alaska. Frozen ground properties are highly controlled by the ground's temperature and ice content. The ice content can vary from above 100% to as little as 10% for saturated sediments and even less for unsaturated ones. The temperature has a pronounced influence on strength and deformation characteristics of permafrost. The following figures[1] show the influence of temperature on

- **(Figure 3)** Young's modulus of frozen gravel. Again the axial deformation of gravel varies largely with temperature, dropping from about 3.2×10^5 psi at 10°F to 1.2×10^5 psi at 28°F and again shows a large temperature influence close to the freezing point.

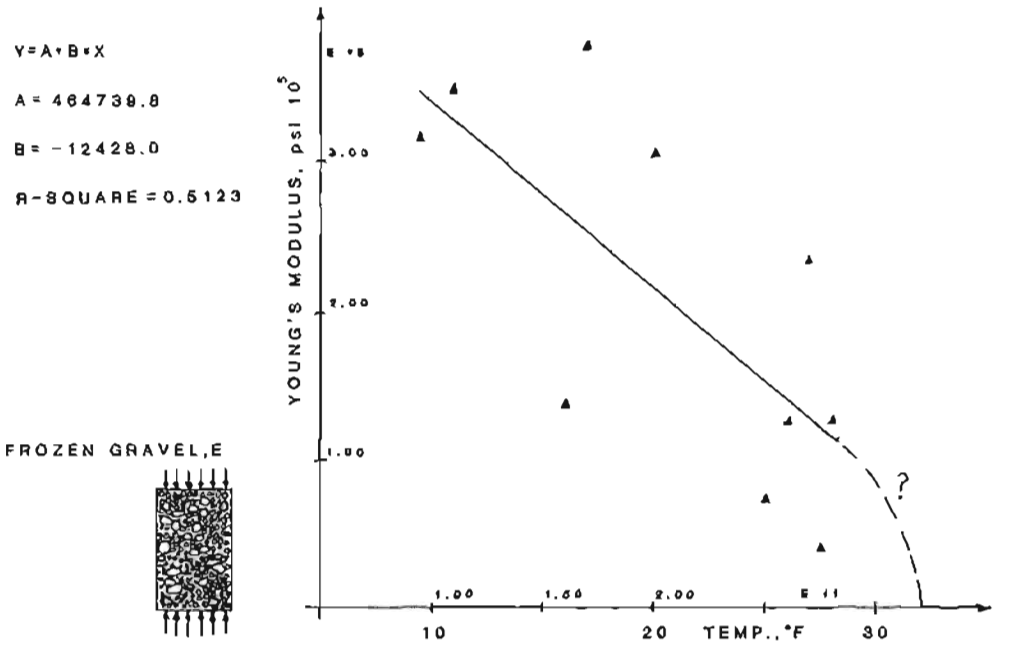

Figure 3. Young's Modulus of Frozen Gravel.

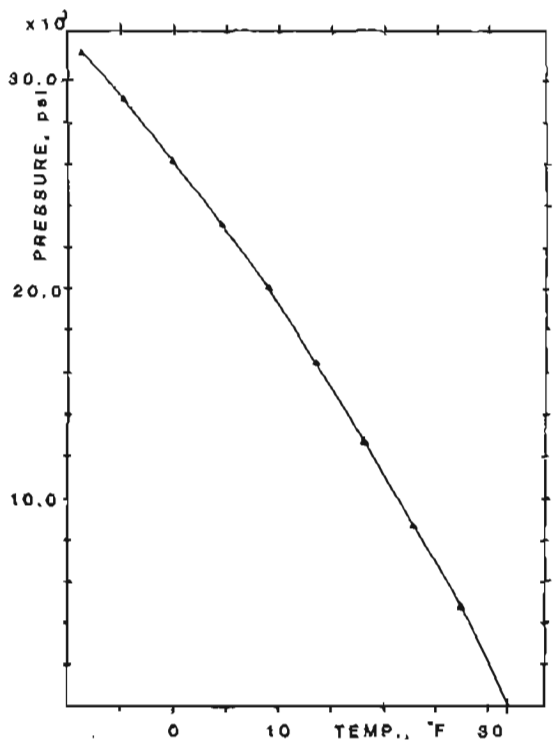

Figure 4. Melting Point of Ice vs. Pressure.

- **(Figure 4)** shows the influence of (hydrostatic) pressure on the melting point temperature of ice. The all-around applied pressure lowers the melting point at the rate of 812 psi per one°F. It is known from tests conducted on frozen soil[2] and other observations that the frozen ground properties are highly time-dependent, and creep and relaxation will greatly influence stability of any opening in such a material. Recently, we made measurements of the convergence between floating points installed by the U.S. Bureau of Mines personnel[3] in 1969 in the CRREL permafrost audit in Fox. Data revealed that the average vertical closure rate is 0.61 in. per year for points installed in winze (stations #10, 18 and 19) and 1.02 in. per year in the gravel chamber having a span of about 20 feet (station #16) as shown in Figure 5. It is quite clear from the brief data presented above that the presence of ice in placer deposit material changes its properties completely. This is a factor which has to be taken into account when developing mining systems for these deposits.

In addition, thermal properties of frozen ground, its specific heat, thermal conductivity and the latent heat of fusion for ice, play an important role in problems related to surface mining and ground thawing in particular, as well as related to ventilation, dust control and stability of openings in an underground operation.

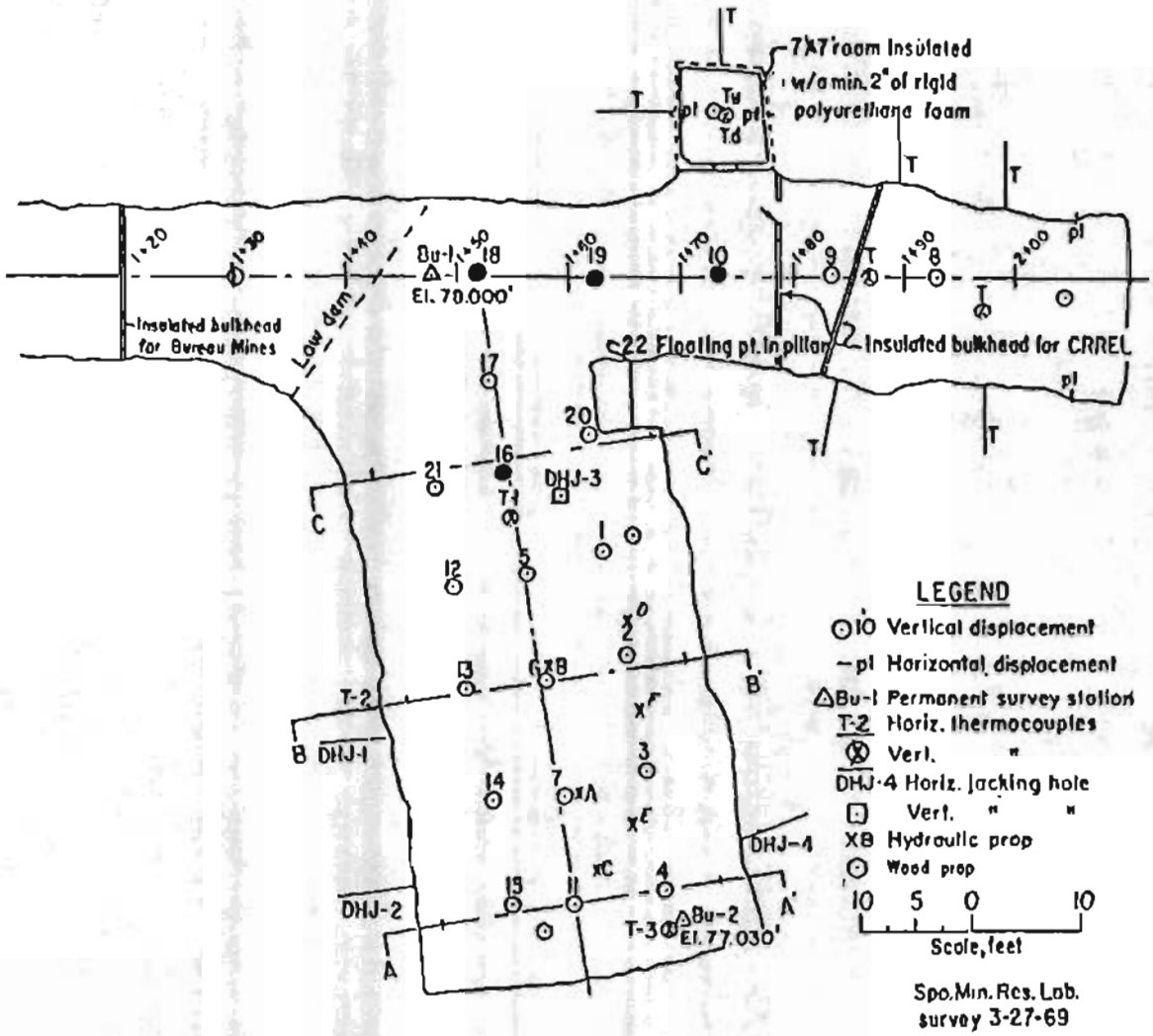

Figure 5. Preliminary Map of the Frozen Gravel Room Area, CRREL Tunnel Site, Fox, Alaska.

Mining Methods for Placer Deposits

The continuity (or lack thereof) of permafrost, the depth, grade and size of the deposit, available equipment and experience, and to some extent, environmental considerations will dictate the overall mining pattern - either it should be a surface operation or perhaps an underground mine could be considered - and the specific mining system employed.

Surface mining methods can be divided, based on the way the overburden is being removed, as follows:

- stripping to allow natural solar thawing of underlying permafrost,
- stripping frozen ground using bulldozers with rippers and/or draglines,
- thawing using hydraulic giants and/or redirecting the creek flow to affect erosion,
- thawing by water circulation through thaw points which are driven or drilled to bedrock.

Underground mining methods have in the past employed

- steam thawing. This method was evaluated by the U.S. Bureau of Mines in the late sixties[4] and found to be the cheapest among the 10 fragmentation subsystems investigated,
- conventional drilling and blasting,
- high pressure water jet cutting. This method was developed originally for coal mines and introduced in the early sixties in Poland and in Soviet Russia. Interest in high pressure water jetting revived in the early seventies with the introduction of improved pumps, flexible hoses and low pressure loss nozzles. Application of this method to permafrost will be discussed later in this paper.
- cold water thawing.

The basis for any mining system is a method of ground breaking. Over the years many methods were devised and tested in permafrost. The best known are thawing (steam and fire), thawing and washing out (low pressure water jets, i.e., - hydraulic giants, hot water) ripping, drilling and blasting by high explosives and cutting with high pressure water jets[5] (above 1,000 psi). Thermal cutting[6] (high frequency electromagnetic radiation), cutting with lasers and other unproven novel

concepts need more testing and development to be considered possible alternatives.

Surface Mining

A major technical problem related to current surface mining of placer deposits is the effective removal of the overburden.

The removal of large volumes of overburden is an area requiring additional research and improvements in technology. One possible solution is a larger scale application of more effective thawing techniques employing a system of borehole drilling, hydrofracturing and water circulation. The hydrofrac technique developed primarily for the petroleum and solution mining industries has proven to be very effective in ground breaking through pumping of water into a section of the borehole isolated by packer seals until failure occurs. As water pressure increases, at some point it will cause a crack to form either vertically or horizontally depending on the field stresses, strength of ground and smoothness of the borehole (Figure 6). If the fracture propagation from the boreholes drilled in a particular area is properly controlled the boreholes can be connected and effective thawing initiated by water circulation.

Underground Mining Method for Placer Deposits

Much discussion, at research and miners initiative, has been devoted to developing an underground mining system for placer deposits in permafrost. Currently, it is being intended for deep deposits in continuous permafrost. It could be also employed for shallower deposits where environmental restrictions may dictate so. In case of discontinuous permafrost, such a system would require additional undertakings including grouting and/or ground refreezing which may prove to be uneconomical.

The basic factors which have to be addressed when designing an underground system are:

- size and shape of production workings (a layout of mining system),
- method of ground breaking,
- roof support and ground (strata) control,
- ventilation,
- haulage (and hoisting),
- water drainage.

I am going to address some of the above mentioned aspects as they are related to the advances in mining technology and to work I have done recently.

Mining System

Longwall and shortwall mining become more and more common for extraction of sedimentary, seam-like deposits. It has many advantages over the traditional room and pillar, stoping and other systems because of its higher extraction ratio, higher rate of production, better roof control, and smaller long term impact on the

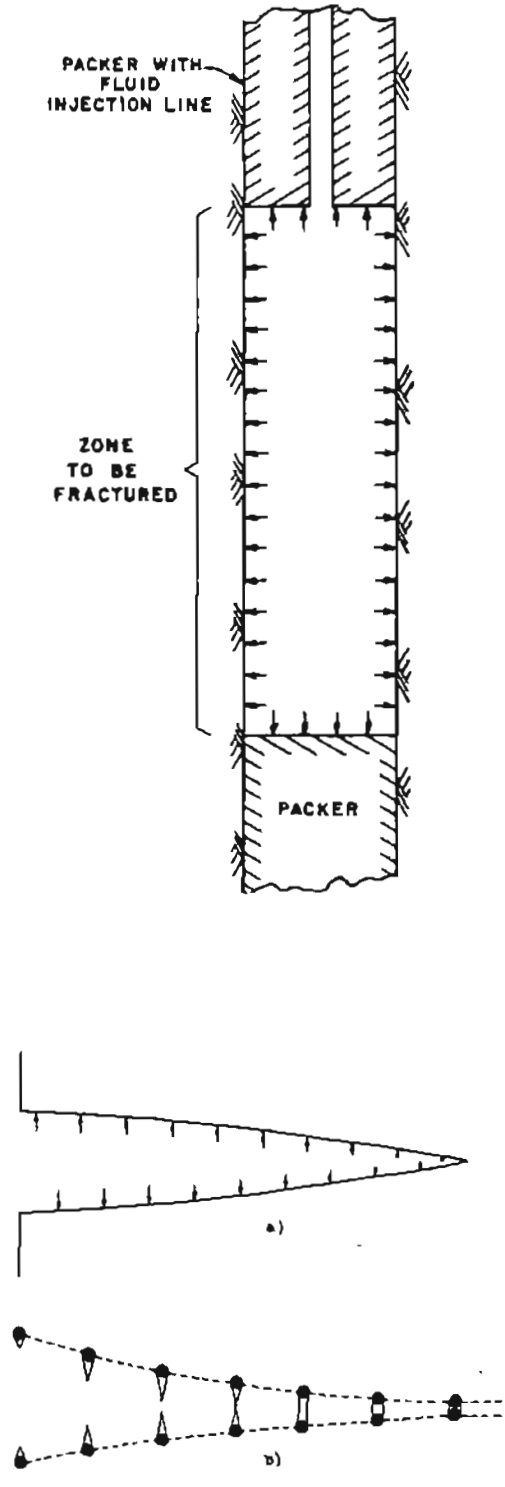

Figure 6. Fracture Propagation from a Smooth and Notched Borehole.

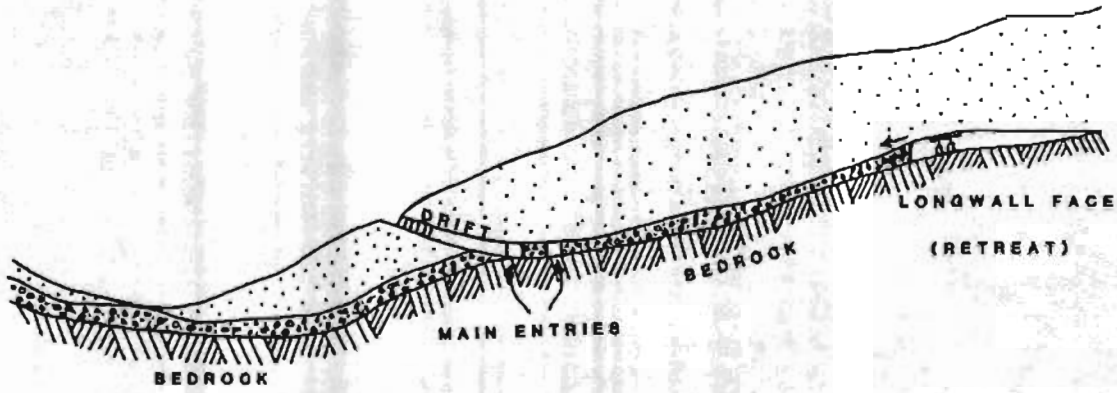

Figure 7. Longwall Mining in a Placer Deposit -- a cross section.

surface. Such a system or modification thereof should be considered for placer deposits, the layout of which is shown in Figures 7 and 8. The length of the face could be from 100 to 300 ft. The width of the face (single cut) could be 6 to 12 ft. depending on the method of ground breaking. The self-advanced frame-type supports placed at some distances along the face would hold up the roof. Each unit, a four-leg chock type with rigid or articulated roof canopies can provide roof support over large areas with a yield capacity of up to 800 tons per unit. With proper roof control and by taking advantage of highly time dependent properties of the frozen silt in the roof it would be possible to lower the roof 20 to 40 ft. behind the support line without actually breaking it. This technique has successfully been used in thin coal seams below thick shale roof. It should minimize any possible damage to the surface.

Ground Breaking

As I mentioned earlier, one of the feasible ground breaking methods for permafrost (frozen gravel) is high pressure water jetting, the method proposed here to cut the permafrost into large blocks to be transported to the surface. Useful penetrations of 6 inches were achieved on laboratory samples in less than one minute at a water pressure of 15,000 psi and flow rate about 6 gal/min. The samples of frozen gravel were tested as shown in Figure 9. The data collected for 0.04 inch diameter nozzle are shown in Figure 10, whereas all the data points for pressures ranging from 3,000 to 15,000 psi in terms of specific energy (water energy needed in in./lb. to remove 1 cubic inch of frozen gravel) are shown in Figure 11. Those data demonstrate that the most effective disintegration, in terms of energy consumption, of frozen gravel can be achieved at pressures around 3,000 psi. The minimum specific energy was (0.1 to 0.15) × 10^5 in lb/in^3 which is about 5 to 20 times less than the energy reported in the early seventies[7]. In general, based on laboratory data, the water jet cutting utilizing multiple pass traversing of continuous jets seems to be an effective method. I understand that a high pressure system has been employed for some time in one of the mines near Fairbanks and found to be a valuable alternative for frozen ground breaking. It should be pointed out, as an advantage of this method, that jetting does not produce much heat and the pump can be driven by an electric motor thus reducing the dissipation of heat underground.

In cooperation with the U.S. Bureau of Mines we are currently working on a small project, within which the efficiency of the cutting of frozen gravel with water jets will be evaluated. A 5,000 psi, 40 gal/min pump is being installed in the CRREL tunnel where the tests will be conducted.

Other Methods of Disintegration

In recent years a variety of tunneling machines has been developed for operation in medium hard rock having an unconfined compressive strength up to 11,200 psi. This is about 10 times higher than strength of the frozen gravel. One of the designs of the boom header, the Alpine Miner AM 50 (Voest Alpine AG, Austria) is mounted on crawler tracks which are individually driven. It can work on inclines up to 30% (16°). The cutter boom can cut any required cross section within limits of up to 13 ft. in height and 16 ft. in width. The minimum height is 5 feet and 5 inches. The cutter head is laced with carbide tipped picks and is driven by 110 kw motor. Selection of the cutter head, picks and speeds is governed by the breaking characteristics of the rock. Gathering arm loading systems feeds a heavy duty conveyor passing through the center of the machine. There are also larger units available from Anderson Strathclyde Limited and other companies.

Ventilation and Heat Balance

The requirement to keep the underground temperature below freezing point imposes severe restrictions on the size of the operation, type of equipment employed and ventilation system. To evaluate the amount of heat underground let us consider the following example: Assume a 1,000 ton per shift output of unthawed, large blocks of frozen gravel cut by water jets or a boom header.

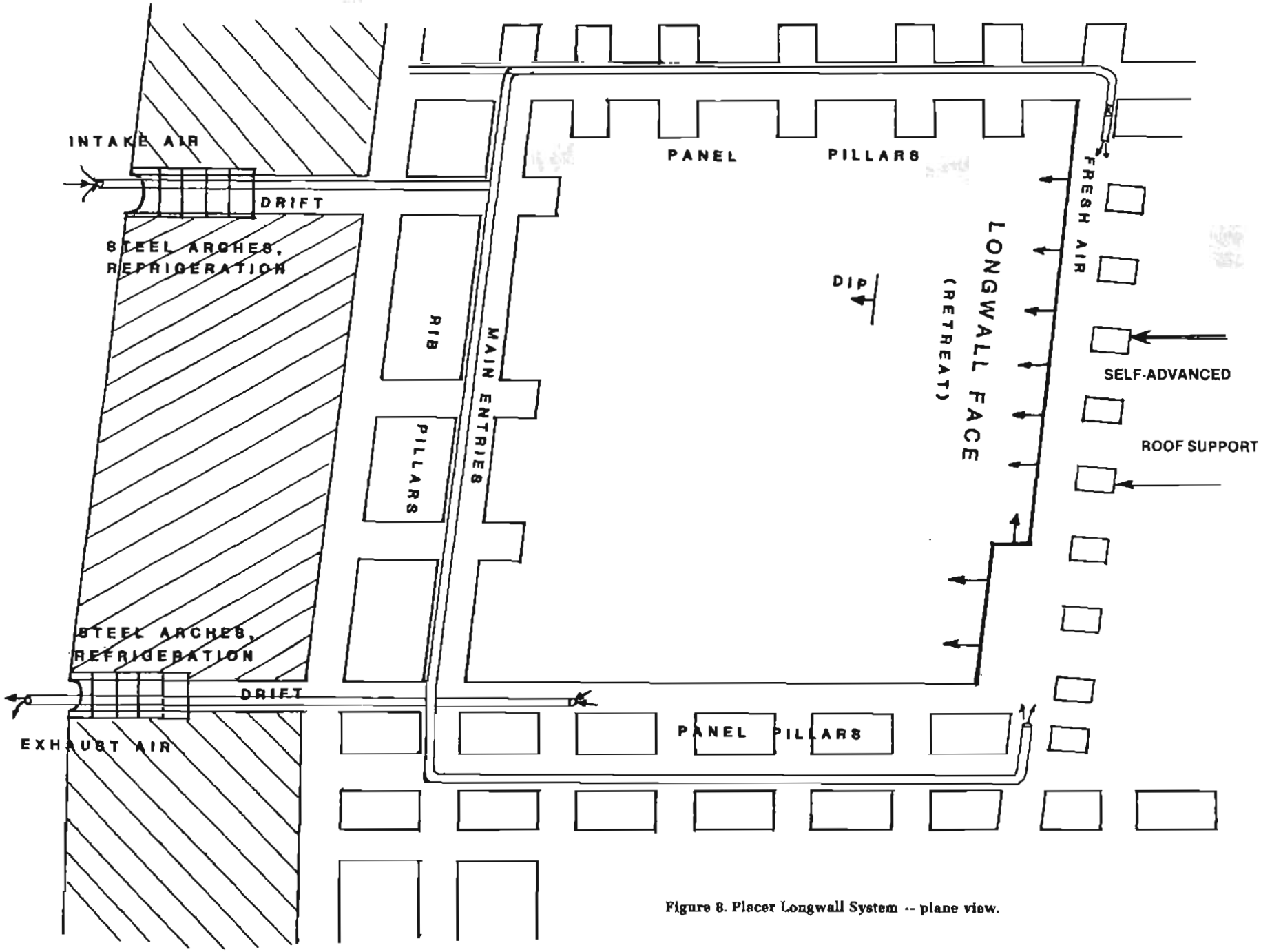

Figure 8. Placer Longwall System -- plane view.

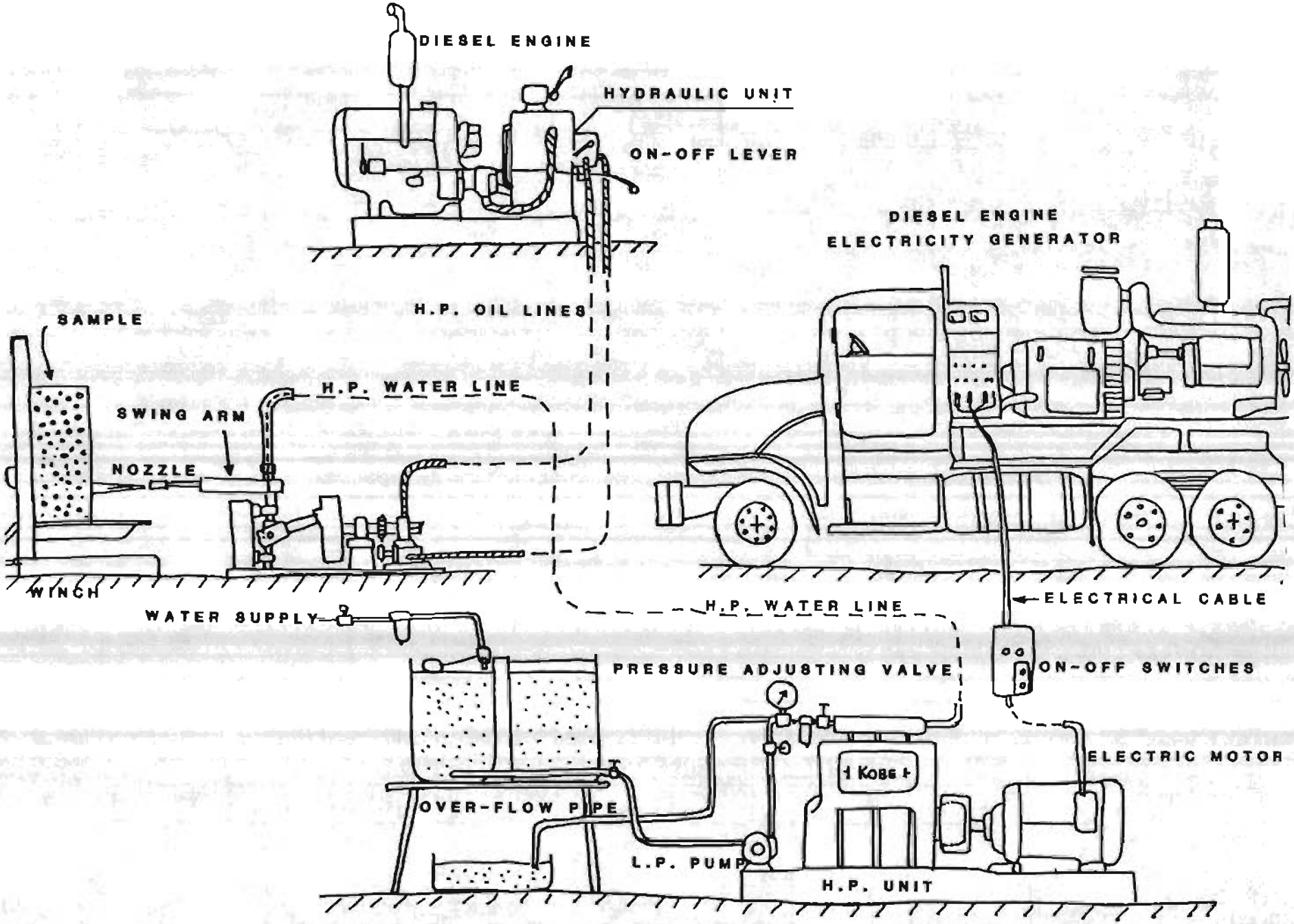

Figure 9. General Layout of Equipment to test the samples of frozen gravel.

Alternative 1:

Equipment underground:

- 200 hp high pressure water jet unit powered by 90% efficient electric motors from remotely generated electricity, all power converted to heat,
- one load-haul-dump 78 hp diesel unit, 40% efficient.

Ventilation requirements:

- 8 men underground, 30 cfm per man,
- 100 cfm per hp of diesel engine.

Temperature:

- average for the outside air 73°F,
- average for permafrost 31°F.

Heat Balance:

- Heat generated by equipment and supplied by air = heating up the permafrost to the melting point + heat for thawing of permafrost.

Assuming average constants for thermal properties of gravel, ice, air, ice content etc., the heat supplied would melt 35% of the assumed output.

Alternative 2: (low efficiency of water jet equipment)
Output: 1000 ton/shift in large blocks

Equipment underground:

- 1000 hp hydraulic unit, pump driven by electric motors,
- one LHD unit as above.

Ventilation - 8 men underground, air requirements as above.
The heat in this case would melt 76% of the assumed output.

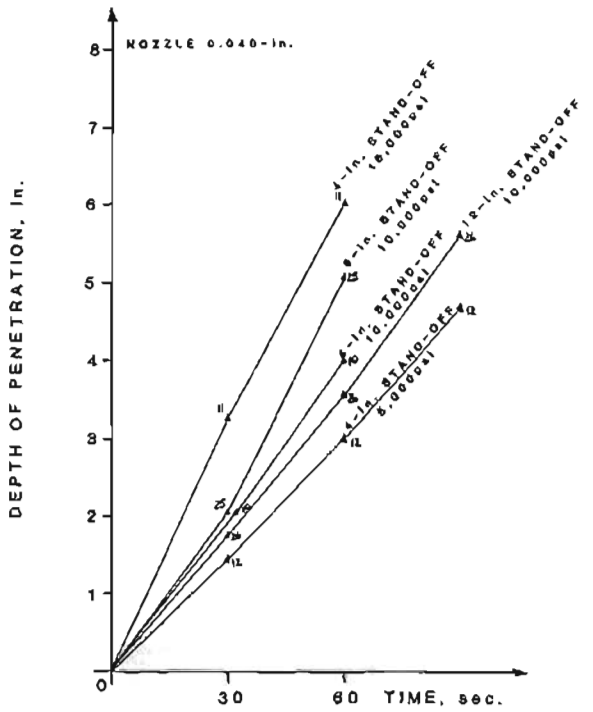

Figure 10. Penetration Depth for 0.04 inch diameter Nozzle at 5,000; 10,000; and 15,000 psi.

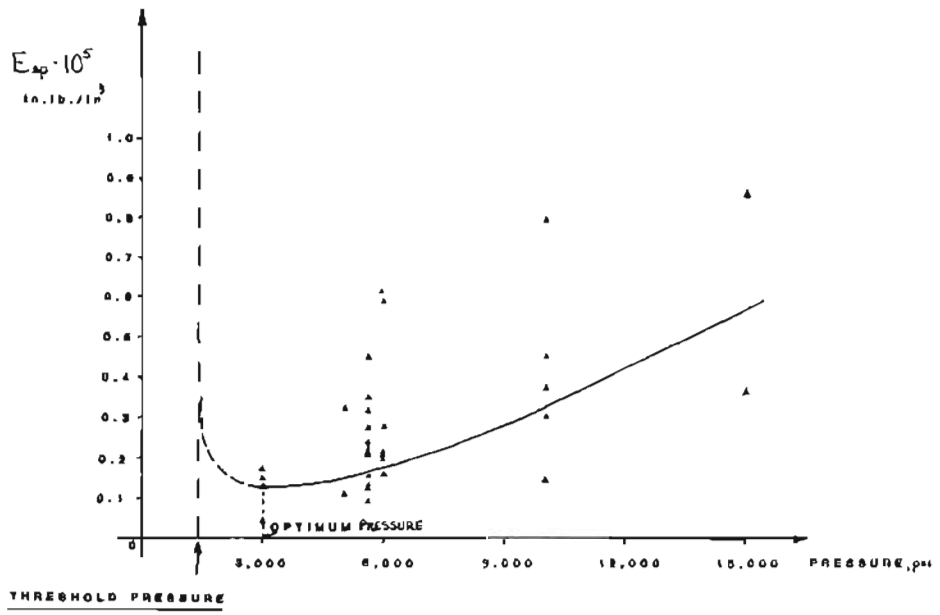

Figure 11. Data Points for pressures ranging from 3,000 to 15,000 psi in terms of specific energy (water energy needed in inch-pounds to remove one cubic inch of frozen gravel).

Alternative 3:
Same output,

Equipment underground as in Alternative 2, driven by diesel engines,

Ventilation requirements:

- 30 cfm per man,
- 150 cfm per hp of diesel engine.

The amount of permafrost melted would be 415% of the assumed output.

The above examples clearly demonstrate that the heat balance for underground mining systems will be a critical factor and such solutions as all electric equipment, air refrigeration and/or shutting down the mine for the summer months would have to be considered. It is obvious that the ventilation system will have to be carefully selected for such conditions.

Final Remark

It seems to be rational to attempt to develop a modern underground system for placer deposits in permafrost. Cooperation, however, of all interested parties, namely the potential operators, the U.S. Bureau of Mines and the University and its Mining Engineering Department is needed to conduct research and semi-technical experiments so the most economical, safe and efficient underground system can be implemented.

REFERENCES

1. Skudrzyk, F.J., Barker, C.R., Mazurkiewicz, M., (1982), *Preliminary Studies of Frozen Gravel Properties Related to Underground Mining*, Report for the Department of Mineral Engineering, University of Alaska, Fairbanks.
2. Haynes, F.D., Karaluis, J.A., Kalafut, J., 1975, *Strain Rate Effect on the Strength of Frozen Silt*, CRREL Report RR 350.
3. Pettibone, H.C., Waddell, G.G., *Stability of an Underground Room in Frozen, Gold-Bearing Strata*, Fairbanks, Alaska, 1969 for presentation at the 7th Annual Northwest Mining Association Convention.
4. Chester, J.W., Frank, J.N., 1969, *Fairbanks Placer Fragmentation Research*, Final Report, Heavy Metals Program, U.S. Bureau of Mines.
5. Mellor, M., 1972, *Jet Cutting in Frozen Ground*, First International Symposium on Jet Cutting Technology, April 1972, Coventry.
6. Hoekstra, P., 1976, *Rock, Frozen Soil and Ice Breakage by High-Frequency Electromagnetic Radiation*, A Review, CRREL Report 76-38.
7. Skudrzyk, F.J., 1982, *Heat Balance for Underground Mining of Frozen Gravel*, unpublished report prepared for the Department of Mineral Engineering, University of Alaska, Fairbanks.

HEAP LEACHING OF GOLD ORES

John Gomes,
Metallurgist, U.S. Bureau of Mines

I have the honor today of presenting a paper by one of the other groups at the Reno Research Center, a group dealing with low grade gold and silver resources. As this project is one of the real successes in the bureau, and because this group has led the way in agglomeration technology for heap leaching, I can say that it is quite an honor to speak on the subject. Furthermore, I can be quite objective about it because I did not have a thing to do with it. I can say, however, that this is not my first experience with cyanidation. I first worked in a cyanide mill some 41 years ago this summer, when I was a kid of 17 years old, and so I got my first experience with cyanidation there. Heap or dump leaching of ore has been practiced by the copper industry for over 30 years, but only recently has it been applied to cyanide leaching of gold and silver ores.

Following the discovery of the Carlin deposit in the early 1960's, there was a great deal of exploration leading to the finding and development of other low grade gold deposits. Some of these deposits were not of sufficient grade or size to support an expensive counter current cyanide mill. Heap leaching was investigated and found to be economically successful for many of these operations, but some operations were unsuccessful due to heap permeability problems. Because of this, the Bureau began working on agglomeration to eliminate or minimize these problems.

I think most of you are familiar with the Carlin deposit. It was a highly disseminated gold deposit. The gold was usually in micron size particles or smaller, and was usually in a porous rock type, such as a shale, that cyanide solutions could penetrate and consequently dissolve the gold particles. So it leached quite readily.

The Bureau of Mines started investigating agglomeration techniques about five years ago to increase metal extraction and decrease leaching times.

Today, I will speak on the state of the art by describing three agglomeration heap leaching operations. The paper was authored by Gene McClellan, Group Supervisor of the low grade gold and silver resources at Reno. A conventional leach pad operation includes building up the leach pile. In building the pile, there is segregation of material, the coarse material will run to the outside, and the finds will be segregated in the center, regardless of whether dump trucks or front end loaders are used. When leaching a pile that is segregated, channelling occurs as solutions flow against least resistance. For example, solutions will flow where there are a lot of coarse particles. Naturally, there will not be nearly as much coarse material where there are a lot of fines. Extreme conditions may exist which produce damming or blinding, and then short circuiting through the side of the pile.

To overcome these problems, the Bureau began working with agglomeration techniques. Agglomeration is nothing more than getting the fine particles in the ore to

for different size operations. In the Western United States there are 36 commercial operations using agglomeration techniques.

Finally, by adapting to agglomerate heap leaching techniques ... leaching periods were decreased and precious metal recoveries were improved over conventional heap leaching. Even though more reagents and equipment are required for agglomeration heap leaching compared to conventional heap leaching, it is cost effective because of the aforementioned decrease in leaching time and improved precious metal recoveries.

The heap leaching technology might be applied to ores in certain areas of Alaska, but modification will have to be made, such as the enclosed vat leaching operation near Cripple Creek, Colorado. Heavy precipitation in Southeastern Alaska would prohibit or decrease efficiency for outdoor operations. In other areas, long winters and cold temperatures would restrict the operations to short summer seasons.

Heap leaching is a technology most efficiently applied to arid regions and tempered climates.

STATE MINING LOAN PROGRAM

Don Hoover
Loan Examiner, ADCED

The mining loan law was passed in 1980 as a direct appropriation fund. As such, the amount of the loan funds available each fiscal year was dependent entirely upon the decision of the Legislature. The first year they established the fund with 10 million dollars, and this was used up pretty quick. The next year they established the fund with 30 million dollars, and at the end of that fiscal year, fiscal year 1982, there were 17 million remaining in the fund. Normally, this surplus would have gone back to the general fund. However, the 1982 Legislature changed the program to a revolving loan fund, so we not only retained the 17 million surplus, but they also added 15 million dollars to that, which made the total $32,747,000 at the start of fiscal year '83.

Additionally, from now on, all the payments of principal and interest go back into the fund. It is pretty difficult to say at this time how long, if ever, it will be before the Legislature needs to put some new monies into the fund. At this point we have $28,327,770 still available for this year, and my best guess at this point is we will end the fiscal year with about $25,000,000 still in the fund. It is getting too late for many miners to put their loan packages together before the mining season.

The law establishes eligibility requirements, but these requirements were also modified by the '82 Legislature. Originally they said that the applicant must be able to show five years of mining experience in Alaska and the applicant must be a resident. They said this would apply to all applicants, whether they be corporations, individuals, or partnerships. Now they have changed the law so that only 50% of a partnership, and only 51% of a corporation must meet the experience and the residency requirement. This now allows miners to bring in junior partners or shareholders who may have money but no other eligibility.

The purpose of the funds is rather narrow and explicit. The loan funds may be used for advanced exploration, development, or mining in Alaska. The law defines Advanced Exploration as the investigation of a known mineral deposit by means of geophysical surveys, boreholes, pits, or underground workings to determine the deposit size, shape, and value, and to determine whether it is feasible for mining. Development is defined as the preparation of a proven mineral deposit for mining. And mining is defined as the extraction of ore and preparation of a mineral for market. That is a restrictive purpose of the loans, and we have gone to the Attorney General's office to see how much leeway we have, and we have very little. For instance, monies cannot be used to buy claims or to pay off liens on claims, buy out partners, or in any other way establish an equity in your mine. It is to be for mining.

The terms of the loan are a maximum of 5 million dollars to any one borrower, the interest rate is 10%, and, depending on the collateral, the maximum term can be 15 years.

If the loan is for placer mining, the principal repayment need not start until the end of the second season after the loan is made. If the loan is for other than placer mining, repayment of principal need not start until 5 years after the loan is made, or one year after the mineral production begins, whichever is sooner. However, in all cases, accrued interest must be paid at least annually.

An operating plan is called for under the law, which should be sufficient to show the nature and location of the claims, establish the probable reserves, the equipment available for the mining operation, and whether or not the planned operation is economically feasible. This information is required for all loans, regardless of the type of collateral offered, or the size of the loan request.

The collateral may be any real estate owned in Alaska, and we may loan up to 75% of the appraised value of real estate collateral. We are allowed to take a second lien position on fee simple real estate. Equipment can also be offered, upon which we can loan up to 60% of the appraised value, or cost, whichever is less. With equipment as collateral, the maximum term is 5 years. It is also possible to use valid mining claims as collateral, provided that they have been appraised for proven reserves by a mining engineer registered in the State of Alaska.

One last change made in the 1982 session was that we now may make a loan to refinance mining debts up to a maximum of 49% of the original debt or loan amount.

This pretty well covers the mining loan law as it is today. I do not know of any changes they are planning to make to the program in the Legislature, but you might want to keep in touch.

For information purposes, I would just like to briefly recap the loan fund activity from its inception in 1980 to date. We have had a total of 69 applications, and of these 37 have been approved. The dollar total of approved loans is $22,630,733. Loan sizes range from $30,000 to

$5 million, but the majority of loans are between $100,000 and $500,000 in size, and 80% of those loans are for operations north of the Alaska Range. The majority of the applications disapproved or rejected were for ineligible purposes or from ineligible applicants. The point being that most of the eligible applications have received at least part, if not all, they asked for.

We have some new loan application packets that more clearly explain the eligibility requirements and other requirements about the operating plan. Hopefully, this will reduce some of the confusion we may have had.

One last thing, as those of you who have a mining loan with us now are aware, this last year Juneau tried to put all the loans in our division on the computer - all 11 thousand of them. And, they did. They got them all in there. Now we are waiting to get some information back.

It has been a rough change. The computer program just flat has a lot of glitches, but they are working on it, so if you will bear with us, we should have them cleared up before the end of this next mining season when some of you have payments coming due again. In the meantime, if you want to, you can make your payments at our office here in Fairbanks. That will not correct the computer program, but it will give you a receipt in hand for your payment made. At least you will have a record of it, and not a check lost somewhere.

CONFERENCE SUMMARY

Paul Glavinovich
President, Alaska Miners Association

I think we have had an extremely successful conference. We have over 600 registrants, which breaks all previous records.

I think it is important to congratulate our conference committee. They provided to us all the elements, basically, of a mining scenario. George Reeves has talked to us on the concept of discovery, and how to preserve that discovery. We have heard something new, at least new to me, in these conferences, and that is the use of geology in evaluation, and projection of possible placer reserves from Steve Morrison, Don Stevens, and Ed Armstrong. I think we will see more and more of this if placer starts to assume its rightful place in the Alaska Economy. We have had several case histories of actual production here in Alaska, we have been introduced to new fine gold recovery systems and to analog systems in the lode mining area. And our last speaker here today told us how to finance our programs. Once we got the product out of the ground, Oxford told us to buy silver, Delta told us to stay in gold, and Merrill Lynch told us to hedge on both. I think you know what to do with your gold.

You have noted on the conference schedule that we have not had any political discussion or discussion of regulations, with the exception of John Reeves. This was intentional, but, it does not mean it is not going on, and it is something that you must remain acutely aware of. I would like to once again remind you of the effort that is being made by the Alaska Miners Association through the Circle Mining District, and also the Fairbanks Branch. In these cooperative meetings the DEC, Fish and Game, etc., are trying to establish more reasonable water quality regulations and factors in the placer mining industry. We have made great, great, strides here. Number one, these people are now admitting that the present levels of compliance are just unrealistic, and it has taken a long time to get there. Some good news, last night at the banquet, from Bettye Fahrenkamp, is that the in-stream flow regulations, which we thought were right on the burner and ready to go, apparently are going to be called back into committee. I think that is a real plus.

There is something else I would like to mention that has not come up in the conference - the EPA-NPDS permits that most of us were issued last year in that 309 letter. If you recall your letter, you do have a compliance requirement to provide EPA with data for monitoring your discharge. Now, whether you monitor it or not is up to you, but they certainly want to hear from you. In my case, I was issued a 309 letter for a placer evaluation program that actually involved only drilling, so as we were not handling any bulk materials, we had no real discharge. I informed the EPA of such, and of course, I have complied with my 309 permit. John Spencer of Region 10 is under extreme pressure to have responses from you people, or he will have a very hard time defending the issuance of new permits in 1983. I know that when you have not been in compliance, you feel that in submitting your data, you are incriminating yourself. Possibly you are. I am not an attorney, and I cannot advise you on what to do. I can tell you what my personal reaction is to this, and that is I think I would rather have the EPA on my side as a buffer against a third party action than coming at me with the federal legal system backing them up. But, that is a decision you are going to have to make for yourself. The association really cannot advise you on what to do. We had hoped to secure some sort of a protective vehicle for everybody who submitted this information, but we are now informed, and several of you have probably already gotten the letters, they cannot protect the information from the freedom of information act.

The other thing I wanted to announce is that fellow miner Joe Usibelli was just named Alaskan of the Year this past week in Anchorage. As you all know, Joe is not a placer miner, he is a coal miner, but he is still a miner. He just has not got the word. It is important to note that in his selection as Alaskan of the Year, he was selected for being a miner, for pioneering arctic mining techniques, particularly surface mining techniques, reclamation methods, and for his civic efforts. It is one of the first times I have seen so much about the good things that a miner can do. I want to thank you all for your participation here, for your interest. Once again, I thank the committee for the excellent conference.