DISTRIBUTION, ANALYSIS, AND RECOVERY OF FINE GOLD FROM ALLUVIAL DEPOSITS

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INTRODUCTION

The United States Bureau of Mines, in its Heavy Metals Program, desired to have research performed to determine the size-frequency distribution and possible economic value of gold particles in the fine size ranges of Alaskan placer deposits. Primary interest was involved in obtaining evidence of the occurrence of fine gold and to determine the ameanability of standard sampling and production methods in the evaluation and recovery processes.

A research contract between the United States Bureau of Mines and the University of Alaska was initiated in June, 1968 as the first phase of this investigation, but was subsequently modified in June, 1969 to include beneficiation processes amenable to recovery as well as evaluation methods for fine and flakey gold.

In searching the literature relative to fine gold in Alaskan placer deposits, it was found that virtually no research has been devoted to determining the extent of fine gold distribution and its effect on evaluation and subsequent recovery methods. Standard evaluation techniques have relied on gravity methods of concentration and recovery of the visible gold from the concentrate. In general, this has proved satisfactory in that operational recovery methods used were probably not conducive to retaining gold particles of less than 100 mesh in size.

Operators generally have made no attempt to obtain a size analysis of gold in a head sample, but many have kept records of the size distribution of the gold as actually recovered. A review of these records, from selected areas, indicates that the -100 mesh gold represents from 0 to 5% of the total gold recovered. Although figures of this type may point to a probably fine gold loss, the difficulties inherent in evaluating the tailing material or modifying the recovery system have usually discouraged efforts in this direction.

Characteristics of Alluvial Deposits

Placers are generally defined as unconsolidated deposits of detrital material containing a valuable mineral or minerals that have been liberated by natural processes. An alluvial deposit, in a strict sense, indicates that the deposition has been affected by flowing water. It is possible then to have placer deposits which are not alluvial and alluvial deposits which are not placers.

For the purposes of this report, the term alluvial is used, and the investigation is concerned with four types of alluvial deposits as characterized by the water carrying capacity and the resulting detrital material.

Creek Deposits: These deposits have constituted the most important types because of the great number of streams past and present eroding the land surface and the generally efficient concentrating action of the running water on the heavy, valuable minerals.

As the composition of a creek deposit is dependent upon the type of rocks present in the vicinity and the degree of erosion that has transpired, they are usually not similar as to mineral content or particle size distribution. They do, however, share the following common features: the valuable component generally constitutes only a minor portion of the mass; the quartz sand with "black sands" make up another portion; the material larger than sand size is the major portion; and all of this material can have various shapes, weights and specific gravities.

Native gold is economically the most important element in these deposits, but other valuable components include platinum, cassiterite, cinnabar, monazite, columbite, ilmenite, zircon, and gems such as diamond, sapphire and ruby.

Because of its hardness and resistance to chemical attack, quartz is the most common constituent of the sand and these same reasons hold true for those minerals that make up the "black sand" fraction. The latter may include such minerals as magnetite, ilmenite, rutile, garnet, chromite, monazite, cinnabar, wolframite, scheelite and cassiterite.

The size and shape of the large fragments as well as the amount of extreme fine clay particles can contribute to preferential carrying capacity and deposition of fine gold in a stream system as well as recovery efficiency in a mining operation.

River Bar Deposits: These deposits differ from creek deposits primarily due to the carrying capacity of the water. The shallower gradient of the river systems limits the carrying capacity of the river as to particle size so that a more uniform size distribution is present.

The bars are usually formed during periods of highwater in zones of lower stream velocity where the settling velocity of the transported particle is greater than the horizontal velocity of the stream. The bars may be exposed during periods of low water, but seldom remain permanent with the tendency to shift downstream.

Gold particles are usually finely divided and difficult to recover, but are similar to the sand particles in that they are of a more uniform dissemination.

Beach Deposits: Like other alluvial deposits, the mineral composition of present and submerged beaches is dependent upon the nature of the source rock from which the detrital material was derived. The source may be from the adjacent sea floor, outcrops along the coast line or more normally from material transported by rivers and streams to the coast line.

In the latter case, the deposits is initiated at the mouth of the transporting stream and elongated parallel to the shore line as a result of wave action and long shore currents. In some cases, wind action may have some bearing in concentration by removal of the lighter material.

These deposits are similar to river bar deposits in regard to uniformity of particle sizes, but differ in percentage of heavy mineral constituents present due to the re-concentration action of the water and wind forces previously mentioned.

Gold in these deposits is generally in the size range of 28 to 150 mesh, but characterized by an extremely thin, flakey shape that defies recovery by conventional gravity methods.

Off-Shore Deposits: These deposits may take the form of drowned placers of other origin, reconcentration of drowned placers by bottom currents and wave action or extremely fine particles carried some distance off-shore by streams transporting to the coastline.

Depending upon the type of deposit, the size distribution of the detrital material including heavy minerals and precious metals, could be similar to or a combination of the other deposits previously discussed.

Characteristics of Gold

The character and size composition of gold particles found in placer deposits, as with the bulk of the detrital material, is a function of the whims of the original lode deposition and the subsequent erosional processes. The particles may vary from relatively large nuggets to minute specks, called "colors." However, the inherent malleable property of gold gives this element an entirely different reaction to erosion forces than that produced in the associated minerals.

Mineral particles exposed to erosional forces undergo a continual process of comminution, but gold particles subjected to the same forces will become rounded and water worn and almost always flattened to some extent. Gold that is ragged and angular, with particles of adhering quartz, indicates little stream action and, consequently, a short distance of travel. Flat, paper thin colors are buoyed up by water particularly water containing much clay or talc; they may be carried long distance by a swift stream.

The extremely high specific gravity, and the ability to amalgamate with mercury, are properties that are utilized to recover gold in placer operations. The shape and size of the gold particles also have considerable bearing as to ease or difficulty of recovery.

Shape and size are correlated with the distance from the lode source in that the farther the gold has travelled, the flatter the particle. It is reasonable to expect then, that without modifications, conventional recovery systems and evaluation processes become progressively less efficient as the distance from the source increases.

Scope of Study

The primary purpose of this study was to determine the size distribution of free gold in alluvial-type deposits with particular emphasis on those sizes not normally recovered in present-day placer mining operations. The shape of the gold, recovery system used, amount and turbidity of water, size of accompanying gravel and many other variables were necessary parameters to be considered. As the project developed, it became evident that secondary objectives of sample evaluation techniques and beneficiation methods were of equal importance and, consequently, were included as Phase II of the study.

In conjunction with the primary objectives, it was necessary that the sampling procedure for evaluation be capable of analyzing total gold content in all size ranges. The analytical scheme for gold must also consider the fact that the gold is in the free state and the probability of obtaining a representative sample of the liberated particles is extremely remote.

The total study was then concerned with determining: the size frequency distribution of free gold particles in various types of alluvial deposits; procedures for sizing the samples through sub-sieve ranges; developing an appropriate analytical scheme; studying the effect of the shape factor of free gold particles recovered; testing methods of fine gold beneficiation for purposes of evaluation and recovery; and where appropriate an evaluation of accessory minerals.

Samples for study were selected to represent alluvial deposits that would give a wide variance of gold characteristics resulting from source material, distance travelled and erosion forces acting on the particles.

It is convenient for the purposes of this study to segregate the samples into the four general deisignations of creek deposits, river bar deposits, beach deposits, and off-shore deposits. As funds and time did not allow on-site selection of samples, the investigators relied on Bureau of Mines personnel and other individuals for assistance in obtaining appropriate samples. This assistance is gratefully acknowledged. Unfortunately, all samples obtained could not be processed in the detail required for this study, so only the samples shown in Table I were selected as being' representative of gold containing alluvial material.

Laboratory Procedure

A significant source of analytical error always involves the possibility of a non-homogeneous sample. This error potential reaches a maximum when we are concerned with free grains of such elements as gold and platinum which have a high economic unit value. We must assume that any sub-sample obtained from the original sample has resulted in an even distribution of the discrete grains of the valuable components.

As each successive sub-sample greatly increases the possibility of error, the reasonable approach to samples of this type is to process the field sample so that the valuable constituents are concentrated. The proportion of valuable to gangue grains are increased, and if done in a quantitative manner, analysis of the concentrate can lead to meaningful calculated data for the original sample.

Separation of the sample into sized components provides valuable information concerning size distribution in the mining section and, in addition, aids in the concentration of the valuable constituents.

For these reasons, the laboratory procedure conducted on the field samples consisted of sizing by screening and sedimentation techniques with subsequent concentration by some combination of sink-float, jigging, elutriation, flotation, magnetic and electrostatic techniques.

During the first phase of the project, a standard laboratory procedure was developed for all samples known to contain material finer than 400 mesh. This procedure, shown in Figure 1, consisted of wet screening stages through 3, 100 and 400 mesh, respectively, to assure breakdown of all clay particles and thorough washing of all sizes. The wet screening procedure was followed by dry screening of all, plus 400 mesh material.

TABLE 1

Sample Selection and Designation

Sample Name	Type of Sample	Contributed By
Chandalar, Head	Creek Placer	Frank Birch
Chandalar, Tailing	Creek Placer	Frank Birch
Livengood, Head	Creek Placer	Carl Heflinger
Livengood, Tailing	Creek Placer	Carl Heflinger
Chicken Creek, Flat	Creek Placer	U.S.B.M.
Willow Creek, Flat	Creek Placer	U.S.B.M.
Willow Creek, Flat	Creek Placer	U.S.B.M.
Goldstream	Creek Placer	U.S.B.M.
Tofty	Jig Concentrate	William O'Neill
Fairview	Jig Concentrate	William O'Neill
Hogatza	Creek Placer	U.S.S.R. & M. Co.
Kuskokwim	River Bar	U.S.B.M.
Holitna	River Bar	U.S.B.M.
Nome	Beach Sand	Pearce Walsh
Bristol Bay (30 samples)	Beach Sand	U.S.B.M.
Yakataga	Beach Sand	John Kubek
Bristol Bay, B7	Off-Shore	Institute of Marine Science, U. of A.
Bristol Bay, D 10	Off-Shore	"
Bristol Bay, E 8	Off-Shore	"
Bristol Bay, E 12	Off-Shore	"
Bristol Bay, E 13	Off-Shore	"
Bristol Bay, G 15	Off-Shore	"

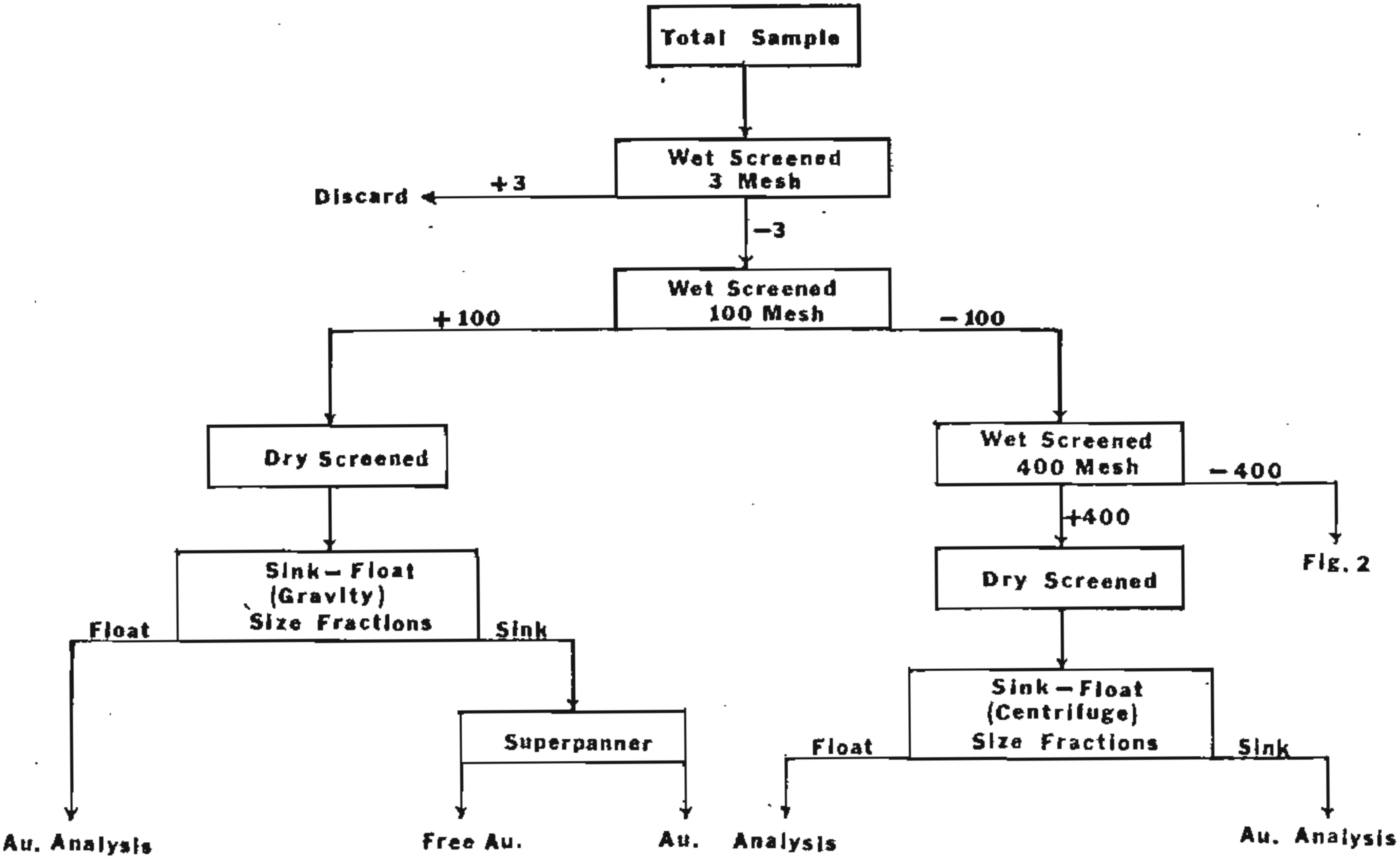


Figure 1

Sizing Procedure

Treatment of minus 400 mesh material was accomplished by sedimentation procedures as shown in Figure 2. Five liter capacity containers were used with pulp density of the slurry not exceeding 5% by weight, and utilizing sodium oxalate as a dispersing agent.

The settling velocity of spherical quartz particles was used for calculation of settling velocities with the resulting 120-minute, 15-minute, and 5-minute settling times for obtaining -5u, 5u/15u, 15u/25u, and 25u/400 mesh fractions, respectively. To assure complete separation of each size range, the slurry was stirred, allowed to settle for the proper time period, unsettled particles siphoned off with the water and this process repeated ten times.

Each screen size fraction was subjected to heavy liquid separation with tetrabromoethane using gravity separation for +100 mesh material and centrifuging for -100 mesh material. Plus 100 mesh sink products were processed on a superpanner to recover free gold, and the tailings analyzed for gold content. The float products were analyzed for gold content with grinding of plus 100 mesh material.

In the second phase of the study, concentration by flotation and elutriation methods were substituted for the sink-float technique when it was deemed advisable for the purposes of the project.

The elutriation apparatus, as shown in Figure 3, was supplied by a 30-gallon tank with an overflow outlet to provide a constant head. Water velocity to the elutriator was controlled by a needle valve located about 5 feet below the head tank outlet.

Operations of the elutriator can be either on a batch or a continuous overflow basis. When operated on a batch basis, the sample is added and water velocity adjusted until overflow of the light particles is near. After a short period of operation, gold or other heavies have either dropped into the drain tube below the mixing chamber or are circulating at the bottom of the tube above the mixing chamber. The pinch clamp on the drain tube is opened to allow the heavy particles to drop into the receiving flask which also allows particles at the bottom of tube 1 to drop into the drain tube. When separation is complete, the entire column may be drained into another container and the process repeated.

In the continuous overflow basis, the operation is similar, except that the lights overflow at the top, the heavy material such as gold pass through the mixing chamber into the collecting flask, and the middling, accumulate in different sections of the

Figure 2
Sedimentation Procedure

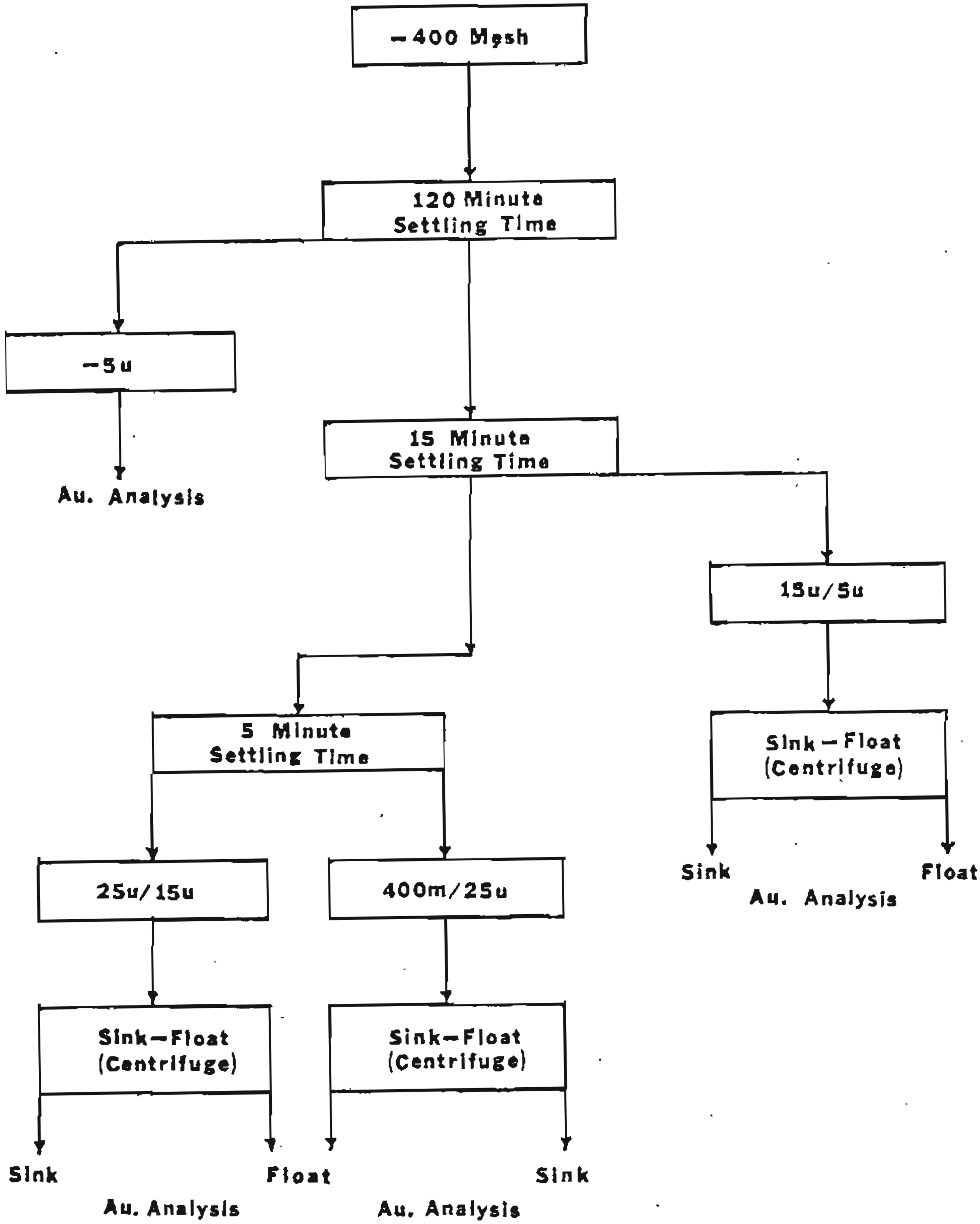
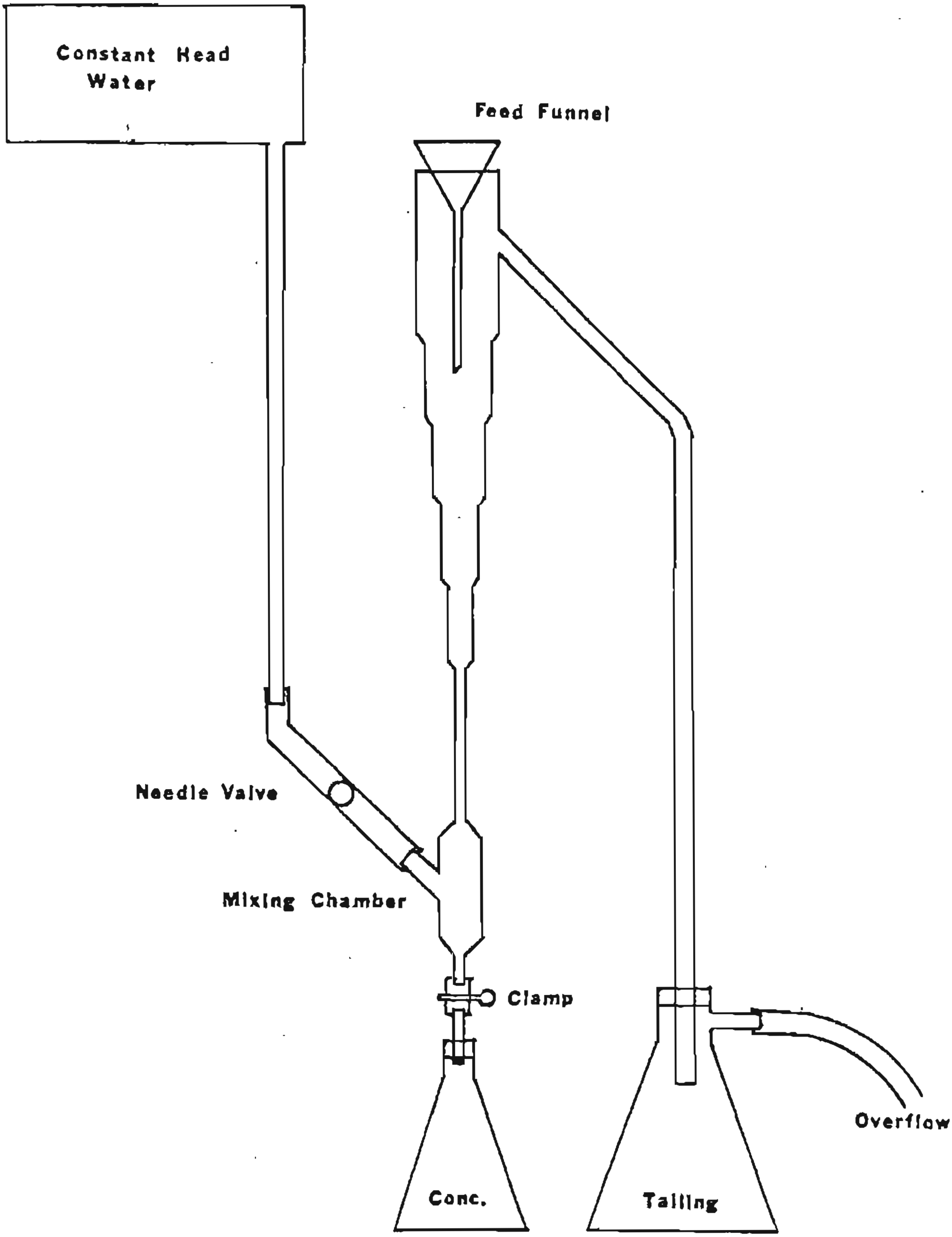


Figure 3
Elutriator



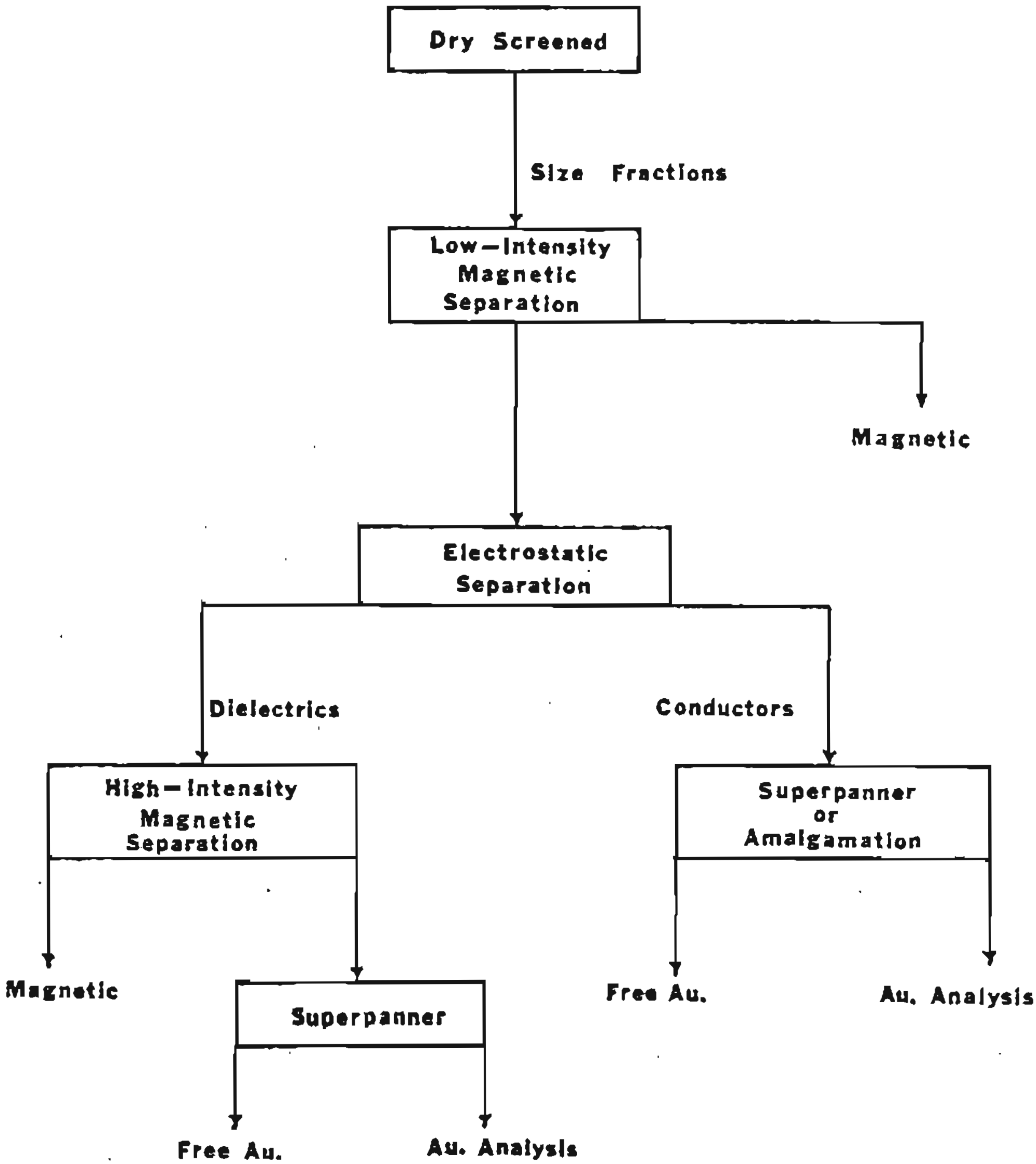
elutriator. Recovery of heavies and middling is similar to the batch operation. Due to the elutriator size and water velocities needed, processing was limited to size ranges between 20 and 200 mesh.

As the beach sand material contained no sediments and a natural concentration of heavy minerals were present, the sink-float technique was impractical. In these cases, a combination of magnetic, electrostatic and superpanner processes were utilized for free gold recovery and analysis. This generalized procedure is shown as Figure 4.

With progress of the study, variations to the generalized flowsheets were made when necessary. These will be explained in the appropriate sections.

Figure 4

Flowsheet For Beach Sands



CREEK DEPOSITS

Chandalar

These samples from Tobin Creek in the Chandalar area represent head and tail samples, respectively, from an active placer mining operation with a sluice box recovery system. The samples, taken by the operator, Mr. Frank Birch, are from the face of the cut and from the tailing pile at the end of the sluice box.

Compiled analytical data for the head and tailing samples are shown in Tables 2 and 3, respectively. The head sample indicates a fairly even distribution of minus ½-inch material down through the 5 micron size range. However, the screen analysis of the tailings shows that the fines have probably been transported some distance as suspended particles in the sluice water.

Data from the sink-float tests show the percentage of material lighter and heavier than a 2.96 specific gravity in each size fraction for head and tailing samples. These data show the total amount of heavy material to be less in the tailing sample with a re-distribution by size fractions. The plus 65 mesh fractions show a percentage increase in a heavy sands and the minus 65 mesh fractions have a corresponding decrease.

The gold values of float and sink fractions and the percent distribution by size indicates that at approximately 65 mesh size range, the value of the tailing material in the minus fractions is similar to that of the head material. This suggests that gold recovery below 65 mesh appears to be poor. The tabulated data showing distribution of minus 8 mesh gold indicates that approximately 15% of the total gold in the head sample can be expected to be in the minus 65 mesh sizes. However, a screen analysis of gold recovered from this operation, shown in Table 54 of the summary section, reveals that the minus 65 mesh gold represents less than 1% of the total. This indicated loss does not include coarser gold not recovered due to shape factor.

The latter point is emphasized in Tables 4 and 5, which show the free gold recovery in the sink fractions coarser than 100 mesh. The number of particles and the average weight per particle indicate that the coarser sized particles recovered in the tailings are inclined to be flat in shape and, consequently, weigh less on the average. It appears that at the 65 mesh size, there is an equal distribution between head and tail samples as far as gold particle weight and assay value are concerned. For the recovery system employed, efficiency drops drastically below this particle size.

TABLE 2

Analysis and Distribution of Gold in Chandalar Head Sample

Sample size, Mesh or Micron	Sample size, Weight Percent	Gold Assay Oz./Ton	Distribution -8 Mesh Gold Percent	SINK-FLOAT ANALYSIS, MINUS 8 MESH PORTION: WEIGHT PERCENT Float	WEIGHT PERCENT Sink	GOLD ASSAY OUNCES/TON Float	GOLD ASSAY OUNCES/TON Sink	GOLD DISTRIBUTION PERCENT Float	GOLD DISTRIBUTION PERCENT Sink
-3+8	18.10	0.000	0.00	1/					
-8+10	6.25	0.014	1.54	7.58	0.05	nil	2.28	0.0	1.6
-10+14	5.82	0.004	0.41	7.03	0.08	nil	0.39	0.0	0.4
-14+20	5.08	0.210	18.72	6.10	0.10	nil	13.30	0.0	19.1
-20+28	5.19	0.280	25.52	6.00	0.34	nil	5.29	0.0	25.7
-28+35	4.02	0.392	23.22	4.59	0.32	nil	4.98	0.0	22.7
-35+48	4.58	0.157	12.62	5.21	0.38	0.008	2.22	0.6	12.0
-48+65	4.63	0.039	3.17	5.08	0.57	0.003	0.36	0.2	2.8
-65+100	4.46	0.009	0.70	4.60	0.85	0.003	0.04	0.2	0.5
-100+150	4.30	0.032	2.42	4.51	0.74	0.012	0.15	0.8	1.6
-150+200	5.70	0.010	1.00	6.00	0.96	0.008	0.02	0.7	0.3
-200+270	9.43	0.013	1.09	9.80	1.71	0.005	0.02	0.7	0.5
-270+400	1.93	0.080	1.08	2.04	0.32	0.008	0.19	0.2	0.9
-400+25u	2.06	0.091	3.28	1.93	0.58	0.010	0.36	0.3	3.0
-25u+15u	5.78	0.019	1.93	5.94	1.12	0.011	0.06	0.9	1.0
-15u+5u	8.20	0.012	1.73	9.81	0.20	0.010	0.13	1.4	0.3
-5u+0	4.47	0.020	1.57	5.46	1/	0.020	1/	1.6	1/
Total or Average	100.00	0.070	100.00	91.68	8.32	0.005	0.78	7.6	92.4

1/ Plus 8 mesh and minus 5 micron fractions not sink-floated.

TABLE 3

Analysis and Distribution of Gold in Chandalar Tail Sample

Sample Size, Mesh or Micron	Sample Size, Weight Percent	Gold Assay Oz./Ton	Distribution -8 Mesh Gold Percent	SINK-FLOAT ANALYSIS, MINUS 8 MESH PORTION: WEIGHT PERCENT Float	WEIGHT PERCENT Sink	GOLD ASSAY OUNCES/TON Float	GOLD ASSAY OUNCES/TON Sink	GOLD DISTRIBUTION PERCENT Float	GOLD DISTRIBUTION PERCENT Sink
-3+8	33.48	0.000	0.00	1/					
-8+10	10.75	0.000	0.00	15.98	0.18	0.000	0.00	0.0	0.0
-10+14	9.70	0.000	0.00	14.36	0.22	0.000	Trace	0.0	0.0
-14+20	8.63	0.001	0.73	12.71	0.26	0.000	0.02	0.0	0.4
-20+28	7.83	0.018	15.43	11.06	0.71	0.000	0.30	0.0	15.2
-28+35	5.40	0.039	23.07	7.48	0.64	0.004	0.45	2.2	20.7
-35+48	5.56	0.021	12.79	7.50	0.86	0.003	0.18	1.6	11.1
-48+65	5.54	0.045	27.30	7.23	1.10	0.000	0.34	0.0	26.9
-65+100	3.32	0.022	7.99	4.26	0.73	0.000	0.15	0.0	7.9
-100+150	2.90	0.002	0.64	3.90	0.46	0.000	0.02	0.0	0.7
-150+200	2.40	0.012	3.16	3.18	0.43	0.000	0.10	0.0	4.6
-200+270	2.00	0.015	1.83	2.56	0.44	0.000	0.06	0.0	0.4
-270+400	0.35	0.022	0.34	0.42	0.11	0.005	0.04	0.1	0.2
-400+25u	0.53	0.061	3.56	0.63	0.17	0.008	0.26	0.4	3.2
-25u+15u	0.48	0.020	1.05	0.66	0.06	0.009	0.13	0.4	0.6
-15u+5u	0.71	0.027	2.10	1.02	0.05	0.019	0.20	1.4	0.7
-5u+0	0.42	0.000	0.01	0.63	1/	0.029	1/	1.3	1/
Total or average	100.00	0.014	100.00	93.58	6.42	0.001	0.20	7.4	92.6

1/ Plus 8 mesh and minus 5 micron fractions not sink-floated.

TABLE 4

Sink Fraction Gold Recovery, Chandalar Head

Tyler mesh Passed	Tyler mesh Retained	Particles Recovered	Mg. weight Per Particle	Free gold Oz./ton	Assay value Tails,oz./ton
8	10	-	-	-	2.28
10	14	-	-	-	0.39
14	20	1	8.38	13.30	nil
20	28	3	3.80	5.29	nil
28	35	9	1.15	4.98	nil
35	48	7	0.65	1.88	0.34
48	65	8	0.16	0.36	Trace
65	100	2	0.10	0.04	Trace

TABLE 5

Sink Fraction Gold Recovery, Chandalar Tails

Tyler mesh Passed	Tyler mesh Retained	Particles Recovered	Mg. weight Per Particle	Free gold Oz./ton	Assay value Tails, oz..ton
8	10	-	-	-	nil
10	14	-	-	-	Trace
14	20	-	-	-	0.02
20	28	1	0.73	0.30	nil
28	35	1	1.00	0.45	nil
35	48	1	0.55	0.18	nil
48	65	5	0.21	0.34	nil
65	100	6	0.06	0.15	Trace

Livengood

Head and tailing samples were obtained from Mr. Carl Heflinger's placer mining operation on Livengood Creek. These samples were taken during a period of low water when sluicing was not in progress. The head sample was representative of the mining section from surface to bedrock, but the tailing sample cannot be considered as representative of the sluice discharge as this material had been pushed out of the area by a bulldozer. Consequently, the tailing sample consists of grab material from the coarse tailing pile and fine sediments in the drain downstream from the sluice box.

Analysis and distribution of gold in the head and tailing samples are shown in Tables 6 and 7, respectively. The gold size distribution in these data show that 26% of the gold in the head sample passes a 65 mesh screen with a high concentration in the 100 by 150 mesh size. Gold in the tailing sample is fairly evenly distributed between minus and plus 65 mesh with high concentrations in the 100 by 150 and 210 by 400 mesh fractions.

The sink-float analysis shows a fairly even distribution of sink material with the expected loss of heavies in the finer sizes of the tailing material. Gold analysis and distribution in the sink products show 54% of the gold recovered in the tailing sample to be minus 65 mesh, which is similar to the distribution obtained in the Chandalar sample.

Plus 65 mesh gold particles recovered in the tailing sample were probably lost in the sluicing operation due to their flat shape as evidenced by the information presented in Tables 8 and 9. It is noted in these data that the average weight per particle in the head sample are approximately twice that of comparable sizes in the tailing sample.

TABLE 6

Analysis and Distribution of Gold in Livengood Head Sample

Sample Size, Mesh or Micron	Sample Size, Weight Percent	Gold Assay Oz./ton	Distribution -8 mesh Gold Percent	SINK-FLOAT ANALYSIS, MINUS 8 MESH PORTION: WEIGHT PERCENT		GOLD ASSAY OUNCES/TON		GOLD DISTRIBUTION PERCENT	
				Float	Sink	Float	Sink	Float	Sink
-3+8	25.27	0.000	0.00	1/					
-8+10	15.38	0.000	0.00	1/					
-10+14	11.45	0.058	5.50	18.31	0.98	0.000	1.15	0.0	5.5
-14+20	9.60	0.036	2.86	15.24	0.94	0.000	0.62	0.0	2.9
-20+28	8.30	0.121	8.32	13.10	0.89	0.000	1.90	0.0	8.3
-28+35	5.13	0.231	9.81	8.03	0.61	0.000	3.27	0.0	9.8
-35+48	3.73	0.819	25.29	5.82	0.46	0.000	11.13	0.0	25.1
-48+65	2.32	1.140	21.92	3.58	0.33	0.000	13.62	0.0	22.0
-65+100	0.84	0.117	0.80	1.35	0.06	0.011	2.75	0.1	0.8
-100+150	2.00	1.445	23.94	2.87	0.50	0.000	9.80	0.0	24.0
-150+200	2.61	0.048	1.03	4.23	0.17	0.000	1.23	0.0	1.0
-200+270	4.02	0.015	0.19	6.50	0.27	0.000	0.16	0.0	0.2
-270+400	2.83	0.004	0.03	4.41	0.36	0.001	0.01	0.0	0.0
-400+25u	1.94	0.010	0.15	2.69	0.58	0.003	0.04	0.0	0.1
-25u+15u	2.88	0.005	0.11	4.53	0.32	0.003	0.04	0.1	0.1
-15u+5u	0.71	0.004	0.02	1.16	0.04	0.003	0.04	0.0	0.0
-5u+0	0.99	0.004	0.03	1.67	1/	0.004	1/	0.0	1/
Total or average	100.00	0.203	100.00	93.49	6.51	0.001	3.13	0.2	99.8

1/ Plus 10 mesh and minus 5 micron fractions not sink-floated.

TABLE 7

Analysis and Distribution of Gold in Livengood Tail Sample

Sample Size, Mesh or Micron	Sample Size, Weight Percent	Gold Assay Oz./ton	Distribution -8 mesh Gold Percent	SINK-FLOAT ANALYSIS, MINUS 8 MESH PORTION: WEIGHT PERCENT Float	WEIGHT PERCENT Sink	GOLD ASSAY OUNCES/TON Float	GOLD ASSAY OUNCES/TON Sink	GOLD DISTRIBUTION PERCENT Float	GOLD DISTRIBUTION PERCENT Sink
-3+8	12.23	0.000	0.00	1/					
-8+10	12.27	0.000	0.00	1/					
-10+14	12.08	0.000	0.00	15.46	0.52	0.000	0.00	0.0	0.0
-14+20	10.86	0.000	0.00	13.94	0.43	0.000	0.00	0.0	0.0
-20+28	9.71	0.024	24.48	12.37	0.48	0.000	0.64	0.0	24.0
-28+35	6.63	0.000	0.00	8.46	0.31	0.000	Trace	0.0	0.0
-35+48	7.69	0.016	12.93	9.85	0.33	0.000	0.49	0.0	12.7
-48+65	5.74	0.011	6.64	7.30	0.30	0.000	0.28	0.0	6.6
-65+100	4.38	0.014	6.45	5.56	0.24	0.000	0.34	0.0	6.4
-100+150	4.19	0.044	19.35	5.16	0.38	0.000	0.65	0.0	19.3
-150+200	4.22	0.011	4.88	5.14	0.45	0.000	0.14	0.0	4.9
-200+270	4.68	0.014	3.46	5.75	0.44	0.000	0.10	0.0	3.4
-270+400	1.37	0.194	16.78	1.61	0.21	0.000	1.06	0.0	17.5
-400+25u	0.90	0.015	1.42	1.01	0.18	0.000	0.10	0.0	1.4
-25u+15u	2.03	0.015	3.20	2.55	0.14	0.010	0.10	2.0	1.1
-15u+5u	0.30	0.013	0.41	0.39	0.01	0.010	0.12	0.3	0.1
-5u+0	0.78	Trace	0.00	1.03	1/	0.004	1/	0.3	1/
Total or average	100.00	0.013	100.00	95.58	4.42	0.001	0.28	2.6	97.4

1/ Plus 10 mesh and minus 5 micron fractions not sink-floated.

TABLE 8

Sink Fraction Gold Recovery, Livengood Head

Tyler Mesh		Particles	Mg. weight	Free Gold	Assay Value
Passed	Retained	Recovered	Per Particle	Oz./ton	Tails, oz./ton
10	14	1	11.10	1.11	0.04
14	20	1	5.90	0.62	Nil
20	28	9	1.93	1.90	Trace
28	35	24	0.85	3.27	Trace
35	48	116	0.32	11.13	Trace
48	65	315	0.15	13.62	Trace
65	100	-	-	-	2.75

TABLE 9

Sink Fraction Gold Recovery, Livengood Tails

Tyler Mesh		Particles	Mg. weight	Free gold	Assay Value
Passed	Retained	Recovered	Per Particle	Oz./ton	Tails, oz./ton
10	14	-	-	-	Nil
14	20	-	-	-	Nil
20	28	2	1.10	0.64	Trace
28	35	-	-	-	Trace
35	48	9	0.13	0.49	Trace
48	65	7	0.08	0.28	Trace
65	100	9	0.06	0.34	Trace

Flat

Samples were submitted by Mr. Arthur Kimble of the United States Bureau of Mines during their investigations of placer deposits in the Flat area. Three samples were selected for the purposes of this study.

The sample from the right limit of upper Chicken Creek was obtained from just above the monzonitic bedrock. It consisted of monzonite and fine grained basic rock fragments. Two samples of placer gravel were selected from just above bedrock on the left limit bench of Willow Creek. This placer deposit is currently being mined by the Fullerton Brothers.

Tabulated data for these samples are presented in Tables 10, 11 and 12. These data indicate a fairly even distribution of minus $\frac{1}{4}$-inch material in all samples with the exception that the Willow Creek samples show a larger percentage of material in the sediment fraction below 400 mesh.

Sink-float and gold distribution data for the Chicken Creek sample, Table 10, show 63% of the gold to be in the minus 65 mesh fractions, while the Willow Creek samples, Tables 11 and 12, show 11% and 4% of the gold to be in the minus 65 mesh fractions. In the latter case, the majority of the fine gold is found in the minus 400 mesh sediments.

Free gold recovery in sink fractions coarser than 100 mesh are shown in Tables 13, 14 and 15. The Chicken Creek gold appears to be lighter than the Willow Creek gold which indicates thinner particles and further transport.

Goldstream

A sample of placer gravel was obtained from a U.S.B.M. experimental project located on the left limit of Goldstream Creek in the Fairbanks area. This bulk sample, weighing 1745 lbs., was taken from the gravel strata above bedrock.

The sample was wet screened on 3 mesh and 65 mesh screens and the plus 3 mesh material discarded after weighing. The plus 3 mesh material included sizes up to 6 inches and constituted 54% of the total sample. The size analysis and gold distribution is shown in Table 16.

All sizes from 20 mesh to 400 mesh were concentrated in the elutriator and the head values calculated from the concentrate analysis. These data, shown in Table 16, indicate the majority of gold is found in sizes coarser than 100 mesh.

A representative portion of 65 mesh by 200 mesh material was selected for flota-

TABLE 10

Analysis and Distribution of Gold in Chicken Creek, Flat Sample

Sample Size, Mesh or Micron	Sample Size, Weight Percent	Gold Assay Oz./ton	Distribution -14 Mesh Gold Percent	SINK-FLOAT ANALYSIS, MINUS 14 MESH PORTION: WEIGHT PERCENT Float	WEIGHT PERCENT Sink	GOLD ASSAY OUNCES/TON Float	GOLD ASSAY OUNCES/TON Sink	GOLD DISTRIBUTION PERCENT Float	GOLD DISTRIBUTION PERCENT Sink
-3+14	23.12	0.000	0.00	1/					
-14+20	9.53	0.000	0.00	1/					
-20+28	9.60	0.007	4.31	13.72	0.53	0.003	0.12	1.8	2.7
-28+35	7.08	0.027	12.31	9.95	0.56	0.005	0.41	2.1	9.9
-35+48	7.81	0.026	13.09	10.69	0.91	0.004	0.29	1.8	11.3
-48+65	7.04	0.017	7.71	9.63	0.82	0.007	0.14	2.8	4.9
-65+100	7.42	0.018	8.61	9.92	1.10	0.007	0.12	3.0	5.7
-100+150	4.36	0.080	22.46	5.58	0.89	0.005	0.55	1.2	21.0
-150+200	4.15	0.046	12.30	5.12	1.04	0.005	0.25	1.1	11.2
-200+270	2.41	0.087	5.67	2.91	0.67	0.005	0.18	0.6	5.2
-270+400	4.10	0.041	5.02	5.04	1.05	0.005	0.09	1.1	4.1
-400+25u	3.23	0.011	2.29	3.88	0.92	0.004	0.04	0.7	1.6
-25u+15u	4.85	0.009	2.81	6.55	0.65	0.006	0.04	1.7	1.1
-15u+5u	3.16	0.008	1.63	4.42	0.27	0.006	0.04	1.1	0.5
-5u+0	2.14	0.013	1.79	3.18	1/	0.013	1/	1.8	1/
Total or Average	100.00	0.023	100.00	90.59	9.41	0.005	0.20	20.8	79.2

1/ Plus 20 mesh and minus 5 micron fractions not sink-floated.

TABLE 11

Analysis and Distribution of Gold in #1 Willow Creek, Flat Sample

Sample Size, Mesh or Micron	Sample Size, Weight Percent	Gold Assay Oz./ton	Distribution -14 Mesh Gold Percent	SINK-FLOAT ANALYSIS, MINUS 14 MESH PORTION: WEIGHT PERCENT		GOLD ASSAY OUNCES/TON		GOLD DISTRIBUTION PERCENT	
				Float	Sink	Float	Sink	Float	Sink
-3+14	21.32	0.000	0.00	1/					
-14+20	2.96	0.000	0.00	1/					
-20+28	3.30	0.089	66.35	4.15	0.21	0.000	1.88	0.0	67.4
-28+35	3.19	0.000	0.00	3.87	0.34	0.000	0.00	0.0	0.0
-35+48	4.91	0.010	11.08	5.58	0.90	0.000	0.07	0.0	10.8
-48+65	5.83	0.009	11.85	6.30	1.40	0.000	0.05	0.0	12.0
-65+100	4.97	0.002	2.24	5.46	1.10	0.000	0.01	0.0	1.9
-100+150	4.53	Trace	0.00	4.91	1.07	0.000	Trace	0.0	0.0
-150+200	3.99	Trace	0.00	4.49	0.78	0.000	Trace	0.0	0.0
-200+270	3.45	Trace	0.00	4.10	0.46	0.000	0.00	0.0	0.0
-270+400	2.38	Trace	0.00	2.97	0.17	0.000	0.00	0.0	0.0
-400+25u	5.45	0.004	4.92	6.34	0.86	0.000	0.03	0.0	4.4
-25u+15u	7.88	0.002	3.56	9.38	1.03	0.000	0.02	0.0	3.5
-15u+5u	16.65	0.000	0.00	21.22	0.77	0.000	Trace	0.0	0.0
-5u+o	9.19	0.000	0.00	12.14	1/	0.000	1/	0.0	1/
Total or Average	100.00	0.006	100.00	90.91	9.09	0.000	0.06	0.0	100.0

1/ Plus 20 mesh and minus 5 micron fractions not sink-floated.

TABLE 12
Analysis and Distribution of Gold in #2 Willow Creek, Flat Sample

Sample Size, Mesh or Micron	Sample Size, Weight Percent	Gold Assay Oz./ton	Distribution -14 Mesh Gold Percent	SINK-FLOAT ANALYSIS, MINUS 14 MESH PORTION: WEIGHT PERCENT Float	WEIGHT PERCENT Sink	GOLD ASSAY OUNCES/TON Float	GOLD ASSAY OUNCES/TON Sink	GOLD DISTRIBUTION PERCENT Float	GOLD DISTRIBUTION PERCENT Sink
-3+14	19.32	0.000	0.00	1/					
-14+20	3.62	0.000	0.00	1/					
-20+28	3.60	0.331	23.13	4.56	0.11	0.000	14.34	0.0	23.4
-28+35	3.01	1.059	61.96	3.68	0.23	0.000	18.16	0.0	61.9
-35+48	3.98	0.090	6.95	4.66	0.50	0.000	0.92	0.0	6.8
-48+65	4.64	0.041	3.69	5.25	0.77	0.000	0.32	0.0	3.7
-65+100	4.12	0.008	0.64	4.66	0.69	0.000	0.06	0.0	0.6
-100+150	4.58	Trace	0.00	5.33	0.61	0.000	Trace	0.0	0.0
-150+200	4.89	Trace	0.00	5.79	0.56	0.000	Trace	0.0	0.0
-200+270	3.09	Trace	0.00	3.72	0.29	0.000	Trace	0.0	0.0
-270+400	5.79	0.001	0.04	7.10	0.41	0.000	0.01	0.0	0.1
-400+25u	6.58	0.007	0.90	7.99	0.55	0.000	0.11	0.0	0.9
-25u+15u	10.81	0.012	2.52	13.21	0.82	0.000	0.20	0.0	2.4
-15u+5u	8.68	0.001	0.17	10.86	0.40	0.000	0.03	0.0	0.2
-5u+0	13.29	0.000	0.00	17.25	1/	0.000	1/	0.0	1/
Total or average	100.00	0.067	100.00	94.06	5.94	0.000	1.14	0.0	100.0

1/ Plus 20 mesh and minus 5 micron fractions not sink-floated.

TABLE 13

Sink Fraction Gold Recovery, Chicken Creek, Flat

Tyler Mesh		Particles	Mg. Weight	Free Gold	Assay value
Passed	Retained	Recovered	Per Particle	Oz./ton	Tails,oz./ton
28	35	8	1.07	0.41	Nil
35	48	16	0.42	0.29	Trace
48	65	27	0.11	0.14	Nil
65	100	39	0.05	0.10	0.02

TABLE 14

Sink Fraction Gold Recovery, #1, Willow Creek, Flat

Tyler Mesh		Particles	Mg. Weight	Free Gold	Assay Value
Passed	Retained	Recovered	Per Particle	Oz./ton	Tails,oz./ton
35	48	1	0.61	0.05	0.02
48	65	1	0.10	0.01	0.04

TABLE 15

Sink Fraction Gold Recovery, #2, Willow Creek, Flat

Tyler Mesh		Particles	Mg. Weight	Free Gold	Assay Value
Passed	Retained	Recovered	Per Particle	Oz./ton	Tails,oz./ton
35	48	16	0.54	0.89	0.03
48	65	15	0.23	0.30	0.02
65	100	2	0.09	0.02	0.04

TABLE 16

Analysis and Distribution of Gold in Goldstream Sample

Sample Size, Mesh or Micron	Sample Size, Weight Percent	Gold Assay Oz./ton	Distribution -6 Mesh Gold Percent	ELUTRIATOR ANALYSIS, MINUS 20 MESH PORTION Ratio of Concentration	Conc. value Oz./ton	Tails value Oz.ton
+3	54.21	0.00	0.00	1/		
-3+6	15.10	0.00	0.00	2/		
-6+20	11.96	0.21	57.68	3/		
-20+28	4.71	0.38	20.92	129	56.21	Nil
-28+35	3.14	0.21	9.16	138	29.47	Nil
-35+48	2.62	0.18	6.71	117	21.26	Nil
-48+65	1.13	0.09	3.43	147	13.43	Nil
-65+100	0.84	0.06	0.82	75	0.05	0.01
-100+150	0.90	0.01	0.16	90	0.01	Trace
-150+200	0.77	0.02	0.32	100	0.02	Trace
-200+270	0.69	0.01	0.16	98	0.02	Trace
-270+400	2.08	0.01	0.32	152	Trace	Trace
-400+25u	0.65	0.01	0.16	4/		
-25u+15u	0.48	0.00	0.00	4/		
-15u+5u	0.36	Trace	0.00	4/		
-5u+0	0.36	0.02	0.16	4/		
Total or average	100.00	0.18	100.00	129	24.20	Trace

1/ Discarded, no gold evident.

2/ Processed in superpanner.

3/ Processed in mineral jig.

4/ Minus 400 mesh fraction not processed in elutriator.

tion tests as a check on the accuracy of the elutriator in this size range. The results of three 500 gram tests are shown in Table 17. These data show an average concentrate value of 0.75 ounces per ton and an average calculated head value of 0.03 ounces per ton. A calculated head value of elutriation tests of 65 x 200 mesh fractions also average 0.03 ounces per ton.

Representative fractions of plus 6 mesh material were processed in a superpanner with no evidence of free gold, and the 6 x 20 mesh material was concentrated as one size range in a small laboratory mineral jig. The results of jig tests, elutriation tests and analysis of minus 400 mesh fractions are also presented in Table 16.

These data calculated as weighted percentages, show only 2% of the gold to pass a 65 mesh screen and the largest portion to be in the 6 x 20 mesh range. However, this information should be tempered with the knowledge that the sample was obtained from directly above bedrock, and did not include the upper gravel strata where the fine gold would be more prevalent.

Tofty

The sample from Sullivan Creek in the Tofty area is a jig concentrate that had been reconcentrated in a sluice box. This sample is not of value in determining the amount of fine gold present in the deposit, but was processed to give some indication of the efficiency of jigs in alluvial deposits.

Table 18 shows the screen analysis of the concentrate. These data indicate that 94% of the material is in the 10 x 65 mesh range and 4.8% is finer than a 65 mesh sieve. Minus 100 mesh material constitutes only 1% of the total sample, which is to be expected in a concentrate.

Sink-float analysis of the sized fractions of this sample, Table 18, show the most effective concentration of minerals heavier than 2.96 specific gravity to be in the 28 x 150 mesh ranges. Atomic absorption analysis of the minus 150 mesh fractions shows fine gold to be present in all fine sizes. The sink product represents 7.04% of the total minus 20 mesh material indicating a not too efficient jig action, but a better efficiency for fine gold recovery than a sluice box.

Sink fraction gold recovery, Table 18, and gold size distribution, Table 19, give an indication of the amount of fine gold present and the more efficient recovery accomplished by jigging.

Fairview

This sample from Twin Creek in the Fairview district is also a jig concentrate, so

TABLE 17

Gold Recovery by Flotation, Goldstream Sample

Tyler Mesh	Conc. Wt. Grams	Ratio of Concentration	Conc. Value oz./ton	Tails value oz./ton	Head value oz./ton
65 x 200	20.6	24	0.71	Nil	0.03
65 x 200	18.9	26	0.77	Nil	0.03
65 x 200	20.2	25	0.79	Nil	0.03
Average	19.9	25	0.75	Nil	0.03

TABLE 18

Analysis and Distribution of Gold in Sullivan Creek, Tofty Sample

Sample Size, Mesh or Micron	Sample Size, Weight Percent	Gold Assay Oz./ton	Distribution -14 Mesh Gold Percent	SINK-FLOAT ANALYSIS, MINUS 14 MESH PORTION: WEIGHT PERCENT Float	WEIGHT PERCENT Sink	GOLD ASSAY OUNCES/TON Float	GOLD ASSAY OUNCES/TON Sink	GOLD DISTRIBUTION PERCENT Float	GOLD DISTRIBUTION PERCENT Sink
-3+14	4.53	0.000	0.00	1/					
-14+20	11.77	0.000	0.00	1/					
-20+28	21.01	0.000	0.00	24.86	1.24	0.000	0.00	0.0	0.0
-28+35	22.25	0.001	5.36	24.31	1.27	0.000	0.03	0.3	7.5
-35+48	23.26	0.001	5.60	26.17	1.62	0.000	0.01	0.0	3.3
-48+65	12.35	0.006	17.85	13.16	1.60	0.000	0.06	0.0	18.9
-65+100	3.77	0.027	24.55	3.57	0.94	0.000	0.13	0.0	24.2
-100+150	0.83	0.130	25.94	0.62	0.37	0.000	0.36	0.0	26.3
-150+200	0.16	0.360	13.79	0.19	1/	0.360	1/	13.5	0.0
-200+270	0.02	2.201	4.44	0.02	1/	1.100	1/	3.8	0.0
-270+400	0.02	0.688	1.38	0.02	1/	0.345	1/	1.4	0.0
-400+0	0.03	0.135	1.09	0.04	1/	0.135	1/	1.1	0.0
Total or average	100.00	0.005	100.00	92.96	7.04	0.001	0.06	19.8	80.2

1/ Plus 20 mesh and minus 150 mesh fractions not sink-floated.

TABLE 19

Sink Fraction Gold Recovery, Sullivan Creek, Tofty

Tyler Mesh		Particles	Mg. Weight	Free Gold	Assay Value
Passed	Retained	Recovered	Per Particle	Oz./ton	Tails, oz./ton
28	35	5	0.49	0.03	Nil
35	48	4	0.16	0.01	Nil
48	65	21	0.09	0.04	0.02
65	100	40	0.04	0.11	0.02

TABLE 20

Sink Fraction Gold Recovery, Fairview

Tyler Mesh		Particles	Mg. Weight	Free Gold	Assay Value
Passed	Retained	Recovered	Per Particle	Oz./ton	Tails,oz./ton
20	28	5	2.39	0.19	0.32
28	35	4	0.46	0.04	Nil
35	48	4	0.19	0.02	0.06
48	65	4	0.12	0.02	0.16
65	100	3	0.03	0.01	0.04

is somewhat similar in nature to the Tofty sample. It was obtained because the deposit is known to contain fine gold, however, an unprocessed sample would have been more beneficial to the purposes of this study.

The screen analysis, Table 21, shows 3.5% of the material passing a 65 mesh sieve, with the largest amount of material concentrated in the plus 48 mesh fraction.

Sink-float analysis of minus 20 mesh material, Table 21, shows gold to be present in all sizes through 400 mesh and the sink fraction representing only 5.3% of the total material. Gold finer than 65 mesh represents 35% of the total.

Sink fraction gold recovery, Table 20, indicates the milligram weight per particle. These data and the similar data from the Tofty concentrate point out that the average milligram weight of particles corresponds to gold particle weights found in the tailing material from sluice box operations.

<u>Hogatza</u>

A bucket line sample was obtained from a dredge operation on Bear Creek in the Hogatza area. The sampling zone was outlined by making a vertical buket line cut through the gravel and bedrock section with a moderate bucket loading rate through a 6'-8' swing distance. This essentially constitutes a channel cut 6'-8' wide, 3'-4' into the face and 15' in depth. An approximate 14 cubic yard total volume is indicated.

The sample submitted for study was taken by grab sampling from the bucket line prior to discharge into the hopper. The bucket line was sampled on a continuous basis, but the total sample was segregated to represent 3-foot intervals from surface to bottom of cut.

The inadequacies and unavoidable errors inherent in grab sampling the bucket line are recognized, but it was felt that because of the economic considerations involved, this method was the most practical under the circumstances.

Each sample, representing a three-foot interval of the total sample depth, was wet screened on 3, 14, 100 and 400 mesh sieves. This was necessary because of the large amount of clay material present.

The plus 400 mesh fractions from the wet screening processes were dried and subjected to complete Tyler screen analysis from 2" through 400 mesh series. These dry screen fractions were weighed and where appropriate, split for the subsequent elutriation and flotation studies, as shown in Figure 5.

TABLE 21

Analysis and Distribution of Gold in Fairview Sample

Sample Size, Mesh or Micron	Sample Size, Weight Percent	Gold Assay Oz./ton	Distribution -14 Mesh Gold Percent	SINK-FLOAT ANALYSIS, MINUS 14 MESH PORTION					
				WEIGHT PERCENT		GOLD ASSAY OUNCES/TON		GOLD DISTRIBUTION PERCENT	
				Float	Sink	Float	Sink	Float	Sink
-3+14	30.25	0.000	0.00	1/					
-14+20	14.98	0.000	0.00	1/					
-20+28	16.68	0.006	19.26	30.12	0.34	0.000	0.51	0.0	18.1
-28+35	13.45	0.001	2.59	23.75	0.81	0.000	0.04	0.0	3.4
-35+48	13.37	0.004	10.29	23.05	1.36	0.000	0.08	0.0	11.3
-48+65	7.75	0.022	32.81	12.42	1.73	0.000	0.18	0.0	32.5
-65+100	2.41	0.014	6.49	3.53	0.87	0.005	0.05	1.8	4.5
-100+150	0.58	0.078	8.71	0.88	0.18	0.040	0.27	3.7	5.1
-150+200	0.19	0.140	5.17	0.35	1/	0.140	1/	5.1	0.0
-200+270	0.12	0.789	6.95	0.21	1/	0.314	1/	6.9	0.0
-270+400	0.17	0.320	5.26	0.31	1/	0.161	1/	5.2	0.0
-400+0	0.05	0.260	2.47	0.09	1/	0.260	1/	2.4	0.0
Total or average	100.00	0.009	100.00	94.71	5.29	0.003	0.14	25.1	74.9

1/ Plus 20 mesh and minus 150 mesh fractions not sink-floated.

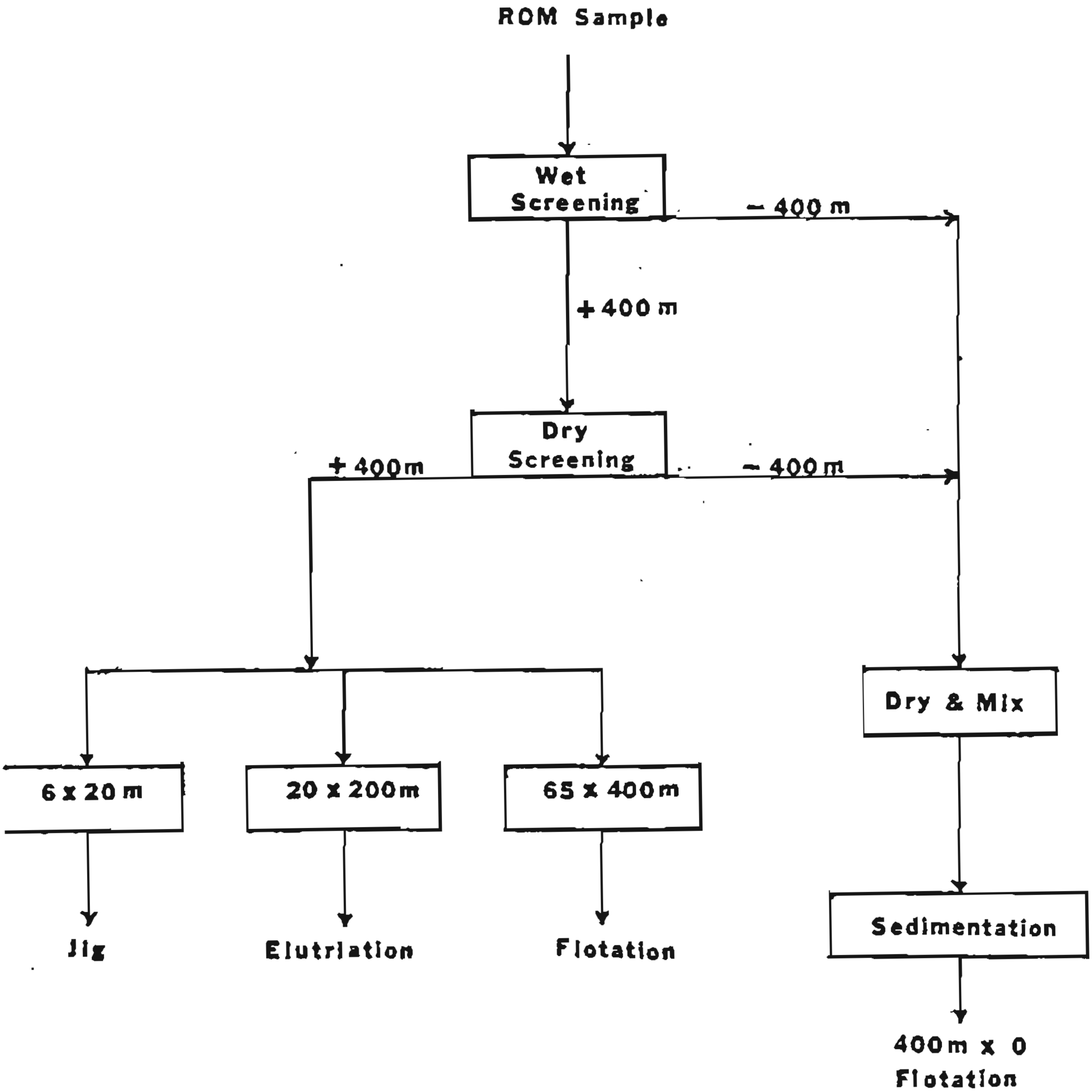


Figure 5
Laboratory Procedure
Hogatza

The minus 400 mesh material obtained from wet and dry screening processes were thoroughly mixed and sized by sedimentation techniques into 400 mesh by 25 micron, 25 micron by 15 micron, and 15 micron by 0 fractions using equivalent quartz sphere settling velocities.

Sample size distribution of minus 3 mesh material is presented in Tables 22-26, inclusively, and show a progressive increase in fine sizes with increase in depth. Due to this excessive amount of fines and the size of the sample, sink-float evaluations were impractical. Consequently, a combination of concentrating methods were used for recovery and evaluation of the gold content.

A Denver laboratory mineral jig was used to process 6x8, 8x10, 10x14, and 14x20 mesh sizes of each sample increment. The jig hutch and bed products were evaluated in each case for gold recovery. One flake of gold was observed in the 14x20 mesh fraction of the 6'-9' sample interval, and two flakes were found in the 14x20 mesh fraction of the 12' -15' interval. All other fractions were entirely void of gold particles.

Due to the lack of gold in sizes coarser than 20 mesh, the analysis in this report is based on the minus 20 mesh material as processed by a combination of elutriation and flotation studies. Elutriation methods were conducted on size ranges from minus 20 mesh to plus 200 mesh and flotation studies conducted on minus 65 mesh fractions. This allowed an overlap in the two methods in the minus 65 by plus 200 mesh range. In both methods, analysis of concentrates and tailings were made and a calculated head value obtained. These data are shown in Tables 22-26.

Flotation studies were conducted on all sizes finer than 65 mesh. This provided for gold concentration in the sizes finer than 200 mesh in which the efficiency of the elutriator was in doubt, and also allowed an overlap to check elutriator efficiency in the 65 x 200 mesh sizes.

The studies were conducted on 500 gram representative samples of each size range. Reagents consisted of a combination of Aerofloat 208 and Aero Xanthate 301 in equal proportions as the primary promoters with Aerofloat 15 as a promotoer-frother. A natural circuit with a pH of 7.2 was used for all tests.

Tests were conducted in five stages allowing 3 minutes of promoting time and 2 minutes of frothing time in each stage for each sample. In the first stage, 0.2#/ton of each reagent was added, and 0.1#/ton was added to each successive stage. In all

TABLE 22
Analysis and Distribution of Gold in Hogatza, o'-3' Section

Sample Size, Mesh or Micron	Sample Size, Weight Percent	Gold Assay Oz./ton	Distribution -20 Mesh Gold Percent	ELUTRIATION AND FLOTATION ANALYSIS			
				WEIGHT PERCENT		GOLD ASSAY, OZ./TON	
				Conc.	Tails	Conc.	Tails
-3+14	48.13	0.000	0.00	1/			
-14+20	8.35	0.000	0.00	1/			
-20+28	5.04	Trace	0.00	0.42	11.22	Trace	Nil
-28+35	4.83	0.004	8.85	0.46	10.37	0.01	Nil
-35+48	3.52	0.010	16.15	0.10	7.80	0.83	Nil
-48+65	2.64	0.029	35.14	0.32	5.95	0.54	Nil
-65+100	1.98	0.012	10.92	0.12	4.42	0.45	Nil
-100+150	1.54	0.006	4.22	0.12	3.54	0.19	Nil
-150+200	2.86	0.011	14.45	0.39	5.94	0.18	Nil
-200+270	2.42	0.001	1.10	0.12	5.40	0.03	Nil
-270+400	4.40	0.002	4.04	0.86	9.03	0.02	Nil
-400+25u	3.74	0.003	5.14	1.16	7.43	0.02	Nil
-25u+15u	5.71	0.000	0.00	1.71	11.59	Nil	Nil
-15u+0	4.84	0.000	0.00	1.40	10.13	Nil	Nil
Total or average	100.00	0.005	100.00	7.18	92.82	0.06	0.00

1/ Processed by jigging.

TABLE 23
Analysis and Distribution of Gold in Hogatza 3'-6' Section

Sample Size, Mesh or Micron	Sample Size, Weight Percent	Gold Assay Oz./ton	Distribution -20 Mesh Gold Percent	ELUTRIATION AND FLOTATION ANALYSIS WEIGHT PERCENT Conc.	Tails	GOLD ASSAY, OZ./TON Conc.	Tails
-3+14	36.88	0.000	0.00	1/			
-14+20	8.07	0.000	0.00	1/			
-20+28	6.69	0.116	42.94	0.07	12.28	20.20	Nil
-28+35	4.97	0.082	22.57	0.09	8.86	7.71	Nil
-35+48	4.80	0.063	16.73	0.27	8.45	2.00	Nil
-48+65	3.95	0.036	7.85	0.43	6.78	0.60	Nil
-65+100	3.26	0.029	5.24	0.08	5.80	1.97	Nil
-100+150	3.26	0.012	2.17	0.09	5.76	0.70	Nil
-150+200	3.60	0.008	1.59	0.26	6.35	0.19	Nil
-200+270	2.74	0.001	0.15	0.21	4.72	0.03	Nil
-270+400	4.63	0.003	0.76	1.11	7.26	0.02	Nil
-400+25u	5.15	0.000	0.00	1.01	8.33	Nil	Nil
-25u+15u	4.97	0.000	0.00	1.39	7.69	Nil	Nil
-15u+0	7.03	0.000	0.00	2.23	10.48	Nil	Nil
Total or average	100.00	0.033	100.00	7.24	92.65	0.44	0.00

1/ Processed by jigging.

TABLE 24
Analysis and Distribution of Gold in Hogatza, 6'-9' Section

Sample Size, Mesh or Micron	Sample Size, Weight Percent	Gold Assay Oz./ton	Distribution -20 Mesh Gold Percent	ELUTRIATION AND FLOTATION ANALYSIS: WEIGHT PERCENT Conc.	WEIGHT PERCENT Tails	GOLD ASSAY, OZ./TON Conc.	GOLD ASSAY, OZ./TON Tails
-3+14	22.19	0.000	0.00	1/			
-14+20	6.77	0.000	0.00	1/			
-20+28	6.22	0.166	29.03	0.08	8.50	17.43	Trace
-28+35	7.04	0.148	29.26	0.05	9.74	24.30	Trace
-35+48	3.79	0.304	32.36	0.16	5.12	9.84	Trace
-48+65	4.60	0.043	5.55	0.12	6.27	2.21	Nil
-65+100	3.11	0.017	1.49	0.21	4.08	0.35	Nil
-100+150	4.60	0.008	1.04	0.57	5.94	0.09	Nil
-150+200	4.74	0.006	0.80	0.61	6.04	0.06	Nil
-200+270	3.65	0.003	0.30	0.69	4.48	0.02	Nil
-270+400	6.09	0.001	0.17	0.76	7.92	0.01	Nil
-400+25u	10.01	0.000	0.00	1.00	13.42	Nil	Nil
-25u+15u	5.82	0.000	0.00	2.21	5.99	Nil	Nil
-15u+0	11.37	0.000	0.00	4.33	11.71	Nil	Nil
Total or average	100.00	0.050	100.00	10.79	89.21	0.43	Nil

1/ Processed by jigging.

TABLE 25
Analysis and Distribution of Gold in Hogatza 9'-12' Section

Sample Size, Mesh or Micron	Sample Size, Weight Percent	Gold Assay Oz./ton	Distribution -20 Mesh Gold Percent	ELUTRIATION AND FLOTATION ANALYSIS: WEIGHT PERCENT Conc.	WEIGHT PERCENT Tails	GOLD ASSAY, OZ./TON Conc.	GOLD ASSAY, OZ./TON Tails
-3+14	17.15	0.000	0.00	1/			
-14+20	6.13	0.000	0.00	1/			
-20+28	6.01	0.000	0.00	0.24	7.54	Nil	Nil
-28+35	4.51	0.000	0.00	0.31	5.64	Nil	Nil
-35+48	4.88	0.024	69.79	0.18	6.19	0.85	Nil
-48+65	4.51	0.003	8.06	0.10	5.85	0.18	Trace
-65+100	4.13	0.005	12.31	0.22	5.17	0.12	Nil
-100+150	3.00	0.000	0.00	0.33	3.57	Nil	Nil
-150+200	6.01	0.000	0.00	1.00	6.87	Nil	Nil
-200+270	4.13	0.004	9.84	1.07	4.39	0.02	Nil
-270+400	6.38	0.000	0.00	2.01	6.24	Nil	Nil
-400+25u	2.50	0.000	0.00	2/	3.29	2/	Nil
-25u+15u	17.27	0.000	0.00	2/	22.43	2/	Nil
-15u+0	13.39	0.000	0.00	2/	17.36	2/	Nil
Total or average	100.00	0.006	100.00	5.46	94.54	0.04	Nil

1/ Processed by jigging.

2/ Not floated.

TABLE 26
Analysis and Distribution of Gold in Hogatza 12'-15' Section

Sample Size, Mesh or Micron	Sample Size, Weight Percent	Gold Assay Oz./ton	Distribution -20 Mesh Gold Percent	ELUTRIATION AND FLOTATION ANALYSIS			
				WEIGHT PERCENT		GOLD ASSAY OZ./TON	
				Conc.	Tails	Conc.	Tails
-3+14	13.62	0.000	0.00	1/			
-14+20	2.29	0.000	0.00	1/			
-20+28	5.03	0.312	95.26	0.28	5.77	6.80	Nil
-28+35	5.38	Trace	0.00	0.17	6.23	Nil	Trace
-35+48	5.03	0.000	0.00	0.04	5.96	Nil	Nil
-48+65	6.86	Trace	0.00	0.05	8.10	Trace	Nil
-65+100	7.09	0.010	4.31	0.74	7.67	0.11	Nil
-100+150	4.12	0.000	0.00	0.32	4.58	Nil	Nil
-150+200	5.72	0.004	0.13	0.70	6.12	0.04	Trace
-200+270	4.92	0.001	0.30	0.74	5.17	0.01	Nil
-270+400	5.96	0.000	0.00	0.96	6.06	Nil	Nil
-400+25u	10.41	0.000	0.00	3.86	8.48	Nil	Nil
-25u+15u	5.84	0.000	0.00	1.02	5.93	Nil	Nil
-15u+0	17.73	0.000	0.00	1.90	19.15	Nil	Nil
Total or average	100.00	0.019	100.00	10.78	89.22	0.19	Nil

1/ Processed by jigging.

instances, no gold recovery was obtained beyond the second flotation stage; consequently, a reagent consumption of 0.3#/ton and a promotion time of 6 minutes appears to be adequate.

Results of the flotation studies for each sample interval were obtained to arrive at ratio of concentration, concentrate value and calculated head values for each size fraction. These data, when compared with the elutriator data for the 65x200 mesh sizes, indicates that the flotation system is more efficient for concentration and evaluation in size fractions finer than 65 mesh.

Tables 22-26 inclusively show the distribution of gold in each size fraction of each sample increment. It is evident from these data that the fine gold is more prevalent in the upper part of the dredge section, and other than in the first sample increment, there is no evidence of gold in sizes finer than 400 mesh. The calculated head value increases to a maximum of 0.05 ounces/ton in the 6'-9' increment, but gold is still evident in the lower portion of the dredge section at about the same proportion as in the upper sections.

The total amount of gold recovered in the samples was disappointing for the purposes and accuracy of this study, but it is assumed that the same ratio of find gold to coarser gold would be present regardless of the tenor of the sample.

A comparison of results obtained by the elutriation and flotation methods indicated that more efficient recovery should be obtained for fine gold by the flotation method than by gravity methods. This same analogy should hold true when evaluating a placer deposit for its total gold content.

RIVER BAR DEPOSITS

As part of the United States Bureau of Mines heavy metal investigation, river bar samples were taken over a 50-mile interval of the Kuskokwim River to include the George and Holitna Rivers. One-quarter cubic yard samples were concentrated at the samplé locations in a small sluice box and this concentrate further reduced by hand panning prior to analysis.

The purpose of this investigation was to determine if there might be significant amounts of gold in these sediments which are a considerable distance from known sources of gold mineralization. Results of this work are available as a United States Department of the Interior open-file report titled, "Sampling for Gold in River Bars, Kuskokwim River Basin, Alaska," by Raymond P. Maloney.

During the process of his investigation, Mr. Maloney submitted 700# bulk river bar samples from the Kuskokwim and Holitna Rivers to aid in the purposes of this particular project. The laboratory procedure for processing these particular samples is shown as Figure 6.

Kuskokwim

This sample was taken from a bar on the Kuskokwim River approximately four miles downstream from Georgetown. It corresponds in location to Mr. Maloney's sample R-1 in his open file report.

A size distribution of this sample, shown as part of Table 27, indicates that the material is predominantly in the 48 mesh by 150 mesh range with only 1.2% less than 200 mesh in size.

Table 27 also shows the sink-float analysis by size fractions with sizes less than 400 mesh being impractical for the conduct of sink-float testing. Total gold values are generally higher in the minus 100 mesh fractions with a fairly even distribution in the minus 270 mesh sizes. The total gold size distribution shows 77% of the gold to be less than 100 mesh in size.

Several particles of free gold were recovered from the 65 by 100 mesh fraction of this sample. The average weight per particle was 0.04 mg., which is comparable to similar sized particles normally lost in sluicing operations. This is indicative of the ability of silt laden streams to carry gold particles that are flat in shape.

Holitna

This sample was obtained from a river bar approximately 1½ miles up the Holitna

Figure 6

Laboratory Procedure
River Bar Samples

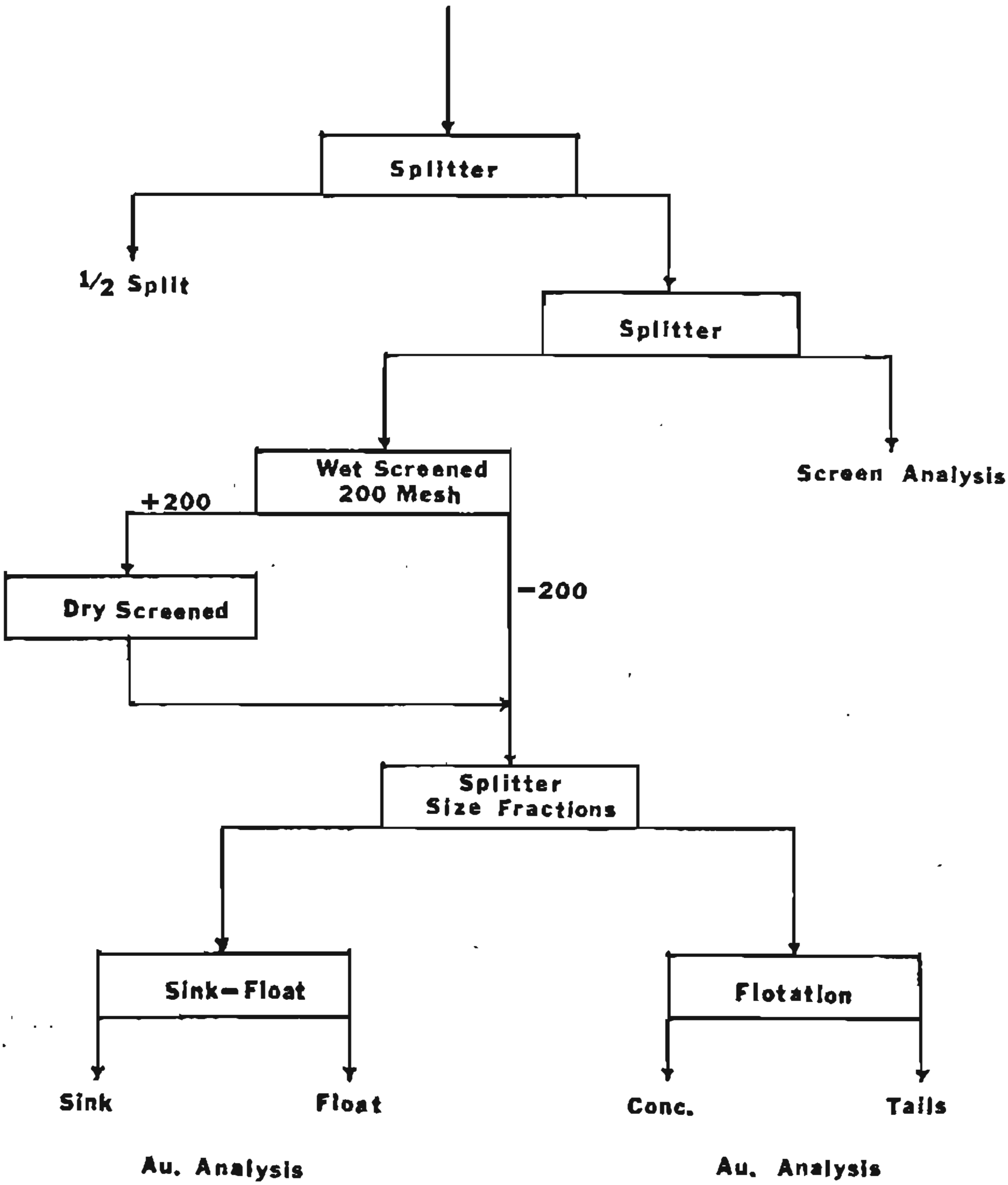


TABLE 27

Analysis and Distribution of Gold in Kuskokwim Riverbar Sample

Sample Size, Mesh or Micron	Sample Size, weight Percent	Gold Assay Oz./ton	Distribution -20 mesh Gold Percent	SINK-FLOAT ANALYSIS					
				WEIGHT PERCENT		GOLD ASSAY OUNCES/TON		GOLD DISTRIBUTION PERCENT	
				Float	Sink	Float	Sink	Float	Sink
-14+20	0.01	0.000	0.00	1/					
-20+28	0.02	0.000	0.00	1/					
-28+35	0.09	0.000	0.00	1/					
-35+48	3.84	0.003	4.70	3.77	0.08	Nil	0.13	0.0	4.4
-48+65	50.48	0.001	6.16	49.75	0.79	Nil	0.02	0.0	6.8
-65+100	30.18	0.001	12.28	28.74	1.47	Nil	0.02	0.0	12.6
-100+150	12.07	0.008	39.32	11.14	0.95	Nil	0.10	0.0	40.6
-150+200	2.11	0.003	2.57	1.75	0.36	Nil	0.02	0.0	3.1
-200+270	0.45	0.021	3.90	0.39	0.06	Nil	0.14	0.0	3.6
-270+400	0.31	0.051	6.43	0.28	0.03	0.01	0.14	1.2	1.8
-400+25u	0.12	0.170	8.29	0.12	1/	0.17	1/	8.7	1/
-25u+15u	0.10	0.140	5.69	0.10	1/	0.14	1/	6.0	1/
-15u+5u	0.10	0.130	5.29	0.10	1/	0.13	1/	5.6	1/
-5u+0	0.12	0.110	5.37	0.12	1/	0.11	1/	5.6	1/
Total or average	100.00	0.003	100.00	96.26	3.74	0.001	0.05	27.1	72.9

1/ Plus 35 mesh and minus 400 mesh not sink-floated.

River from its confluence with the Kuskokwim. It corresponds in location to sample H-4 of Mr. Maloney's report.

The size distribution, Table 28, shows a greater percentage of coarser sizes above 48 mesh and also more fine material below 200 mesh than was noted in the Kuskokwim river bar sample. This is understandable as the current is slower and less silty in the Holitna.

The sink-float data, shown in Table 28, indicates less total sink material than in the Kuskokwim sample, and only 23% of the gold size distribution to be in the minus 100 mesh range. The latter, however, is strongly influenced by high assay values in the minus 20 plus 35 mesh size ranges.

Free gold particles recovered in the 48 by 65 and 65 by 100 mesh size fractions gave an average weight per particle at 0.02 mg., and 0.01 mg., respectively. This is considerably less than found in the Kuskokwim, but is reasonable when considering the current and sediment loads of the two rivers.

Flotation tests were conducted on 500 gram batch size fractions of both river bar samples. The average results of duplicate tests are shown in Tables 29 and 30, respectively. These data indicate the ratio of concentration, concentrate value and calculated head value in ounces per ton.

When compared with results of the sink-float tests on the same samples, the evaluations are not compatible. This is understandable in that the sink-float tests were conducted on much larger samples with a correspondingly greater accuracy.

By either sink-float or flotation methods, however, the gold values were considerably higher than those obtained by Mr. Maloney on similar samples.

TABLE 28
Analysis and Distribution of Gold in Holitna Riverbar Sample

Sample Size, Mesh or Micron	Sample Size, Weight Percent	Gold Assay Oz./ton	Distribution -20 Mesh Gold Percent	SINK-FLOAT ANALYSIS: WEIGHT PERCENT Float	Sink	GOLD ASSAY OUNCES/TON Float	Sink	GOLD DISTRIBUTION PERCENT Float	Sink
-3+20	8.90	0.000	0.00	1/					
-20+28	7.40	0.037	44.90	8.10	0.02	Nil	19.62	0.0	49.8
-28+35	17.58	0.009	25.99	19.25	0.05	Nil	3.85	0.0	24.5
-35+48	32.19	0.000	0.00	35.04	0.30	Nil	Nil	0.0	-
-48+65	12.11	0.000	0.00	13.01	0.28	Nil	0.02	0.0	0.7
-65+100	8.75	0.004	5.75	9.24	0.37	Nil	0.10	0.0	4.7
-100+150	6.64	0.000	0.00	7.05	0.24	Nil	Trace	0.0	-
-150+200	3.41	0.006	3.36	3.51	0.23	Nil	0.10	0.0	2.9
-200+270	1.12	0.024	1.82	1.13	0.10	Nil	0.13	0.0	1.7
-270+400	0.79	0.029	1.80	0.79	0.08	Nil	0.16	0.0	1.6
-400+25u	0.30	0.100	4.79	0.32	1/	0.10	1/	4.1	1/
-25u+15u	0.21	0.100	3.44	0.23	1/	0.10	1/	2.9	1/
-15u+5u	0.30	0.160	7.90	0.33	1/	0.16	1/	6.7	1/
-5u+0	0.30	0.005	0.25	0.33	1/	0.01	1/	0.4	1/
Total or average	100.00	0.007	100.00	98.33	1.67	0.001	0.40	14.1	85.9

1/ Plus 28 mesh and minus 400 mesh fractions not sink-floated.

TABLE 29

Gold Recovery by Flotation - Kuskokwim Riverbar

Tyler Mesh	Conc. Wt. Grams	Ratio of Concentration	Conc. Value Oz./ton	Tails Value Oz./ton	Head Value Oz./ton
+48	3.4	148	Nil	Nil	Nil
48 x 65	3.2	157	Nil	Nil	Nil
65 x 100	3.3	152	Nil	Nil	Nil
100 x 200	4.7	106	Nil	Nil	Nil
-200	67.4	7	0.02	Nil	0.003
Total or Average	82.0	31	0.02	Nil	0.001

TABLE 30

Gold Recovery by Flotation -- Holitna Riverbar

Tyler Mesh	Conc. Wt. Grams	Ratio of Concentration	Conc. Value Oz./ton	Tails Value Oz./ton	Head Value Oz./ton
28 x 35	1.4	357	Nil	Nil	Nil
35 x 48	1.1	454	Nil	Nil	Nil
48 x 65	2.5	200	Nil	Nil	Nil
65 x 100	3.6	139	0.24	Nil	0.002
100 x 200	7.2	69	0.04	Nil	0.001
200 x -	49.8	10	Nil	Nil	Nil
Total or average	65.6	46	0.02	Nil	0.0004

BEACH DEPOSITS

Samples of beach sands were obtained from Nome, Bristol Bay and Cape Yakataga areas. The Nome and Yakataga samples were single, bulk samples selected from sands known to contain gold for the purposes of this study. The Bristol Bay samples were obtained from a United States Bureau of Mines reconnaissance study for the purpose of determining the valuable mineral constituents.

Nome

This sample, submitted by Mr. Pearce Walsh, was obtained from a natural beach concentrate approximately 2½ miles east of Nome.

The sample was processed during the first phase of the study and the laboratory procedure followed the generalized flowsheet shown in Figure 4 with the effort primarily concerned with gold size distribution.

A size distribution, shown in Table 31, establishes the major amount of material to be in the 28 by 100 mesh range with less than 1% minus 100 mesh.

The sample was subjected to magnetic and electrostatic processes of concentration with the gold recovered by superpanner concentration and amalgamation from the electrostatic concentrate and non-magnetic fraction. Amalgamation was not efficient in the coarser sizes, probably due to an oxide coating on the gold particles. Results of these tests are shown in Table 31, where it is noted that the highest values are in the minus 100 mesh sizes. The gold size distribution is also presented, and it is noted that 73% of the total gold is in the minus 100 mesh material.

Unfortunately, the size of this sample did not allow continued studies to include the processes of recovery by elutriation and flotation methods.

Bristol Bay

These samples, submitted by Mr. Arthur L. Kimball of the United States Bureau of Mines, were obtained from the Bristol Bay shoreline in the general area indicated in Figure 7. Samples 22, 96, 107, 155, and 157 were surface grab samples in areas of black sand concentration, and samples 159 through 165 were channel grab samples along the side of shovel pits. The remainder were obtained as tube samples in the sand layer ranging from 14" to 41" in depth.

Most of the samples were taken from the vicinity of the high tide crest line, and in some cases, samples were combined to lessen the workload in processing.

TABLE 31
Analysis and Distribution of Gold in Nome Beach Sand Sample

Sample Size, Mesh	Sample Size, Weight Percent	Gold Assay Oz./ton	Distribution -20 Mesh Gold Percent	AMALGAMATION RESULTS Gold Amalgamated Mgs.	Gold not Amalgamated Mgs.	Percent Total Gold Amalgamated
-3+14	0.36	0.00	0.00	0.00	0.00	0.00
-14+20	0.82	0.00	0.00	0.00	0.00	0.00
-20+28	4.79	0.00	0.00	0.00	0.00	0.00
-28+35	64.76	0.01	15.35	0.00	3.50	0.00
-35+48	15.21	0.00	0.00	0.00	0.50	0.00
-48+65	6.42	0.01	1.52	0.35	0.20	3.72
-65+100	7.13	0.06	10.15	2.80	0.10	29.76
-100+150	0.44	0.10	1.05	0.30	0.00	3.19
-150+200	0.04	42.43	49.72	1.25	0.00	13.28
-200+270	0.01	91.22	21.38	0.25	0.00	2.66
-270+400	0.01	2.43	0.57	0.10	0.00	1.06
-400+0	0.01	1.09	0.26	0.06	0.00	0.64
Total or average	100.00	0.04	100.00	5.11	4.30	54.31

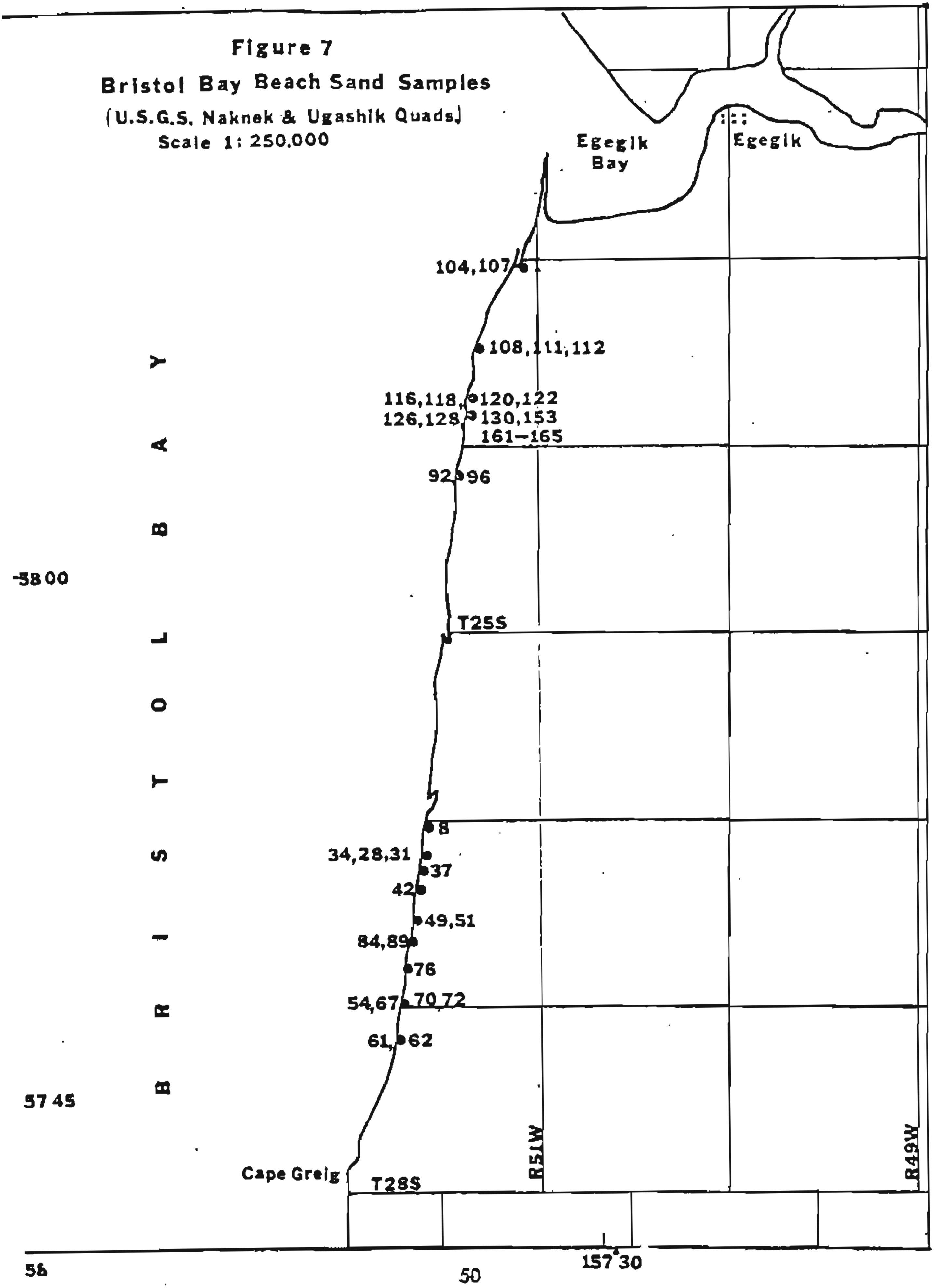


Figure 7
Bristol Bay Beach Sand Samples
(U.S.G.S. Naknek & Ugashik Quads)
Scale 1: 250,000

The primary purpose was to evaluate the samples for gold content, but due to the processing technique used and the mineral constituents, information concerning magnetic components are also presented.

A representative portion of each sample was obtained for screen analysis, the results of which are shown in Table A of the appendix. The bulk of each sample was screened at 28 mesh with the minus 28 mesh material to be used for the subsequent gold flotation tests. Tailings from the flotation tests were treated by electrostatic and magnetic processes with gold analysis conducted on the electrostatic concentrate and the final non-magnetic tailings. This procedure is shown in the flowsheet of Figure 8.

Flotation tests were conducted on 500 gram representative portions of minus 28 mesh material of each sample. This limiting size was selected because it is extremely doubtful that valuable constituents coarser than this size would be present, and any gold recovered would be found in the 28 by 200 mesh range in this type of deposit. Screen analyses indicate that the material is predominantly in the 28 by 100 mesh range with a minor amount finer than 200 mesh.

Table 32 presents the information obtained from the flotation tests. These data indicate that gold was either absent from the sample or was present in insignificant amounts. Due to the lack of fines in the sample, the concentrate yield was small, consequently, the total amount could be analyzed for gold content. Flotation tails were further concentrated by electrostatic and magnetic methods and the products analyzed for gold. The calculated head value concerns only the minus 28 mesh flotations feed, and considers any gold found in the flotation tails.

As in most beach-type deposits, it is noted that those samples containing gold are associated with heavier concentrations of magnetite, ilmenite and garnet as accessory minerals.

Any attempt to analyze the flotation tails for gold poses the same problem as evaluating the original sample. Therefore, it is advisable to further concentrate any free gold left in the flotation tails.

Gold is a good conductor, so will be separated from the bulk silicate material in a high tension electrostatic process. This was accomplished by evaluating the gold content of the thrown product in the electrostatic process and calculating this concentrate value back to a total tail analysis.

These data are shown as concentrate values in Table 33 and as calculated flotation tails in Table 32. Due to the large amount of high iron content silicates that reported

Figure 8

Process Procedure

Bristol Bay Beach Sands

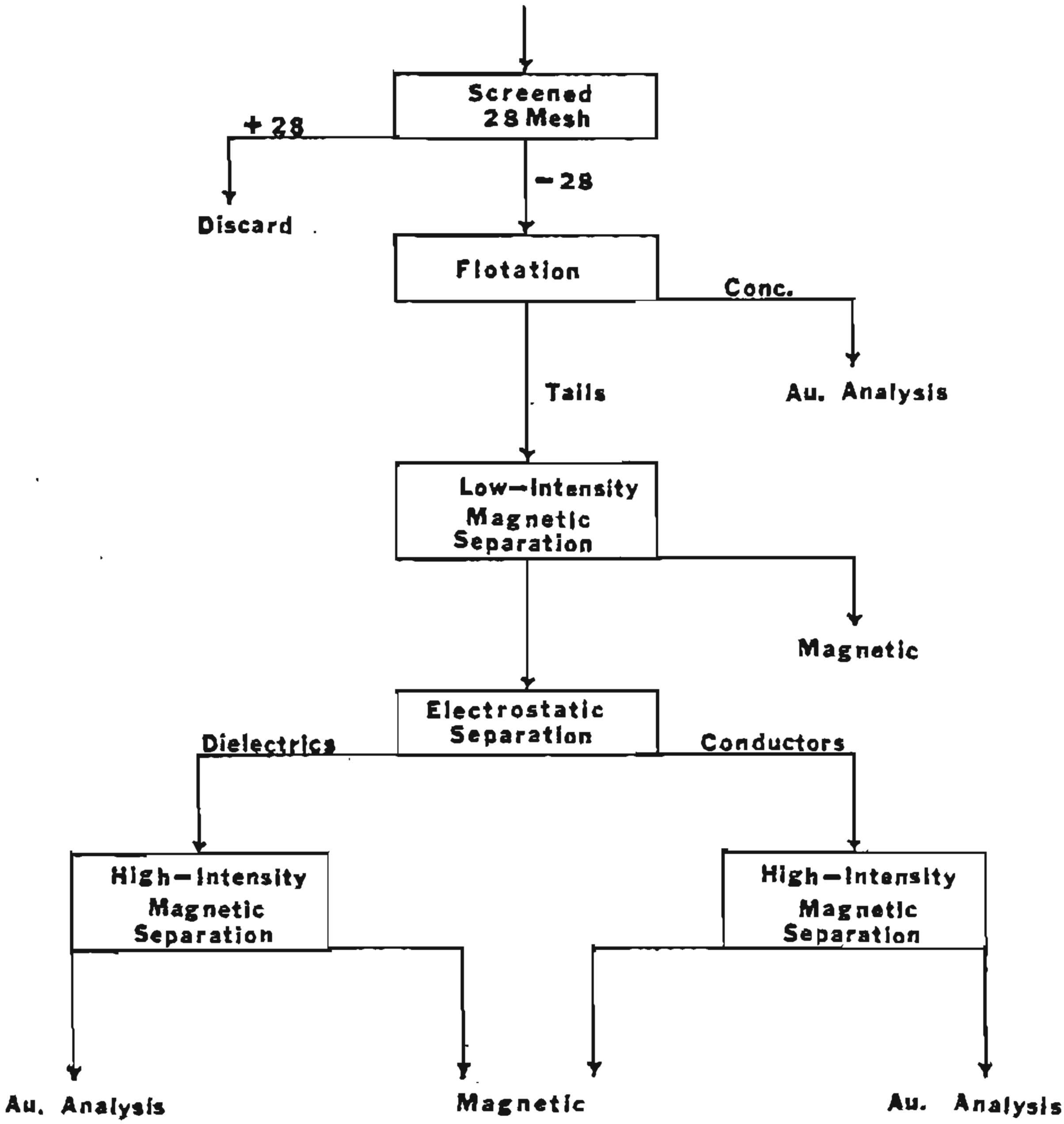


TABLE 32

Gold Flotation, Bristol Bay Beach Sands

Sample No.	Conc. Wt. Grams	Ratio of Concentration	Conc. Value OZ./Ton	Tails Value Oz./ton	Head Value Oz./ton
8	3.3	151	Nil	Nil	Nil
18,26	2.8	177	Trace	0.06	0.006
22	0.3	1666	10.50	Nil	0.006
28	1.4	357	0.43	Nil	0.001
31,34	1.0	500	Nil	Nil	Nil
37A,37B	2.3	220	Nil	Nil	Nil
42	6.3	80	0.05	Nil	0.001
49	10.5	48	Nil	Nil	Nil
51	1.7	290	Nil	Nil	Nil
54	1.0	500	0.29	Nil	0.001
62	1.2	403	Nil	Nil	Nil
67,70,72	0.3	1666	0.94	0.05	0.008
76	0.6	833	Nil	0.06	Nil
84	0.7	714	Nil	Nil	Nil
89	1.1	438	Nil	Nil	Nil
92	0.6	833	Nil	Nil	Nil
96	0.4	1250	12.50	0.23	0.017
104	0.6	833	Nil	Nil	Nil
107	0.3	1666	0.94	0.07	0.001
108,111,112	2.6	192	Trace	Trace	Trace
126,128,130, 133,153	2.7	185	Trace	Trace	Trace
155	0.2	2500	2.49	Trace	0.001
157	1.0	500	1.19	0.03	0.005
159	0.3	1666	Nil	Nil	Nil
161	0.5	1000	Nil	Nil	Nil
162	0.7	714	Nil	Nil	Nil
163	0.7	714	Nil	Nil	Nil
164	0.7	714	Nil	Nil	Nil
165	0.4	1250	0.66	Nil	0.001

TABLE 33
Magnetic and Electrostatic Separations, Bristol Bay Beach Sands

Sample No.	MAGNETIC SEPARATIONS Low Intensity Weight%	MAGNETIC SEPARATIONS High Intensity Weight %	ELECTROSTATIC SEPARATIONS Concentrate Weight	ELECTROSTATIC SEPARATIONS Conc. Value Oz. gold/ton
8	0.7	23.1	17.8	Nil
18,26	16.1	38.3	9.8	0.06
22	66.0	32.3	0.9	Nil
28	8.4	32.8	18.0	Nil
31,34	15.4	34.1	14.4	Nil
37a,37b	3.4	30.9	7.9	Nil
42	6.5	34.3	5.9	Nil
49	1.5	27.8	12.1	Nil
51	1.0	26.3	11.8	Nil
54	13.3	38.2	5.1	Nil
62	2.3	36.1	5.2	Nil
67,70,72	9.9	36.1	14.0	0.05
76	4.6	31.8	3.7	0.06
84	4.1	33.0	2.7	Nil
89	2.6	29.8	8.8	Nil
92	6.7	33.9	1.8	Nil
96	50.2	39.4	3.0	0.23
104	12.5	39.8	2.5	Nil
107	34.9	50.8	0.7	0.07
108,111.112	5.3	28.8	4.2	Trace
116,118 120,122	5.5	38.1	2.8	Nil
126,128,130, 133,153	2.8	38.0	7.7	Trace
155	9.1	63.0	4.6	Trace
157	8.1	50.9	7.6	0.03
159	11.1	49.1	3.4	Nil
161	0.5	28.1	20.4	Nil
162	2.7	37.9	10.1	Nil
163	0.8	26.5	21.3	Nil
164	2.6	23.4	34.9	Nil
165	0.3	35.5	8.6	Nil
Average	10.3	35.6	9.1	Trace

to the electrostatic concentrate, this fraction was further processed by high intensity magnetic separation. The concentrate listed in Table 33 is, therefore, the non-magnetic portion of the electrostatic concentrate.

Magnetic studies consisted of a combination of low intensity and high intensity applications. Low intensity separations were conducted on the flotation tails prior to electrostatic separation. These data, as shown in Table 33, indicate an average of 10.3% magnetite for all samples. Extreme high values of magnetite are usually associated with those grab samples taken in areas of black sand concentration, and are also generally associated with the presence of gold.

The high intensity magnetic fractions, also shown in Table 33, are a combination of high intensity separations from the electrostatic tails and electrostatic concentrates. This material is predominantly iron-magnesium-silicates with ilmenite and garnet usually found in those samples of high magnetite content.

The final non-magnetic tails were also analyzed for gold content with negative results in all cases.

The samples studied proved to contain insignificant amounts of gold, but the evaluation process used is considered to be more accurate than convention methods of either gravity concentration followed by analysis or only analysis of what is hoped to be a representative sample.

The possibility of this area containing magnetite of high enough grade and large enough volume is of interest, but requires considerable further sampling and evaluation.

Yakataga

The investigation on beach sand material from the Yakataga area was conducted in two different phases utilizing entirely different samples. During the course of the first phase investigation, it was found that the gold particles were so thin and flakey that they would float on water up to 28 mesh in particle size.

This posed a question as to the validity of evaluating these types of deposits by using conventional gravity methods of gold recovery. On the basis of the apparent natural floatability of the gold, further study, in the second phase, was undertaken to determine the amenability of the froth flotation process for recovery and evaluation in these types of deposits.

Phase I:

The initial sample consisted of a natural concentration of beach sand from the vicinity of Crooked Creek in the Cape Yakataga area. A screen analysis, Table B of the appendix, indicates a typical beach sand concentrate with the majority of the material in the 28 x 100 mesh range and 1.7% as minus 100 mesh.

Gold recovery as actual particle count in sizes coarser than 150 mesh is shown as Table 34. These are gold particles recovered from superpanner concentration of electrostatic and non-magnetic fractions. The average weight per particle is considerably less than particles of the same size ranges in other types of alluvial deposits.

Table 35 shows the gold size distribution of particles recovered. It is similar to other deposits of this type in that 69% of the gold is finer than 65 mesh. The ability to save this gold by conventional gravity methods is greatly aggravated by its flakey shape as compared to similar particle sizes from creek placers.

Phase II:

For the continuation of this study, Mr. John Kubek submitted a 538 pound bulk sample of natural beach material collected from the high tide line of the Sunrise Fraction #1 Claim in the Yakataga area.

The total sample, as submitted, was thoroughly mixed and split with a riffle splitter into four portions. On the basis that previous investigations had shown no appreciable amount of gold in the plus 28 mesh material, one-quarter split of the sample was screened to give plus and minus 28 mesh sizes. The minus 28 mesh material was then sized into 28/35, 35/48, 48/65, 65/100, 100/150, and -150 mesh fractions.

Flotation studies were conducted on each size fraction to determine the floatability of gold in each size range, reagent selection, reagent concentration and flotation time.

With the information obtained from the sized flotation tests, samples of unsized, minus 28 mesh material were floated by multiple and single stage flotation techniques. The laboratory procedure is shown as Figure 9.

The gold flotation characteristics of each size fraction were investigated in order to determine the variables and their effect on each gold particle size. Tables 36, 37, 38, 39, 40, and 41 show the results of these tests and the calculated head values of the minus 28 mesh flotation feed for each test. These data show the results as obtained for various reagent combination, reagent concentrations and pH conditions.

Although the data as presented is for different reagent conditions, the average results tabulated is fairly consistant for each size fraction. A reagent combination of 0.5# ton of Zanthate 301 and Aerofloat 208 as promoters, with Aerofloat 15 as an

TABLE 34

Gold Recovery, Yakataga I

Tyler Mesh Passed	Tyler Mesh Retained	Particles Recovered	Mg. Weight Per Particle	Free Gold Oz./ton	Assay Value Tails, oz./ton
-	10	-	-	-	Nil
10	14	-	-	-	Nil
14	20	-	-	-	Nil
20	28	1	2.65	0.07	Nil
28	35	44	0.14	0.03	Nil
35	48	100	0.06	0.02	Nil
48	65	419	0.03	0.07	Nil
65	100	547	0.02	0.15	Nil
100	150	1,276	0.01	1.23	Nil
150	200	-	-	-	25.95
200	270	-	-	-	225.45
270	400	-	-	-	22.19
400	-	-	-	-	6.52

TABLE 35

Gold Size Distribution, Yakataga I

Tyler Mesh		Analysis	Percent	Cumulative Distribution	
Passed	Retained	ounces/ton	of size	Retained	Passed
-	10	Nil	0.00	-	-
10	14	Nil	0.00	-	-
14	20	Nil	0.00	-	-
20	28	0.070	3.11	3.11	100.00
28	35	0.030	6.46	9.57	96.89
35	48	0.020	5.87	15.44	90.43
48	65	0.070	15.82	31.26	84.56
65	100	0.150	11.74	43.00	68.74
100	150	1.230	14.69	57.69	57.00
150	200	25.950	18.50	76.19	42.31
200	270	225.450	20.09	96.28	23.81
270	400	22.190	1.98	98.26	3.72
400	Pan	6.520	1.74	100.00	1.74
Total or average		0.112	100.00		

Figure 9

Laboratory Procedure

Yakataga II

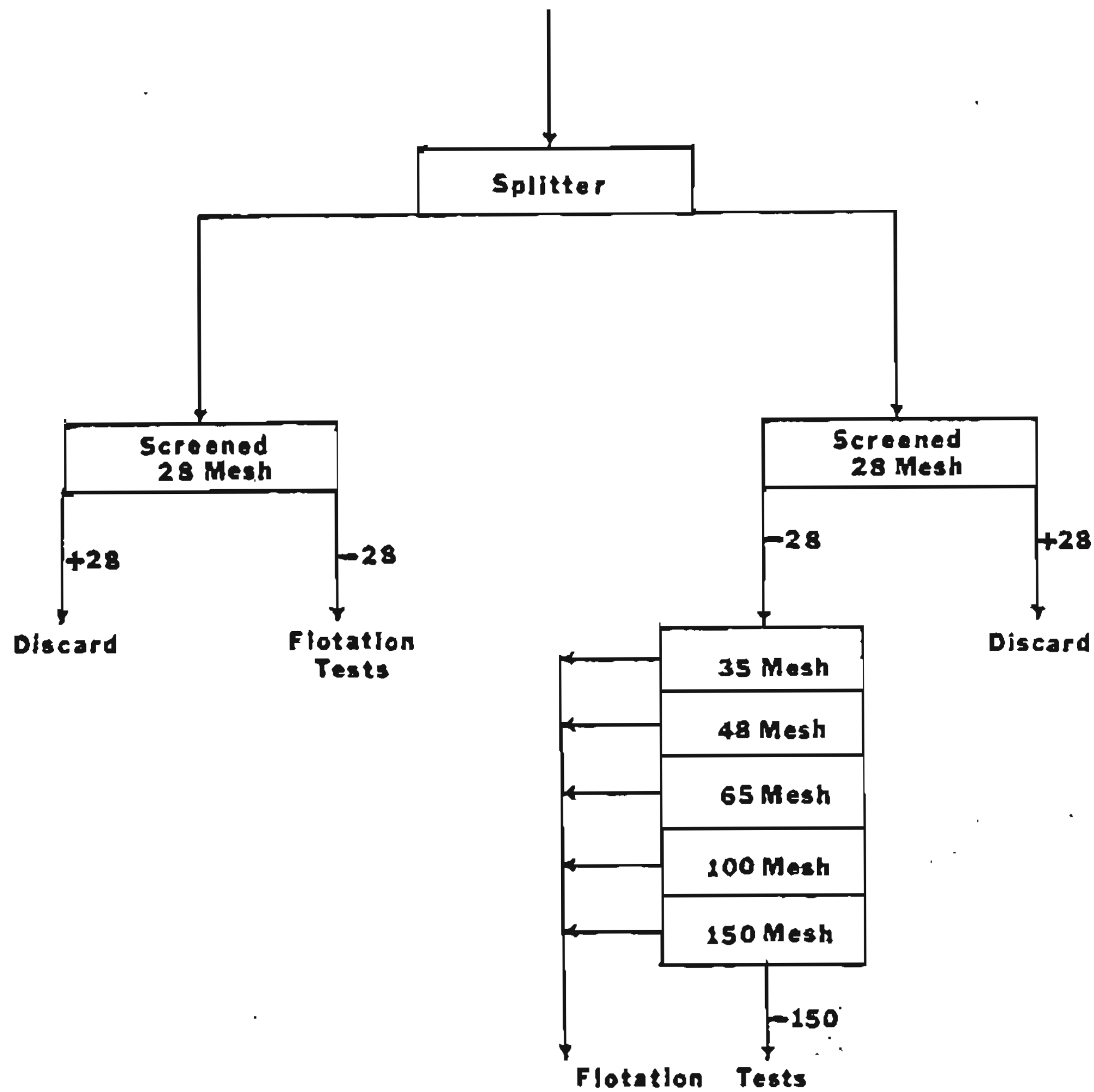


TABLE 36

Flotation, 28/35 Mesh, Yakataga II

Test No.	Conc. Wt. Grams	Conc. Grade oz/ton	Ratio of Concentration	Calc. Head oz./ton
1	0.35	20.86	1428	0.02
2	0.81	3.61	620	0.01
3	0.76	9.99	657	0.02
4	0.75	15.48	663	0.02
5	0.63	9.30	797	0.01
6	0.83	Nil	599	Nil
7	0.68	2.15	737	0.003
8	0.88	11.21	566	0.02
9	1.12	0.78	477	0.002
10	1.34	2.82	372	0.01
Total or average	8.15	6.29	613	0.01

TABLE 37

Flotation, 35/48 Mesh, Yakataga II

Test No.	Conc. Wt. Grams	Conc. Grade oz./ton	Ratio of Concentration	Calc. Head oz./ton
1	0.34	115.80	1470	0.08
2	0.67	82.70	746	0.11
3	0.53	96.30	943	0.10
4	0.71	41.90	704	0.06
5	0.65	80.76	769	0.11
6	0.38	101.31	1315	0.08
7	1.24	48.21	403	0.12
8	0.68	45.03	735	0.06

TABLE 37, Cont.

Flotation, 35/48 Mesh, Yakataga II

Test No.	Conc. Wt. Grams	Conc. Grade oz./ton	Ratio of Concentration	Calc. Head oz./ton
c				
9	0.81	90.01	617	0.15
Total or average	6.01	70.86	749	0.10

TABLE 38
Flotation, 48/65 Mesh, Yakataga II

Test No.	Conc. Wt. Grams	Conc. Grade oz./ton	Ratio of Concentration	Calc. Head oz/ton
1	0.30	934.28	1666	0.56
2	0.59	474.57	847	0.56
3	0.73	385.55	685	0.56
4	0.90	280.32	556	0.50
5	0.73	363.58	685	0.53
6	0.76	362.66	658	0.55
7	0.79	323.04	633	0.51
8	0.93	327.41	537	0.61
9	0.84	290.96	595	0.49
10	0.96	265.83	521	0.51
11	1.26	203.23	397	0.51
12	0.80	300.77	625	0.48
Total or av.	9.59	332.75	626	0.53

TABLE 39
Flotation 65/100 Mesh, Yakataga II

Test No.	Conc. Wt. Grams	Conc. Grade oz./ton	Ratio of Concentration	Calc. Head oz./ton
1	1.64	536.19	304	1.77
2	1.76	536.09	294	1.89
3	2.19	300.31	228	1.32
4	1.93	361.17	259	1.39
5	1.57	378.97	318	1.19
Total or average	9.09	415.03	275	1.51

TABLE 40

Flotation, 100/150 Mesh, Yakataga II

Test No.	Conc. Wt. Grams	Conc. Grade oz./ton	Ratio of Concentration	Calc. Head oz./ton
1	3.16	484.10	158	3.06
2	2.29	392.57	166	2.36
Total or average	5.45	445.64	161	2.77

TABLE 41

Flotation, -150 Mesh, Yakataga II

Test No.	Conc. Wt. Grams	Conc. Grade oz./ton	Ratio of Concentration	Calc. Head oz./ton
1	17.53	21.22	8	2.65

additional frother appeared to give the best results. This was accomplished in a neutral circuit as the addition of soda ash for pH regulation has no advantageous effect.

Table 42 indicates the compiled flotation results by size fractions as calculated from the optimum reagent conditions. It is noted from this data that an average grade of 0.39 ounces per ton of gold is indicated for the minus 28 mesh material.

Stage flotation tests were conducted on two unsized minus 28 mesh samples. In this procedure, 0.1#/ton of reagents were used in each stage to determine the optimum reagent concentration. Results of these tests are shown in Tables 43 and 44. These data show calculated head values of 0.37 and 0.41 ounces of gold per ton of minus 28 mesh feed which is comparable with the 0.39 ounces per ton calculated from the size fraction flotation tests.

Two additional unsized minus 28 mesh samples were tested in a single stage approach to see if the results were compatible with the multiple stage procedure. The results are as follows:

Test No.	Conc. Wt. Grams	Conc. Grade Oz./ton	Ratio of Concentration	Calc. Head Oz./ton
3	1.23	135.27	407	0.33
4	0.81	184.53	614	0.30

The four unsized samples were subjected to the laboratory procedure shown in Figure 8 to determine gold loss in the flotation tailings and the amount of auxilliary minerals present. The electrostatic concentrate and the non-magnetic tailings were analyzed for gold content. The non-magnetic tailings were free of gold, and the total gold evaluation is shown as follows:

Test No.	Flotation Conc. Oz./ton	Electrostatic Conc. oz./ton	Calc. Head oz./ton	% Recovery by floatation
1	56.55	Nil	0.37	100.0
2	77.58	0.36	0.42	97.6
3	135.27	0.72	0.35	94.3
4	184.53	2.38	0.35	85.7

The above data verifies that by controlled flotation techniques, 98-100% gold recovery can be obtained from this type of deposit. The lower recoveries, shown for tests 3 and 4, are probably due to mechanically-entrapped gold particles in the flotation cell which were not recovered in a single stage approach.

The percentage of low intensity magnetic concentrate, electrostatic concentrate and high intensity magnetic concentrate recovered during processing of the four unsized samples are as follows:

Sample No.	Low Intensity Weight %	Electrostatic Weight %	High Intensity Weight %
1	4.0	3.5	44.1
2	4.0	5.6	39.0
3	3.9	3.9	36.3
4	4.0	4.0	44.2
Average	4.0	4.2	40.9

The low-intensity magnetic products is magnetite, the electrostatic concentrate is primarily ilmenite, and the high intensity magnetic product is a combination of garnet and iron-magnesium silicates. A minor amount of zircon is also present.

TABLE 42

Compilation, Size Flotation, Yakataga II

Mesh Size	Weight % Flotation Feed	Calculated Head oz/ton	Product Wt. x Grade
28/35	29.9	0.02	0.60
35/48	34.2	0.10	0.34
48/65	24.8	0.61	15.13
65/100	7.9	1.89	14.93
100/150	2.8	2.36	6.61
-150	0.4	2.65	1.06
Total or average	100.00	0.39	38.67

TABLE 43

Stage Flotation, Yakataga II

Stage No.	Conc. Wt. Grams	Conc. Grade oz./ton	Ratio of Concentration	Calc. Head oz./ton
1	0.60	43.29	829	0.29
2	0.78	14.96	641	0.02
3	0.75	26.16	669	0.04
4	0.64	5.48	782	0.01
5	0.54	10.76	923	0.01
Total or aver.	3.31	56.55	151	0.37

TABLE 44

Stage Flotation, Yakataga II

Stage No.	Conc. Wt. Grams	Conc. Grade oz./ton	Ratio of Concentration	Calc. Head oz./ton
1	0.60	222.66	839	0.27
2	0.38	146.60	1323	0.11
3	0.52	20.35	969	0.02
4	0.46	13.29	1085	0.01
5	0.69	Nil	725	Nil
Total or average	2.64	77.58	189	0.41

OFF-SHORE DEPOSITS

Selected off-shore samples from the Bristol Bay area were obtained from the Institute of Marine Science of the University of Alaska. Sample locations are shown in Figure 10.

These are grab samples obtained off the bay floor by a Shipek sampling device with the capability of a maximum 10 centimeter sampling depth. Consequently, the information obtained is not valid for deposit evaluation purposes, but is usable in studying the nature of gold particles present. Size distribution of the samples are shown in Tables 45-50 inclusively.

The sample designated as B7 was found to contain no evidence of gold in any size fraction. From the screen analysis, the sample was found to be predominantly sand with 99% coarser than 65 mesh. Table 45 presents the sink-float analysis of this sample in which 8.52% is heavier than a 2.96 specific gravity.

Sample D10 was found to be primarily sand more typical of a beach sand material in size analysis with minor amounts of fine material in the minus 200 mesh fractions. The sink-float analysis, shown in Table 46, also verifies that a certain degree of concentration has taken place with gold present only in the minus 270 mesh material. Gold value of the head sample is calculated at 0.000028 ounces per ton.

A sample obtained from considerably farther off-shore, designated E8, was found to contain a greater amount of fine material. A screen analysis shows 73% of this material to be minus 100 mesh in size. This sample did not contain as much heavy material as sample D10, but the sink-float analysis, Table 47, shows a higher gold content. The gold is found in the minus 270 mesh sizes and has a calculated head value of 0.0118 ounces per ton.

Sample E12 contained only trace amounts of gold (less than 0.01 ounces/ton) in the 48 by 100 mesh sizes. The screen analysis indicates a typical beach sand with the major percentage of material in the 28 by 150 mesh range. The sink-float analysis, Table 48, shows approximately 9% of the material to be a heavy fraction.

Sample E13 was composed primarily of plus 48 mesh material with no evidence of gold in any size fraction. As seen from the sink-float analysis, Table 49, only 3% was heavier than 2.96 specific gravity.

Sample G15 contained a calculated head analysis of 0.035 ounces of gold per

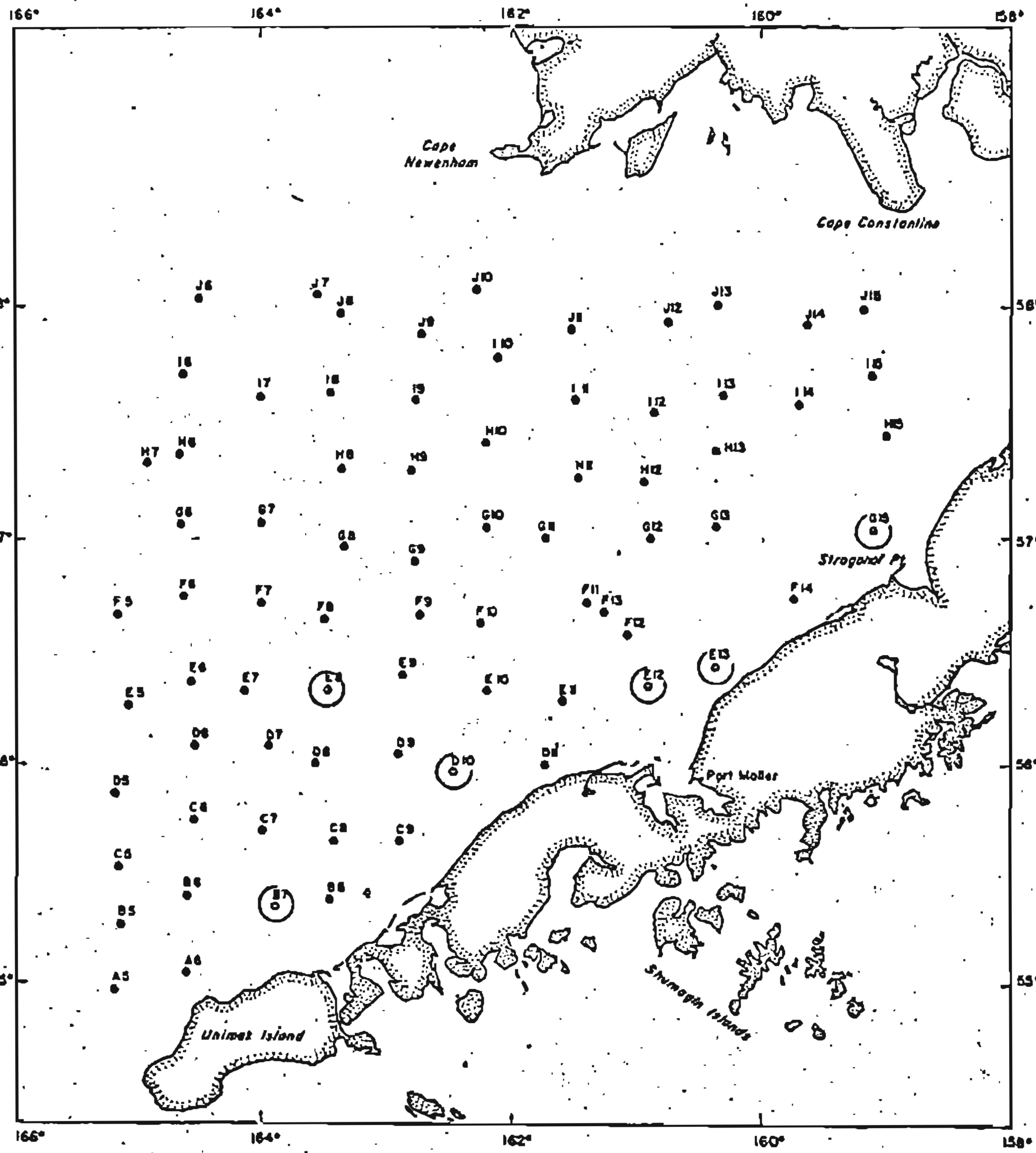


Figure 10

Off-Shore Sample Locations

Institute Of Marine Science

University Of Alaska

TABLE 45
Analysis and Distribution of Gold in Off-Shore Sample B7

Sample Size Mesh	Sample Size Weight Percent	Gold Assay Oz./ton	Distribution -20 Mesh Gold Percent	SINK-FLOAT ANALYSIS WEIGHT PERCENT Float	Sink	GOLD ASSAY OUNCES/TON Float	Sink
-3+20	58.42	Nil	-	1/			
-20+28	23.26	Nil	-	55.01	1.94	Nil	Nil
-28+35	9.38	Nil	-	20.32	2.27	Nil	Nil
-35+48	5.15	Nil	-	9.75	2.64	Nil	Nil
-48+65	2.54	Nil	-	4.44	1.67	Nil	Nil
-65+100	0.56	Nil	-	1.32	1/	Nil	1/
-100+150	0.12	Nil	-	0.29	1/	Nil	1/
-150+200	0.09	Nil	-	0.21	1/	Nil	1/
-200+270	0.06	Nil	-	0.13	1/	Nil	1/
-270+400	0.07	Nil	-	0.17	1/	Nil	1/
-400+0	0.35	Nil	-	0.84	1/	Nil	1/
Total or average	100.00	Nil	-	92.48	8.52		

1/ Plus 20 mesh and minus 65 mesh fractions not sink-floated.

TABLE 46

Analysis and Distribution of Gold in Off-Shore Sample D10

Sample Size Mesh	Sample Size Weight Percent	Gold Assay Oz./ton	Distri-bution -28 Mesh Gold Percent	SINK-FLOAT ANALYSIS WEIGHT PERCENT Float	SINK-FLOAT ANALYSIS WEIGHT PERCENT Sink	SINK-FLOAT ANALYSIS GOLD ASSAY OUNCES/TON Float	SINK-FLOAT ANALYSIS GOLD ASSAY OUNCES/TON Sink
-3+28	4.59	Nil	0.00	1/			
-28+35	4.45	Nil	0.00	4.53	0.14	Nil	Nil
-35+48	13.11	Nil	0.00	12.91	0.84	Nil	Nil
-48+65	43.23	Nil	0.00	41.80	3.49	Nil	Nil
-65+100	26.59	Nil	0.00	22.62	5.24	Nil	Nil
-100+150	6.31	Nil	0.00	3.53	3.09	Nil	Nil
-150+200	1.46	Nil	0.00	1.53	1/	Nil	1/
-200+270	0.18	Nil	0.00	0.20	1/	Nil	1/
-270+400	0.05	0.030	51.02	0.06	1/	0.030	1/
-400+0	0.03	0.048	48.98	0.02	1/	0.048	1/
Total or average	100.00	Trace	100.00	87.20	12.80	0.001	Nil

1/ Plus 28 mesh and minus 150 mesh fractions not sink-floated.

TABLE 47
Analysis and Distribution of Gold in Off-Shore Sample E8

Sample Size Mesh	Sample Size Weight Percent	Gold Assay Oz./ton	Distribution -48 Mesh Gold Percent	Sink-Float Analysis: Weight Percent Float	Sink-Float Analysis: Weight Percent Sink	Sink-Float Analysis: Gold Assay Ounces/Ton Float	Sink-Float Analysis: Gold Assay Ounces/Ton Sink
-3+28	0.14	Nil	0.00	1/			
-28+35	0.21	Nil	0.00	1/			
-35+48	0.93	Nil	0.00	1/			
-48+65	6.81	Nil	0.00	6.80	0.10	Nil	Nil
-65+100	19.14	Nil	0.00	18.79	0.60	Nil	Nil
-100+150	18.28	Nil	0.00	17.56	0.95	Nil	Nil
-150+200	28.39	Nil	0.00	27.52	1.22	Nil	Nil
-200+270	10.84	Nil	0.00	9.77	1.22	Nil	Nil
-270+400	8.11	0.037	67.73	6.95	1.28	0.012	0.173
-400+0	7.15	0.020	32.27	7.24	1/	0.020	1/
Total or average	100.00	0.012	100.00	94.63	5.37	Trace	0.032

1/ Plus 65 mesh and minus 400 mesh fractions not sink-floated.

TABLE 48
Analysis and Distribution of Gold in Off-Shore Sample E 12

Sample Size Mesh	Sample Size Weight Percent	Gold Assay Oz./ton	Distribution -20 Mesh Gold Percent	SINK-FLOAT ANALYSIS: WEIGHT PERCENT Float	SINK-FLOAT ANALYSIS: WEIGHT PERCENT Sink	SINK-FLOAT ANALYSIS: GOLD ASSAY OUNCES/TON Float	SINK-FLOAT ANALYSIS: GOLD ASSAY OUNCES/TON Sink
-3+20	0.44	Nil	-	1/			
-20+28	3.76	Nil	-	3.75	0.02	Nil	Nil
-28+35	13.97	Nil	-	13.72	0.31	Nil	Nil
-35+48	38.63	Nil	-	36.64	2.15	Nil	Nil
-48+65	23.61	Trace	-	20.88	2.85	Nil	Trace
-65+100	12.84	Trace	-	10.77	2.13	Nil	Trace
-100+150	5.51	Nil	-	4.13	1.40	Nil	Nil
-150+200	1.11	Nil	-	1.12	1/	Nil	1/
-200+270	0.09	Nil	-	0.09	1/	Nil	1/
-270+400	0.03	Nil	-	0.03	1/	Nil	1/
-400+0	0.01	Nil	-	0.01	1/	Nil	1/
Total or average	100.00	Trace	-	91.14	8.86	Nil	Nil

1/ Plus 20 mesh and m inus 150 mesh fractions not sink-floated.

TABLE 49
Analysis and Distribution of Gold in Off-Shore Sample E 13

Sample Size Mesh	Sample Size Weight Percent	Gold Assay Oz./ton	Distribution -20 Mesh Gold Percent	SINK-FLOAT ANALYSIS WEIGHT PERCENT Float	Sink	GOLD ASSAY OUNCES/TON Float	Sink
-3+8	34.92	Nil	-	1/			
-8+10	17.66	Nil	-	1/			
-10+14	17.84	Nil	-	1/			
-14+20	13.46	Nil	-	1/			
-20+28	9.78	Nil	-	58.88	1.86	Nil	Nil
-28+35	4.02	Nil	-	23.46	1.51	Nil	Nil
-35+48	1.48	Nil	-	9.22	1/	Nil	1/
-48+65	0.49	Nil	-	3.01	1/	Nil	1/
-65+100	0.16	Nil	-	1.00	1/	Nil	1/
-100+150	0.08	Nil	-	0.47	1/	Nil	1/
-150+200	0.05	Nil	-	0.29	1/	Nil	1/
-200+270	0.03	Nil	-	0.15	1/	Nil	1/
-270+400	0.02	Nil	-	0.11	1/	Nil	1/
-400+0	0.01	Nil	-	0.04	1/	Nil	1/
Total or average	100.00	Nil	-	96.63	3.37	Nil	Nil

1/ Plus 20 mesh and minus 35 mesh fractions not sink-floated.

TABLE 50
Analysis and Distribution of Gold in Off-Shore Sample G 15

Sample Size Mesh	Sample Size Weight Percent	Gold Assay Oz./ton	Distribution -20 Mesh Gold Percent	SINK-FLOAT ANALYSIS WEIGHT PERCENT Float	Sink	GOLD ASSAY OUNCES/TON Float	Sink
-3+20	5.71	Nil	0.00	1/			
-20+28	9.85	Nil	0.00	10.33	0.12	Nil	Nil
-28+35	15.54	Nil	0.00	16.20	0.29	Nil	Nil
-35+48	32.64	0.004	73.93	33.54	1.06	Nil	0.13
-48+65	27.55	0.001	13.20	26.76	2.46	Nil	0.01
-65+100	7.47	0.030	12.87	5.93	2.00	Nil	0.12
-100+150	1.07	Nil	0.00	1.13	1/	Nil	1/
-150+200	0.12	Nil	0.00	0.13	1/	Nil	1/
-200+270	0.02	Nil	0.00	0.02	1/	Nil	1/
-270+400	0.02	Nil	0.00	0.02	1/	Nil	1/
-400+0	0.01	Nil	0.00	0.01	1/	Nil	1/
Total or average	100.00	0.035	100.00	94.07	5.93	Nil	0.03

1/ Plus 20 mesh and minus 100 mesh fractions not sink-floated.

ton. The gold was coarser than the other off-shore samples and found in the 35 by 100 mesh ranges, as shown in the sink-float analysis of Table 50. The sample material was also coarser and similar to a typical beach sand with predominantly 28 by 100 mesh material.

GOLD SIZE, SHAPE FACTORS and RECOVERY PROBLEMS

Gold Characteristics

As would be expected, gold from each deposit category had certain characteristics developed from processes of erosion and transportation by water action. These physical characteristics were studied by microscopic measurements of gold particles in the plus 100 mesh sizes in which Corey's shape factor is a ratio of the thickness of a particle to the square foot of the surface area. These data are presented in Table 51.

In the creek placer deposits, some comparative interpretation may be made as to how far the gold has traveled from its original source by the amount of flattening that has occurred. For example, the Chicken Creek, Chandalar and Livengood head samples the shape factors averaged 0.65, 0.53, and 0.29 respectively. When comparing creek deposits, river bar deposits, the ratio is seen to decrease drastically.

A comparision of shape factors for the Chandalar head and tailing samples indicates that some of the gold recovered in the tailings has had considerable flattening and that in the 48/65 mesh size particles with the same shape factor of 0.39 were found in both head and tails. The latter point suggests that the recovery of gold below 65 mesh is questionable, especially with a shape factor below 0.40.

The Livengood gold is considerably flatter than the Chandalar gold, and comparision of head and tail specimens suggest that recovery efficiency drops off when the shape factor is below 0.25.

Shape factor measurements of the jig concentrates from Tofty and Fairhaven samples indicates that a jig is superior to sluice boxes for recovery of fine gold that has a low shape factor.

Creek Deposits

Of the four types of alluvial deposits considered in this report, creek placers present the most variables to be considered for purposes of evaluation and recovery of the total gold content.

Depending upon the distance from the lode source and the gradient of the carrying stream, the gold can be fairly coarse with a minimum of fines, fairly fine with a minimum of coarse or some combination of two extremes. Tables 52 and 53

TABLE 51

Corey's Shape Factor for Gold Particles

	TYLER MESH SIZE					
Sample	20/28	28/35	35/48	48/65	65/100	100/150
Chandalar, Head	0.56	0.51	0.56	0.39	0.65	-
Chandalar, Tails	0.09	0.22	0.26	0.39	0.37	-
Livengood, Head	0.23]	0.31	0.31	0.33	-	-
Livengood, Tails	0.16	-	0.17	0.19	0.25	-
Chicken Creek, Flat	-	0.64	0.69	0.68	0.60	-
Willow Creek, Flat	-	-	0.41	0.51	-	-
Willow Creek, Flat	-	-	0.40	0.51	0.68	-
Tofty	-	0.22	0.13	0.16	0.22	-
Fairhaven	0.32	0.22	0.32	0.40	0.58	-
Kuskokwim	-	-	-	-	0.68	-
Holitna	-	0.09	0.12	0.15	0.15	-
Yakataga I	0.14	0.08	0.10	0.09	0.09	0.11

TABLE 52

Screen Analysis of Gold Recovered from Tobin Creek, Chandalar Area

Tyler Mesh		Weight	Weight	Cumulative Weight %	
Passed	Retained	Grams	Percent	Retained	Passed
3	8	3,237	11.99	11.99	100.00
8	20	16,493	61.10	73.09	88.01
20	35	6,257	23.18	96.27	26.91
35	48	652	2.42	98.69	3.73
48	65	276	1.02	99.71	1.71
65	100	59	0.22	99.93	0.29
100	150	17	0.06	99.99	0.07
150	0	1	0.01	100.00	0.01
TOTAL		26,992	100.00		

TABLE 53

Screen Analysis of Gold Recovered from Ready Bullion Creek, Fairbanks Area

Tyler Mesh		Weight	Weight	Cumulative Weight %	
Passed	Retained	Grams	Percent	Retained	Passed
3	8	0.0	0.00	0.00	100.00
8	20	43.6	10.32	10.32	100.00
20	35	141.6	33.51	43.83	89.68
35	48	113.4	26.85	70.68	56.17
48	65	78.6	18.61	89.29	29.32
65	100	32.4	7.67	96.96	10.71
100	150	8.9	2.11	99.07	3.04
150	0	3.9	0.93	100.00	0.93
TOTAL		422.4	100.00		

show screen analyses of gold recovered from two small scale placer operations. The gold from Tobin Creek is considerably coarser with 73% beingin the plus 20 mesh sizes as compared to 10% in the Ready Bullion sample. These data also indicate 0.3% and 10.7%, respectively in the minus 65 mesh sizes. Although retention of minus 65 mesh gold is to some degree a function of recovery efficiency, it is also indicative of the characteristics of the carrying stream.

To illustrate this point further, Tables 54 and 55 give average screen analyses of gold recovered from Upper Goldstream Creek and Lower Goldstream Creek as designated by the area dredged on this creek. It is noted from these tables that within a distance of approximately four miles, the gold size distribution has changed considerably. The physical dimensions of the gold particles may also be accompanied by any shape factor between the extremes of one and zero.

The major difficulty, however, arises from the fact that the unconsolidated matrix is composed of material that can range from large boulders to extremely fine clay-like sediments both of which present obstacles to the recovery of fine gold. In the conventional small scale sluice box operations, the higher velocity of water necessary to move coarse gravel, the inability to break up clay balls or the high slurry pulp density caused by recirculation of water are recognized hazards to gold recovery. Unfortunately, economics have discouraged operators from experimenting or elaborating on recovery systems and they are usually content to recover the coarser gold.

Larger operations employing screening devises for removal of coarse gravel, methods of breaking up clay balls and jigs to aid concentration are more successful in fine gold recovery, but still suffer gold losses due to the inadequacy of the system. As evaluation procedures usually involved gravity methods comparable in efficiency to the recovery methods contemplated, a true evaluation of fine gold content and the economic feasibility of recovery is not known.

Generally speaking, indications are that creek placers should contain 15% to 25% of the gold as minus 100 mesh particles, but screen analysis of gold recoveries from selected placer operations show that the minus 100 mesh gold represents 0% to 5% of the recovered product. When considering the many variables that could effect gold recovery in the conventional creek placer mining operation, it is extremely doubtful that recovery systems are applicable to gold particles less than 65 mesh in

TABLE 54

Screen Analysis of Gold Recovered from Upper Goldstream Creek

Tyler Mesh Passed	Tyler Mesh Retained	Weight Percent	Cumulative Weight % Retained	Cumulative Weight % Passed
3	8	0.00	0.00	100.00
8	20	6.59	6.59	100.00
20	28	26.03	32.62	93.41
28	35	41.12	73.74	67.38
35	65	17.11	90.85	26.26
65	100	7.63	98.48	9.15
100	-	1.52	100.00	1.52
TOTAL		100.00		

TABLE 55

Screen Analysis of Gold Recovered from Lower Goldstream Creek

Tyler Mesh Passed	Tyler Mesh Retained	Weight Percent	Cumulative Weight % Retained	Cumulative Weight % Passed
3	8	0.00	0.00	100.00
8	20	0.37	0.37	100.00
20	28	7.42	7.79	99.63
28	35	25.47	33.26	92.21
35	65	34.79	68.05	66.74
65	100	25.94	93.99	31.95
100	-	6.01	100.00	6.01
TOTAL		100.00		

size.

River Bar Deposits

The physical characteristics of gold particles in river bar samples is dependent upon the velocity and turbidity of the transporting waters. This is evident in the shape factors shown in Table 51.

Matrix material in these deposits is considerably different from the creek placers in that the extreme sizes are not present. Depending upon the velocity of the stream, the top size is relatively small and sediments below 200 mesh are usually negligible.

Because of the size and shape factor of the gold particles, efficient valuation and recovery of gold particles cannot be accomplished by gravity methods. Proper sizing techniques followed by froth flotation offers an acceptable solution for both evaluation and recovery purposes.

Beach Deposits

The evaluation and recovery of gold from beach sand deposits pose three basic problems that are generally not inherent in the other general types of alluvial materials:

1. The gold content is less homogeneous, or confined to channels, due to the erratic forces of nature that contribute to concentrations of precious metals and heavy minerals. These are wind and wave action and long shore currents.

2. The extremely flat character of the gold particles, see Table 51, are not conducive to recovery by gravity methods.

3. A much larger concentration of high specific gravity minerals are present.

Analysis of the gold content cannot be determined with any degree of accuracy unless effective concentration can be obtained. This concentration cannot be made by further gravity methods without a substantial gold loss.

The investigations conducted for this report show that the froth flotation process can be used as a method of gold recovery for these deposits. The same technique should also then be used in determining the gold content in an evaluation program.

In evaluating the Yakataga sample, a gold value of approximately 0.39 ounces per ton of minus 28 mesh material is shown with 95-100% recovery by flotation. This was obtained by scalping off 47.1% of the run of mine, plus 28 mesh material as non gold bearing.

Deposits of this type usually contain other potentially valuable constituents such as magnetite, ilmenite and zircon which are also predominantly retained as minus 28 mesh products. A suggested flowsheet for evaluation and recovery processes, shown in Figure 11, includes a combination of sizing, flotation, gravity, electrostatic and magnetic processes.

Off-Shore Deposits

Gold in off-shore deposits may be derived from a local source, from streams transporting to the coastline, from drowned placers or from reconcentrated drowned placers. It is possible then, that these deposits may have any combination of problems inherent in the other three types.

The problems and cost of obtaining a sample of alluvial material from the ocean floor, which is homogeneous as to liberated gold content, are more pronounced than for land-based operations. By the same token, it appears that evaluation should consider the total size range and methods applicable to the recovery of gold in fine sizes and/or of deterrent shape factors.

CONCLUSIONS

In the course of this study, fifty-three samples of alluvial material were processed to determine the size distribution of gold particles, expected losses by conventional recovery methods and accuracy of analysis and evaluation techniques.

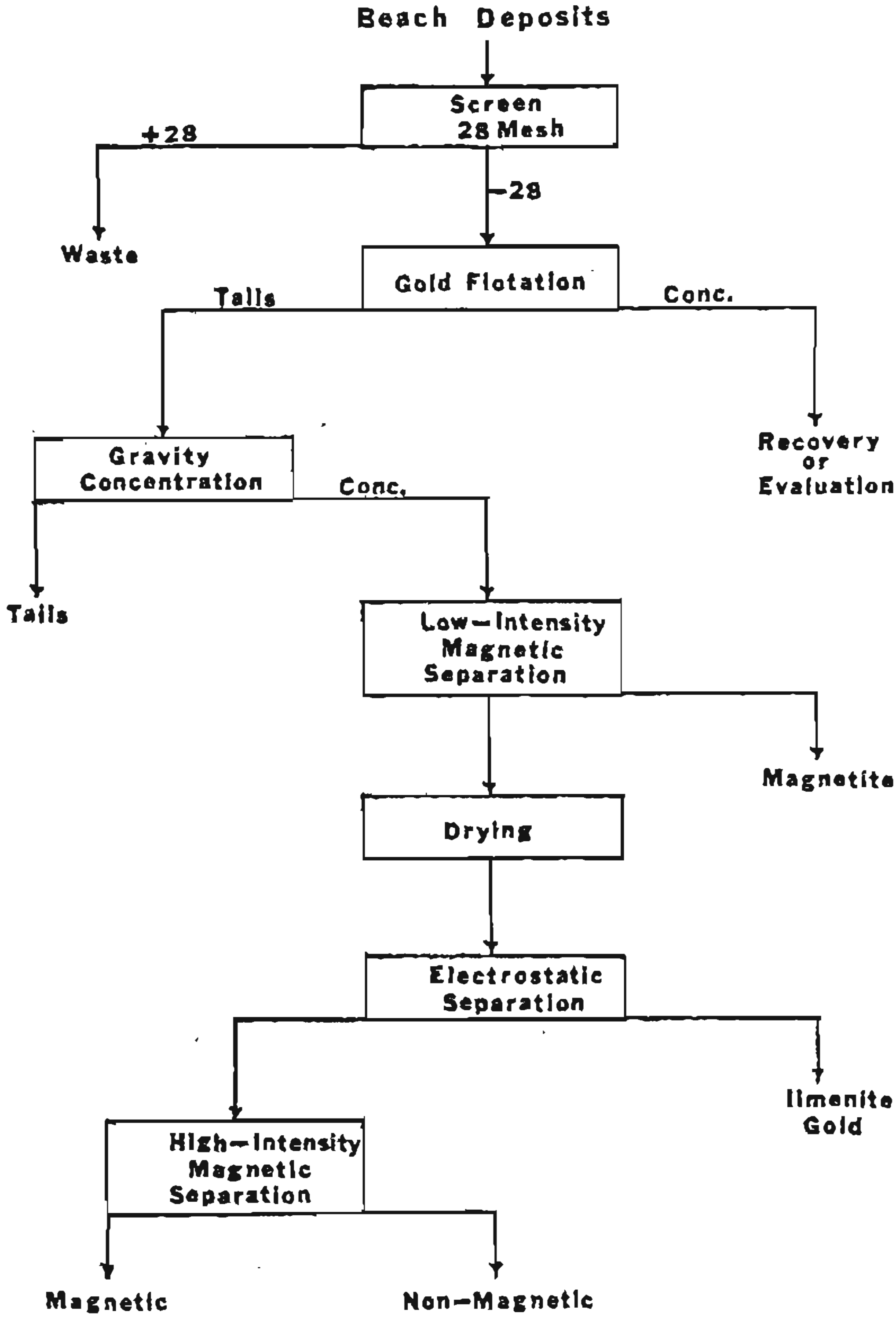
The samples were selected to represent not only a geographical distribution, but also to cover those types of deposits in which changes could be expected in the physical character of the gold. Consequently, samples were grouped into the general categories of creek deposits, river bar deposits, beach deposits and off-shore deposits.

Sampling, analysis and recovery of alluvial material in which the element desired is in a liberated state, and composed of a wide range of sizes, involves specialized processing techniques. These require cognizance of the non-homogeneity of the deposit, the wide range of particle size possible in the matrix material, and the possibility of losing fine and/or flakey particles by the gravity methods in current use.

Deposits which contain a more concentrated size distribution of matrix material

Figure 11

Evaluation & Recovery Procedure



present less problems in the procedure used in this study. For this reason, it is recommended that further study be applied to evaluation of beach deposit material from known gold containing areas such as Nome, Yakataga and Yakatat. Representative samples of the deposits should be evaluated by concentration methods that assure complete gold recovery in all size ranges. This is best accomplished under controlled laboratory conditions, but a small portable field unit could be designed for this purpose.

Applications to creek and off-shore deposits would be more complex because of the wide range of matrix sizes encountered. Further studies in these areas should be confined to evaluation of drill hole samples by a combination of flotation and gravity methods and design of a recovery system capable of economically processing minus 65 mesh material separately from the coarser sizes.

APPENDIX

TABLE A
Screen Analysis, Bristol Bay 8

Tyler Mesh		Weight	Weight	Cumulative Weight%	
Passed	Retained	Grams	Percent	Retained	Passed
-	20	585	61.4	61.4	100.0
20	28	92	9.6	71.0	38.6
28	35	80	8.4	79.4	29.0
35	48	114	11.9	91.3	20.6
48	65	65	6.8	98.1	8.7
65	100	17	1.8	99.9	1.9
100	150	1	0.1	100.0	0.1
150	200	0	0.0	0.0	0.0
200	-	0	0.0	0.0	0.0
TOTALS		954	100.0		

Screen Analysis, Bristol Bay 18 & 26

-	20	70	7.2	7.2	100.0
20	28	101	10.4	17.6	92.8
28	35	144	14.8	32.4	82.4
35	48	294	30.3	62.7	67.6
48	65	244	25.1	87.8	37.3
65	100	104	10.7	98.5	12.2
100	150	12	1.2	99.7	1.5
150	200	0	0.0	99.7	0.3
200	-	3	0.3	100.0	0.3
TOTALS		972	100.0		

TABLE A

Screen Analysis, Bristol Bay 22

Tyler Mesh		Weight	Weight	Cumulative Weight %	
Passed	Retained	Grams	Percent	Retained	Passed
-	20	0	0.0	0.0	100.0
20	28	0	0.0	0.0	100.0
28	35	3	0.2	0.2	100.0
35	48	316	21.1	21.3	99.8
48	65	917	61.2	82.5	78.7
65	100	251	16.7	99.2	17.5
100	150	11	0.7	99.9	0.8
150	200	1	0.1	100.0	0.1
200	-	0	0.0	100.0	0.0
TOTALS		1499	100.0		

Screen Analysis, Bristol Bay 28

-	20	305	25.1	25.1	100.0
20	28	199	16.5	41.6	74.9
28	35	197	16.3	57.9	58.4
35	48	274	22.9	80.8	42.1
48	65	162	13.4	94.2	19.2
65	100	60	5.0	99.2	5.8
100	150	5	0.4	99.6	0.8
150	200	1	0.1	99.7	0.4
200	-	4	0.3	100.0	0.3
TOTALS		1207	100.0		

TABLE A

Screen Analysis, Bristol Bay 31 & 34

Tyler Mesh Passed	Tyler Mesh Retained	Grams	Percent	Cumulative Weight% Retained	Cumulative Weight% Passed
-	20	116	8.9	8.9	100.0
20	28	144	11.1	20.0	91.1
28	35	203	15.6	35.6	80.0
35	48	429	32.9	68.5	64.4
48	65	292	22.4	90.9	31.5
65	100	104	8.0	98.9	9.1
100	150	12	0.9	99.8	1.1
150	200	1	0.1	99.9	0.2
TOTALS		1302	100.0		

Screen Analysis, Bristol Bay 37A & 37B

-	20	41	5.1	5.1	100.0
20	28	70	8.8	13.9	94.9
28	35	135	17.0	30.9	86.1
35	48	298	37.5	68.4	69.1
48	65	178	22.4	90.8	31.6
65	100	59	7.4	98.2	9.2
100	150	9	1.1	99.3	1.8
150	200	2	0.3	99.6	0.7
200	-	3	0.4	100.0	0.4
TOTALS		795	100.0		

TABLE A

Screen Analysis, Bristol Bay 42

Tyler Mesh		Weight	Weight	Cumulative Weight %	
Passed	Retained	Grams	Percent	Retained	Passed
-	20	92	6.3	6.3	100.0
20	28	108	7.4	13.7	93.7
28	35	189	13.0	26.7	86.3
35	48	404	27.7	54.4	73.3
48	65	308	21.1	75.5	45.6
65	100	177	12.1	87.6	24.5
100	150	55	3.8	91.4	12.4
150	200	62	4.3	95.7	8.6
200	-	63	4.3	100.0	4.3
TOTALS		1458	100.0		

Screen Analysis, Bristol Bay 49

-	20	59	4.9	4.9	100.0
20	28	41	3.3	8.2	95.1
28	35	84	6.8	15.0	91.8
35	48	237	19.3	34.3	85.0
48	65	329	26.8	61.1	65.7
65	100	243	19.8	80.9	38.9
100	150	75	6.1	87.0	19.1
150	200	79	6.4	93.4	13.0
200	-	81	6.6	100.0	6.6
TOTALS		1228	100.0		

TABLE A

Screen Analysis, Bristol Bay 51

Tyler Mesh		Weight	Weight	Cumulative Weight %	
Passed	Retained	Grams	Percent	Retained	Passed
-	20	544	41.6	41.6	100.0
20	28	150	11.5	53.1	58.4
28	35	141	10.8	63.9	46.9
35	48	246	18.8	82.7	36.1
48	65	160	12.2	94.9	17.3
65	100	53	4.0	98.9	5.1
100	150	9	0.7	99.6	1.1
150	200	3	0.2	99.8	0.4
200	-	3	0.2	100.0	0.2
TOTALS		1309	100.0		

Screen Analysis, Bristol Bay 54

-	20	64	6.0	6.0	100.0
20	28	148	13.7	19.7	94.0
28	35	212	19.6	39.3	80.3
35	48	358	33.1	72.4	60.7
48	65	211	19.5	91.9	27.6
65	100	77	7.1	99.0	8.1
100	150	9	0.8	99.8	1.0
150	200	1	0.1	99.9	0.2
200	-	1	0.1	100.0	0.1
TOTALS		1081	100.0		

TABLE A

Screen Analysis, Bristol Bay 67, 70 & 72

Tyler Mesh		Weight	Weight	Cumulative Weight %	
Passed	Retained	Grams	Percent	Retained	Passed
-	20	175	11.4	11.4	100.0
20	28	213	13.8	25.2	88.6
28	35	314	20.3	45.5	74.8
35	48	488	31.6	77.1	54.5
48	65	246	15.9	93.0	22.9
65	100	87	5.6	98.6	7.0
100	150	13	0.8	99.4	1.4
150	200	2	0.2	99.6	0.6
200	-	6	0.4	100.0	0.4
TOTALS		1544	100.0		

Screen Analysis, Bristol Bay 76

-	20	225	21.2	21.2	100.0
20	28	151	14.2	35.4	78.8
28	35	159	15.0	50.4	64.6
35	48	314	29.6	80.0	49.6
48	65	148	13.9	93.9	20.0
65	100	55	5.2	99.1	6.1
100	150	8	0.7	99.8	0.9
150	200	1	0.1	99.9	0.2
200	-	1	0.1	100.0	0.1
TOTALS		1062	100.0		

TABLE A

Screen Analysis, Bristol Bay 84

Tyler Mesh		Weight	Weight	Cumulative Weight %	
Passed	Retained	Grams	Percent	Retained	Passed
-	20	98	8.7	8.7	100.0
20	28	184	16.4	25.1	91.3
28	35	203	18.1	43.2	74.9
35	48	368	32.8	76.0	56.8
48	65	189	16.8	92.8	24.0
65	100	71	6.3	99.1	7.2
100	150	8	0.7	99.8	0.9
150	200	1	0.1	99.9	0.2
200	-	1	0.1	100.0	0.1
TOTALS		1123	100.0		

Screen Analysis, Bristol Bay 89

-	20	116	12.3	12.3	100.0
20	28	124	13.1	25.4	87.7
28	35	172	18.2	43.6	74.6
35	48	316	33.6	78.2	56.4
48	65	155	16.4	94.6	22.8
65	100	51	5.4	99.0	6.4
100	150	8	0.8	99.8	1.0
150	200	1	0.1	99.9	0.2
200	-	1	0.1	100.0	0.1
TOTALS		944	100.0		

TABLE A

Screen Analysis, Bristol Bay 92

Tyler Mesh Passed	Tyler Mesh Retained	Weight Grams	Weight Percent	Cumulative Weight % Retained	Cumulative Weight % Passed
-	20	1	0.1	0.1	100.0
20	28	30	3.2	3.3	99.9
28	35	114	12.1	15.4	96.7
35	48	430	45.4	60.8	84.6
48	65	255	26.9	87.7	39.2
65	100	101	10.7	98.4	12.3
100	150	14	1.5	99.9	1.6
150	200	1	0.1	100.0	0.1
200	-	0	0.0	100.0	0.0
TOTALS		946	100.0		

Screen Analysis, Bristol Bay 96

-	20	0	0.0	0.0	100.0
20	28	5	0.5	0.5	100.0
28	35	22	2.3	2.8	99.5
35	48	212	22.9	25.7	97.2
48	65	461	49.0	74.7	74.3
65	100	215	22.7	97.4	25.3
100	150	22	2.3	99.7	2.6
150	200	2	0.2	99.9	0.3
200	-	1	0.1	100.0	0.1
TOTALS		940	100.0		

TABLE A

Screen Analysis, Bristol Bay 104

Tyler Mesh		Weight	Weight	Cumulative Weight%	
Passed	Retained	Grams	Percent	Retained	Passed
-	20	16	1.5	1.5	100.0
20	28	70	6.7	8.2	98.5
28	35	133	12.8	21.0	91.8
35	48	352	33.9	54.9	79.0
48	65	293	28.1	83.0	45.1
65	100	153	14.7	97.7	17.0
100	150	22	2.1	99.8	2.3
150	200	1	0.1	99.9	0.2
200	-	1	0.1	100.0	0.1
TOTALS		1041	100.0		

Screen Analysis, Bristol Bay 107

-	20	6	0.7	0.7	100.0
20	28	15	1.7	2.4	99.3
28	35	47	5.4	7.8	97.6
35	48	279	32.0	39.8	92.2
48	65	355	40.8	80.6	60.2
65	100	149	17.1	97.7	19.4
100	150	18	2.1	99.8	2.3
150	200	1	0.1	99.9	0.2
200	-	1	0.1	100.0	0.1
TOTALS		871	100.0		

TABLE A

Screen Analysis, Bristol Bay 108, 111 & 112

Tyler Mesh		Weight	Weight	Cumulative Weight %	
Passed	Retained	Grams	Percent	Retained	Passed
-	20	29	1.9	1.9	100.0
20	28	117	7.7	9.6	98.1
28	35	306	20.0	29.6	90.4
35	48	590	38.6	68.2	70.4
48	65	352	23.1	91.3	31.8
65	100	110	7.2	98.5	8.7
100	150	19	1.3	99.8	1.5
150	200	2	0.1	99.9	0.2
200	-	2	0.1	100.0	0.1
TOTALS		1527	100.0		

Screen Analysis, Bristol Bay 116, 118, 120 & 122

-	20	62	7.0	7.0	100.0
20	28	60	6.8	13.8	93.0
28	35	119	13.4	27.2	86.2
35	48	355	40.0	67.2	72.0
48	65	200	22.5	89.7	32.8
65	100	77	8.7	98.4	10.3
100	150	12	1.4	99.8	1.6
150	200	1	0.1	99.9	0.2
200	-	1	0.1	100.0	0.1
TOTALS		887	100.0		

Table A

Screen Analysis, Bristol Bay 126, 130, 133 & 153

Tyler Mesh Passed	Tyler Mesh Retained	Weight Grams	Weight Percent	Cumulative Weight% Retained	Cumulative Weight% Passed
-	20	173	14.9	14.9	100.0
20	28	175	15.0	29.9	85.1
28	35	262	22.5	52.4	70.1
35	48	339	28.9	81.3	47.6
48	65	158	13.5	94.8	18.7
65	100	50	4.3	99.1	5.2
100	150	8	0.7	99.8	0.9
150	200	1	0.1	99.9	0.2
200	-	1	0.1	100.0	0.1
TOTALS		1167	100.0		

Screen Analysis, Bristol Bay 155

Tyler Mesh Passed	Tyler Mesh Retained	Weight Grams	Weight Percent	Cumulative Weight% Retained	Cumulative Weight% Passed
-	20	41	2.3	2.3	100.0
20	28	21	1.2	3.5	97.7
28	35	126	7.1	10.6	96.5
35	48	943	53.3	63.9	89.4
48	65	443	25.1	89.0	36.1
65	100	167	9.5	98.5	11.0
100	150	24	1.3	99.8	1.5
150	200	1	0.1	99.9	0.2
200	-	1	0.1	100.0	0.1
TOTALS		1767	100.0		

TABLE A

Screen Analysis, Bristol Bay 157

Tyler Mesh		Weight	Weight	Cumulative Weight%	
Passed	Retained	Grams	Percent	Retained	Passed
-	20	99	8.9	8.9	100.0
20	28	15	1.3	10.2	91.1
28	35	74	6.6	16.8	89.8
35	48	506	45.4	62.2	83.2
48	65	288	25.8	88.0	37.8
65	100	120	10.8	98.8	12.0
100	150	12	1.1	99.9	1.2
150	200	1	0.1	100.0	0.1
200	-	0	0.0	100.0	0.0
TOTALS		1115	100.0		

Screen Analysis, Bristol Bay 159

-	20	31	3.1	3.1	100.0
20	28	51	5.0	8.1	96.9
28	35	114	11.3	19.4	91.9
35	48	395	39.1	58.5	80.6
48	65	276	27.3	85.8	41.5
65	100	127	12.6	98.4	14.2
100	150	14	1.4	99.8	1.6
150	200	1	0.1	99.9	0.2
200	-	1	0.1	100.0	0.1
TOTALS		1010	100.C		

TABLE A

Screen Analysis, Bristol Bay 161

Tyler Mesh		Weight	Weight	Cumulative Weight%	
Passed	Retained	Grams	Percent	Retained	Passed
-	20	671	54.0	54.0	100.0
20	28	125	10.1	64.1	46.0
28	35	121	9.7	73.8	35.9
35	48	185	14.9	88.7	26.2
48	65	101	8.1	96.8	11.3
65	100	36	2.9	99.7	3.2
100	150	3	0.2	99.9	0.3
150	200	1	0.1	100.0	0.1
200	-	0	0.0	100.0	0.0
TOTALS		1243	100.0		

Screen Analysis, Bristol Bay 162

-	20	1119	69.4	69.4	100.0
20	28	115	7.2	76.6	30.6
28	35	99	6.2	82.8	23.4
35	48	149	9.3	92.1	17.2
48	65	87	5.4	97.5	7.9
65	100	36	2.2	99.7	2.5
100	150	2	0.1	99.8	0.3
150	200	1	0.1	99.9	0.2
200	-	1	0.1	100.0	0.1
TOTALS		1609	100.0		

TABLE A

Screen Analysis, Bristol Bay 163

Tyler Mesh		Weight	Weight	Cumulative Weight %	
Passed	Retained	Grams	Percent	Retained	Passed
-	20	1002	66.1	66.1	100.0
20	28	118	7.8	73.9	33.9
28	35	108	7.1	81.0	26.1
35	48	166	10.9	91.9	19.0
48	65	94	6.2	98.1	8.1
65	100	27	1.8	99.9	1.9
100	150	1	0.1	100.0	0.1
150	200	0	0.0	100.0	0.0
200	-	0	0.0	100.0	0.0
TOTALS		1516	100.0		

Screen Analysis, Bristol Bay 164

-	20	1376	69.5	69.5	100.0
20	28	91	4.6	74.1	30.5
28	35	111	5.6	79.7	25.9
35	48	238	12.0	91.7	20.3
48	65	122	6.2	97.9	2.1
65	100	37	1.9	99.8	0.2
100	150	3	0.1	99.9	0.2
150	200	1	0.1	100.0	0.1
200	-	1	0.0	100.0	0.0
TOTALS		1980	100.0		

TABLE A

Screen Analysis, Bristol Bay 165

Tyler Mesh		Weight	Weight	Cumulative Weight %	
Passed	Retained	Grams	Percent	Retained	Passed
-	20	1056	75.0	75.0	100.0
20	28	110	7.8	82.8	25.0
28	35	102	7.2	90.0	17.2
35	48	86	6.1	96.1	10.0
48	65	40	2.8	98.9	3.9
65	100	12	0.9	99.8	1.1
100	150	1	0.1	99.9	0.2
150	200	0	0.0	99.9	0.1
200	-	1	0.1	100.0	0.1
TOTALS		1408	100.0		

TABLE B

Screen Analysis, Yakataga

Tyler Mesh		Weight	Weight	Cumulative Weight %	
Passed	Retained	Grams	Percent	Retained	Passed
-	10	52	0.24	0.24	100.00
10	14	122	0.55	0.79	99.76
14	20	331	1.50	2.29	99.21
20	28	1,100	4.99	7.28	97.71
28	35	5,327	24.15	31.43	92.72
35	48	7,271	32.97	64.40	68.57
48	65	5,593	25.36	89.76	35.60
65	100	1,936	8.78	98.54	10.24
100	150	296	1.34	99.88	1.46
150	200	18	0.08	99.96	0.12
200	270	1	0.00	99.96	0.04
270	400	2	0.01	99.97	0.04
400	-	6	0.03	100.00	0.03
TOTALS		22,055	100.00		

REFERENCES

Berryhill, R.V., Reconnaissance of Beach Sands, Bristol Bay, Alaska, United States Bureau of Mines, Washington, D.C., R.I. 6214, 1963.

Boericke, William F., Prospecting and Operating Small Gold Placers, John Wiley & Sons, Inc., New York, 1941.

Cook, Donald J., Gold Recovery in a Sluice Box, Thesis, University of Alaska, 1954.

Cook, Donald J., Heavy Minerals in Alaskan Beach Sand Deposits, M.I.R.L. Report No. 20, University of Alaska, 1969.

Cruickshank, M.J., Mining Offshore Alluvials, Institute of Mining and Metallurgy, London, 1964.

Gilbert, G.K., Transportation of Debris by Running Water, U.S.G.S. Professional Paper 86, Washington, D.C., 1914.

Hess, H.D., The Ocean: Mining's Newest Frontier , Engineering and Mining Journal, New Jersey, August 1965.

Mero, John, The Mineral Resources of the Sea, Elsevier Publishing Co., New York, 1965.

Paterson, Norman R., Underwater Mining -- New Realms for Exploration, Mining in Canada, Toronto, April 1967.

Peele, Robert, Mining Engineers Handbook, John Wiley & Sons, New York, 1941.

Thomas, B.I. and Berryhill, R.V., Reconnaissance Studies of Alaskan Beach Sands, Eastern Gulf of Alaska, United States Bureau of Mines, R.I. 5986, Washington, D.C., 1962.

Wilson, Eugene B., Hydraulic and Placer Mining, John Wiley & Sons, New York, 1940.