

# The Yukon Consolidated Gold Corporation Limited

DAWSON, Y.T.

CANADA

## EVALUATION AND EXPLORATION OF PLACER GOLD RESERVES IN THE DAWSON AREA

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### SUMMARY:

1. An outline is given of the suggested manner in which the placer deposits were formed.
2. Features of the distribution of gold values, as evinced by actual recovery figures, is described. This distribution is compared with that indicated by drill hole data, and it is concluded that the latter are not sufficiently specific to permit precise estimating under any circumstance.
3. Estimating procedures are examined and the suggestion is made that historical data be used to a greater extent than is present practice. A procedure based on cumulative frequencies of historical data appears to have application.
4. Areas which appear, as a result of the application of the principles outlined, to hold promise of containing gold in economic amounts, are listed.
5. An outline of the proposed programme for continuing this aspect of the study is given.

### SOURCE OF THE GOLD:

Regional mapping in the Dawson area during 1961 indicated that the source of the gold now found in placer deposits was the coarse, pseudo-porphyrific, silicious, sedimentary rock which occurs in thick bands in a monotonous series of schists of sedimentary origin. The rock was probably an arkose. No occurrences of volcanic rocks of greenstone-type, iron formation, or large scale faulting, with which economic gold deposits are frequently associated, were found. Most of the known occurrences of gold in veins in the area lie on or near the crests of folds in the supposed arkoses. Several specimens of very coarse gold in white quartz cobbles of the type found in the placer deposits were examined in 1961. It is assumed that the gold occurs with quartz in gash veins of this type, in an irregular manner throughout the arkoses. The fold crest areas represent too large a target to permit consideration of drilling. Outcrop is too scant to allow any detailed structural study of these areas. Both a geochemical approach and an approach based on panning soil are vitiated in large areas on account of a superficial veneer of frozen muck.

The manner in which economic placer deposits terminate where a creek cuts a band of this supposed arkose is striking.

FORMATION OF THE PLACER DEPOSITS:

The concentration of the gold into placer deposits of economic grade has been the result of a combination of a number of both tectonic and climatic events. Recent tectonic history of the area is mostly connected with vertical movements in the Ogilvie Mountains, which lie north of the Dawson area. There, uplift has been very great, and continues at present. Two stages of valley formation are evident in these mountains, and there are nick points on most streams. The Ogilvie mountains are separated from the Dawson placer area by the Tintina Valley Fault, which is a major structural feature of continental proportions. L. Green, of the Geological Survey of Canada, reports evidence of movement on this fault throughout geological time. He has been unable to correlate rocks of any age across this fault anywhere in the Yukon.

Climatic history of the period immediately before, and during, the Pleistocene glaciation, has had an important effect on the placer deposits. At its epoch, the ice sheet extended to within a few miles of the Dawson area. Variations in the flow of outwash water from melting glaciers and ice sheets, and wind-blown dust from the outwash fans, have played important parts in the form of the deposits as they are known today.

The chronological sequence of events, as they are at present interpreted, which led to the formation of the placer deposits in their present form, may be expressed best in numerical order, as follows:

1. Broad valley erosion in a warm humid climate occurred at the end of the Tertiary period. Material was carried away by solution, as result of chemical, rather than mechanical erosion. Deep weathering effects developed in the country rocks and laterites formed, even in the valley bottoms. Quartz and heavy minerals, including gold, resisted the tendency to dissolve, and were left on the surface as residuals. Most of the gold found its way to the valley floors, where much of it worked its way into cracks in the lateritized bedrock. The quartz remained on the flanks of the valleys.
2. In Pliocene time, the area tilted slightly down to the north, and up on its southern side, along a hinge line parallel to Indian River. The centres of the broad valleys of the northward-flowing streams filled in with the residual gravels from the valley flanks. The matrix of these gravels is a white clay which adheres to the tongue and is probably of the kaolin group. This clay material was derived from the laterite soils of the valley flanks. On account of their white appearance, these gravels are known as "white channel". Due to the tilting, the gradient of the southward-flowing streams was decreased, with the result that they do not have the same great thickness of "white channel" gravels as the northward-flowing streams. While the valleys of the northward-flowing streams were being filled in with the "white channel" gravel, the valleys of those

streams which flow southward received only a thin veneer of gravel. From the Indian River valley, the southward-flowing streams started to cut back upstream from the fault scarp on the north side, or right limit, of the valley. This accounts for the youthful cross-section of the Dominion River valley just before it enters that of Indian River, while the upstream sections of both Sulphur and Dominion Creeks are those of mature valleys.

3. With the onset of glaciation in the Pleistocene, the climate became cold and there was a rush of "Klondike River" gravels of glacial outwash origin into the valley of the Klondike. The narrow "Klondike Spillway" just upstream from Dawson on the Klondike began to develop at this time. Benches of "white channel" covered with layers of "Klondike River" gravels were left on either side. Four separate glacial epochs are recognized. Between each was a warm interglacial period, during which the ground tilting movement along the same hinge line along Indian River was reversed in sense. The north-flowing streams were rejuvenated and cut down into their valley floors. In this way the thick benches of "white channel" gravel were left high on the present valley walls, e.g., Bonanza and Hunker Creeks. On the southward-flowing streams, low benches were developed in some of the valleys, as on Dominion Creek. The climate was sufficiently warm and humid in interglacial time to permit development of laterites on the valley floors.
4. As the ice sheet advanced and retreated during the last glacial epoch, so extensive areas of dry, outwash debris were exposed. The finer portion of this material was carried by wind and deposited over the Dawson area, and especially in the valleys, as a mantle of "muck" which may exceed 80 feet in thickness. On account of the very cold climate at that time, permafrost formed in the ground, which became insulated by a vegetation layer as the climate moderated.

With the successive reworking and depositing of gold which followed the destruction of benches by erosion, the fineness of the gold and the grade of the deposits increased. Very little seems to be known about the method of transport of gold in placer deposits like these, nor is there much known about the mechanism by which nuggets form. Both mechanical and chemical processes have been suggested.

It is of interest to note that important deposits of gold bearing gravels were found at Fairbanks, Alaska, under thicknesses of muck greater than the maximum noted around Dawson so far. In the enclosed plan of "Operations on Middle Dominion Creek" it will be noted that the configuration of the valley, as indicated by contours on the bedrock, is not coincident with that of the present water course which is being followed by Dredge 10. This situation is to be investigated during the 1962 season. There is strong evidence that the valley on bedrock has become obscured by either muck or slide debris on the right limit.

DISTRIBUTION OF GOLD WITHIN THE PLACER DEPOSITS:

The distribution of gold within the deposits has been under investigation for over a year. For this purpose it is more convenient to consider the distribution of gold in terms of dust ounces, or dollars recovered per square yard of bedrock than in terms of cubic yards. In most areas the value of the ground dredged per month, in terms of square yards, has been found sufficiently accurate to give a good picture of the distribution of gold. However, in wide areas, such as the Granville Flat, the time interval has been shortened and recoveries plotted from successive clean-ups. A map, prepared by Nemesvari, of this area is appended. For a number of reasons, outlined later, it is probably better to use "dust ounces recovered" per yard rather than dollars, although for this immediate purpose the loss in accuracy is probably slight.

In the map of the Granville area, the way in which the trends of gold values follow old channels on the bedrock is remarkable. Many of the areas of higher than average values have the form of remnants of meanders. It is thought that the gold was deposited from a large number of anastomosing rivulets, the courses of which were constantly changing, and which flowed over the wide, flat area. Very little of this gold appears to have been brought from the drainage of Sulphur Creek.

A feature of the map of the Granville area which is probably of great importance economically, is that the trends in the higher grade distributions of gold cut the edges of the dredge cuts at high angles in many cases. This remark applies equally to the whole of the lower Dominion Creek area up to Gold Run Creek. Nemesvari's map of this area is appended. With no drill hole information, or knowledge of the configuration of the bedrock in much of this area, it is impossible to make any estimate of the extent of these values beyond the edges of the present dredge cuts. An idea of the dimension of this marginal area is obtained when it is realized that the dredge cut between the mouth of Gold Run Creek and the present position of Dredge 6 on lower Dominion Creek, represents almost forty years of continuous dredging. Some drilling is planned during 1962 in this marginal area along the left limit of lower Dominion Creek, but, on the evidence of gold distribution shown in these two maps, it would seem that an extension of the dredge limits is justifiable on this basis alone. The problem here is not one of deciding whether a marginal area constitutes dredgable ground or not, but is one of determining a limit.

Close contouring the bedrock valley on Dominion Creek has indicated a number of steps in the surface on which the gold was deposited. At the top of each one of these there is a sudden increase in the value of gold recovered per square yard. This value falls off gradually to the next step, where there is a sudden increase in values recovered. The distance between steps is in the order of roughly five hundred to one thousand feet. With a knowledge of the configuration of the bedrock, it is a simple matter to predict the position of these steps, and thus of any expected increase in recoveries.

Gold now in the placer deposits of the creek valleys has been derived from the erosion of higher benches. In most cases there does not appear to have been much migration downstream in this process, as it is generally a simple matter to relate an unusually high grade area in a creek bottom to a nearby bench on which good grade gravel occurs. On Parker's plan of Lower Hunker Creek, which is appended, the high grade streak along the left limit of the Yukon Gold Company dredge cut can be related to the bench deposits of white channel gravel along this same limit. Below this cut the original valley of the white channel gravel crosses from the left to right limit of the present Hunker Creek valley. A very large volume of white channel gravel must have been destroyed during the process of erosion. On a smaller scale, a similar instance of gold derived from a bench is seen in No. 16 Bench Operation. (See plan of Operations on Middle Dominion, appended). The gold in an area of higher than normal recoveries in the valley appears to have been derived from the adjacent No. 16 Bench. On this basis, it would seem advisable to examine the possibility of extending the present limits of mining on this bench upstream sufficiently to include this possible source.

#### SAMPLING PLACERS BY DRILLING:

For the exploration and evaluation of placer deposits, two techniques of churn drilling have been employed, depending on whether the ground is frozen or not. In thawed ground the technique is that generally used for churn drilling in unconsolidated material, and involves the use of casing. Where the ground is frozen, open hole drilling is used. These methods are fully explained by A. M. Nordale in C. I. M. M. Bulletin No. 425 of September, 1947. This same technique has been employed very extensively at both Nome and Fairbanks, in Alaska.

Both drilling and sampling in the Dawson area have been carried out with as great care and diligence as anywhere. In spite of this, there is a considerable disparity between estimates made of recoveries based on results of drill samples, and actual recoveries. This is not a unique feature of the Dawson camp. At Fairbanks, where the drilling of the Fairbanks Exploration Company was to a comparative standard of performance as that at Dawson, the over-all recovery to estimate ratio for the entire operation from 1928 to 1960 is about 118%. Similar results were obtained earlier in the placer goldfields of California. With so much information on actual recoveries now available, it is important that the estimating procedures be examined for means of improvement. Since the application of churn drilling to placer deposits was first made in the Dawson area, there have also been important applications of statistics to mine sampling theory.

There are inherent errors in any sampling procedure. For successful sampling it is generally conceded that the following conditions should be fulfilled:

1. Assay data must constitute a statistically homogenous series. Such homogeneity is lacking in the drilling of "old works", for instance.

2. The larger the number of samples, the better the estimate of the mean, and thus the evaluation.
3. Data must be obtained by random sampling. This condition is probably fulfilled at Dawson by the rigid grid pattern on which the holes were layed out.
4. Samples must be of uniform size, especially in low grade deposits. The only way this condition may be fulfilled in our case is to consider the sample to be one of area rather than volume. To use figures of cents per cubic yard is to invite errors from this source.
5. The presence of a trend within a series of samples impairs the validity of an estimate of their mean. This is clearly a consideration in Dominion Creek, where the steps described above are responsible for very definite fluctuations in gold values, and in Sulphur Creek (see Graph 1), where there is a downward trend in values.
6. A bias is introduced into the sampling data if there is a density contrast between the materials which constitute the sample. This is an unavoidable feature in sampling placer gold deposits.

Further specific sources of possible error in sampling by the method used at Dawson are as follows:

1. By using one method of drilling thawed ground, and another for frozen ground, two different bias errors are introduced, one for each method.
2. Increases in the value of a sample can only be by the presence in the sample of another particle of gold. Wide fluctuations in value of a hole may be brought about by the presence or absence of only one or two discrete grains of gold. The extent to which such fluctuations may influence a valuation may be appreciated when it is realized that a sample represents about 1/100,000 of the material sampled.
3. Holes drilled in frozen ground show wide variations in diameter from the average. This variation has been employed in weighting the values in each hole for determination of values per cubic yard. This is a questionable procedure. It might be better, statistically, to consider each hole, provided it was drilled with a standard size of bit, to be a "per square yard sample of bedrock", and to consider any changes in the diameter of the hole to constitute sampling error. Any measurement has three fundamental components, viz., the true value, the bias error inherent to the process employed, and the sampling error, peculiar to the individual measurement. The magnitudes of these two errors is unknown.

4. Variations in fineness of gold within the deposit can give appreciable errors in evaluation by drilling. An example of this is the Gold Run examination. A standard value for fineness of gold for the creek was taken as 805.346 for the evaluation of gold recovered by drilling. The arithmetic average fineness of 75 bars of gold actually recovered by dredging is 838.19. On the basis of these two figures, it would appear reasonable to suggest increasing the valuation of undredged portions of Gold Run Creek by a factor of  $\frac{838.19}{805.35}$  or 104.4%.  
Variations of this order are common, and must be held responsible in part for the differences between recoveries and estimates.
5. When casing is used in a hole in unconsolidated material, an estimate must be made of the true cross-sectional area of material forced inside the casing by the driving shoe. Either the inside or the outside diameter of the driving shoe may be used to calculate this area. Both figures are commonly used in placer drilling practice, as are other figures in between these two limits. This factor is known as the "Radford Factor". This factor is 0.3068 square feet when the outside diameter of the driving shoe is used, and 0.27 when the inside diameter is used. The larger factor gives a more conservative value per cubic yard, since it effectively increased the volume of the material removed by the drill. Standard practice at Dawson has been to use this larger figure consistently. This gives an estimate of value per cubic yard of roughly 12% less than would have been obtained had the smaller figure been used as a factor. Which factor is the better is a debatable point.
6. The effectiveness of hole spacing on success in exploration for a target of specific shape has been examined by Slichter. (Economic Geology, Anniversary Volume 2, 1955). If this treatment be extended to the problem of evaluation by considering each band of material of different metal content to be a separate target, then Slichter's concept may be used to test the effectiveness of a drilling grid for evaluation. On this basis, the hole spacing used on most of the examinations of the various creeks is found to be about 75%. An exception is the Granville Flat area of lower Dominion Creek, where an unusual spacing pattern was employed. Holes were drilled at the apices of equilateral triangles with sides 600 feet long. With this spacing, and the knowledge of gold distribution from Nemesvari's map (appended), the effectiveness of the drilling may be determined to have been of very low order, probably between 30 and 40%. It is worthy of note that, when the area which had been drilled on this equilateral pattern was mined by Dredge 6, the complete lack of relation between estimates and recoveries was a matter for some concern. There was no previous mining in the area, which would have complicated the evaluation. If it be accepted that the spacing of the holes seriously affected evaluation in this particular area, then it must be a significant factor in other areas too.

TECHNIQUES USED FOR EVALUATION AND ESTIMATION:

In the evaluation of reserves, several premises have been observed consistently. These are:

1. Any ground which has been worked by underground methods will repay dredging.
2. Ground which has been dredged previously, but which was thawed by steam, as opposed to the cold water method now used, will repay dredging. Profit may be very small, but operating costs will generally be returned.
3. In any drill hole, the gold recovered is assumed to be exactly proportional to the volume of gravel and gold-bearing bedrock removed from the hole. The value of the dredgable section in any hole is quoted in cents per cubic yard, and this value is assumed to vary linearly between adjacent holes.

The suppositions in (1) and (2) above have been more or less substantiated by experience. In neither one is any precision in evaluating to be anticipated. The suppositions which concern drill holes are a different matter. Limits of reserves have been drawn to exclude areas containing holes which showed sub-marginal values but, in many instances, where it has been necessary to mine areas containing such holes in order to bring a dredge into what is apparently better grade material, this has been achieved with no great diminution in gold recovery. Clearly, some holes show no value because they lie beyond the mineralized area, while others contain low values on account of features of the statistics of the gold distribution or sampling method. This is a basic problem of the mining operation, and bears careful study.

It has been argued that, over the years, discrepancies between recovery and estimate "iron out and become part of the law of average". Such an assertion makes no provision for valuable ground which might have been left on the margins of the dredge cuts, nor does it give an idea of precisely how many years might be involved in fulfillment. That it must be held suspect over at least a five year period is well demonstrated by the following figures, which represent gross recovery to estimate for the five-year period 1957 to 1961, inclusively, in percentage form:

Dredge Number:	6	8	9	10	11
Recovery/Estimate	91	89	136	118	145

Annual figures show even wider fluctuations. These figures of estimates are derived from drill hole information in the area actually dredged. The volumes of material involved in estimate and actual recovery figures are virtually identical.

In pre-season estimating for budgetary purposes, the value of the area which it is predicted will be dredged, is frequently adjusted by multiplying the expected gross by a factor based on recent experience with the recovery to estimate percentage in the particular area. In an effort to rationalize this procedure, a series of plan factors was suggested. (See "Notes on the Evaluation of Placer Ground in the Klondike Area" - B.W. Hester, 1st May, 1961). A specific factor was suggested for each of a number of

arbitrarily selected divisions in the range of values per cubic yard of ground most commonly encountered in mining. On a purely overall-average basis, the employment of these factors showed some improvement in estimates, but there were severe restrictions in their application, and wide discrepancies were still not unusual between actual recovery and estimate.

For both geological and statistical purposes, it is better to consider the gold values to be distributed on an areal basis, rather than on a volume basis. In this way the parameter of the variable dredging section is removed. For the initial steps in valuation, it seems preferable to continue this procedure and to involve the third dimension only when the problem of gold distribution has been solved adequately, when the problem of evaluation descends to one concerned with the practicability of mining. At this stage only should the concept of cents per cubic yard be introduced. It is intended here to discuss some features of the gold distribution as illustrated by actual recoveries compared with results from previous drilling. Clearly, any estimate should be coloured by the geological considerations already outlined.

Before the discussion of actual recovery figures is allowed to proceed further, it is necessary to outline the method by which these figures are determined, and to point out sources of error which they themselves contain. It has been the practice for many years to combine all the raw gold dust recovered from all operations, into a common melt. The fine ounces recovered from this are then distributed among the operations in proportion to the dust ounces multiplied by a factor. This factor, which remained unchanged between 1942 and 1961, is supposed to incorporate an adjustment for fineness variation between operations. Assays of bars made entirely from gold mined on leased ground show the extent of fineness variations in the deposit within a creek. Operations on Hunker Creek provide an outstanding example of the manner in which fineness variation influences both estimates and recovery figures. Fineness determinations of individual bars from leased, or lay ground on the creek have been obtained from 737 to 824, yet no change was made in the appropriate factor. In drilling, and so in estimating value, a fineness of 800 was assumed. The subject of fineness is examined more elaborately in my report of 27th January, 1961, on "The Effect of Variations in Bullion Fineness on the Evaluation of Gravels". On account of the practice of quoting production in terms of money instead of fine ounces, it is not always possible to determine the precise physical amount of gold recovered from an operation, on account of exchange variations. There is thus room for both bias and sampling errors within the actual recovery figures.

It has already been stated that there is good reason for considering the values from drill holes on an areal rather than volume basis, and for regarding variations in diameter of holes as sample errors, rather than attempting to correct them by weighting. If this procedure is followed, it is convenient to consider the actual weight in milligrams of gold dust recovered from each hole as a measure of the material present. This procedure removes any errors due to fineness variations from the estimating, although these may still be present in the recovery figures.

While the values in a single, specific hole are suspect, the combined value of a group of adjacent holes has, over a considerable period, provided a good criterion, in the vast majority of cases, on which to base a decision to dredge. The most convenient group of holes to consider is that presented by a line of holes drilled across a valley. An area involving over three miles of lower Sulphur Creek, which has been mined by Dredge 8, was selected for study. The average recovery of gold in terms of dollars per square yard of bedrock was calculated for each line of drill holes. Figures obtained show a well defined decrease in the value of the ground on successive downstream section lines. (see Graph I). Because it was decided to consider the values from drill holes as a group, rather than individually, the mean of the milligrams of gold recovered from all the holes was chosen as representative of the value of the group of holes. To minimize the effect of the very high values which occur occasionally, the geometric, rather than the arithmetic, mean was used. The logarithms of these means are plotted in Graph I for comparison with the values per square yard actually recovered. It will be noticed that, while the values per square yard show a definite trend as the creek is followed downstream, the milligram values do not. In fact, the logarithm of the geometric mean appears to be normally distributed. The successive recovery to estimate percentages for square yards of bedrock were not plotted, but they show a marked tendency to exceed 100% at the upstream end of the area examined, and to be below 100% at the downstream end. This substantiates the evidence from the "milligram" distribution that the estimated value tends to remain constant, in this instance, and in no way reflects the trend to be discovered in actual values.

Section lines 200 feet apart were drawn through the Granville Flat area of lower Dominion Creek, where Dredge 6 has been mining in recent years. These lines are much closer than the drill hole lines, which were widely spaced here. The average recovery of gold in terms of dollars (gold at \$35 per ounce) per square yard was calculated for each line, and plotted on Graph II, to show any trends in a downstream direction. The effect of minor channels, which enter the area roughly at right angles to the section lines, is very apparent. It would appear that these minor water courses have introduced some of the gold into the area which has been dredged, and that the margins of the cut would bear investigation. This was suggested earlier when reference was made to the map of distribution of gold in the Granville area. Only those section lines on which mining has been completed were used in the construction of this graph. However, several further lines have been cut, but not yet completely mined. The averages obtained so far from these lines lie within the range of values usual for completed section lines. Thus, the general tendency for the values to fluctuate between fairly well defined limits of \$2.00 and \$3.00 per square yard may be expected to continue beyond the present position of the dredge to a point below the last side channel. The logarithms of the geometric means of milligrams recovered in drill hole lines across the direction of flow of the creek show a tendency to be normally distributed about a mean, much as they do in lower Sulphur Creek. Individual drill hole values do not reflect the position of the side channels, nor do they show any relation to actual gold dust recoveries which is at all apparent. Graph IV shows a comparison between the distribution of milligrams recovered in drilling three different areas.

From the above evidence, it appears that all that is provided by a group of drill holes is a threshold figure, which, if obtained, signifies that economic values exist. Indications of grade are, at best, generalities from which no precision should be expected. That very little precision is, in fact, received is well demonstrated by the recovery-to-estimate figures. Reference to the gross recovery-to-estimate percentages for 1961 shows that these figures lie between 106½% and 189½% for the five dredges operated in that year. It is pertinent here to examine other methods of estimating gross recoveries which have been developed where it is impossible to sample ahead, as in agriculture and fishing, for example.

Taylor has already pointed out that, without recourse to any maps or drill results, he is able to predict the actual recovery by extrapolating historical averages. Both for individual dredges and for the operation as a whole the estimates he made show a remarkable resemblance to the actual results obtained. For the five dredges, Nos. 6, 8, 9, 10, 11, for the period 1952 - 1961, the following table clearly indicates that this method, before refinement, came very close:

<u>AU. @ \$35.00 PER OZ.</u>	<u>ACTUAL</u> <u>\$ PER CU. YD.</u>	<u>TAYLOR</u> <u>\$ PER CU. YD.</u>	<u>PRE-SEASON</u> <u>\$ PER CU. YD.</u>
1952	43.8	40.9	39.1
1953	40.3	41.8	41.4
1954	41.7	41.4	39.3
1955	39.9	41.4	36.2
1956	43.8	41.2	33.7
1957	36.1	41.5	37.0
1958	35.4	40.9	38.0
1959	43.1	40.3	42.1
1960	44.5	40.5	35.1
1961	37.1	40.9	33.3
10 Year Av.	40.5	41.1	37.5

On the basis of 37,200,000 cubic yards actually dredged in the period, the overall results would be:

	<u>ACTUAL</u>	<u>TAYLOR</u>	<u>PRE-SEASON</u>
	\$15,060,000	\$15,289,000	\$13,950,000
Difference from Actual:		+ \$ 229,000	- \$ 1,110,000
% Variation from Actual:		+ 1.5%	- 7.4%

In only two years did this method vary from the actual by more than 7%, and then only by 15% and 14% respectively.

An attempt has been made to refine this technique by substituting cumulative probabilities for the averages, and, based on this procedure, a forecast was made of the 1961 production from both individual dredges and from

all dredges taken together. The basic operations of the technique are outlined in Graph III. In an attempt to forecast expected production for all dredges for 1961, the actual figures for this amount for the period 1950-1960, inclusive, have been considered. In the upper curve, the probability that a given number of fine ounces, or less, will be produced is expressed graphically.

Clearly, the steeper the curve, the greater is the probability of occurrence within any particular range. In the lower curve, the actual amount of slope has been plotted on the ordinate. The most probable value, and thus the best estimate, is that which occurs at the peak of this curve. From this, the best estimate of 1961 fine ounces to be produced is read as 41,800. The actual figure obtained was 42,955. The technique was applied to the individual dredges. The sum of the estimates for each dredge is 43,395 ounces. The closeness of these estimates is remarkable, but it must be realized they represent a purely statistical value, which must be modified in the light of any geological evidence. A comparison of the various estimates for 1961 production in fine ounces is given in the following table. All percentages are for the value of actual recovery to estimate.

	DREDGE NUMBERS					AVERAGE DIFFERENCE OF R/E FROM 100%
	NO. 6	NO. 8	NO. 9	NO. 10	NO. 11	
Actual Recovery In Ounces (R)	9,431	9,579	6,057	7,131	10,757	
Pre-Season Estimate From drill holes (E)	7,888	6,449	4,647	4,509	5,611	
R/E %	120	148	130	158	191	49.8%
Pre-Season Estimate For Budget	8,677	6,449	5,809	6,763	7,014	
R/E %	109	148	104	106	153	24%
Post-Season Estimate From drill holes	8,787	6,826	3,337	5,197	5,607	
R/E %	107	139	180	135	190	50%
Post-Season Estimate From drill holes, Using Plan Factors	11,400	8,200	3,660	6,500	7,050	
R/E %	83	116	165	110	152	25.4%
Estimate Based On Cumulative Probabi- lity of Historic Data	7,200	10,625	5,830	7,740	12,000	
R/E %	131	90	104	93	90	1.2%

Differences between pre- and post-season estimates based on drill hole values reflect the differences between yardages estimated and actually dug. This aspect of estimating is not considered here.

The estimate of the production to be expected from Dredge 6, made on the basis of cumulative probability, shows the effect of ignoring a geological feature. During the early part of the period for which data was considered, this dredge was in Sulphur Creek. Later it was below the confluence with Dominion Creek. Lower recoveries in Sulphur Creek are responsible for the low estimate for this dredge.

The lower curve of Graph III should be symmetrical, but it shows a pronounced positive skewness. This is interpreted as the effect of Dredge 11, which is located in Hunker Creek. The mode of deposition of gold in this creek was different from that in the other creeks now being dredged, in that Hunker Creek flows northward, while the others all flow southward. A similar effect would be expected from any dredge in Bonanza Creek.

#### APPLICATIONS TO SPECIFIC AREAS:

##### 1. DOMINION CREEK, BELOW GOLD RUN CREEK:

The maps of the gold distribution in the Granville and lower Dominion Creek areas show that, in many instances, the higher grade pay streaks cut the edges of the old dredge cuts at high angles. Although there is no information on the form of the bedrock under the area which has not been dredged, the form, where known, is fairly regular, and from experience elsewhere in the camp, there is no reason to suppose large irregularities exist. If this is so, then mineable grade material may be expected within this area which has not yet been drilled. The extent and value of this material must remain a matter for conjecture. Should this be to the present position of Dominion Creek, then roughly forty million cubic yards at about 35 cents per cubic yard would be involved. This is in addition to the "Twitt-Peterson Tract", which lies at the mouth of Gold Run Creek, between the two old dredge cuts, and to the lower section of Gold Run Creek itself. These two areas contain another 20 million cubic yards, at least, and are probably of higher grade. Some drilling is planned for 1962 to investigate both the configuration of bedrock and the gold distribution.

##### 2. MIDDLE DOMINION CREEK:

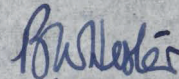
Below claim 125 in this area (see map of Operations on Middle Dominion Creek which is enclosed), the valley on bedrock swings into the right limit and is not discernable again from the drilling information. It appears that the channel of the creek has been swung towards the opposite bank by either a slide or thick deposit of muck. The valley on bedrock generally contains a valuable concentration of gold, so it is important to investigate the position of this channel fully. From the enclosed plan, it can be seen that Dredge 10 is presently working on what appears to be a bench. Values there are not good, and the operation is barely economic. It is hoped that drilling during 1962 will locate the correct bedrock channel, and that values will be found in it to justify the continuation of dredging in this area beyond the present estimate.

The proposed bench operation No. 16 is in the same general vicinity. Dredge 10 cut a section of ground of higher than average gold content just below the upstream continuation of the present

reserves of this bench. Gold for this enrichment probably came from the partial destruction of the bench by erosion, and it appears logical to suggest an extension of the limits of the reserves on what remains of the bench, so that the source of this enrichment is included. This could be effected by using the 855 foot bedrock contour as a limit, unless this is precluded by excessive mining costs.

PLANS FOR FUTURE WORK:

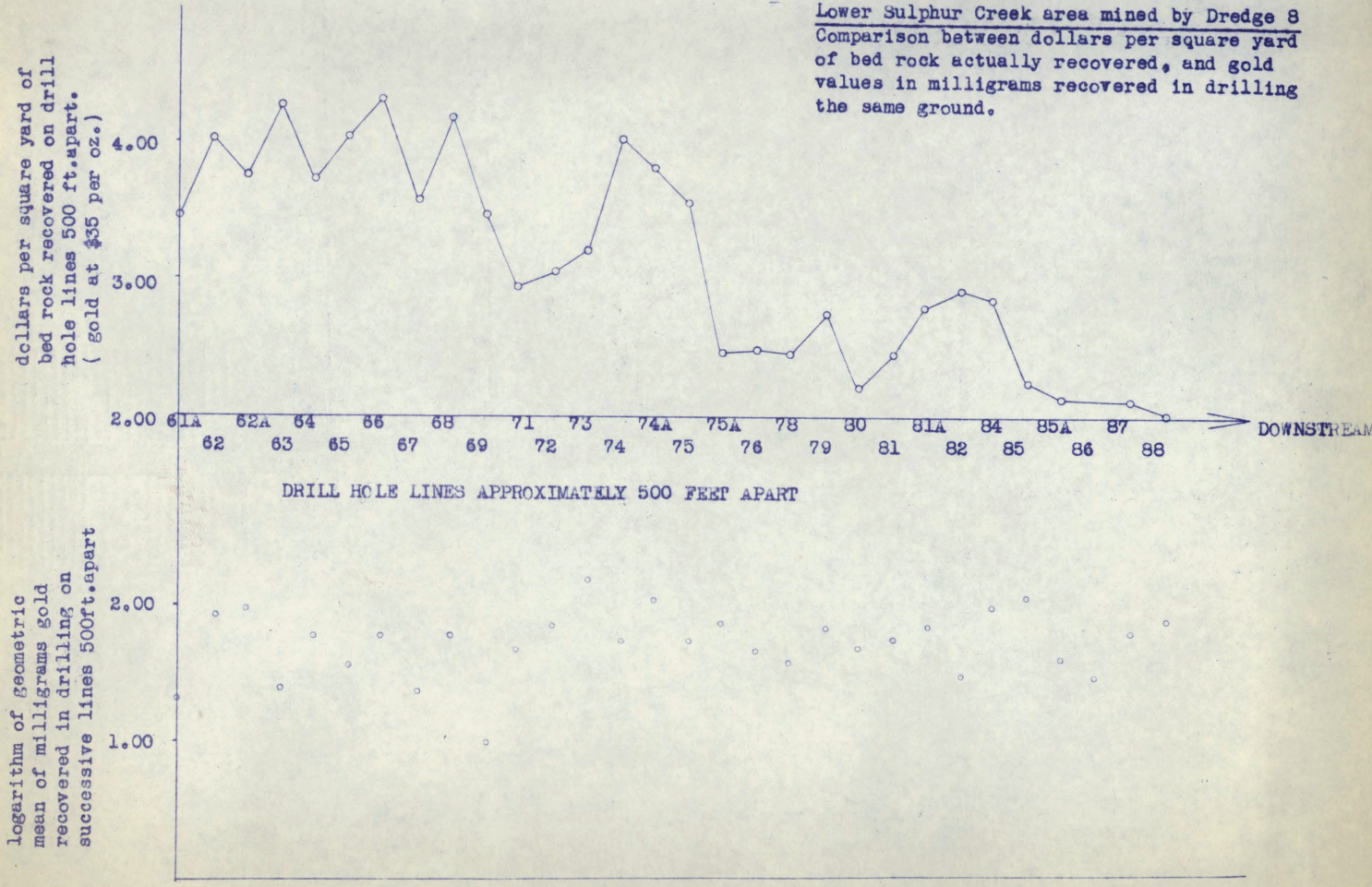
1. Clean-up information will be plotted on plans on a regular basis. Consideration is being given to a convenient method for the recording of size and colour of gold dust, on a systematic and regular basis.
2. Preparation of plans to show the distribution of gold values obtained from past clean-ups will continue. Part of this will be a special study of the recoveries obtained from the white channel gravels on Bonanza Creek. From this it is hoped to obtain information on which to base a better estimate of the contents of the remaining portion of the Jackson-Lovett bench.
3. Estimating procedures will be kept under continuous review, in the hope that improvements will be found.
4. The possibility of using rotary, instead of churn, drills is to be studied. Should this prove possible, drilling speed should be increased and costs reduced.

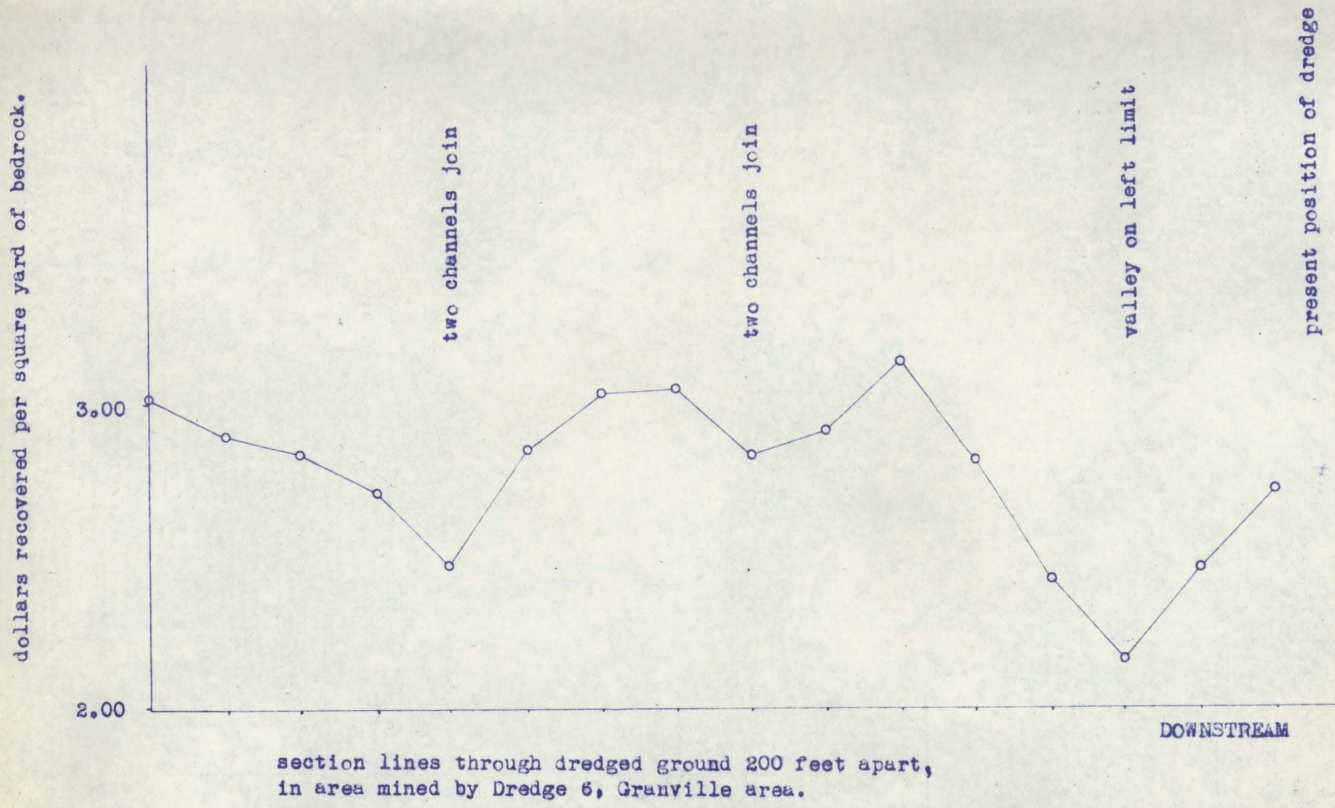


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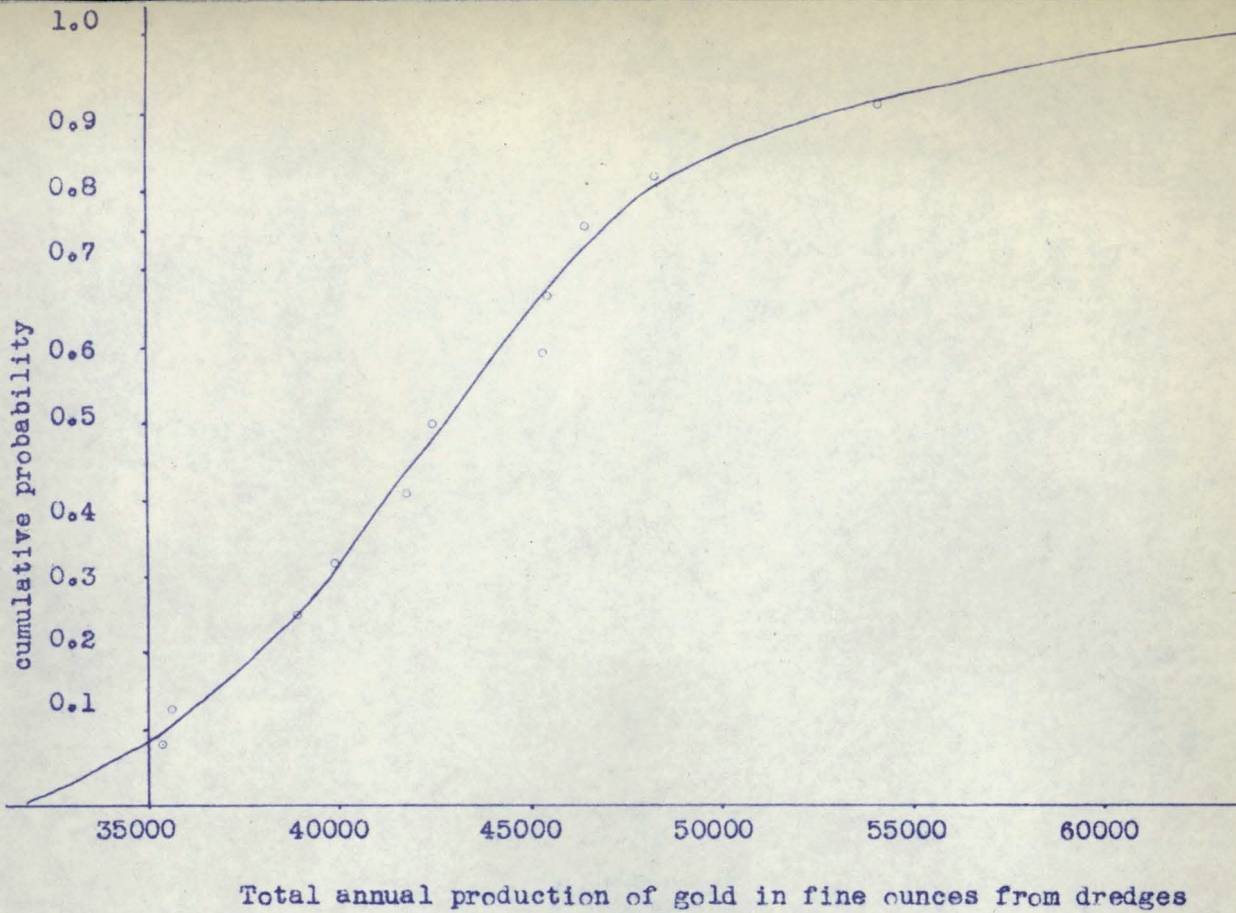
B. W. Hester,  
Assistant Manager.

BWH:w

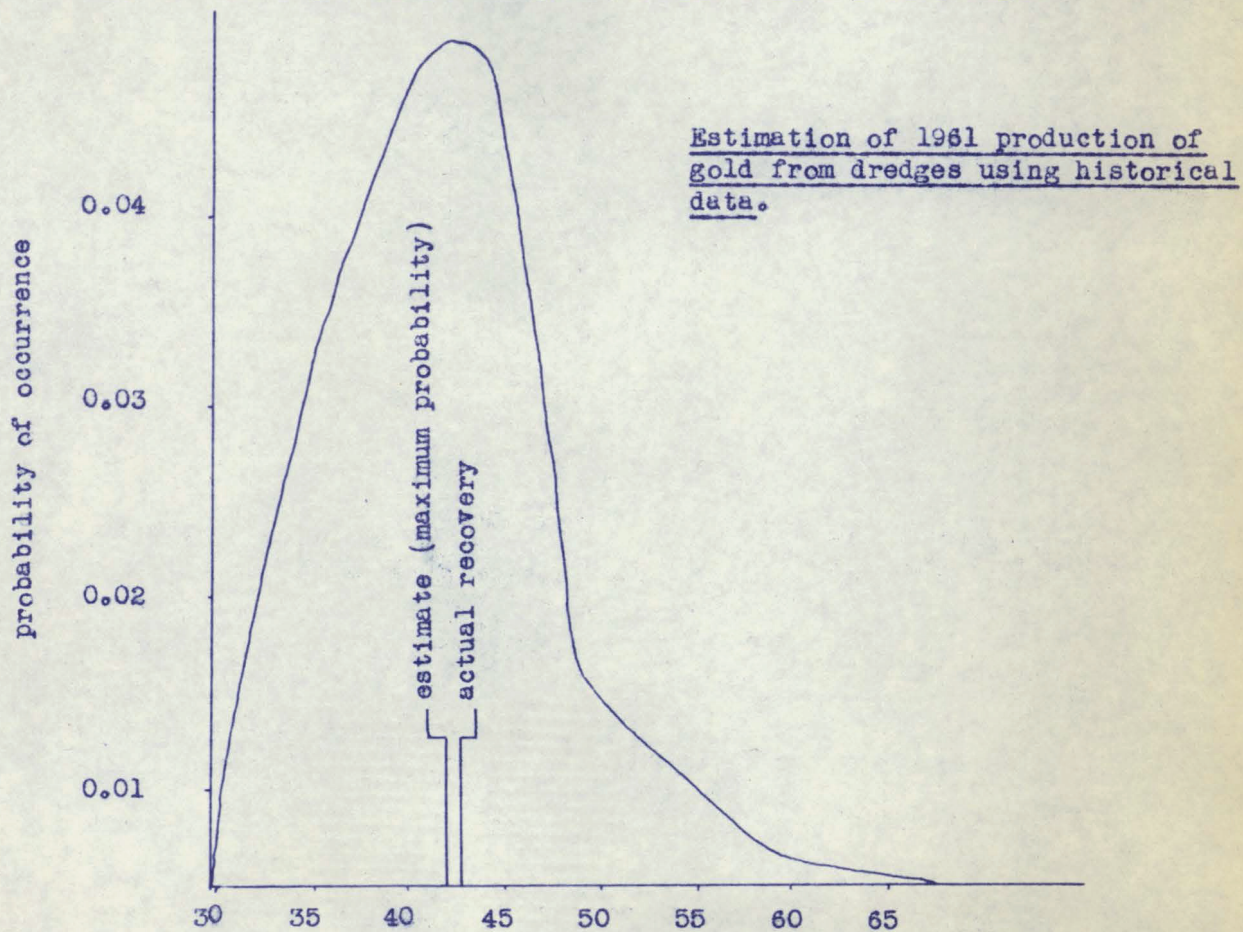




section lines through dredged ground 200 feet apart, in area mined by Dredge 6, Granville area.

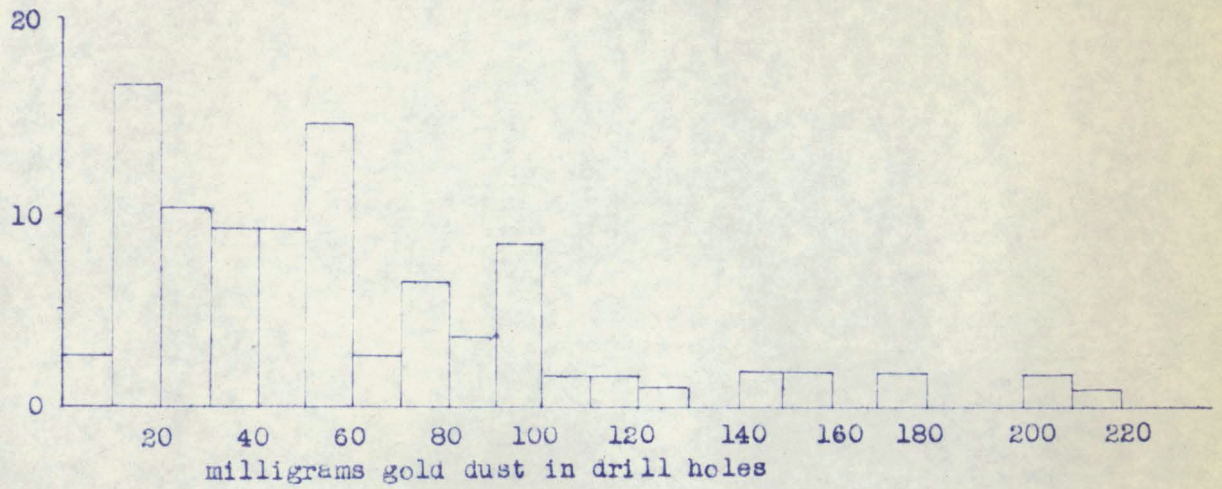


Total annual production of gold in fine ounces from dredges

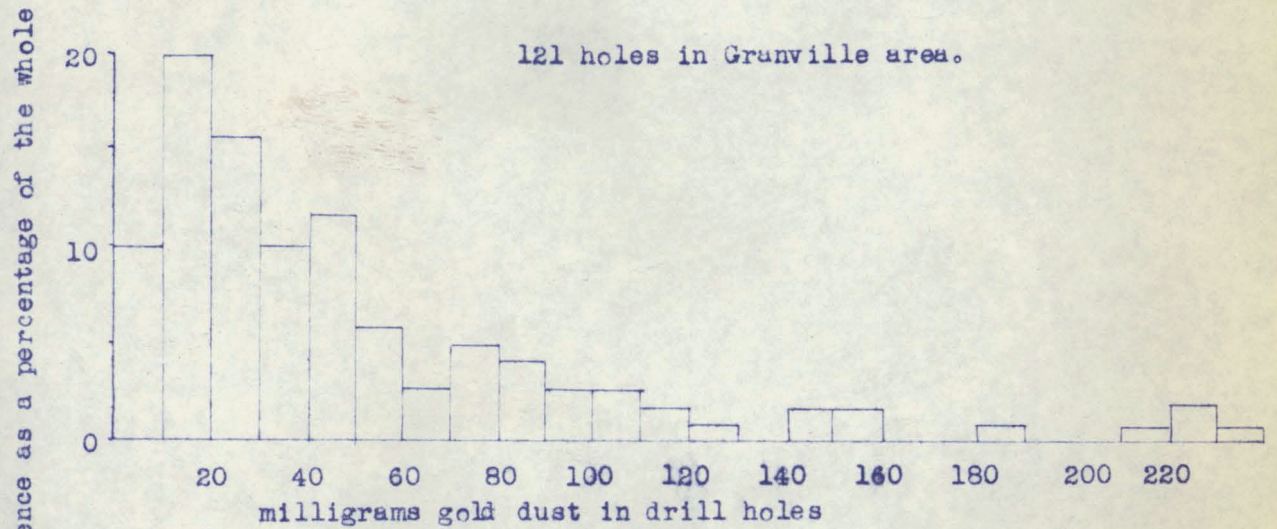


Total annual production of gold in thousands of ounces from all dredges (6,8,9,10,& 11).

109 holes on lower Sulphur Creek.



121 holes in Granville area.



147 holes in lower Gold Run Creek.

