

The Yukon Consolidated Gold Corporation Limited

DAWSON, Y.T.

CANADA

NOTES ON THE VALUATION OF GOLD PLACER GROUND IN THE KLONDIKE AREA

INTRODUCTION:

In the report of his visit to the Yukon Consolidated Gold Corporation operations in 1958, Mr. H. F. King expressed concern over the disparity between drilling and dredging results, and suggested a review of the evaluation methods used, in the light of experience and recent advances in statistics. This, he felt, could lead to improvements in the delineation of ore reserves.

Mr. A. Nordale, in his 1957 "Study of the Company's Operations", drew attention to the same problem in his reference to Dredge 9 performance on Sulphur Creek. He noted the tendency to over-run coincided with low estimates, while the converse was true for high estimates.

Similar observations were made by Mr. E. Dawson in his report on the Company's operations in 1933. He attributed the poor correlation between estimates and recovery to an insufficiency of holes. These problems are common to any mining enterprise; their exact resolution is a very difficult task.

The procedure in forecasting performance of any repetitive event is divisible under four headings:

1. Assemble data.
2. Forecast.
3. Compare forecast with results.
4. Refine technique of forecasting.

These notes are concerned primarily with these last two headings. Any improvement in valuation ability would lead to better control of immediate operations and the better planning of long term activities. It is with these objectives in mind that these notes have been prepared. They are intended, primarily, to be a progress report. Conclusions and recommendations should be interpreted in this light.

EVIDENCE OF DISTRIBUTION OF GOLD FROM DRILL-HOLES

It is an observed fact that the distribution of the valuable material within most mineral deposits follows one of the distributions commonly encountered in statistical analysis. With this in mind, the frequency of occurrence of "cents per cubic yard" values of gold have been plotted from the results of 1,750 holes in the Quartz, Sulphur, Dominion and Granville examinations. The results are given in Graph 1 (q.v.), where logarithms of the two functions have been plotted in order to obtain a straight line relationship. A definite interruption in continuity is evident in the distribution of values greater than 4.5 (\$1.60 per cubic yard at \$35 gold or 90¢ at \$20 gold).

Thus, from the evidence of 1,750 holes, a limit can be established, on a scientific basis, beyond which values obtained become suspect. About 7.4% of the total fall into this latter division. Treatment of anomalous values has long been a contentious subject. In our own case they may result from a number of causes, among which are pay streak remnants left by old workings, a poor drilling practice, or normal sampling error. Whatever their cause, or causes, estimates involving values in this "anomalous" range warrant special attention.

Test work has shown that the actual recovery of gold by a dredge is, for practical purposes, 100%. Production from each dredge is known for each month of operation, consequently there is a ready method of measuring the effectiveness with which the drill holes within any monthly cut predicted the actual recovery. To test this idea, the frequencies of values, on a basis of dollars per square yard of bedrock, from both dredging and drilling operations have been plotted (Graphs ll and lll). A substantial bias error appears to exist between the two sets of results, which is especially noticable in the lower range of values. The smaller peak on Graph ll is due to the effect of results from Dominion Creek in which there are apparently two separate modes of value distribution.

COMPARISON OF RECOVERIES WITH ESTIMATES

The annual recovery to estimate ratio ($\frac{R}{E}$ factor) for many of the dredge operations varies widely from the optimum 100%. Fundamentally, this ratio does not express the efficiency of the dredging, but is a measure of the precision of the evaluation procedure. As such, its variations deserve careful attention.

Performance of Dredge 7 on Quartz Creek has been used to support the contention that, because the overall $\frac{R}{E}$ for this operation was nearly 100%, the same will hold true for other operations as they progress. This argument is largely academic, since the major purpose of the valuation is to guide operations over much shorter periods. It is interesting to compare the frequency with which the values greater than \$1.35 per cubic yard occur in the creeks considered in Graph 1 :

<u>Creek</u>	<u>Total holes Considered</u>	<u>%Greater than \$1.35/cu. yd. (\$35 gold)</u>
Quartz	177	4.5
Sulphur	662	7.7
Dominion & Granville	911	7.8

With so many more "anomalous" values in the examination of Sulphur, Dominion and Granville than Quartz, and the current practice of estimating reserves strictly on the drill hole values, it will be interesting to see how this contention is upheld.

From Graphs ll and lll there is evidently a bias, which is more marked in the lower values. It therefore seems logical to examine the spread of R/E factors in suitable ranges of estimated values. To do this the annual R/E factors for 126 seasons' operations have been grouped according to the estimated recoveries in ten cent divisions (Graph IV). A smooth curve

joins the average of each group, although there is a considerable spread of R/E factors within each group. In order that the amount of spread may be appreciated graphically, the area containing two-thirds of the R/E factors in each range of estimated values has been plotted on Graph IV. Thus there is roughly a 2 to 1 chance that the R/E factor obtained by dredging ground of any given estimated value will fall within this area.

Were estimates made of monthly recoveries, it would be possible to refine this technique by virtue of the much larger number of R/E factors and estimates available. Even so, there seems to be a good case for adjusting estimates in accordance with the trends of the graph. The R/E factors from Graph IV would then be used as plan factors to be multiplied by the value of the estimate arrived at from the drilling, and so arrive at a more precise valuation.

In that estimates would then fulfill their intended purpose as an aid to planning and control, a device such as that outlined would surely be more acceptable than the present practice of adjusting estimates arbitrarily by large percentages in the making of production forecasts for budgeting. The use of carefully calculated plan factors would employ all the accumulated knowledge of valuation variation and thus ensure, on average, a better control of operations.

The manner in which present valuation estimates are adjusted for forecasts may be appreciated from the following table for 1960:

DREDGE	Pre-Season Estimate of Planned dredging ¢/CU.YD.	Adjustment %	Adjusted Pre-Season Estimate ¢/CU.YD.	Post-season Estimate of Actual dredging ¢/CU. YD.	Actual Recovery ¢/CU.YD.
6	25	N11	25.3	26.8	29.4
8	35	+10	38.5	36.2	33.0
9	15	+25	19.3	18.3	38.3
10	20	+25	25.0	25.0	48.1
11	62	-10	59.4	65.5	68.9

With adjustments of this magnitude being made arbitrarily to estimates of ground value, there is clearly little justification for the current practice of giving estimated values to five and six significant figures. Such a degree of accuracy could not be expected from plan factors either. The R/E factor, as calculated at present, is put to no real use, since the "E" used is that derived from the drilling results, while the only "E" used in making any decisions is that which has been "adjusted" in the manner outlined above.

In the R/E estimated value curve in Graph IV the lower limit of the area containing two-thirds of the values shows a downward trend in the range of lower estimates, which is a deviation from the symmetry of the distribution. An examination of the individual values of R/E in this lower range of estimated values shows that they are predominantly from Dredges 3, 4 and 6. Both Dredges 3 and 4 were working in abnormal ground,

which had either previously been worked or was in the main Klondike Valley, so any unusual deviations in valuation precision are readily explicable. Until recently the performance of Dredge 6 has been enigmatic. If R/E factors outside the area containing 2/3 of the values be termed "anomalous" for the sake of the argument, then the extents of the deviations by Dredge 6 from expected performance may be judged from the following table:

<u>Dredge</u>	<u>Number of years "anomalous"</u> <u>performance - 1949 - 1960</u>
6	9
8	2
9	1
10	2
11	1

No geological reason is evident in the records for this unusual performance. The only possible conclusion is that the deviations from the expected are, in some way, a function of the method of evaluation. In 1954, after four "anomalous" years out of five, the remaining part of the reserves of Dredge 6 which had been valued by widely spaced holes were revalued by a weighting method evolved by Mr. W. H. S. McFarland. Even this did not ameliorate the situation markedly. When the original evaluation of drill holes in this area is used, it is noticeable that Dredge 6 performance did not cease being "anomalous" until after 1959, when the last of the widely spaced drill hole area was finally reached.

From the above considerations, the amendment to Graph IV seems to be justified (q.v.).

CONCLUSIONS AND RECOMMENDATIONS

1. A statistical approach to the evaluation of drill holes shows that there is a well defined upper limit to the value per cubic yard which, where exceeded, should be suspect.
2. The existence of a bias error has been demonstrated in correlating monthly dredge returns with drill hole evaluations of the same area.
3. The variations in recovery to estimate factors in respect to estimates from drilling of the value of dredge ground show that a definite correlation exists. Adoption of plan factors for adjusting valuations based on drill hole data is suggested as an alternative to present practice.
4. It is recommended that the recovery to estimate factors be calculated for as many months' dredging as feasible, and that this information be used for determining plan factors as accurately as possible.

CONCLUSIONS AND RECOMMENDATIONS (Cont'd.)

5. With the drill hole information, accurate plan factors, and a knowledge of the stripping, thawing and dredging costs for different depths of material, it would be possible to calculate the optimum reserves for each dredging operation. This might be best effected by a small electronic computer programme in much the manner of current practice in many open-pit mining operations today.

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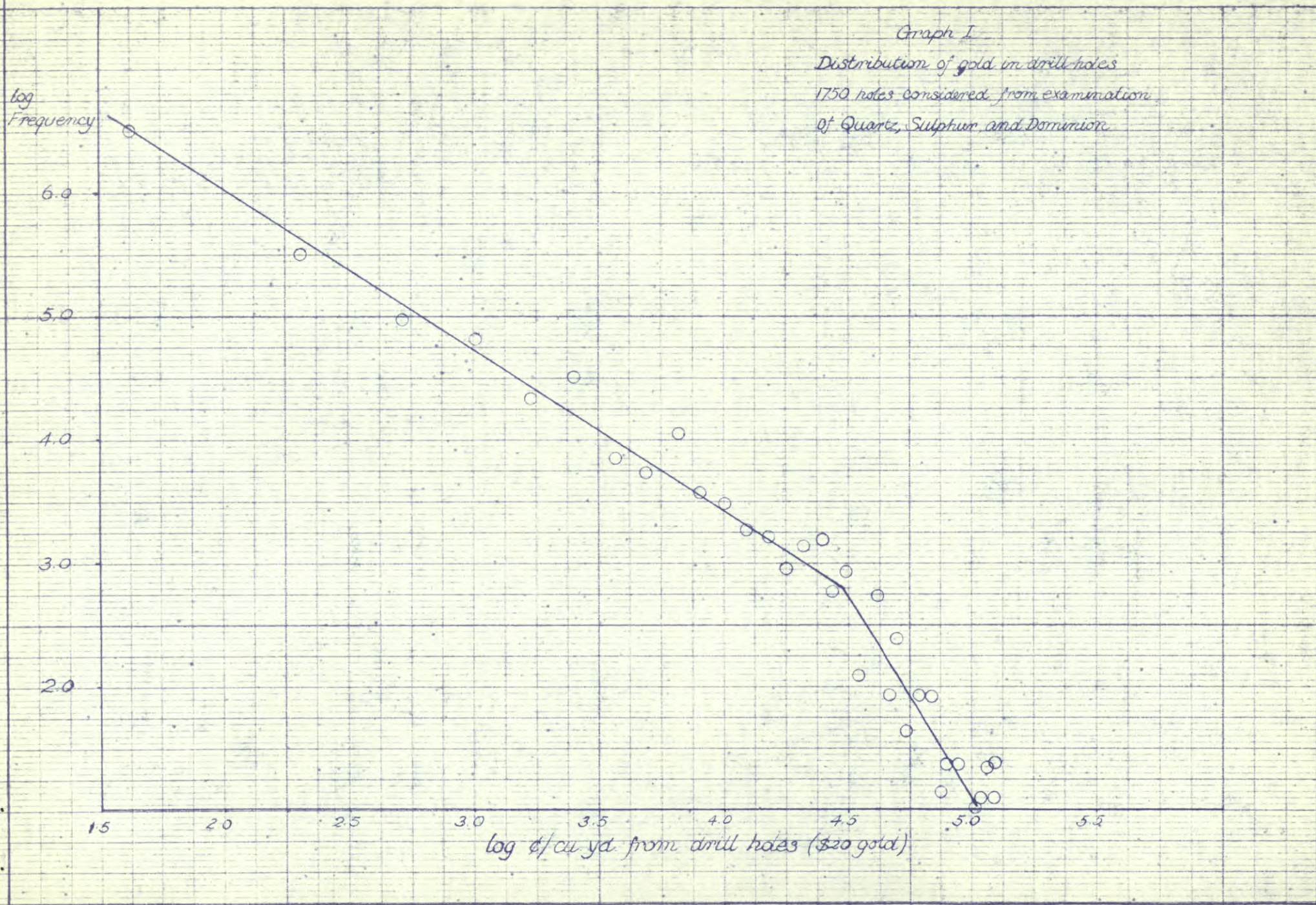
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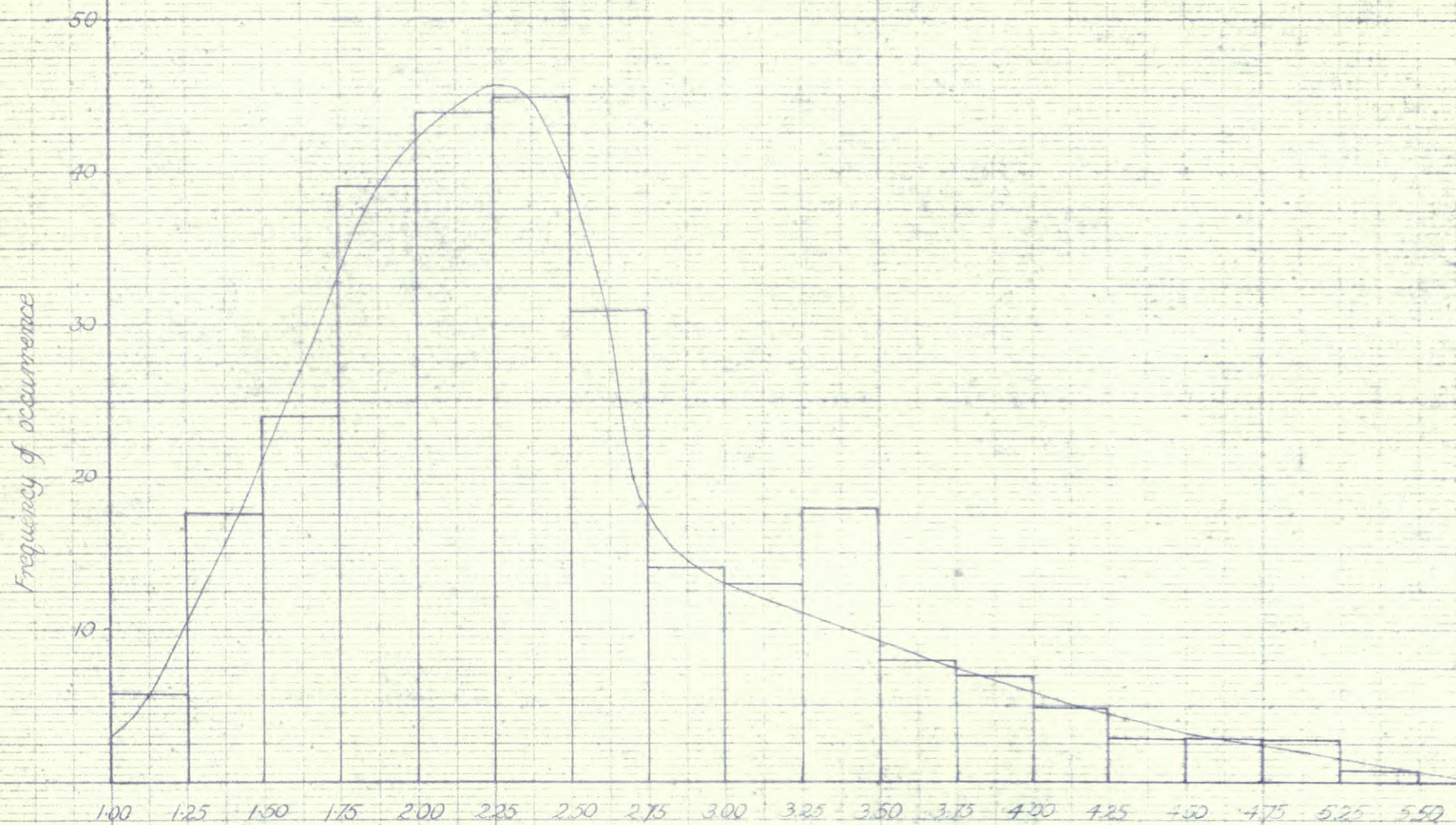
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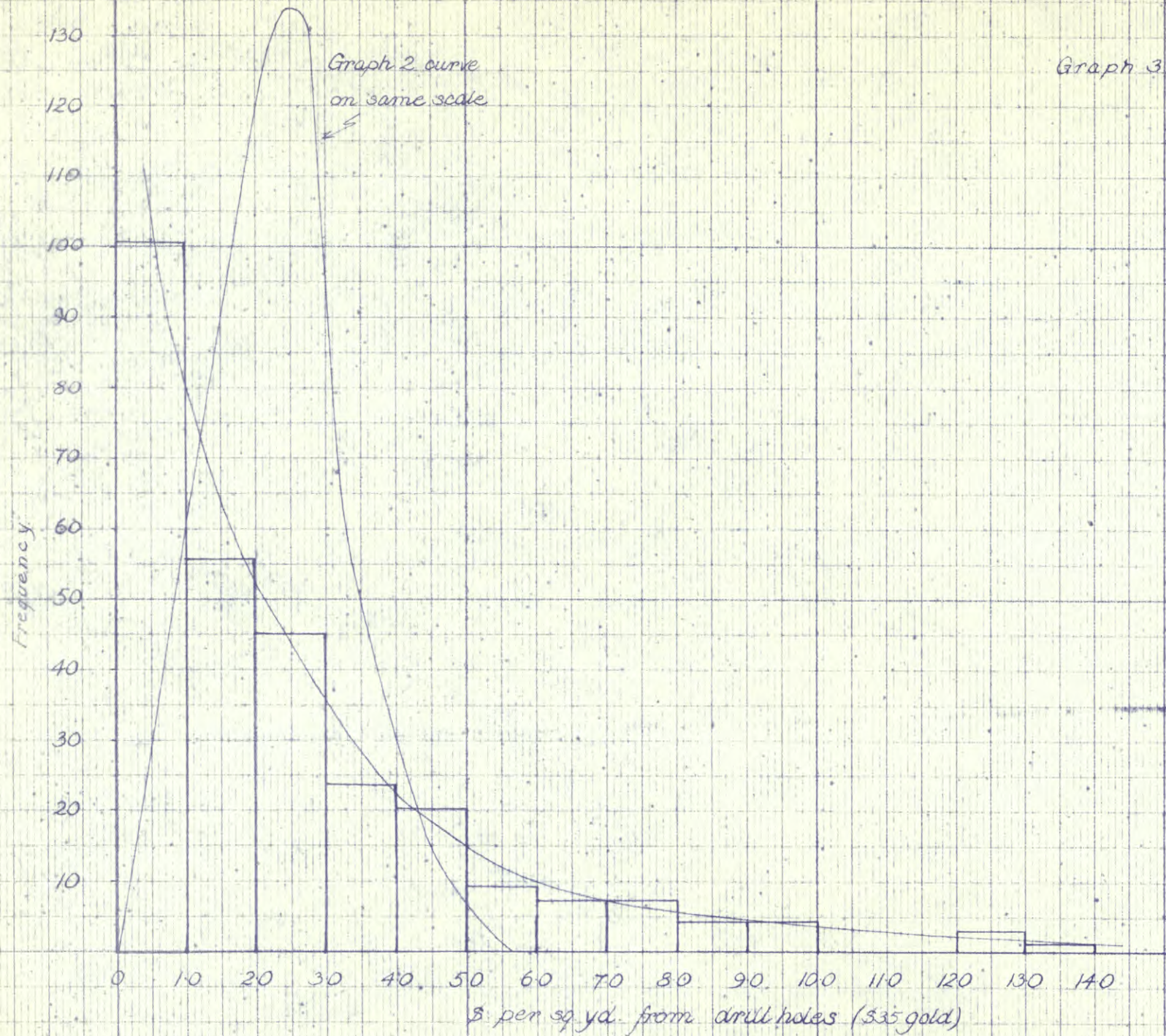
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Graph 2

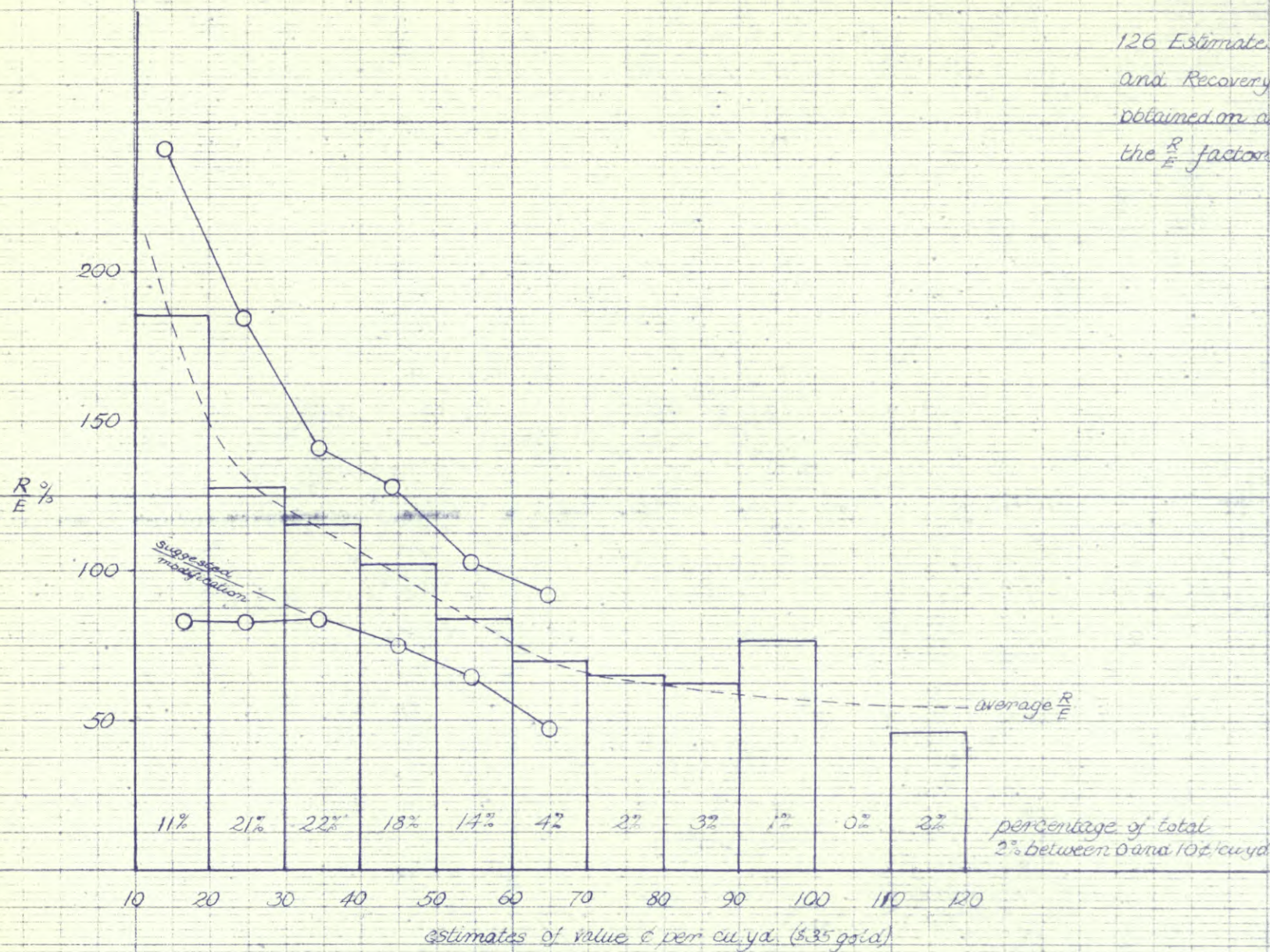


Drillhole values from monthly dredge returns 3 per sq. yd. (#35 gold)
 Values from Drages 6, 8, 9, & 10



Graph 4

126 Estimates of value per cubic yard
and Recovery to Estimate factor ($\frac{R}{E}$)
obtained on average. Two-thirds of
the $\frac{R}{E}$ factors lie between limits shown.





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