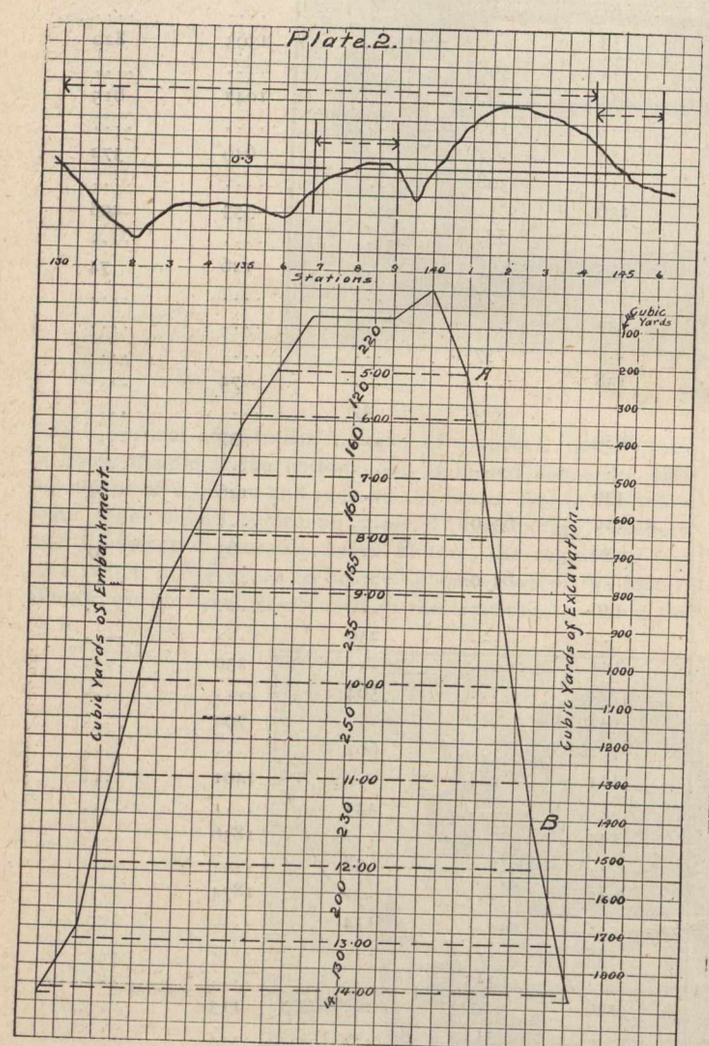
we now proceed to plot two curves, one representing the quantities in the cut, and the other the quantities in the fill. From Table 1 we see that the change from cut to fill occurs at sta. 140. To prevent confusion select a point an inch below the plotted grade point and let this point represent the axis of the co-ordinates of the two curves to be plotted. On the vertical lines of the profile paper, which represent stations, plot points representing the summation of the cubic yards up to that station.

For example the point A represents sta. 141 and 230 cubic yards, the point B, sta. 143 and 1401 cubic yards, etc. Join the plotted points and we have curves as in Plate 1.

The quantities hauled and the distance hauled are now required.

To find the free haul, that is the haul less than 500 feet, scale and mark the points on the curve that are horizontally 500 feet apart. The scaled distance from this 500 foot line measured vertically to the axis represents the cubic yards of free haul.



To calculate the overhaul draw from the points of abrupt change in direction of curves horizontal line intersecting the curves. Scale the length of these lines in 100 foot stations, take the average of each successive pair and from this average subtract the freehaul distance, and you have the average haul of the yardage represented by the vertical distance between each pair of lines. The product of this average haul and the yards hauled will give the number of cubic yards, per station, of overhaul. In this way Table 2 is prepared.

Table 2.

220 cubic yards.	Free haul.	
155 cubic yards	×.625=	96.87
455 cubic yards	×2.67=1190.37	
575 cubic yards	×5.25=3018.75	
300 cubic yards	×7.07=2122.50	
175 cubic yards	×8.45=1478.75	
1870	Total	7907.25

Summing up we have from sta. 140 to 144+25.

220 cubic yards freehaul
7907 cubic yards overhaul
and 144+25 to 145
424 cubic yards freehaul.

Another method, and one in common use, assumes that material hauled over 700 feet has been hauled 800 feet and similarly for every hundred feet. Should this method be adopted the profile, Table 1, and the plotted curves will be the same as in the first method, but instead of drawing horizontal lines at each abrupt change in the direction of the curves horizontal lines are drawn where the lines of the curve are, 500, 600, 700, etc., feet apart as in Plate 2. The distance between each pair of horizontal lines represents the number of cubic yards hauled beyond a certain even hundred-foot distance up to another even hundred-foot distance.

From Plate 2 we see that 120 cubic yards have been hauled beyond 500 feet and distributed up to 600 feet. By this method it will give 120+1=120 cubic yards overhaul. In this way Table 3 is prepared.

220 cubic yards.	Freehaul.	
120 cubic yards	×1=	120
160 cubic yards	×2=	320
160 cubic yards	×3=	480
155 cubic yards	×4=	620
235 cubic yards	×5=1175	
250 cubic yards	×6=1500	
230 cubic yards	×7=1610	
200 cubic yards	×8=1600	
130 cubic yards	×9=1170	
14 cubic yards	×10=140	
1874 cu. yds.	Total,	8735

Summing up we have

220 cubic yards freehaul,
8735 cubic yards overhaul.

Comparing the results we see the second methods gives 838 cubic yards more of overhaul than the first method.

It would be interesting to know why this second method is in such common use, the assumption on which it is based being so far from correct.

NEW MILLING MACHINES.

Two milling machines are now being manufactured by the Becker Brainard Milling Machine Co., of Hyde Park, Mass. These machines are made in two styles, back geared and not back geared respectively. They are known as Nos. 25 and 26, the former being shown in the illustration.

In their design special attention has been paid to the requirements of the manufacturer of small machine parts, which are produced in large quantities such as found in small arms, typewriters, sewing machines, and electrical works. In bringing out the new model especial attention has been given to the feed works that they may be able to withstand the full power of the driving belt, and at the same time give good service in the rough usage to which these machines are subjected. This new feed is driven by belts which get their motion from the spindle of the machine by means of a train of gears, so arranged that the velocity of the belt is sufficient to drive all feeds that the main belt will stand. The changes of the feed are obtained by four step cones and by interchanging the feed driving pulleys on the back of the machine, giving in combination eight changes from .007 to .100.

The ranges of these machines are: Longitudinal feed, 34 inches; cross feed, 8 inches: vertical adjustment, 18 inches; net weight, 1,650 lbs.

The table is operated by worm and hobbed rack, the worm being driven by means of a worm gear of large size and worm of coarse pitch and of correspondingly high efficiency. The arrangement for disengaging the feed is by