Valuation of a Coal

Mining Property

By

Niles E. Grosvenor

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Signed:

Niles E. Grosvenor

Golden, Colorado

Date _May 28_, 1952

Approved:

Clifton W. Livingston

Golden, Colorado

Date _May 28_, 1952

ACKNOWLEDGMENTS

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VALUATION OF A COAL MINING PROPERTY

A mining property at any given time has but one true value. The most important factor to be considered in arriving at the true, or present, value of the property is the amount of coal remaining to be mined.

Various methods for valuation of coal mining properties have been suggested. Some of these methods are a capitalization of the estimated future earnings, cost values, assessed valuation, sales values, royalty valuations, tonnage values, and valuation based on past earnings.

The Engineers' Advisory Valuation Committee of the United States Coal Commission 1/ believes that the fairest, most practicable, and

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1/ Engineers' Advisory Valuation Committee of the United States Coal Commission, Valuation of coal mining properties in the United States: A.I.M.E. Trans., vol. 70, p. 794, Feb. 1924.

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most logical method of valuation of a coal mining property is a capitalization of the estimated future earnings, when such estimate can reasonably be made. The Committee 2/ further states:

2/ Idem. p. 795.

"Cost, which is urged as representing the actual investment
in a property, is no criterion of value; the great bulk of
the anthracite lands were patented to individuals by the
State of Pennsylvania from about 1795 to 1816, at from two
to four dollars per acre. No one could consider that as a
present value, and if it were maintained the anthracite com-
munities would be bankrupt for lack of taxable assets, yet
$4 per acre at 6 per cent. compound interest from 1800 to
date would amount to $5200 per acre, more than the present
average value of the lands, and the undeveloped area has
paid taxes for all this time, besides accumulating interest.

"If the last purchase price be taken, the wildest confusion and injustice ensues, a property which may cost $1000 a half century ago would be valued at that in the hands of the original purchasers, on its sale it may immediately jump to $100,000 in the hands of a new owner, while identical property not sold remains valued at the original cost.

"Assessed valuation is not a reliable indication of value, particularly in the case of coal where the widest variation exists in the values assigned in adjoining counties and municipalities, and when quite generally coal land in the hands of the farmers is unassessed or assessed at nominal value. Similar land in the hands of operating companies, even if undeveloped, is often heavily assessed. In the anthracite region, the basis of valuation varies from about $30 to $500 per foot-acre for land in adjacent counties.

"Sale prices are a just basis of valuation for the particular lands sold, provided that the sale was between a 'willing seller and a willing buyer,' but sales are not even an indication of the value of other properties. As is well known, one mine may be a bonanza and the adjoining one a liability. Further, the value of a mining property may be greatly enhanced, or much depreciated, by the method adopted in opening, development or equipment; and in the sale of properties all of these considerations are taken into account.

"Royalty values are useful as indications of value of unopened lands, it is self-evident that anyone paying royalty expects to make a material profit above that royalty, and the value of operating lands is hence based on the sum of the royalty to the lessor and the profit to the lessee.

"Tonnage Values - While all values can be reduced to value per ton, there is a tendency to estimate tonnage and then apply an assumed figure of value per ton; this is not a valuation but guessing."

H. M. Chance 3/ states:

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3/ Chance, H. M., Appraisal of coal-property values: A.I.M.E. Trans., vol. 74, pp. 445-446, Oct. 1926.

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"For many years there has been a growing tendency to base the valuation of the property of an operating coal-mining company or organization upon past, present, or prospective earnings.

"The application of this method gives a gross value representing that of all of the property and assets, tangible and intangible, of such company as a going concern. If from such

value there be deducted the value of improvements, personal
property, buildings, fixtures, structures, plant and other
tangible property, the values of which may be determined by
their replacement costs; and the amount of an arbitrary ap-
praisal fixed, or agreed upon, as the value of the intangible
property, goodwill, trademarks; and the values of surface
real estate determined by standard real estate appraisal
methods; the balance will represent the value of minable coal
remaining in the property.

"The proponents of such method claim that the value of a
property is limited to a sum upon which the net income will
be sufficient to pay a satisfactory rate of interest and to
provide a sinking fund to extinguish such value at or before
all of the coal is mined.

"This reasoning is doubtless sound as effecting the protection
of prospective investors in mortgage securities based upon
such valuation, but it ignores conditions or facts which may
be of equal or greater importance than the current profit
or loss shown by the books.

"Earnings indicate values only during the periods in which
conditions are normal or approximately normal.

"Earnings may fluctuate while the value of the property
remains unchanged.

"Past earnings do not assure a continuance of like earnings
in the future.

"If valuation be based upon average earnings extending back
over a period of years, the date of valuation is virtually
set midway in the period used, so that the value is as of
some year prior to the present. If the trend of earnings
during such period has been downward, the value reached is too
high; if upward, the value is too low. In neither case does
the result represent the present value.

"Therefore, valuation by past earnings is permissible only
when it can be conclusively shown that no evidence proving
current sales value is obtainable.

"Past earnings, if large, may encourage a buyer to pay a price
in excess of the value; or if small, may prevent him from
purchasing even at a price much below the real value.

"In addition, because the recent past includes periods of
remarkable, unusual and extraordinary fluctuations in
prices of materials, supplies, labor, taxes, and other items

that affect earnings, both gross and net, and because of similar unusual variations in the prices of coal and in the demand, the national method for the evaluation of coal properties is that based on sales value.

"It may also be noted that during this period royalty values have been singularly free from the marked fluctuations recorded by the prices of other commodities."

The location of the mining property to be valuated is such that royalty values have a direct effect upon the true or present value of the property.

The property to be valuated is located in Section 12, Township 4 North, Range 89 West, 6th Principal Meridian. It is approximately 14 miles south of Hayden, Colorado. It is near the center of the Yampa coal field. The district is a part of the upland known as the Colorado Plateau.

The coal-bearing rocks of the Yampa field are found in the Mesaverde formation and are of Cretaceous age.

The present value of this property will be determined by an investigation of the following: (1) Factors Determining Value of Property, (2) Surface Plant, (3) Taxes and Royalties, (4) Mining Methods and Cost Estimates, (5) Valuation Procedure, and (6) Conclusions.

Sec 35   Sec 36

N 89°04' E

Coal outcrop

Mine Portal

County Road

Coal outcrop

N

Pitch 7½°
Strike N40°W   N 50° E

Map of Mining
Property
Located in Section 12
T4N, R89W, 6 P.M.
Scale 1 in = 300 ft.

FACTORS DETERMINING VALUE OF PROPERTY

The factors determining the value of the property will be discussed in the following order: (1) Extent of Area, (2) Coal Seam, (3) Analysis of Coal, (4) Markets, and (5) Value of Coal per Ton.

Extent of Area

The total area of this property is 186.3 acres. The coal seam underlies 179.4 acres of this area.

The total tonnage of positive, probable, and possible coal was calculated as follows:

$$\frac{179.4 \times 43,560 \times 8.75}{25 \times 0.99144} = 2,758,747 \text{ tons of coal}$$

179.4	acres of coal
43,560	square feet per acre
8.75	foot seam of coal
25	cubic feet of coal per ton measured on the solid
0.99144	cosine of 7.5°, the dip of the coal seam

Coal Seam

The coal seam is 8 feet, 9 inches thick with a 3- to 6-inch bone parting. This parting is located about 30 inches above the floor. The dip of the seam is 7½ degrees, and the direction of the dip is N 50° E.

The coal outcrops as shown on the map.

The immediate roof above the coal seam is a layer of massive sandstone about 2 feet thick.

The thickness of the overburden above the coal seam varies from 150 to 175 feet.

Analysis of Coal

The proximate and ultimate analysis of the coal seam as reported

by the U. S. B. M. 4/ from a sample taken at the end of a 180-foot

4/ Analysis of Colorado coals: U. S. B. M. Tech Paper 574, pp. 118-
   119, 1937.

entry are as follows:

Proximate Analysis (percent)

	As received basis	Moisture-free basis	Moisture- and ash-free basis
Moisture	12.2	—	—
Volatile Matter	35.8	40.8	43.0
Fixed Carbon	47.4	53.9	57.0
Ash	4.6	5.3	—

Ultimate Analysis (percent)

	As received basis	Moisture-free basis	Moisture- and ash-free basis
Sulphur	0.4	0.5	0.6
Hydrogen	5.5	4.7	5.0
Carbon	65.0	74.0	78.0
Nitrogen	1.4	1.6	1.7
Oxygen	23.1	13.9	14.7
Ash	4.6	5.3	—

The British thermal units per pound are as follows:

As received basis	11,380
Moisture-free basis	12,960
Moisture- and ash-free basis	13,680

Markets

The local market is for coal for domestic use in Hayden, Craig, and Steamboat Springs. The total tonnage required for this market is about 6000 tons per year.

If the property were developed, all distant market coal would be hauled by railroad. The coal would be hauled 14 miles to the railroad at Hayden by truck. At the present time, it is impractical to truck coal to the Eastern Slope because of the mountain passes.

For the valuation of this property, it is assumed that there will be a market for all the coal that can be produced.

Value of Coal per Ton

The average value of coal placed in railroad cars at Hayden, Routt County, Colorado, is $5.69 per ton.

The value per ton of coal was computed from the following data:

Lump coal, plus 3 inches - $6.70 per ton

Nut coal, $1\frac{1}{4}$ x 3 inches - 4.75 per ton

Coal, minus $1\frac{1}{4}$ inches   - 4.60 per ton

The ratio of sizes of coal placed in railroad cars was assumed to be 50 percent plus 3 inches, 25 percent $1\frac{1}{4}$ x 3 inches, and 25 percent minus $1\frac{1}{4}$ inches.

SURFACE PLANT

The selection of a coal tipple and a preparation plant of the proper capacity is the result of a careful study of the estimated daily tonnage of the mine. Two factors must be considered before deciding upon an economic daily tonnage. These factors will be discussed in the following order: (1) life of the mine based upon the total tons of coal and (2) the economic capacity of a preparation plant.

Life of the Mine Based upon the Total Tons of Coal

The life of the mine is determined by the daily production of coal and the total tons of coal to be mined.

The total tons of coal on this property are estimated to be 2,758,747. Assuming ideal conditions for the mining methods discussed, a 90-percent recovery factor will be used to determine the tonnage of coal mined. Therefore, the total tonnage of coal to be mined is

2,758,747 tons x 0.90 = 2,482,872 tons.

The life of the mine, based upon the estimated production of 100 tons per day and assuming 250 working days in a year, would be calculated as follows:

$$\frac{2,482,872 \text{ tons}}{100 \text{ tons per day} \times 250 \text{ days}} = 99.3 \text{ years}$$

The life of the mine based upon 500 tons per day would be 20 years, and based upon 1000 tons per day would be 10 years.

The Economic Capacity of a Preparation Plant

The economic capacity of a preparation plant is determined from a study of the graph on page 10.

Graph for Selection of Preparation Plant
Cost vs Capacity
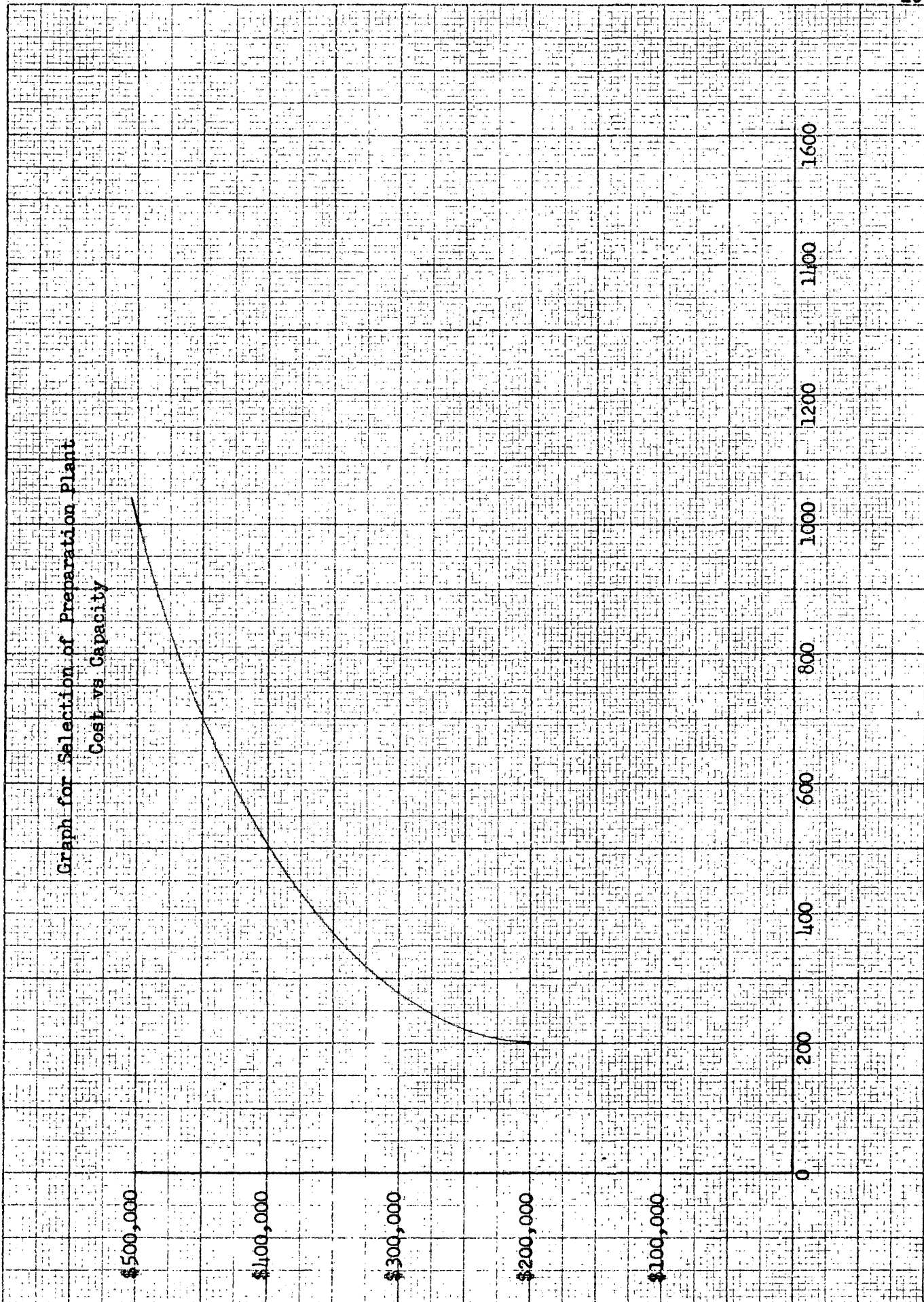
TONNAGE PER DAY

TOTAL COST

$500,000

$400,000

$300,000

$200,000

$100,000

0   200   400   600   800   1000   1200   1400   1600

A preparation plant to handle the production of 100 tons per day cannot be justified: it is impractical to build a preparation plant for a production so low. The cost to operate a plant of this size would be approximately the same as that of a plant with a capacity of 200 tons per day.

The cost of a preparation plant for a production of 200 tons per day is approximately $200,000. The cost of a preparation plant for a production of 1000 tons per day is approximately $500,000. A study of these figures shows that the larger the daily tonnage, the smaller the capital investment per ton of coal produced.

A preparation plant capacity of 1000 tons per day was found to be the most economical for handling 2,482,872 tons over a period of 10 years. A preparation plant with a capacity of 2000 tons per day would not be justifiable because of the total tonnage of the property.

The recovery of the preparation plant is assumed to be 90 percent.

The total tonnage of coal placed on the market will be:

$$2,482,872 \text{ tons} \times 0.90 = 2,234,585 \text{ tons}.$$

The average cost of preparing this coal is 20 cents per ton.

Taxes and Royalties

The Colorado Tax Commission in April, 1947, described coal lands for taxation purposes as follows:

> "Producing Coal Lands. - Producing Coal Lands shall be deemed to be such forty-acre units as have workings in a seam of merchantable coal and from which coal is being extracted during the current year. Maximum valuation $400.00 per acre. Five foot vein. Other veins at the discretion of the assessor.

"Non-Producing Coal Land. - Non-Producing Coal Land shall be deemed to be such forty-acre units of undeveloped merchantable coal as adjoin forty-acre tracts of producing or developed coal land, providing the non-producing acreage shall not exceed ten years of normal production from the mine. Maximum valuation $100.00 per acre.

"Developed Coal Land. - Developed Coal Land shall be deemed to be such forty-acre units as shall have at least one entry driven more than halfway across such forty, indicating probability of merchantable coal in place throughout the forty but from which no coal excepting entry coal is being removed during the current year. Maximum valuation $200.00 per acre.

"Undeveloped Coal Land. - Undeveloped Coal Land shall be such forty-acre tracts believed to contain merchantable coal which do not fall within the classification of producing, non-producing, developed or coal reservations.

"We have no recommendations to make on the valuations to be placed on undeveloped coal lands. We believe there can be no uniformity of valuation of this classification, either between counties or in counties as the values vary according to location and other factors at from $5.00 per acre to $75.00 per acre."

The assessed value of the land would vary from year to year. The maximum value of the land would be attained at a time when all development work had been completed and production was at a maximum.

Taxes upon the land are very low as compared to the amount of royalties upon leased land.

Most of the mineral rights of Routt County are reserved by the national government. The royalty upon a small mining property is 15 cents per ton of coal mined.

A royalty of 15 cents per ton of coal mined will be used in determining the final value of the land, because it will be representative of the conditions that exist in the area.

The total ad valorem taxes in effect in Routt County, Colorado, are:

School tax	10.50 mills
Routt County tax	15.30 mills
Colorado State tax	3.86 mills
Moffat Tunnel tax	2.00 mills
Total	31.66 mills

MINING METHODS AND COST ESTIMATES

Two methods of mining and cost estimates for each method will be discussed. The first method of mining to be discussed will be with the use of duckbills, shaker conveyors, and track haulage. The second method of mining to be discussed will be with the use of Joy-loaders with belt haulage.

Duckbills, Shaker Conveyors, and Track Haulage

The mine portal will be located as shown on the map on page 5.

A room-and-pillar retreat mining system will be used. A 4-entry system will be used for main and slope entries. A 3-entry system will be used for room entries. All development work will be done with duckbills and shaker conveyors.

The sketch on page 15 shows a plan view of this system of mining.

The sketch on page 16 shows a detailed plan view of the arrangement of workings, air currents, and blower fan setup in the triple room entry system.

Duckbills will be used to load the coal onto shaker conveyors in the rooms. The shaker conveyors will load directly into mine cars, as shown by the sketch on page 16.

Track haulage will be used throughout the mine. Gathering haulage will be done by trolley locomotives. The cars will be taken to the slope, where they will be let down by a direct-drive hoist to the main haulage way. From the bottom of the slope the cars will be transported to the portal by trolley locomotives. The coal will be placed in a surge bin at the portal. The coal will be transported by truck from the surge bin to the preparation plant.

Hoist Station →

Gathering Haulage Entries

Slope Haulage Entries

Strike

$7\frac{1}{2}°$ Pitch

Main Haulage Entries
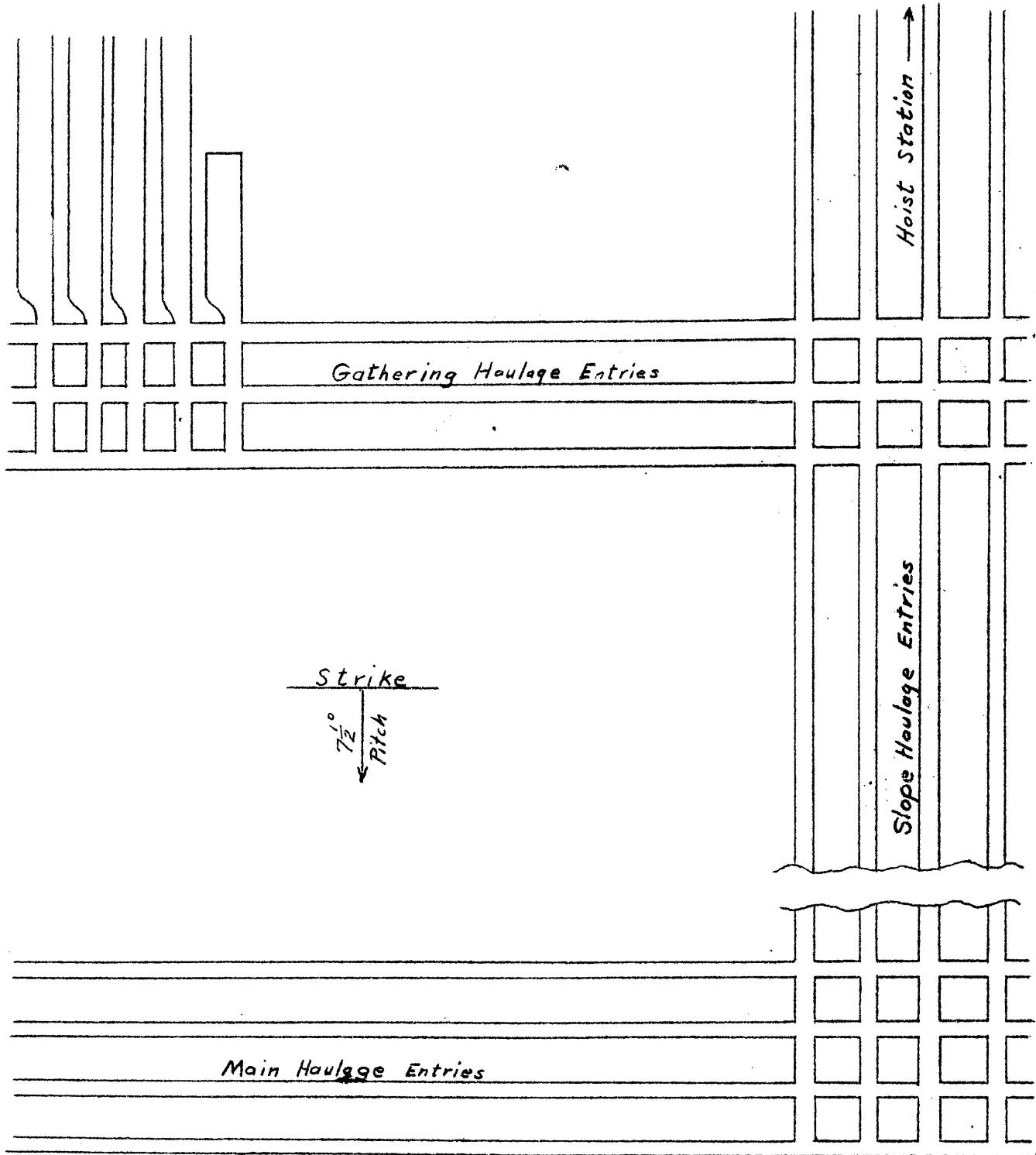
System of Mining
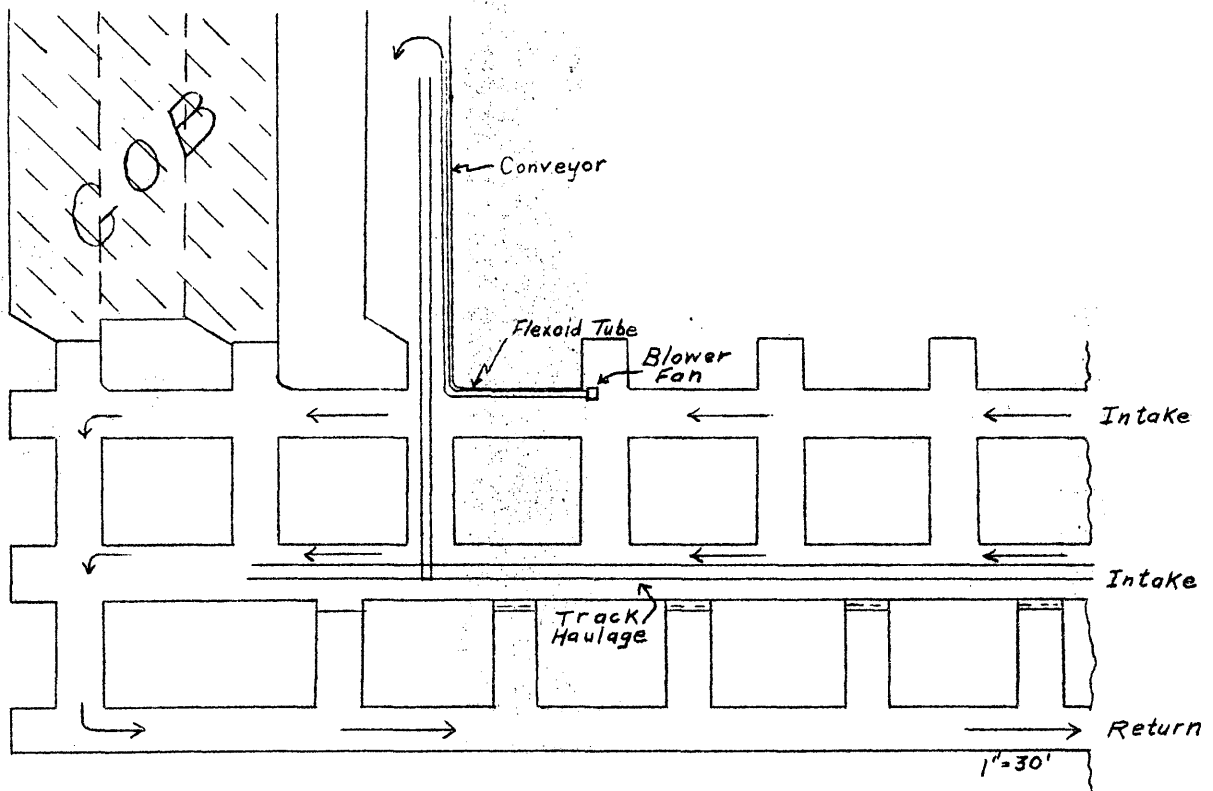
Arrangement of workings, air currents,
and blower fan setup

after

Thomas Allen

The cost estimate of equipment for mining 1000 tons of coal per

day by this system is as follows:

A. Mining Equipment at Face
   9 Duckbills with conveyors at $8,000 each . $ 72,000.00
   9 Cutting machines at $15,000 each. 135,000.00
   9 Coal drills at $600 each. 5,400.00
   Miscellaneous 750.00

                              Total $ 213,150.00

B. Power and Transmission Equipment
   1 Mercury-arc rectifier, 300 kw . . . . . $ 16,000.00
   1 Oil circuit breaker, 300 amp. 1,100.00
   1 Reclosing circuit breaker 1,000.00
   Trolley wire, main haulage, $0.163 per ft   848.00
   Feeder wire, main haulage, $0.66 per ft .   2,310.00
   Power transmission cable and wire acces-
      sories 14,090.00

                              Total $ 35,348.00

C. Track Material and Accessories
   Steel rail, 70 lb. at $0.43 per ft. . . . $ 7,482.00
   Track turnouts at $202.00 each. 2,020.00
   Ties, treated wood. 5,000.00
   Track accessories 5,100.00

                              Total $ 19,602.00

D. Haulage Equipment and Accessories
   1 Locomotive, main line, 10 ton . . . . . $ 14,000.00
   2 Locomotives, gathering, 6 ton 14,000.00
   50 Mine cars, capacity 6 tons. 40,000.00
   Haulage accessories 3,293.00

                              Total $ 71,293.00

E. Track-mounted Accessory Equipment
   4 Mantrip cars. . . . . $ 4,800.00
   1 Rock-dust distributor 4,700.00
   1 Mine car trucks, insulated, delivery of
      explosives 225.00
   1 Mine car trucks, insulated, delivery of
      blasting caps. 225.00
   Miscellaneous track-mounted accessory
      equipment. 2,000.00

                              Total $ 11,950.00

F. Hoisting Equipment and Accessories
  1 Hoist, 200 hp. . . . . $ 48,000.00
  Hoisting rope, 1½-in. plow steel at
    $0.76 per ft. 2,280.00
  Hoisting accessories 75.00

          Total $ 50,355.00

G. Ventilation Equipment and Material
  1 Ventilation fan, 100,000 c.f.m. . . . . . $ 30,000.00
  Ventilation materials. 7,255.00

          Total $ 37,255.00

H. Drainage Equipment and Accessories
  Total cost, drainage equipment and
    accessories . . . . $ 5,733.00

I. Roof-Support Material
  Total cost, roof support material. . . . $ 28,970.00

J. Illumination Underground
  Total cost, mine illumination. . . . . . $ 5,541.00

K. Safety and First-aid Equipment
  Total cost, safety and first-aid
    equipment. . . . . $ 4,077.00

L. Shop Equipment and Tools
  Total cost, shop equipment and tools. . . $ 8,118.00

M. Tools and Miscellaneous Equipment
  Total cost, tools and miscellaneous
    equipment. . . . . $ 3,389.00

N. Operating Supplies . . . . Monthly Cost
  1. Face supplies . . . . $ 882.00
  2. Power transmission supplies 199.00
  3. Track material and accessories. 833.00
  4. Haulage supplies. 46.00
  5. Ventilation supplies. 344.00
  6. Drainage supplies 52.00
  7. Roof-support supplies 860.00
  8. Illumination supplies 5.00
  9. Shop supplies 79.00
  10. Hand tool supplies. 31.00
  11. Hose supplies 44.00
  12. Miscellaneous supplies. 14.00

          Total $ 3,389.00

O. Maintenance Supplies and Parts. . . . . Monthly Cost
      Total cost, all maintenance supplies and
        parts . . . . $ 2,529.00

P. Total Cost of All Items $500,699.00

The labor cost for mining 1000 tons of coal per day using this system of mining is as follows:

1. Direct labor cost based on 36 men at an average
     of $18.11 per day . . . .$ 651.96

2. Service labor cost based on 42 men at an average
     of $18.11 per day 760.42

3. Supervision cost based on
     1 Supervisor, $1,000 per month 48.00
     1 Mine foreman, $600 per month 28.80
     1 Fire boss, $350 per month. 16.80

              Total cost per working day $ 1,505.98

The labor cost to produce a ton of coal by this system is $1.51.

Joy-loaders with Belt Haulage

The mine portal will be located as shown on the map on page 5.

A retreat system of room-and pillar mining will be used. A 4-entry system will be used for main and slope entries. A 3-entry system will be used for cross and room entries.

A sketch on page 20 shows a plan view of this system of mining.

Development work will be done with duckbills and shaker conveyors loading into mine cars.

The coal in the rooms will be loaded by Joy-loaders into shuttle cars. The shuttle cars will transport the coal to the room necks to be loaded onto belts.

Belt haulage will be used throughout the mine. The belts will transport the coal to the portal, where it will be placed into a surge

Rooms - Shuttle Car Haulage

500'

500'

36" Belt Conveyor

36" Belt Conveyor

Barrier Pillar

Strike

Pitch

7½°
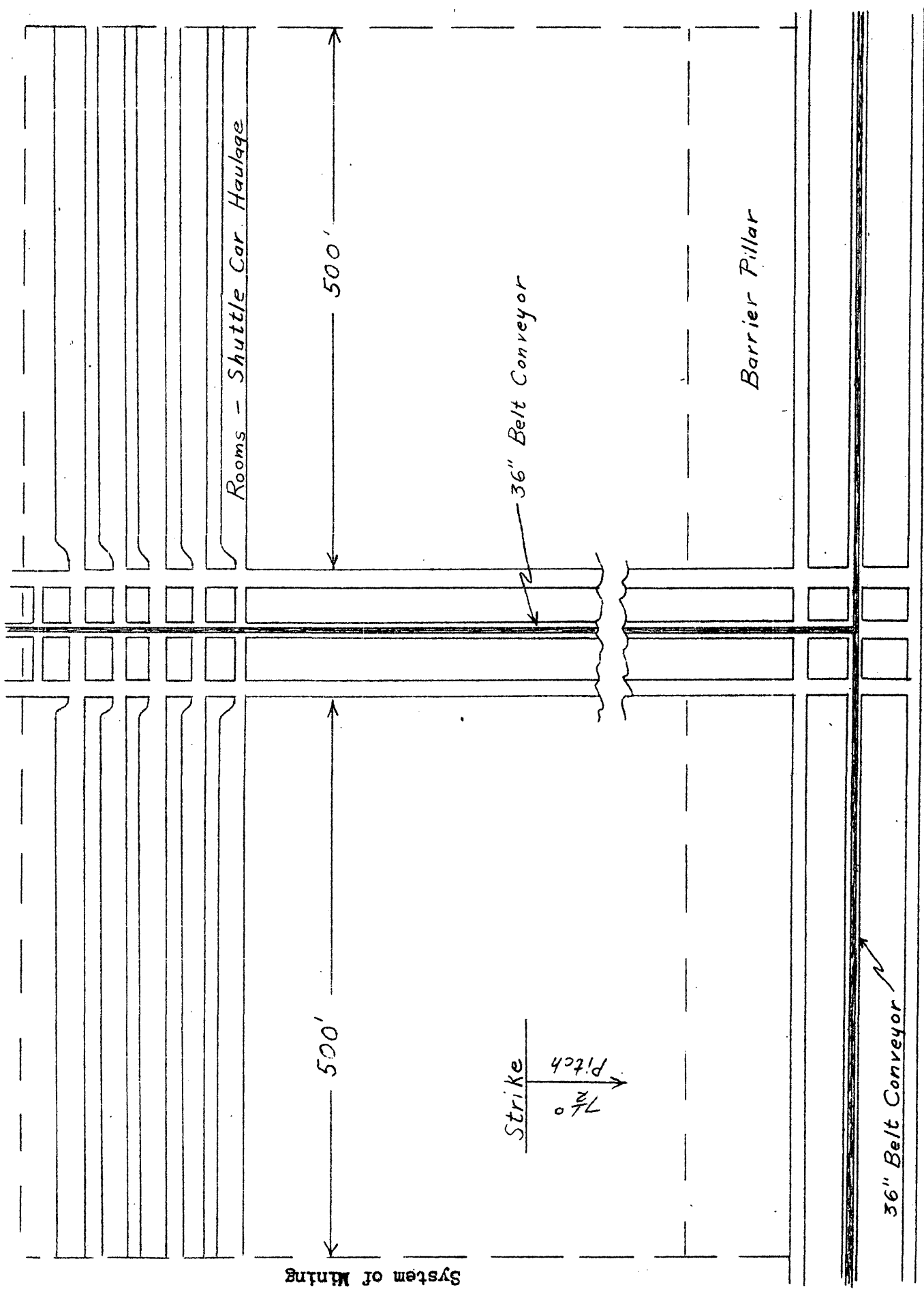
System of Mining

bin. The coal will be transported by truck from the surge bin to the preparation plant.

A cost estimate of equipment to mine 1000 tons of coal per day by this system is as follows:

A. Mining Equipment at Face
4 Duckbills with conveyors at $8,000 each. . $ 32,000.00
2 Joy-loaders at $21,000 each. 42,000.00
4 Shuttle cars at $20,000 each 80,000.00
6 Cutting machines at $15,000 each 90,000.00
6 Coal drills at $600 each 3,600.00
Miscellaneous items. 750.00

                              Total $ 248,350.00

B. Power and Transmission Equipment
1 Mercury-arc rectifier, 300 kw. . . . . . . $ 16,000.00
1 Oil circuit breaker, 300 amp 1,100.00
1 Reclosing circuit breaker. 1,000.00
Trolley wire, supply haulage, $0.163 per ft   684.00
Feeder wire, supply haulage, $0.66 per ft. 2,772.00
Power transmission cable and wire acces-
sories. 23,090.00

                              Total $ 44,646.00

C. Track Material and Accessories
Steel rail, 70-lb, at $0.43 per ft . . . . $ 2,150.00
Track turnouts at $202.00 each 1,010.00
Ties, treated wood 2,000.00
Track accessories. 1,000.00

                              Total $ 6,160.00

D. Haulage Equipment and Accessories
1 Locomotive, main line, 6 ton . . . . $ 7,000.00
5 Mine cars, supply. 5,000.00
3200 ft 36-in. conveyor belts. 96,000.00
1600 ft 30-in. conveyor belts. 40,000.00
Haulage accessories. 3,000.00

                              Total $ 151,000.00

E. Track-mounted Accessory Equipment
 - 4 Mantrip cars . . . . $ 4,800.00
 - 1 Rock-dust distributor. 4,700.00
 - 1 Mine car trucks, insulated, delivery of
    explosives. 225.00
 - 1 Mine car trucks, insulated, delivery of
    blasting caps 225.00
 - Miscellaneous track-mounted accessory
    equipment 500.00

                        Total $ 10,450.00

F. Hoisting Equipment and Accessories
 - 1 Hoist, 100 horsepower . . . . $ 24,000.00
 - Hoisting rope at $0.76 per ft 2,280.00
 - Hoisting accessories. 75.00

                        Total $ 26,355.00

G. Ventilation Equipment and Material
 - 1 Ventilation fan, 100,000 c.f.m. . . . . . $ 30,000.00
 - Ventilation materials 7,255.00

                        Total $ 37,255.00

H. Drainage Equipment and Accessories
 - Total cost, drainage equipment and
    accessories. . . . .$ 5,733.00

I. Roof-Support Material
 - Total cost, roof-support material . . . . $ 28,970.00

J. Illumination Underground
 - Total cost, mine illumination . . . . . . $ 5,541.00

K. Safety and First-aid Equipment
 - Total cost, safety and first-aid equipment$ 4,077.00

L. Shop Equipment and Tools
 - Total cost, shop equipment and tools. . . $ 8,118.00

M. Tools and Miscellaneous Equipment
 - Total cost, tools and miscellaneous
    equipment . . . . $ 3,389.00

N. Operating Supplies . . . . Monthly Cost
     1. Face supplies . . . . $ 882.00
     2. Power transmission supplies 199.00
     3. Track material and accessories. 300.00
     4. Haulage supplies. 50.00
     5. Ventilation supplies. 344.00
     6. Drainage supplies 52.00
     7. Roof-support supplies 860.00
     8. Illumination supplies 5.00
     9. Shop supplies 79.00
    10. Hand-tool supplies. 31.00
    11. Hose supplies 44.00
    12. Miscellaneous supplies. 14.00

                            Total $ 2,860.00

O. Maintenance, Supplies, and Parts . . . . . . Monthly Cost
    Total cost, all maintenance, supplies, and
      parts . . . . $ 2,529.00

P. Total Cost of All Items . . . . $ 585,433.00

The labor cost for mining 1000 tons of coal per day using this system of mining will be as follows:

1. Direct labor cost based on 36 men at an
    average of $18.11 per day . . . . $ 651.96

2. Service labor cost based on 42 men at an
    average of $18.11 per day 760.42

3. Supervision cost based on
    1 Supervisor, $1,000 per month 48.00
    1 Mine foreman, $600 per month 28.80
    1 Fire boss, $350 per month. 16.80

                            Total $ 1,505.98

The labor cost to produce a ton of coal by this system is $1.51.

VALUATION PROCEDURE

The valuation procedure will be discussed in two parts:
(1) operating and non-operating expenses and (2) mathematical
calculations to determine the value of the property.

Operating and Non-operating Expenses

The operating and non-operating expenses for the mine are sum-
marized in Table I. This is followed by a brief description of the
method used to arrive at these expenses.

Table I

Summary of Operating Plus Non-Operating Expense

No.	Item	Tons	$/Ton	Total Cost
1.	Mining	2,482,872	1.41	$ 3,500,849.52
2.	Preparation	2,482,872	0.20	496,574.40
3.	Supervision	2,482,872	0.09	223,458.48
4.	United Mine Workers assessment	2,482,872	0.30	744,861.60
5.	Royalty	2,482,872	0.15	372,430.80
6.	Miscellaneous expense	2,482,872	0.35	869,005.20
7.	Transportation	2,482,872	1.00	2,482,872.00
8.	State and local tax			187,535.15
9.	Social Security tax			45,927.00
10.	Workmen's Compensation Insurance			249,876.23
11.	Federal income tax			611,361.02
12.	Interest on working capital			342,193.66
			Total	$10,126,945.06

The calculations for each item of Table I are as follows:

1. Mining costs are based on a total production tonnage of
2,482,872 tons. The cost per ton, excluding supervision cost, to
produce this tonnage is $1.41.

$$2,482,872 \text{ tons} \times \$1.41 = \$3,500,849.52$$

2. Preparation costs are based upon the tons of coal produced by the mine. The cost of $0.20 per ton to prepare the coal for market includes all operating expenses of the preparation plant and tipple.

$$2,482,872 \text{ tons } x \ \$0.20 = \$496,574.40$$

3. Supervision costs are based upon the total tonnage of coal produced. The cost per ton of $0.09 includes only direct supervision.

$$2,482,872 \text{ tons } x \ \$0.09 = \$223,458.48$$

4. The assessment by the United Mine Workers of America is $0.30 per ton of coal produced.

$$2,482,872 \text{ tons } x \ \$0.30 = \$744,861.60$$

5. The royalty paid upon this property is $0.15 per ton of coal produced.

$$2,482,872 \text{ tons } x \ \$0.15 = \$372,430.80$$

6. Miscellaneous expense includes such expense as powder, caps, miscellaneous supplies and parts, fire insurance, donations, subscriptions, and traveling. A cost of $0.35 per ton of coal produced is charged for these expenses.

$$2,482,872 \text{ tons } x \ \$0.35 = \$869,005.20$$

7. The cost to transport the coal to the railroad is $1.00 per ton.

$$2,482,872 \text{ tons } x \ \$1.00 = \$2,482,872.00$$

8. The state and local tax is computed on an assessed value of the equipment and the buildings. The assessed value is never more than 70 percent or less than 40 percent of the purchase price. An average assessed value of 55 percent of the purchase price will be used to compute these taxes.

$1,025,699.00 x .55 x .03166 x 10.5 = $187,535.15

$ 500,000.00 - value of preparation plant and
       equipment
  500,699.00 - value of underground equipment
   25,000.00 - value of miscellaneous surface
       buildings
_____

$1,025,699.00 - total value

55 percent - factor used to determine assessed
       value
31.66 mills - mill levy in School District 23,
       Routt County, Colorado
10.5 years - effective life of the mine

9. Social Security tax is based upon 1.5 percent of each employee's salary up to $3600.00.

$3600.00 x 1.5 x 81 x 10.5 = $45,927.00

10. Workmen's Compensation Insurance is paid at the rate of $5.92 per $100.00 of the payroll.

$4,220,882.40 x .0592 = $249,876.23

11. Federal income tax is computed on net income, which is the gross income minus allowable deductions.

The income tax is 30 percent of the net income plus a surtax of 22 percent of the net income above $25,000.00.

The gross income is based upon the recoverable tonnage and the value of the coal per ton.

2,234,585 tons x $5.69 = $12,714,788.65

Table II is a summary of deductions from gross income allowable in determining net income for the calculation of Federal income tax.

Table II

Allowable Deductions for Computing Income Tax

No.	Item	Cost
1.	Mining	$ 3,500,849.52
2.	Preparation	496,574.40
3.	Supervision	223,458.48
4.	United Mine Workers assessment	744,861.60
5.	Royalty	372,430.80
6.	Miscellaneous expenses	869,005.20
7.	Transportation	2,482,872.00
8.	State and local tax	187,535.15
9.	Social Security tax	45,927.00
10.	Workmen's Compensation Insurance	249,876.23
11.	Depreciation	1,025,699.00
12.	Depletion	1,234,235.78

Total allowable deductions $11,433,325.16

Items 1 through 10 of Table II are calculated in the same manner as discussed for items 1 through 10 of Table I.

Depreciation is based on the life of the mine. The total value of the preparation plant, equipment, and miscellaneous buildings will be depreciated during the 10-year productive life of the mine.

Preparation plant and equipment	$	500,000.00
Mining equipment and supplies		500,699.00
Miscellaneous buildings		25,000.00
Total		$1,025,699.00

Depletion charges are charges allowed for the return of invested capital to the investor by the time that the profitable life of the mine is ended. These charges are based upon the estimated gross income.

The allowable depletion charge for coal mines is 10 percent of the gross income excluding royalties paid to the land owner. This depletion charge cannot be greater than 50 percent of the net income.

($12,714,788.65 - $372,430.80) x 0.10 = $1,234,235.78

The gross income minus allowable deductions equals net income.

$12,714,788.65 - $11,433,325.16 = $1,281,463.49

The Federal income tax is computed on the net income as follows:

$1,281,463.49 x 0.30 = $384,439.05
($1,281,463.49 - $250,000) x 0.22 = 226,921.97

Total Federal income tax $611,361.02

12. Interest on working capital is computed on the necessary

capital that must be kept on hand as a revolving fund throughout the

productive life of the mine.

Table III is a summary of necessary working capital to be used

during the productive life of the mine.

Table III

Working Capital

No.	Item	Period	Cost
1.	Mining	2 mos.	$ 58,347.49
2.	Preparation .	2 mos.	8,276.24
3.	Supervision	2 mos.	3,724.31
4.	United Mine Workers assessment	2 mos.	12,414.36
5.	Royalty	2 mos.	6,207.18
6.	Miscellaneous expenses	6 mos.	43,450.26
7.	Transportation	2 mos.	41,381.20
8.	State and local tax	6 mos.	9,376.76
9.	Social Security tax	2 mos.	765.45
10.	Workmen's Compensation Insurance	12 mos.	24,987.62
11.	Federal income tax	6 mos.	30,568.05

Total $239,498.92
10 percent for contingencies   23,949.89

Total working capital $263,448.81

The sum to which this working capital amounts in 10 years at 4.25 percent interest compounded semi-annually is:

$$S = PR^n$$
$$S = \$263,448.81 \times (1.0425)^{20}$$
$$S = \$605,642.47$$

The interest on the working capital is:

$605,642.47 - $263,448.81 = $342,193.66.

Mathematical Calculations to Determine the Value of the Property

The net profit is equal to gross income minus operating and non-operating expenses.

$12,714,788.65 - $10,126,945.06 = $2,587,843.59

The interest rates used will be as follows:

2.5 percent net interest rate

4.25 percent bankers' loan rate

9 percent speculative rate

These interest rates are the results of a study made of the graphs on pages 30, 31, and 32.

The annual net profit for the 10-year period of production is $258,784.36.

The valuation formula to be used in calculating the present value of the mining property will be the Livingston Modification of the Morkill Formula 5/ as given in classroom lectures.

5/ Livingston, C. W., Livingston Modification of the Morkill Formula, Classroom lectures in Mining 416, Mine Valuation, 1951.

The Livingston Modification of the Morkill Formula is:

$$V = i_o \left[\frac{R^n - 1}{R^t - 1}\right]\left[\frac{R'^t - 1}{R'^t \ r'}\right]$$

where, V is present value
i_o is average annual net income before depreciation and depletion
R is ratio of increase $(1 + r)$ at net interest rate
n is life of the mine
t is life of the mine plus the deferment period
R' is ratio of increase $(1 + r)$ at the speculative rate

Interest Rates Paid on Government Bonds

Interest Rates vs Maturity Date

MATURITY DATE

PERCENT RATE OF INTEREST

4

3½

3

2½

2

1½

1

½

1952   1954   1956   1958   1960   1962   1964   1966   1968

The Morkill Formula 6/ is based upon the productive life of the

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6/ Parks, R. D., Examination and valuation of mineral property, 3rd
        ed., p. 351, Cambridge, Addison-Wesley Press, Inc., 1949

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mine. A period of deferment precedes the productive life of the mine;

therefore the Morkill Formula does not apply.

The Livingston Modification of the Morkill Formula 7/ allocates

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7/ Livingston, C. W., Livingston Modification of the Morkill Formula,
        Classroom lectures in Mining 416, Mine Valuation, 1951.

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the equivalent net income in a manner identical to the allocation of

Morkill and based upon the Morkill premises. The essential difference

is that the time of the investment equals m plus n periods rather than

n periods.

If a period of deferment does not precede the productive life of

the mine, the results obtained by using the Livingston Modification of

the Morkill Formula are identical with the results obtained by using

the Morkill Formula.

The Morkill Formula can be interpreted to be either a sinking-fund

or a non-sinking-fund type formula.

The O'Donahue Formula 8/ is a sinking-fund type formula.

8/ Op. Cit. (Examination and valuation of mineral property), p. 348.

The Livingston Modification of the Morkill Formula is a sinking-

fund type formula for it incorporates the premises of both Morkill and

O'Donahue.

The present value of the mining property is:

$$V = i_o \left[\frac{R^n - 1}{R^t - 1}\right] \left[\frac{R'^t - 1}{R'^t \, r'}\right]$$

$$V = 258,784.36 \left[\frac{\dfrac{1.025^{10} - 1}{1.025^{11} - 1}}{}\right]\left[\frac{1.09^{11} - 1}{1.09^{11} \times .09}\right]$$

$$V = 258,784.36 \left[\frac{1.2801 - 1}{1.3121 - 1}\right] \left[\frac{2.5804 - 1}{2.5804 \times .09}\right]$$

$$V = \$1,580,515.13$$

CONCLUSIONS

"Present value" as described by Parks _/ is as follows:

_/ Parks, R. D., Examination and valuation of mineral property, 3rd
    ed., p. 157, Cambridge, Addison-Wesley Press, Inc., 1949.

"'Present value' and 'present worth' are synonymous terms used
to designate the capital which must be invested immediately
(or at a given date of valuation) to be equivalent to the future
income to be received in exchange therefor. Or, in other words,
'present value' is the immediate (or valuation-date) worth of
a future receivable income whether that income be an annuity
extending over a period of time or a principal sum payable at
a specified time."

The "present value" of this mining property was found to be

$1,580,515.13, using duckbills, shaker conveyors, and track haulage

for mining and transporting the coal.

The method of loading the coal with Joy-loaders into shuttle cars

and placing the coal into mine cars or onto belts would be impractical

in this mine because of the greater capital investment required for

such equipment.

It is the opinion of the writer that a mining property has but

one true value and that no two mining properties are identical. How-

ever, a true value of any mining property can be determined if a

careful study of the following factors is made:

1. A detailed survey of the mining property to determine coal

reserves.

2. A geological study of the coal seam thickness, analysis, dip,

roof, and floor.

3. Selection of a suitable mining method and necessary equipment

costs.

4. A study of the markets and an average price of the product produced.

5. A study of the economic factors controlling the output of the mine, such as coal reserves, plant capacity, and immediate markets.

6. A study of all operating and non-operating expenses.

7. A study of valuation formulas so that the proper formula is used to compute the "present value" of the mining property.

BIBLIOGRAPHY

1 -   Engineers' Advisory Valuation Com-
                                mittee of the United States Coal
                                Commission, Valuation of coal mining
                                properties in the United States:
                                A.I.M.E. Trans., vol. 70, p. 794,
                                Feb. 1924.

2 - Chance, H. M.   Appraisal of coal-property values,
                                A.I.M.E. Trans., vol. 74, pp. 445-
                                446, Oct. 1926.

3 - Parks, R. D.   Examination and valuation of mineral
                                property, 3rd ed., pp. 504, Cambridge,
                                Addison-Wesley Press, Inc., 1949.

4 - Hesse, A. W.   Principles of coal property valua-
                                tion, New York, John Wiley and Sons,
                                Inc., 1930.

5 -   Analysis of Colorado coals: U.S.B.M.
                                Tech Paper 574, pp. 118-119, 1937.

6 -   Livingston, C. W., Livingston Modifi-
                                cation of the Morkill formula, Class-
                                room lectures in Mining 416, Mine
                                Valuation, 1951.