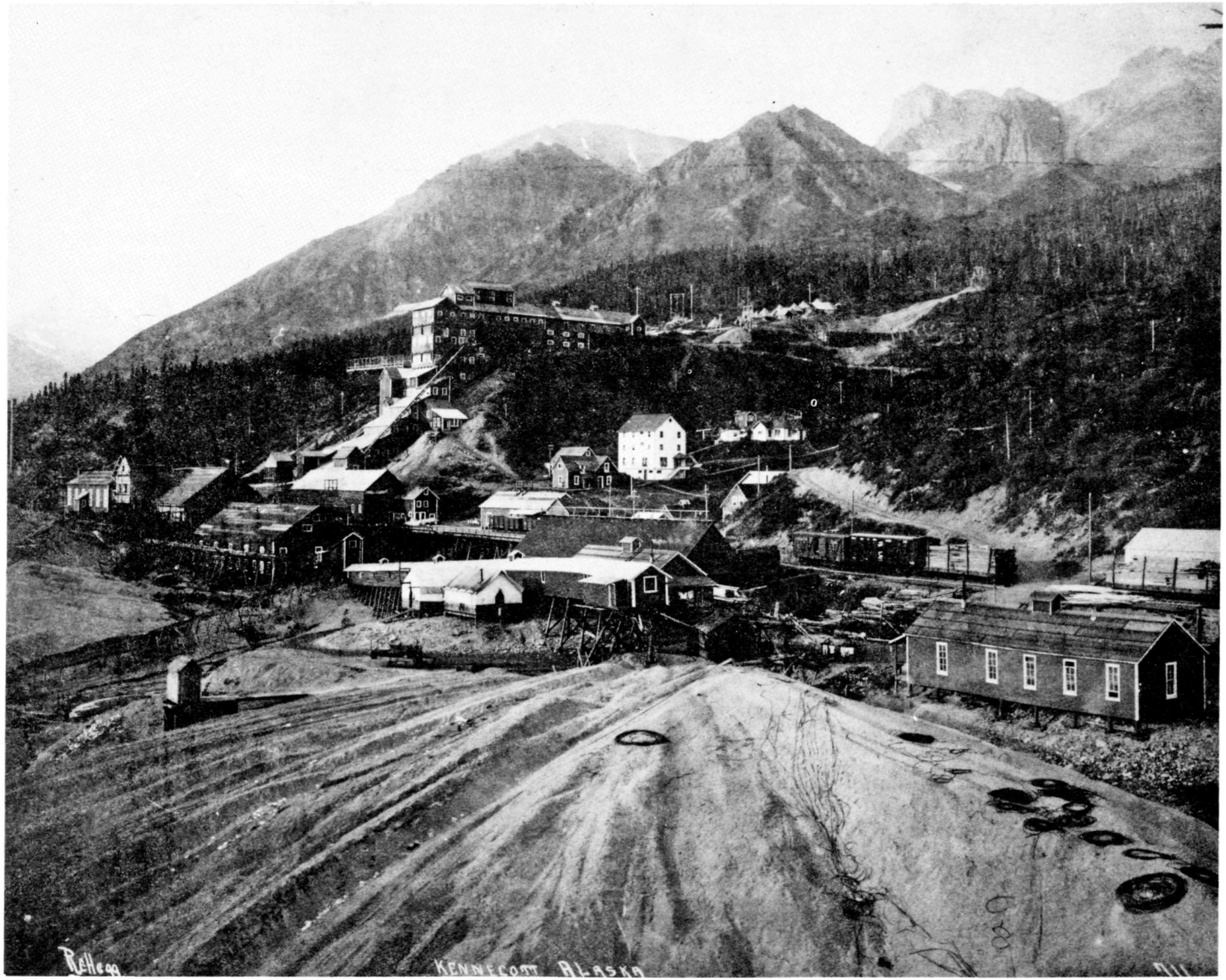
KENNECOTT, ALASKA


KENNECOTT ALASKA

KENNECOTT, ALASKA

Historic American Engineering Record
Recording Project

Compiled by

Robert L. S. Spude
Sandra McDermott Faulkner

National Park Service
Alaska Region
Anchorage, 1987

Frontispiece: Kennecott ca. 1917. Courtesy Cordova Historical Society.

All HAER record photographs by John T. "Jet" Lowe, III.

Preface

This brief Historic American Engineering Record project report is the culmination of a summers work at Kennecott, Alaska, a National Historic Landmark located within Wrangell-St. Elias National Park and Preserve. Much of this historic mining camp remains, but because of the limited duration of the project, the team focussed on the recording of the significant mill at Kennicott. It is the best extant example of an early twentieth century copper concentrator. Since the significance of the mill is the information it displays of the mineral benefaction process, the record depicts this process rather than the structural components of the mill. Original design drawings of the mill are at the University of Alaska-Fairbanks.

Seasonal historical architects Dave and Nan Anderson prepared the record drawings, while Historic American Engineering Record photographer Jet Lowe prepared the record photographs. Seasonal historical architect Ken Martin finished the drawings and completed site plans. The project was directed by regional historian Robert Spude with the assistance of Dave Snow, regional historical architect, Richard Anderson, HAER architect from the Washington Office, and Robert Vogel of the Smithsonian Institution. The staff of Wrangell-St. Elias National Park and Preserve provided work space and field assistance.

R. L. S. S.

S. M. F.

Contents

Copper Experts at future site of Kennecott, 1902.
Courtesy National Archives.

Kennecott: Historical Overview

During the two decades preceding and those following World War I, when the United States produced more than half the world's copper, the mines at Kennecott, Alaska were among the nation's largest, and contained the last of the great high grade copper ore deposits discovered in the American West. Just as mining technology was gearing up to exploit the low-grade ores that remained in the West, the Kennecott mines exposed an ore deposit of a quality unequaled anywhere in the twentieth century. Mining journals and mining engineers used superlatives to describe the rich deposit found at the Kennecott mine. Competition for the ownership and the development of the mine affected territorial and national politics and led to the Ballinger-Pinchot affair.

On July 4, 1900, Clarence Warner and "Tarantula Jack" Smith staked the Bonanza mine outcrop. By mid-August they and nine of their partners had staked much of the ground which would become known as the Kennecott mines. A young mining engineer, Stephen Birch, was in the area and acquired options on the claims. Backed by Henry O. Havemeyer, a New York investor, Birch formed the Alaska Copper and Coal Company which was promptly sued by others claiming ownership of the rich deposit. From 1901 to 1904 the Chitina Exploration Company, which claimed to have grubstaked the prospectors, and the Copper River Mining Company, which claimed legal title, dragged the suit through territorial and federal court and were denied judgement in their

Work train on Copper River & Northwestern Railway, 1910.
Courtesy Anchorage Historical and Fine Arts Museum.

favor. The Supreme Court of the United States refused to hear the case.

In 1905 the Alaska Copper and Coal Company was reorganized as the Kennecott Mines Company. The Guggenheim family, controllers of the American Smelting and Refining Company (ASARCO) smelter monopoly, and J.P. Morgan, another wealthy industrial investor, entered the enterprise and organized the "Alaska Syndicate" to fund the mine's development. Between 1905 and 1911 the syndicate spent $25 million to build mine and mill works, a 196-mile railroad, and organize a steamship line connecting the copper port of Cordova with ASARCO's Tacoma smelter. All this occurred prior to the first shipment of copper.

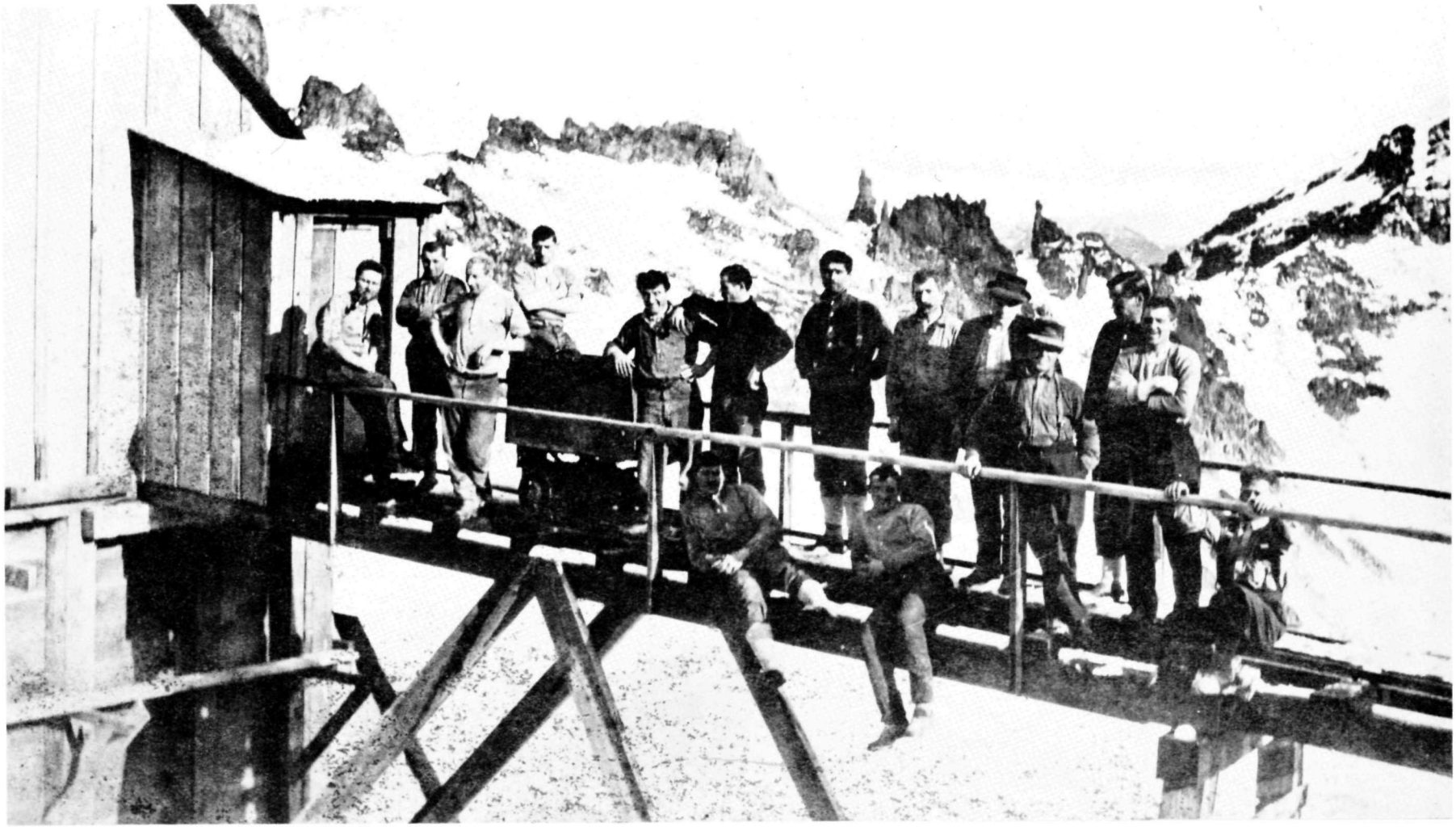
On April 8, 1911, the first trainload of copper, worth $250,000, was shipped from Kennecott in 32 railroad cars. By 1916 production had reached 108,372,783 pounds of copper worth $28,042,396. Kennecott was classed among the nation's largest mines, with those at Butte, Montana, Bisbee, Arizona, and Bingham Canyon, Utah. During 1915-1922 it ranked 3rd to 7th in production. With the building and operation of the mines and their supply line - the Copper River and Northwestern Railway - this was the largest, most costly, and complex mining enterprise in Alaska. But Kennecott's significance lies more in the quality of it's ore. Despite the general assumption that Alaska's gold was preeminent, no single Alaskan placer gold district or gold lode entity was as productive of mineral wealth as the Kennecott.

Kennecott mill, 1912.
Courtesy Museum of History and Industry, Seattle.

At the same time, the Guggenheim's acquisition of fraudulent coal claims in the nearby Bering Rive coal fields caused a feud between Secretary of Interior Richard Ballinger and the head of the Forest Service, Gifford Pinchot. President William H. Taft inflamed the feud by firing Pinchot, but declared the coal claims invalid over Ballinger's protests. Taft's action effected the upcoming presidential election. The Alaska Syndicate failed to acquire the coal needed to fuel their railroad and mill and became, to many people, a monstrous grabber of Alaska's resources.

To meet the changing political and mining world, on April 12, 1915, the Guggenheim and Morgan interests formed the Kennecott Copper Corporation. Stephen Birch became the first president and saw to the transfer of the Alaska Syndicate holdings--the Kennecott Mines Company, the Copper River and Northwestern Railway, the Alaska Steamship Company, and the Beatson Copper Company, all in Alaska--into the new corporation. The phenomenal profits from the Alaska mine provided the capital to fund Kennecott's purchase of the Bingham Canyon mine in Utah and other low-grade mines in Nevada, Arizona, and New Mexico. By the 1930s, while the deposit in Alaska was nearing exhaustion, the corporation had expanded to become the nation's largest copper company and an international force in the metals market. The Kennecott business organization had met the shifting realities of the mining world.

The structures at Kennecott, cumulatively, are a true vestige of an early twentieth century copper mining camp. The mill represents mining technology of the era. The copper industry was transformed



Bonanza Mine, ca. 1920.
Courtesy Cordova Historical Society.

during the first quarter of the twentieth-century by the ability to work large deposits of low grade ore by concentrating 2% or lower grade ore up to 50% to 80% copper concentrate, which then went to the smelter. Among other innovations were "leaching," where chemicals acted to dissolve out the mineral, then precipitate it into a concentrate, and "flotation," where oil or grease was used to separate, through a bubbling action, the mineral from its host rock. All these processes are represented at Kennecott; the ammonia leaching process was first successfully used on a commercial scale at Kennecott. E. Tappan Stannard perfected the process in 1915 and enabled the company to work its "low grade" (8%) ores. A flotation plant, planned earlier but delayed because of litigation between the patent holder and a number of western mining companies, was built in 1922-1923 (the year of an out of court settlement). Thus by 1924 the milling plant equalled, if not in size at least in function, all western copper mills. That year was the last year of major mining discoveries at Kennecott.

The Kennecott deposit, though rich, proved limited in extent. The operation closed in 1938 (producing an estimated $200 to 300 million worth of copper in 28 years); the company vacated the camp and donated its railroad to the territory.

Unlike most Western mining companies capable of working with only geographically isolated, high grade ore deposits, the Kennecott Copper Corporation (backed by the Guggenheims) was able to reorient into an international conglomerate owning long-term, low grade ore mines. By designing the

Kennecott at its zenith, ca. 1925.
Courtesy Alaska Historical Library.

world's first ammonia-leaching plant at the Kennecott site, the corporation was able to extract higher mineral values from the low-grade ores which were once discarded, ensuring further profits. Increased profits allowed investment and expansion elsewhere.

The camp of Kennecott is little changed since the 1938 closing and today provides a window into the technology and work environment of the early twentieth century. Technological artifacts remain in situ due to the site's remoteness. The mining camp, with its striking red buildings with white trim, dominated by the woodframe fourteen-story concentrator, is overwhelmed by the Kennecott Glacier and the Wrangell Mountains, which stand 14,000 feet above the camp. The camp is within the Wrangell-St. Elias National Park and Preserve/Kluane National Park (Canada) area, a World Heritage Site noted for its geology.

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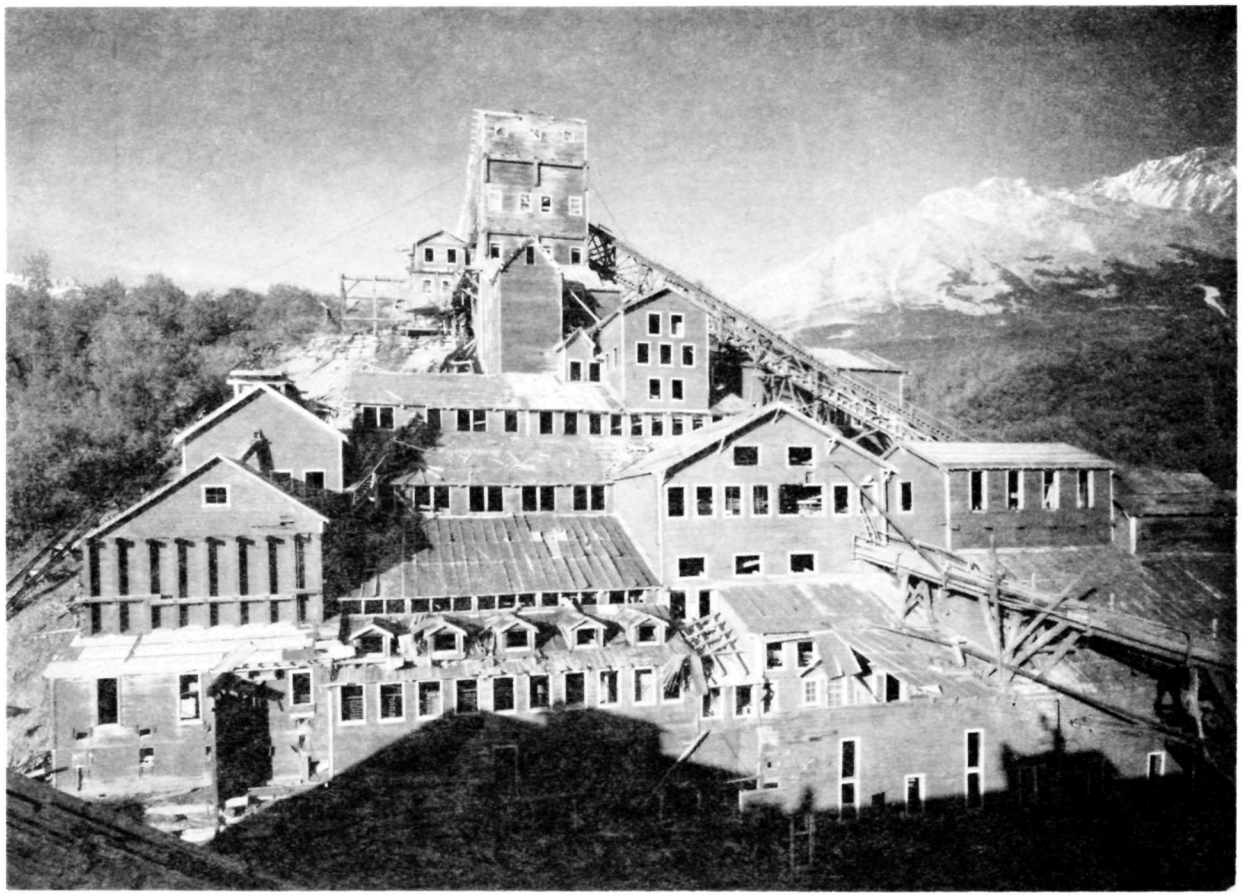
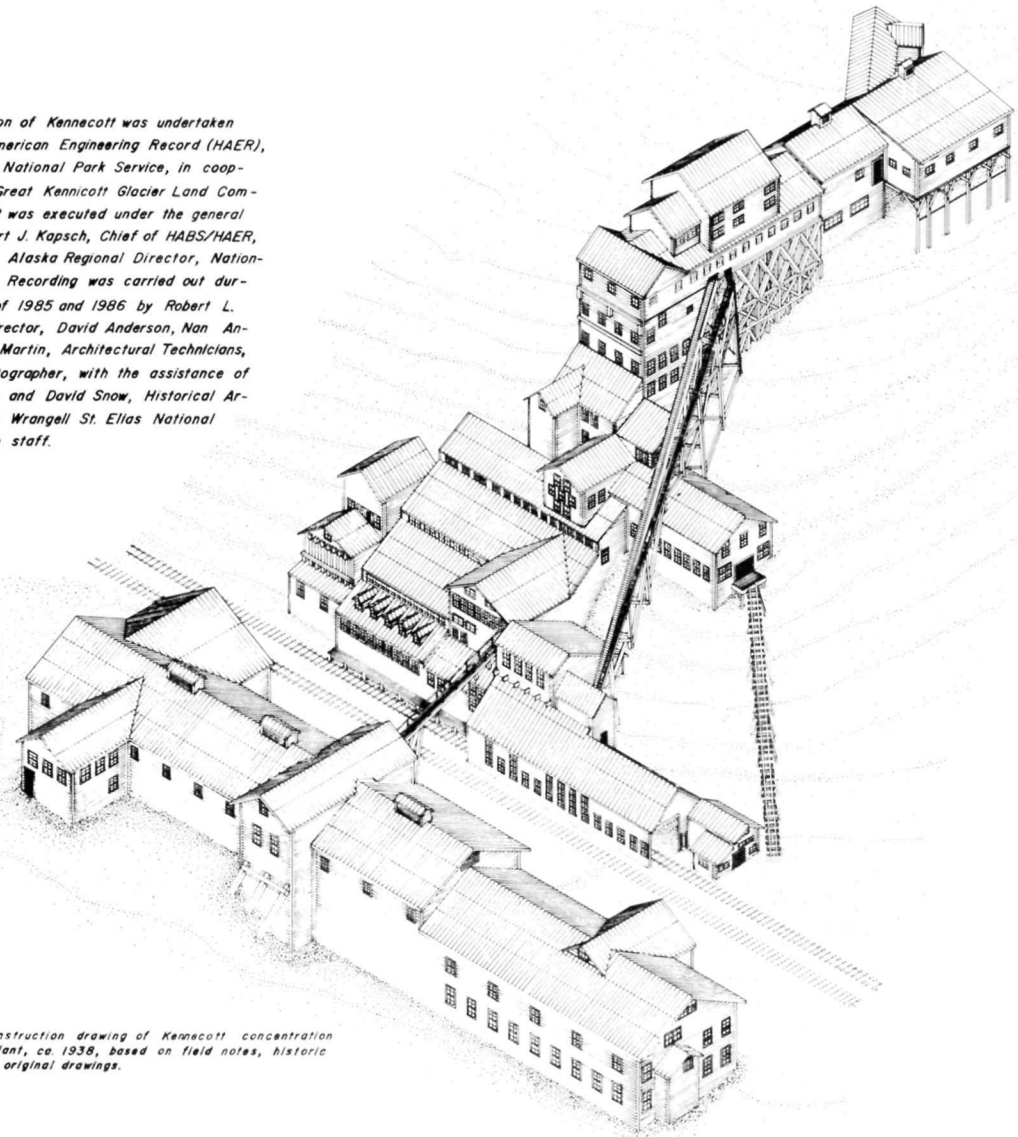


Kennecott mill. 1985.

KENNECOTT COPPER CORPORATION
KENNICOTT, ALASKA

Documentation of Kennecott was undertaken by the Historic American Engineering Record (HAER), a Division of the National Park Service, in cooperation with the Great Kennicott Glacier Land Company. The project was executed under the general direction of Robert J. Kapsch, Chief of HABS/HAER, and Boyd Evison, Alaska Regional Director, National Park Service. Recording was carried out during the summers of 1985 and 1986 by Robert L. Spude, Project Director, David Anderson, Nan Anderson, and Ken Martin, Architectural Technicians, John Lowe III, Photographer, with the assistance of Richard Anderson and David Snow, Historical Architects, and the Wrangell St. Elias National Park and Preserve staff.



Note: Partial reconstruction drawing of Kennecott concentration mill and leaching plant, ca. 1938, based on field notes, historic photographs, and original drawings.

In 1900, prospectors discovered the copper outcrops located atop Bonanza Ridge in the Wrangell Mountains, Alaska. The high-grade surface ore, assaying up to 70% copper, astounded the mining world, but years of litigation over ownership and the distance from cheap transportation delayed development of the mines. In November, 1906, the House of JP Morgan and Company and the Guggenheims united to consolidate ownership of the richest claims, fund mine work, build a milling plant, and complete the Copper River and Northwestern Railway from the coast to the Kennecott mines. The railroad reached Kennicott on March 29, 1911, and full scale production began.

The high grade ore was shipped directly to the Guggenheims' Tacoma smelter, while low grade ore was first processed in the concentration mill below the mines. The mill town and mines were equipped with advanced machinery and the latest technolical innovations in mineral benefaction. The first successful application of the ammonia leaching process occurred here in 1915.

In 1916, the most productive year, the copper produced amounted to 55,085.8 tons, making the Kennecott mines the third-largest producer in the United States. That year, the newly formed Kennecott Copper Corporation began acquiring other properties which would eventually include mines throughout the world.

The Kennicott deposit, though a unique, high grade deposit, proved to be of limited extent. Altogether, $300 million worth of copper and silver were produced by the time Kennecott closed the mines in 1938. Standing above the mill town, the mill and its machinery remain today, a classic example of early twentieth century mining technology, while the Kennecott Copper Corporation continues as an international mining conglomerate.

Note: The town and glacier are named for Alaska explorer Robert Kennicott. The company name is a misspelling of the glacier name.

DELINEATED BY: K. Martin, 1986

HISTORIC AMERICAN ENGINEERING RECORD
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KENNICOTT

KENNECOTT COPPER CORPORATION: COVER SHEET
WRANGELL-ST. ELIAS NATIONAL PARK and PRESERVE
ALASKA

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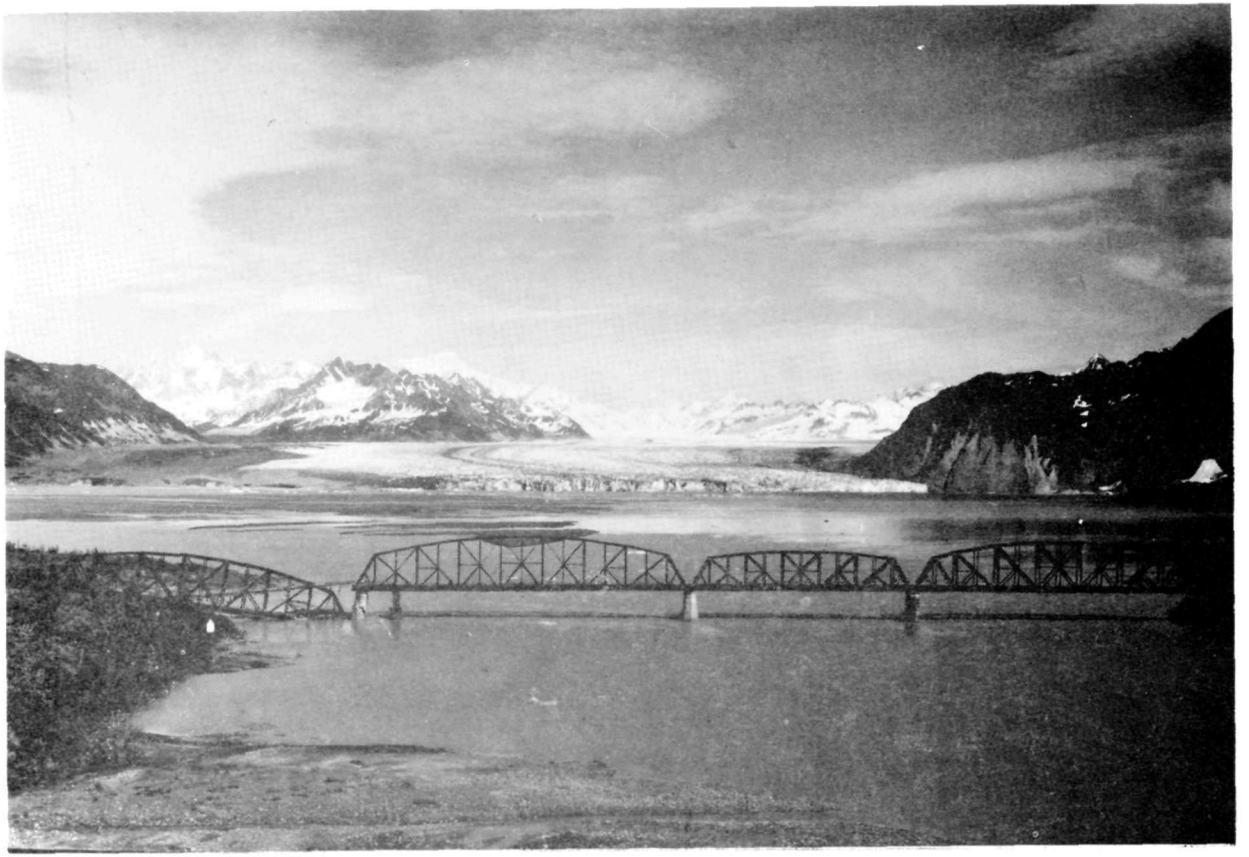
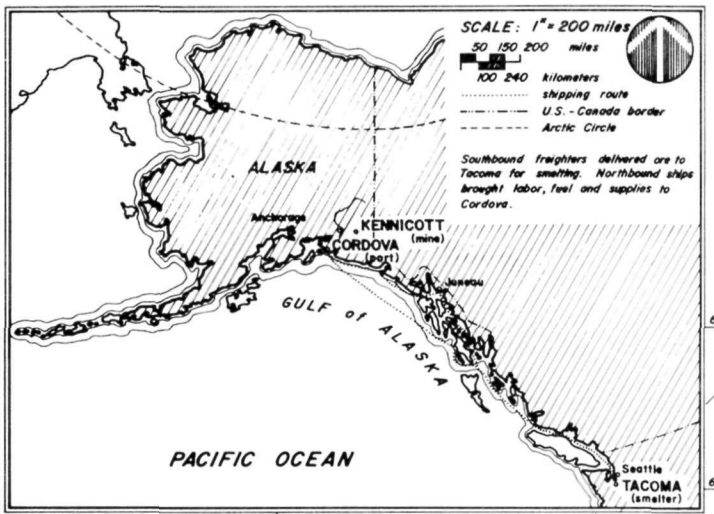
HISTORIC AMERICAN ENGINEERING RECORD
AK-1



The "Million Dollar Bridge. Former Copper River and Northwestern Railway bridge across the Copper River. Miles glacier in the distance. 1985.

COPPER ORE TRANSPORTATION
1911 - 1938



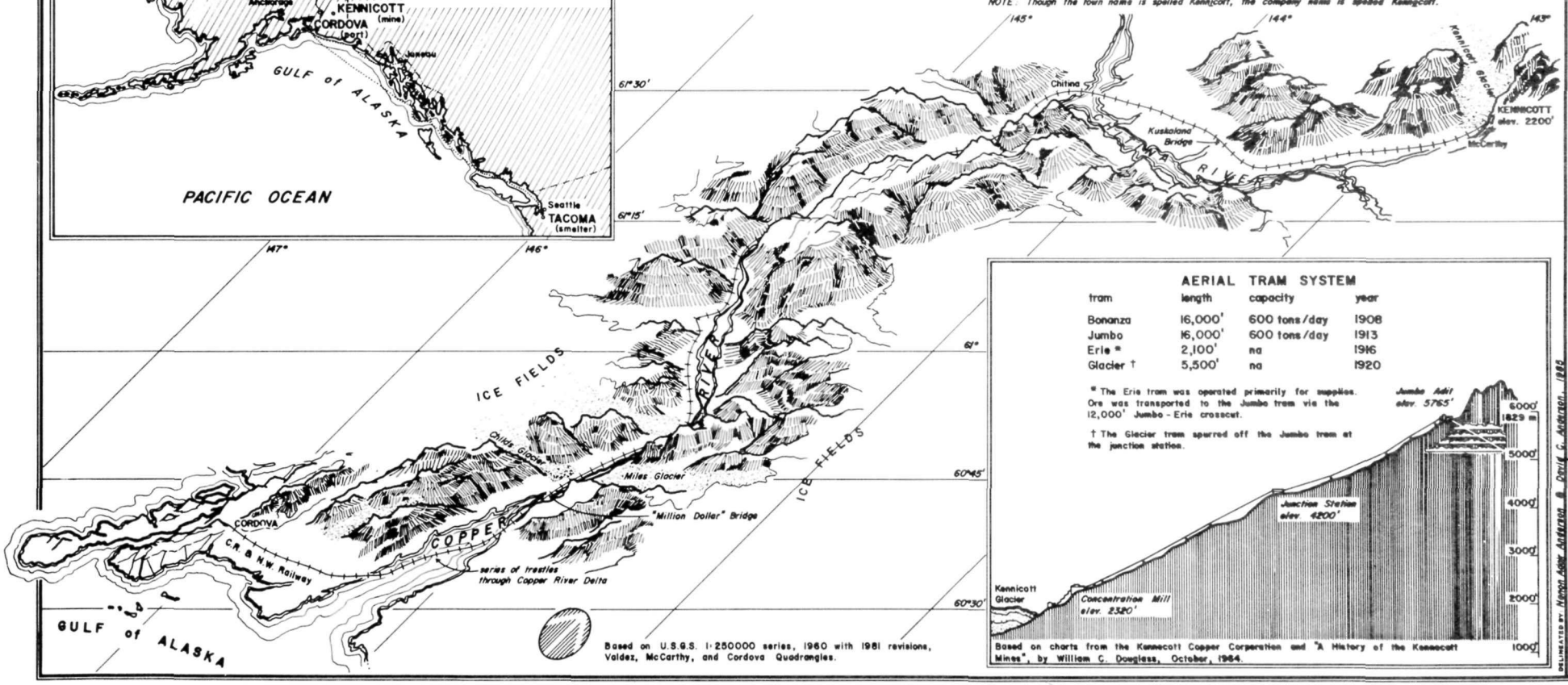
Three modes of transportation carried Kennecott ore from mine to smelter:

1. Aerial Tramways (manufactured by the Trenton Iron Company)
2. Railroad (the Copper River & Northwestern Railway, a 196 mile line from Cordova to Kennicott, completed in 1911 at a cost of $ 23,000,000)
3. Steamship (operated from Cordova to Tacoma by the Alaska Steamship Company)

All three systems were controlled by the Alaska Syndicate, an organization consolidating the backing of H.O. Havemeyer, the House of Morgan, the Guggenheims and the Kuhn Loeb Company. In 1915 the syndicate incorporated as the Kennecott Copper Corporation.

Trams and the railway both ceased operations in 1938 when Kennecott closed its mines. Only the Alaska Steamship Company continued servicing Alaska's coast until superceded by air transport in 1971.

NOTE: Though the town name is spelled Kennicott, the company name is spelled Kennecott.



Based on U.S.G.S. 1:250000 series, 1960 with 1981 revisions, Valdez, McCarthy, and Cordova Quadrangles.

AERIAL TRAM SYSTEM

tram	length	capacity	year
Bonanza	16,000'	600 tons/day	1908
Jumbo	16,000'	600 tons/day	1913
Erie *	2,100'	na	1916
Glacier †	5,500'	na	1920

* The Erie tram was operated primarily for supplies. Ore was transported to the Jumbo tram via the 12,000' Jumbo - Erie crosscut.

† The Glacier tram spurred off the Jumbo tram at the junction station.

Based on charts from the Kennecott Copper Corporation and "A History of the Kennecott Mines", by William C. Douglass, October, 1984.

DELINEATED BY Nancy Anne Anderson & Doris C. Anderson, 1988

KENNECOTT COPPER CORPORATION: COPPER ORE TRANSPORTATION

WRANGELL-ST. ELIAS NATIONAL PARK and PRESERVE

KENNICOTT

ALASKA

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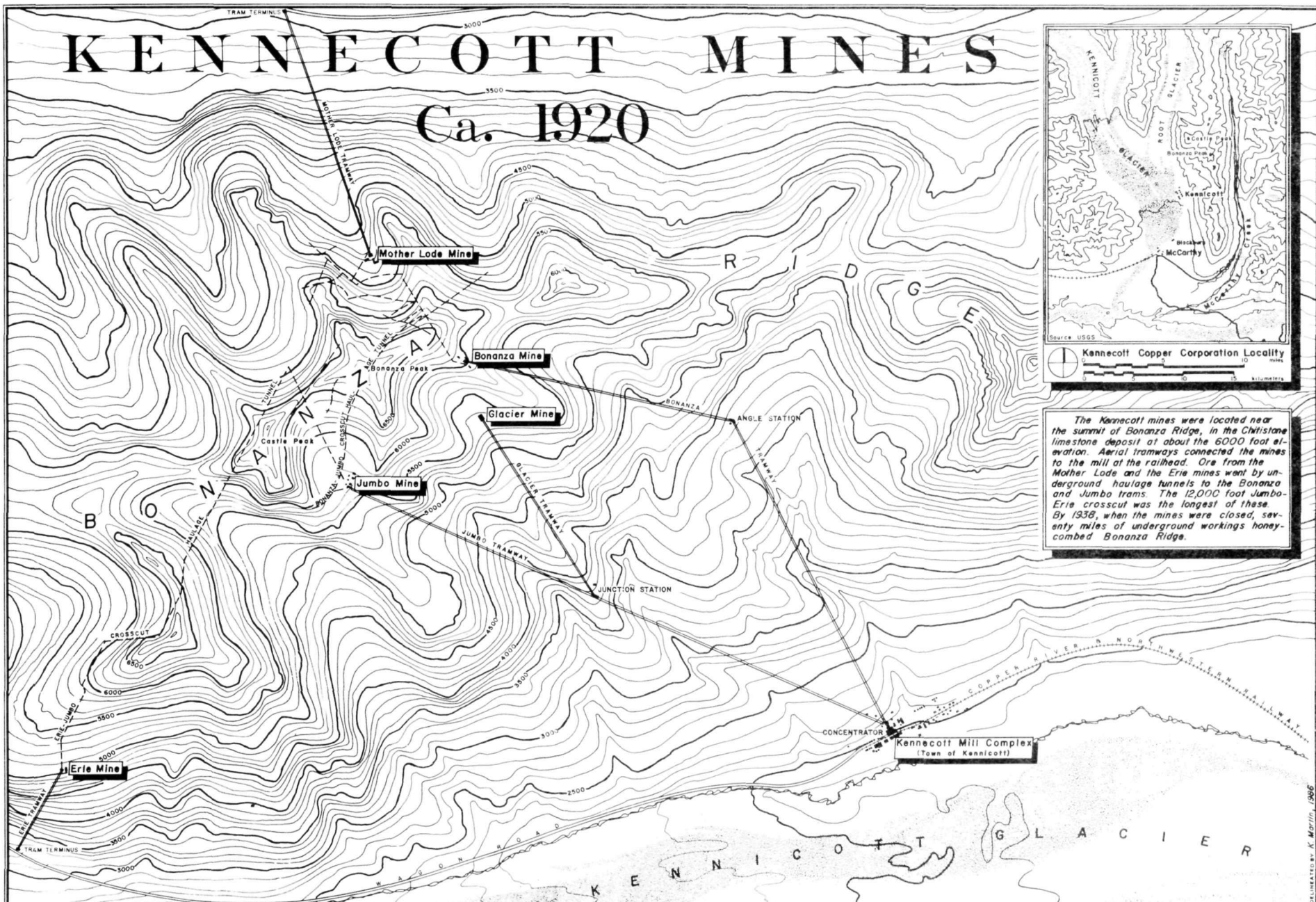
Bonanza Ridge. 1985.

KENNECOTT MINES

Ca. 1920



The Kennecott mines were located near the summit of Bonanza Ridge, in the Chitistone limestone deposit at about the 6000 foot elevation. Aerial tramways connected the mines to the mill at the railhead. Ore from the Mother Lode and the Erie mines went by underground haulage tunnels to the Bonanza and Jumbo trams. The 12,000 foot Jumbo-Erie crosscut was the longest of these. By 1938, when the mines were closed, seventy miles of underground workings honeycombed Bonanza Ridge.

KENNECOTT COPPER CORPORATION: BONANZA RIDGE

WRANGELL-ST ELIAS NATIONAL PARK and PRESERVE

KENNICOTT ALASKA

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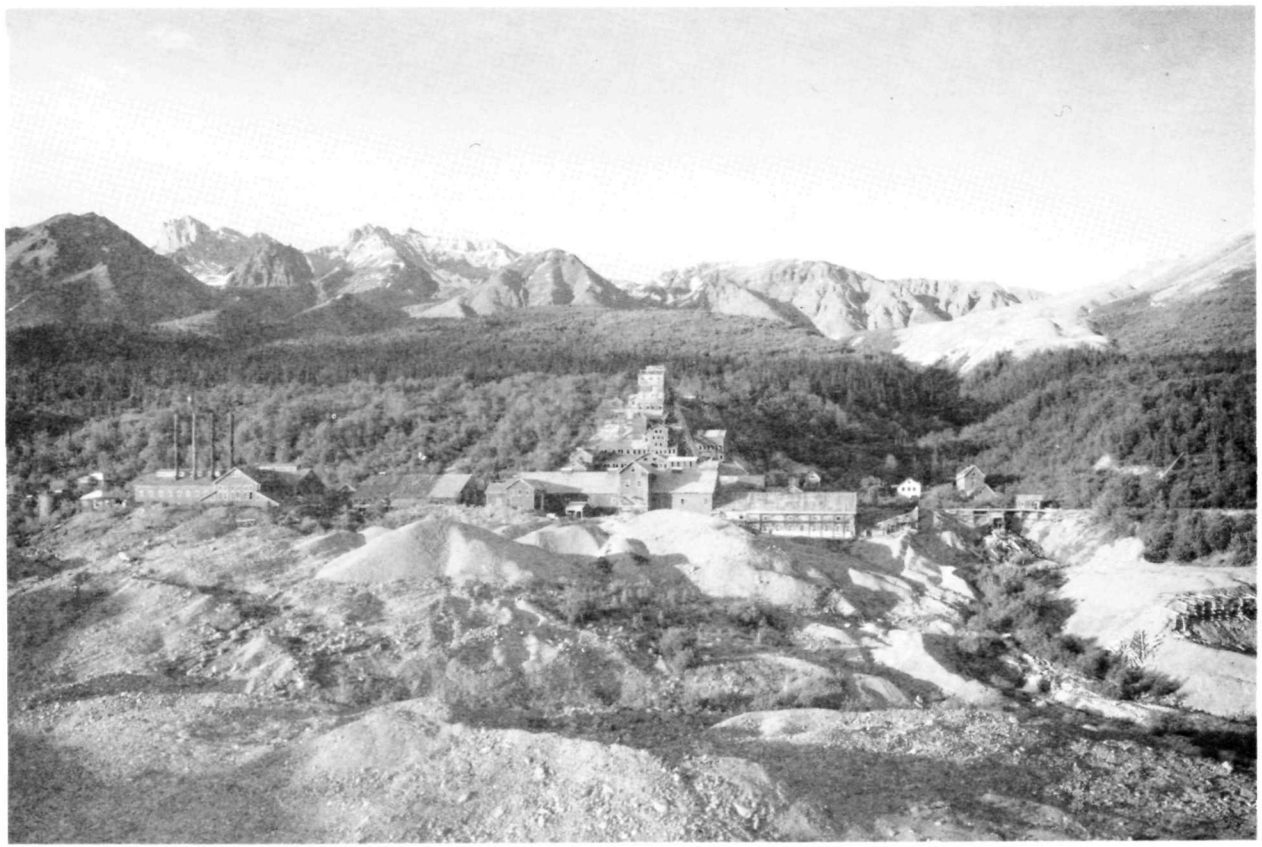
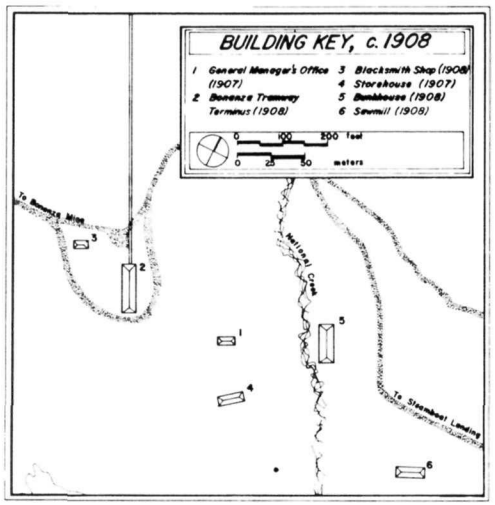
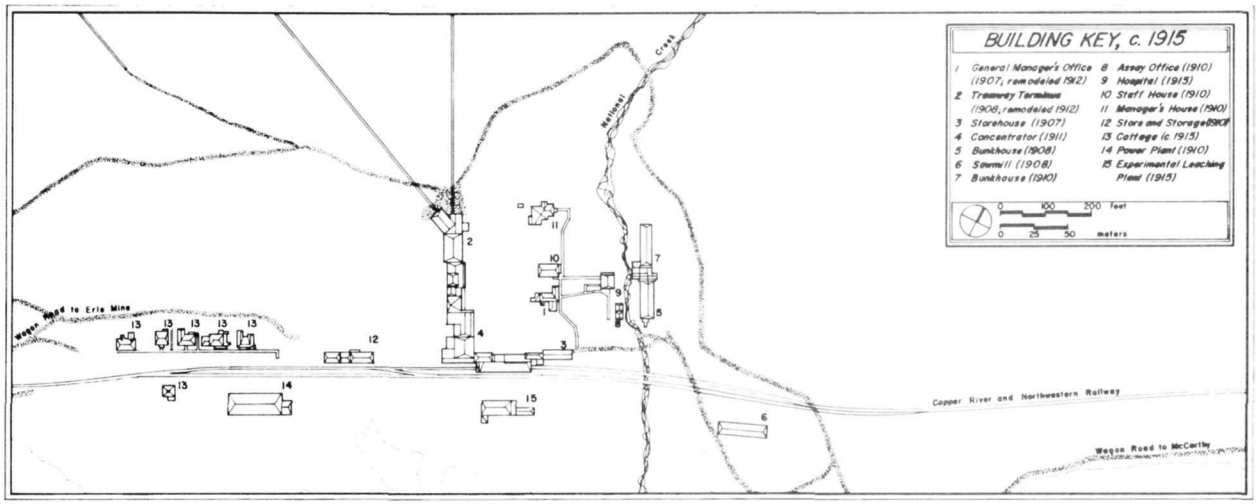
UNITED STATES DEPARTMENT OF THE INTERIOR

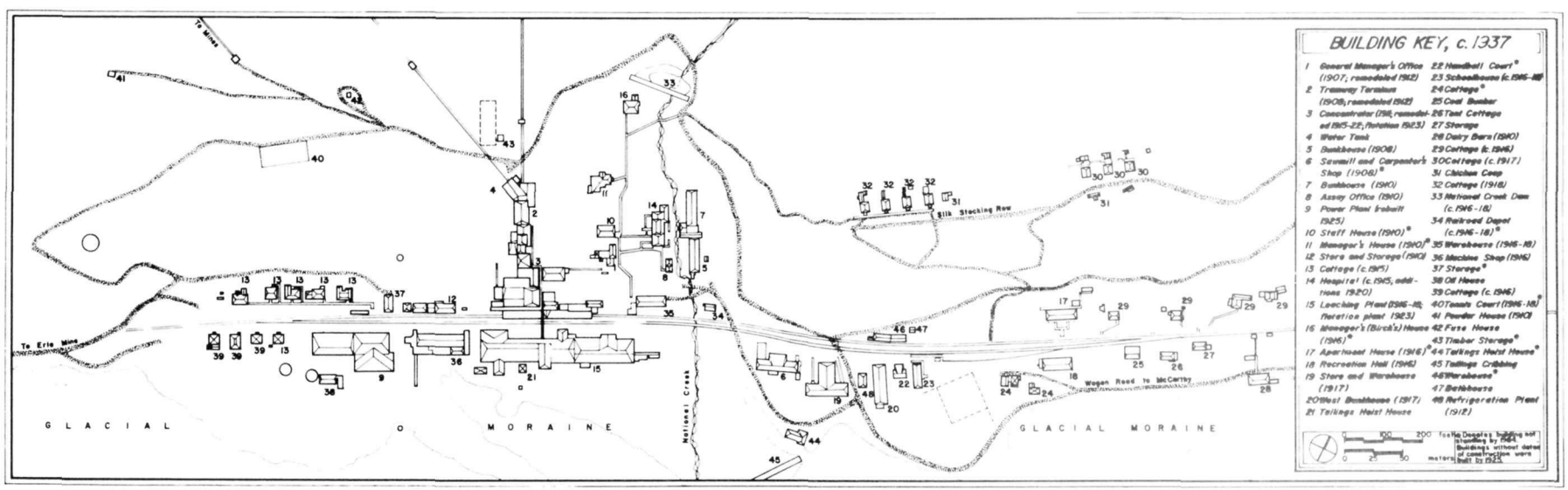


Bonanza ridge and Kennicott from Kennicott Glacier moraine. 1985.





KENNICOTT MILL TOWN



DELINEATED BY K. Morin, 1986 Source for maps: O'Sullivan, Kennicott, (1981), and historic photographs.

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KENNICOTT COPPER CORPORATION: SITE PLANS
WRANGELL-ST. ELIAS NATIONAL PARK and PRESERVE
KENNICOTT ALASKA

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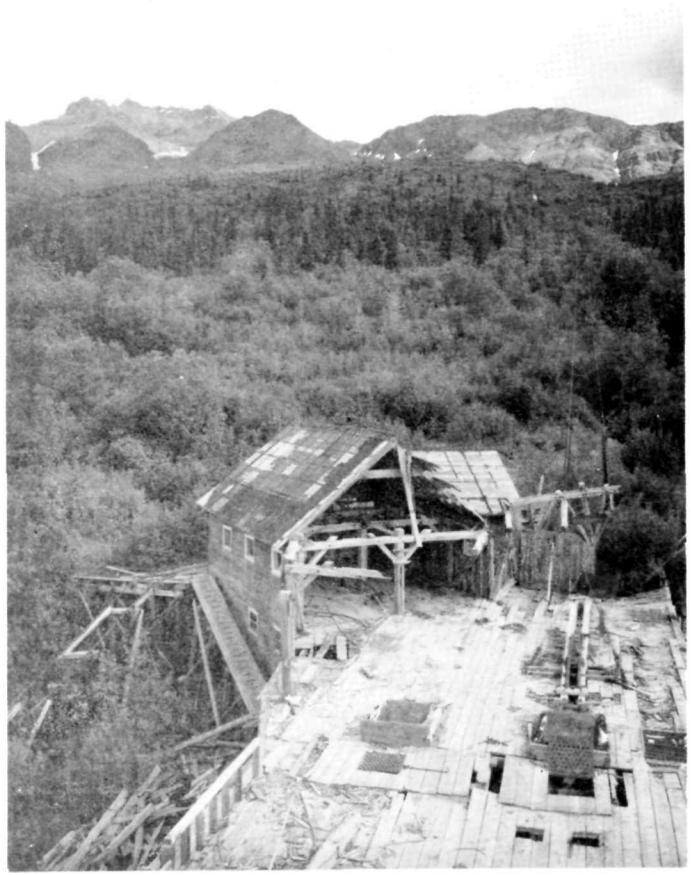
AK-1



Tramway terminus, rear of mill.

CONCENTRATION MILL / LEACHING PLANT
c. 1938

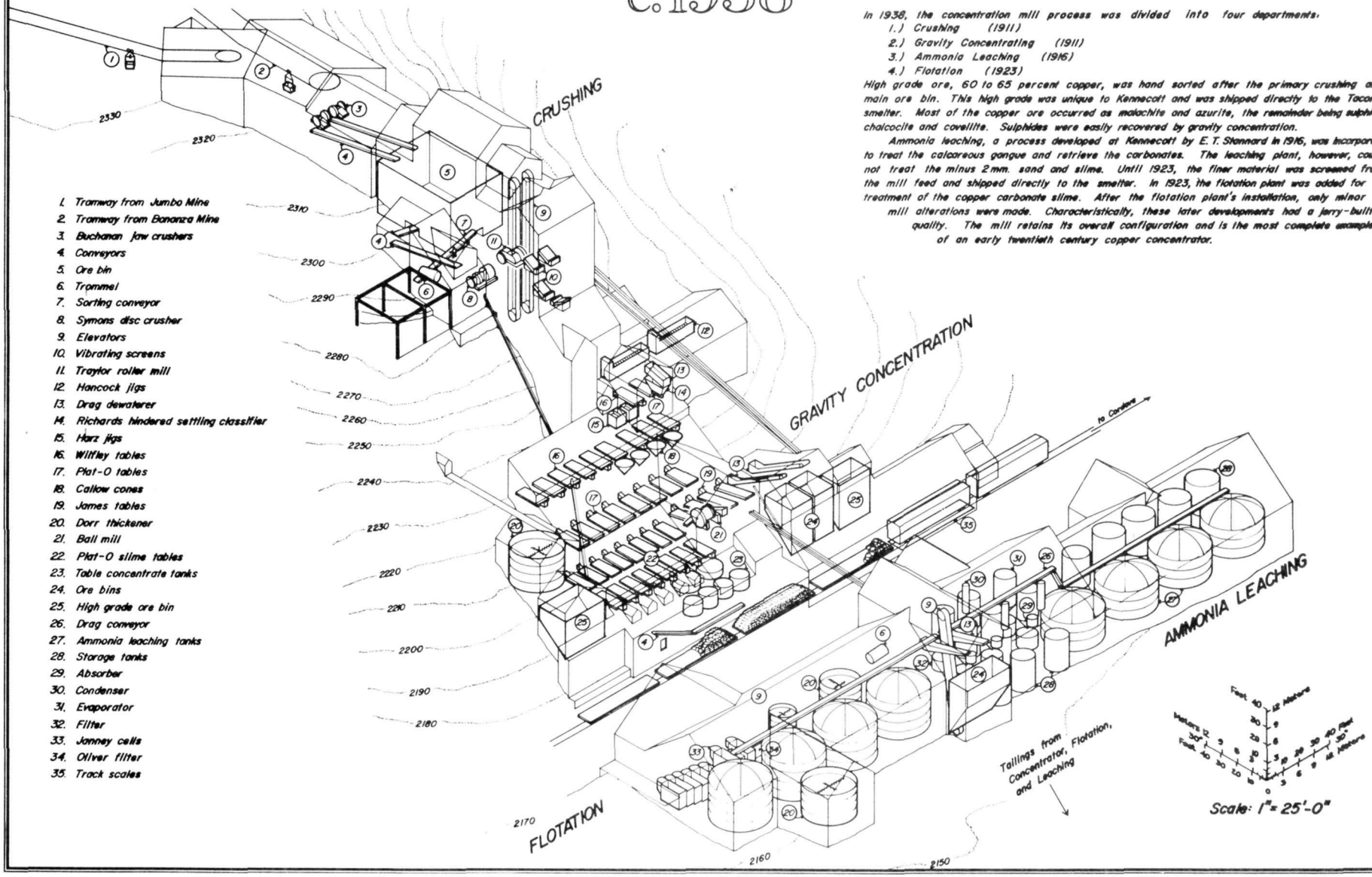
In 1938, the concentration mill process was divided into four departments.

1.) Crushing (1911)
2.) Gravity Concentrating (1911)
3.) Ammonia Leaching (1916)
4.) Flotation (1923)

High grade ore, 60 to 65 percent copper, was hand sorted after the primary crushing and main ore bin. This high grade was unique to Kennecott and was shipped directly to the Tacoma smelter. Most of the copper ore occurred as malachite and azurite, the remainder being sulphides - chalcocite and covellite. Sulphides were easily recovered by gravity concentration.

Ammonia leaching, a process developed at Kennecott by E. T. Stannard in 1916, was incorporated to treat the calcareous gangue and retrieve the carbonates. The leaching plant, however, could not treat the minus 2 mm. sand and slime. Until 1923, the finer material was screened from the mill feed and shipped directly to the smelter. In 1923, the flotation plant was added for treatment of the copper carbonate slime. After the flotation plant's installation, only minor mill alterations were made. Characteristically, these later developments had a jerry-built quality. The mill retains its overall configuration and is the most complete example of an early twentieth century copper concentrator.

1. Tramway from Jumbo Mine
2. Tramway from Bonanza Mine
3. Buchanan jaw crushers
4. Conveyors
5. Ore bin
6. Trommel
7. Sorting conveyor
8. Symons disc crusher
9. Elevators
10. Vibrating screens
11. Traylor roller mill
12. Hancock jigs
13. Drag dewaterer
14. Richards hindered settling classifier
15. Harz jigs
16. Wilfley tables
17. Plat-O tables
18. Callow cones
19. James tables
20. Dorr thickener
21. Ball mill
22. Plat-O slime tables
23. Table concentrate tanks
24. Ore bins
25. High grade ore bin
26. Drag conveyor
27. Ammonia leaching tanks
28. Storage tanks
29. Absorber
30. Condenser
31. Evaporator
32. Filter
33. Janney cells
34. Oliver filter
35. Track scales



DELINEATED BY Paul C. Anderson, Notre Dame, Indiana, 1966

IMPERIAL AUSTRALIAN AIRCRAFT INDUSTRIES REGRESS
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KENNICOTT COPPER CORPORATION: KENNECOTT CONCENTRATION MILL - c. 1938
WRANGELL-ST. ELIAS NATIONAL PARK and PRESERVE
KENNICOTT ALASKA

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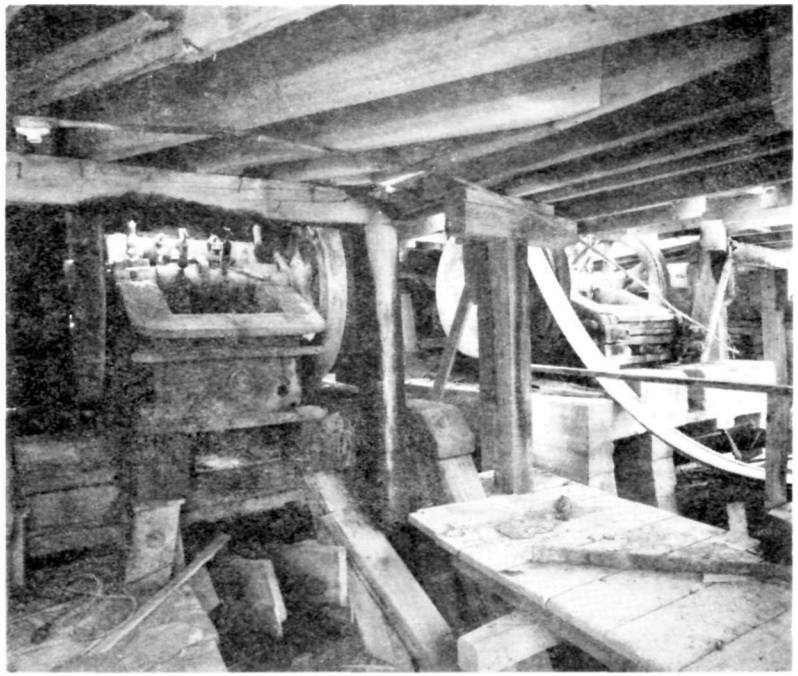
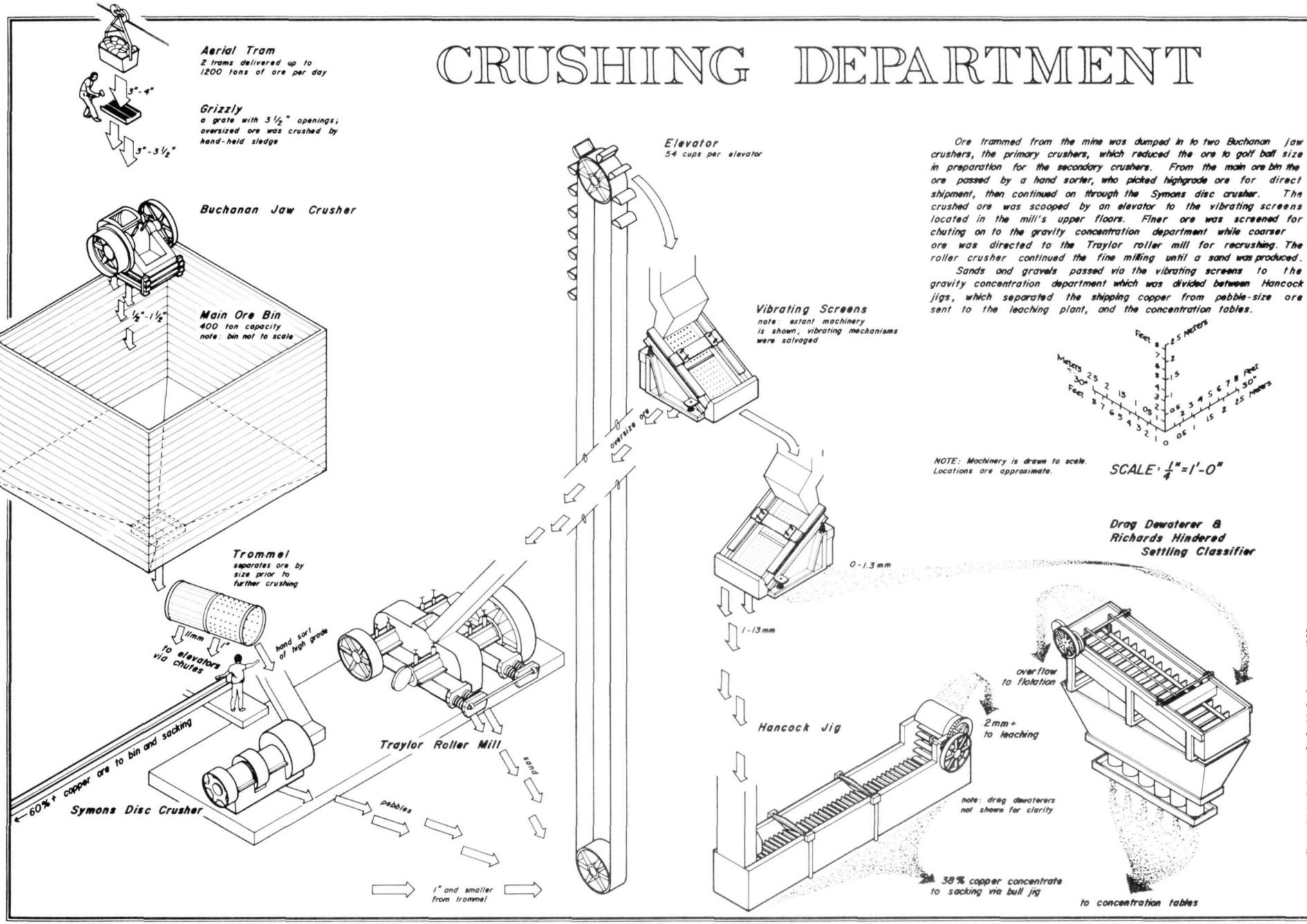


Buchanan Jaw Crusher.

CRUSHING DEPARTMENT



Ore trammed from the mine was dumped in to two Buchanan jaw crushers, the primary crushers, which reduced the ore to golf ball size in preparation for the secondary crushers. From the main ore bin the ore passed by a hand sorter, who picked highgrade ore for direct shipment, then continued on through the Symons disc crusher. The crushed ore was scooped by an elevator to the vibrating screens located in the mill's upper floors. Finer ore was screened for chuting on to the gravity concentration department while coarser ore was directed to the Traylor roller mill for recrushing. The roller crusher continued the fine milling until a sand was produced.

Sands and gravels passed via the vibrating screens to the gravity concentration department which was divided between Hancock jigs, which separated the shipping copper from pebble-size ore sent to the leaching plant, and the concentration tables.

DELINEATED BY: Nanon Adair Anderson & David C. Anderson, 1985

KENNECOTT COPPER CORPORATION: CRUSHING DEPARTMENT

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ALASKA

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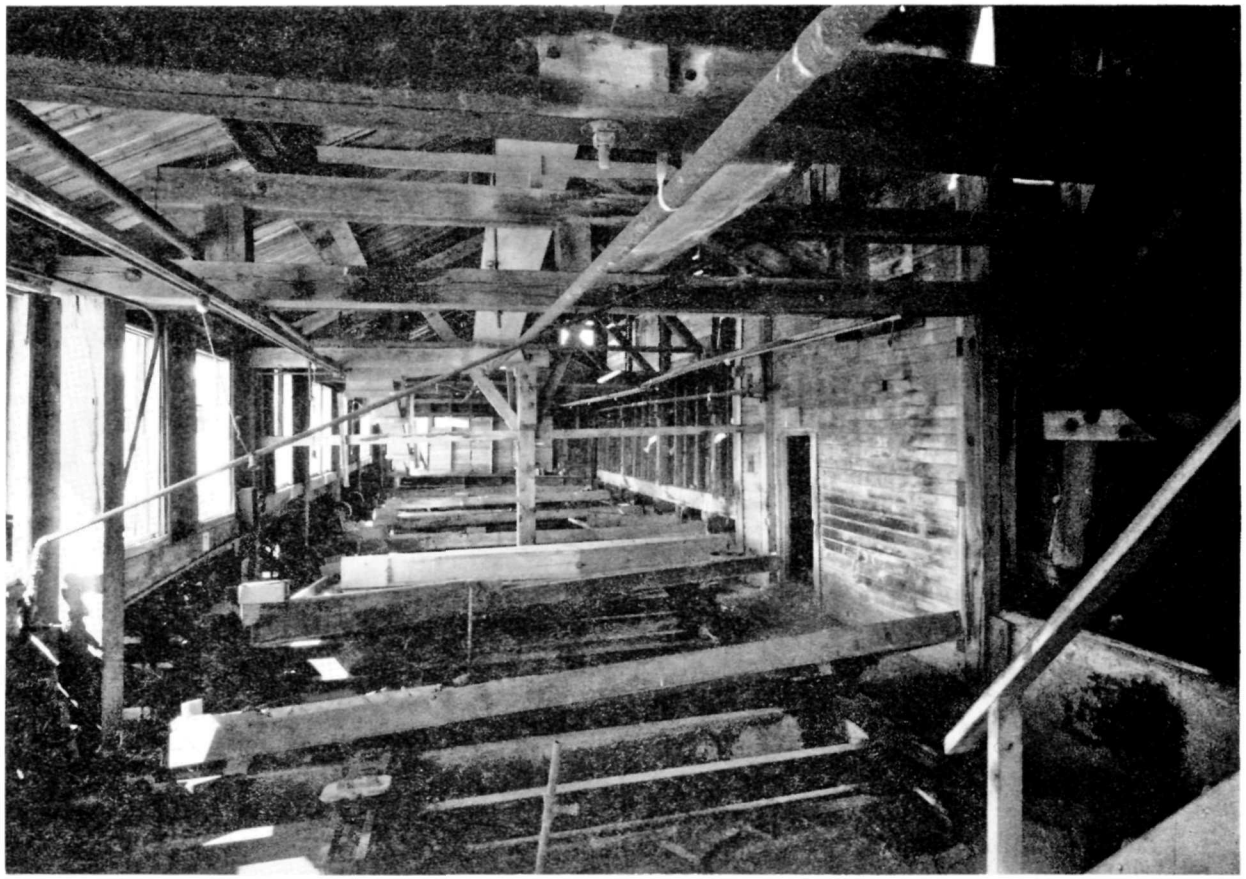


Plat-O Slime Tables.

CONCENTRATION DEPARTMENT

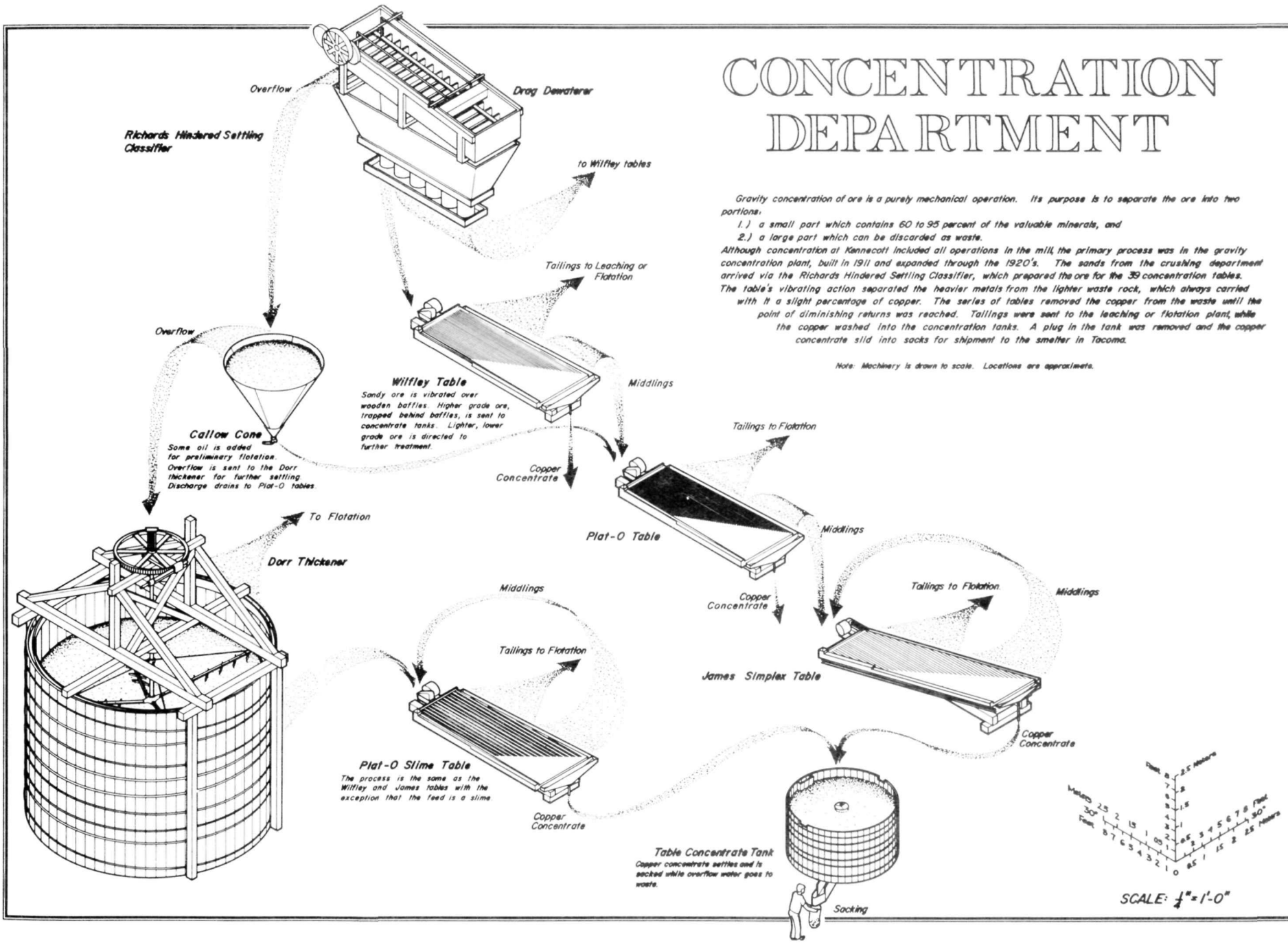
Gravity concentration of ore is a purely mechanical operation. Its purpose is to separate the ore into two portions:

1.) a small part which contains 60 to 95 percent of the valuable minerals, and

2.) a large part which can be discarded as waste.

Although concentration at Kennecott included all operations in the mill, the primary process was in the gravity concentration plant, built in 1911 and expanded through the 1920's. The sands from the crushing department arrived via the Richards Hindered Settling Classifier, which prepared the ore for the 39 concentration tables. The table's vibrating action separated the heavier metals from the lighter waste rock, which always carried with it a slight percentage of copper. The series of tables removed the copper from the waste until the point of diminishing returns was reached. Tailings were sent to the leaching or flotation plant, while the copper washed into the concentration tanks. A plug in the tank was removed and the copper concentrate slid into sacks for shipment to the smelter in Tacoma.

Note: Machinery is drawn to scale. Locations are approximate.



KENNECOTT COPPER CORPORATION: CONCENTRATION PROCESS

WRANGELL-ST. ELIAS NATIONAL PARK and PRESERVE

ALASKA

KENNICOTT

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HISTORIC AMERICAN ENGINEERING RECORD AK-1

DELINEATED BY: David C. Anderson, Hernot Aufer, Anchorage, 1986

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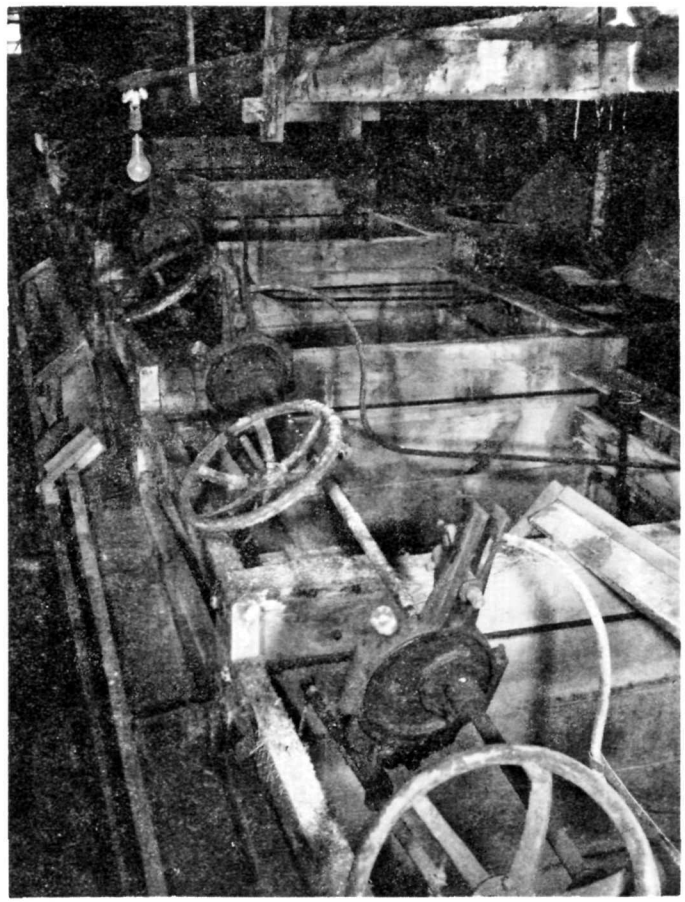
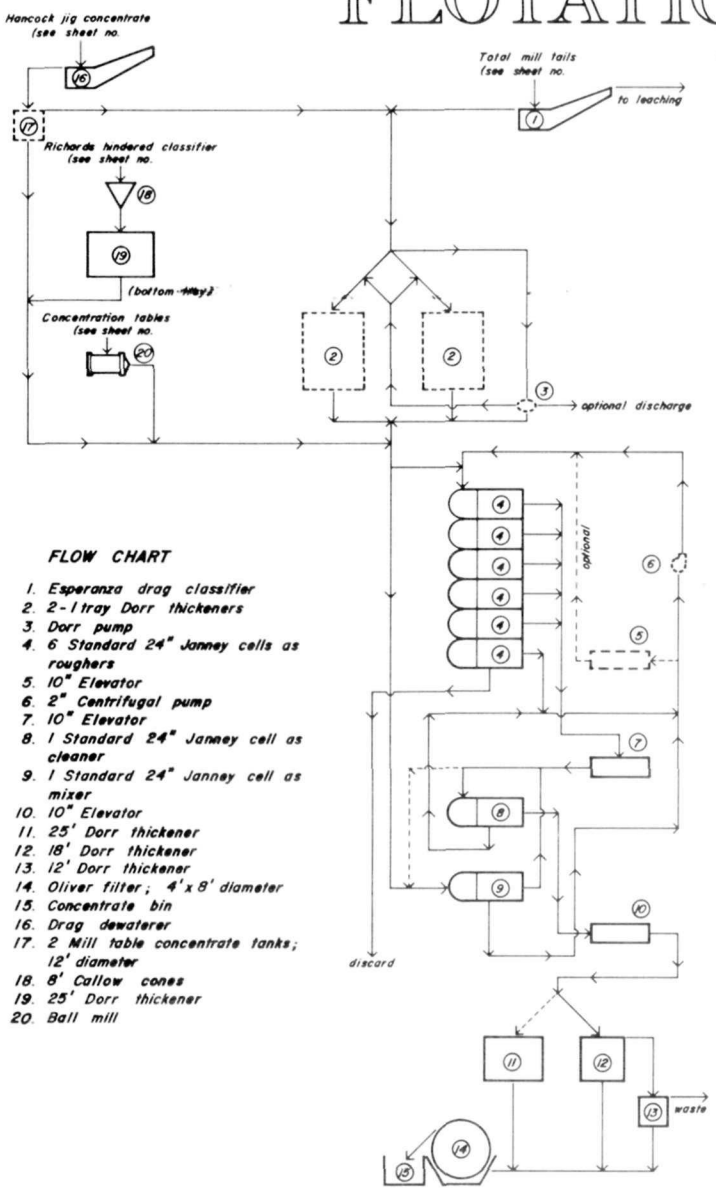
PACIFIC WEST REGION
SEATTLE, WASHINGTON



Janney Flotation Cells.

FLOTATION DEPARTMENT



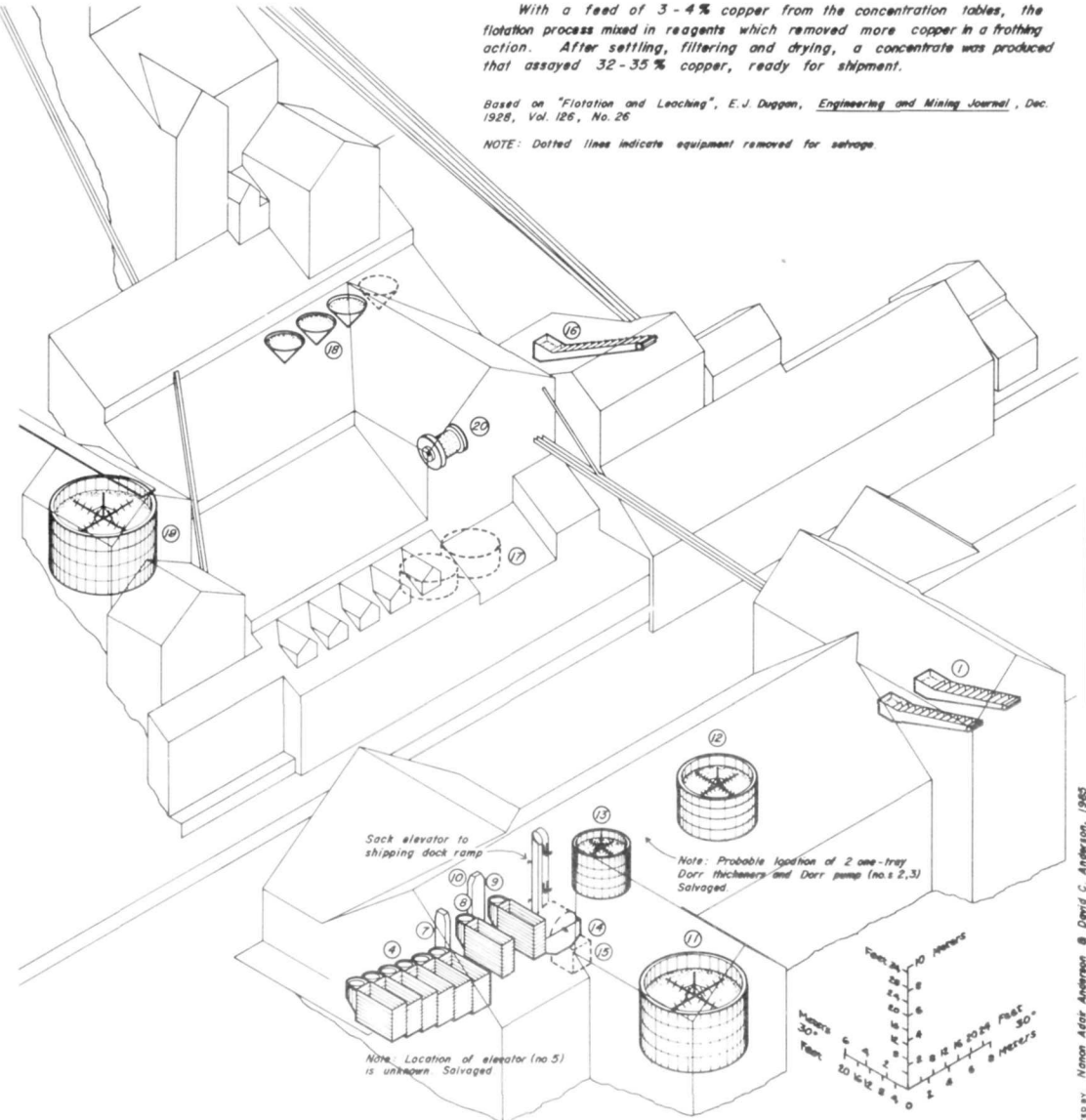
FLOW CHART

1. Esperanza drag classifier
2. 2-1 tray Dorr thickeners
3. Dorr pump
4. 6 Standard 24" Janney cells as roughers
5. 10" Elevator
6. 2" Centrifugal pump
7. 10" Elevator
8. 1 Standard 24" Janney cell as cleaner
9. 1 Standard 24" Janney cell as mixer
10. 10" Elevator
11. 25' Dorr thickener
12. 18' Dorr thickener
13. 12' Dorr thickener
14. Oliver filter; 4' x 8' diameter
15. Concentrate bin
16. Drag dewaterer
17. 2 Mill table concentrate tanks; 12' diameter
18. 8' Callow cones
19. 25' Dorr thickener
20. Ball mill

With a feed of 3-4% copper from the concentration tables, the flotation process mixed in reagents which removed more copper in a frothing action. After settling, filtering and drying, a concentrate was produced that assayed 32-35% copper, ready for shipment.

Based on "Flotation and Leaching", E.J. Duggan, Engineering and Mining Journal, Dec. 1928, Vol. 126, No. 26

NOTE: Dotted lines indicate equipment removed for salvage.



SCALE: 1/16" = 1'-0"

DELINEATED BY Nanon Astor Anderson & David C. Anderson, 1965

KENNECOTT COPPER CORPORATION; FLOTATION PROCESS

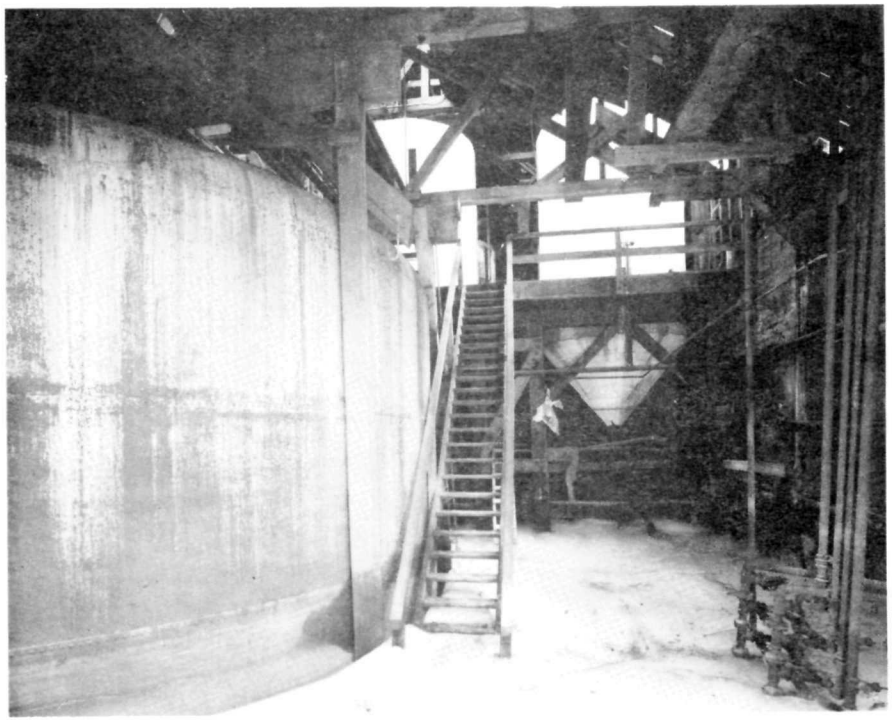
WRANGELL-ST. ELIAS NATIONAL PARK and PRESERVE ALASKA

KENNICOTT

HISTORIC AMERICAN ENGINEERING RECORD
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

HISTORIC AMERICAN ENGINEERING RECORD
AK-1

SHEET 9 of 15



Leaching Tank. Evaporators at rear.

AMMONIA LEACHING FLOW DIAGRAM

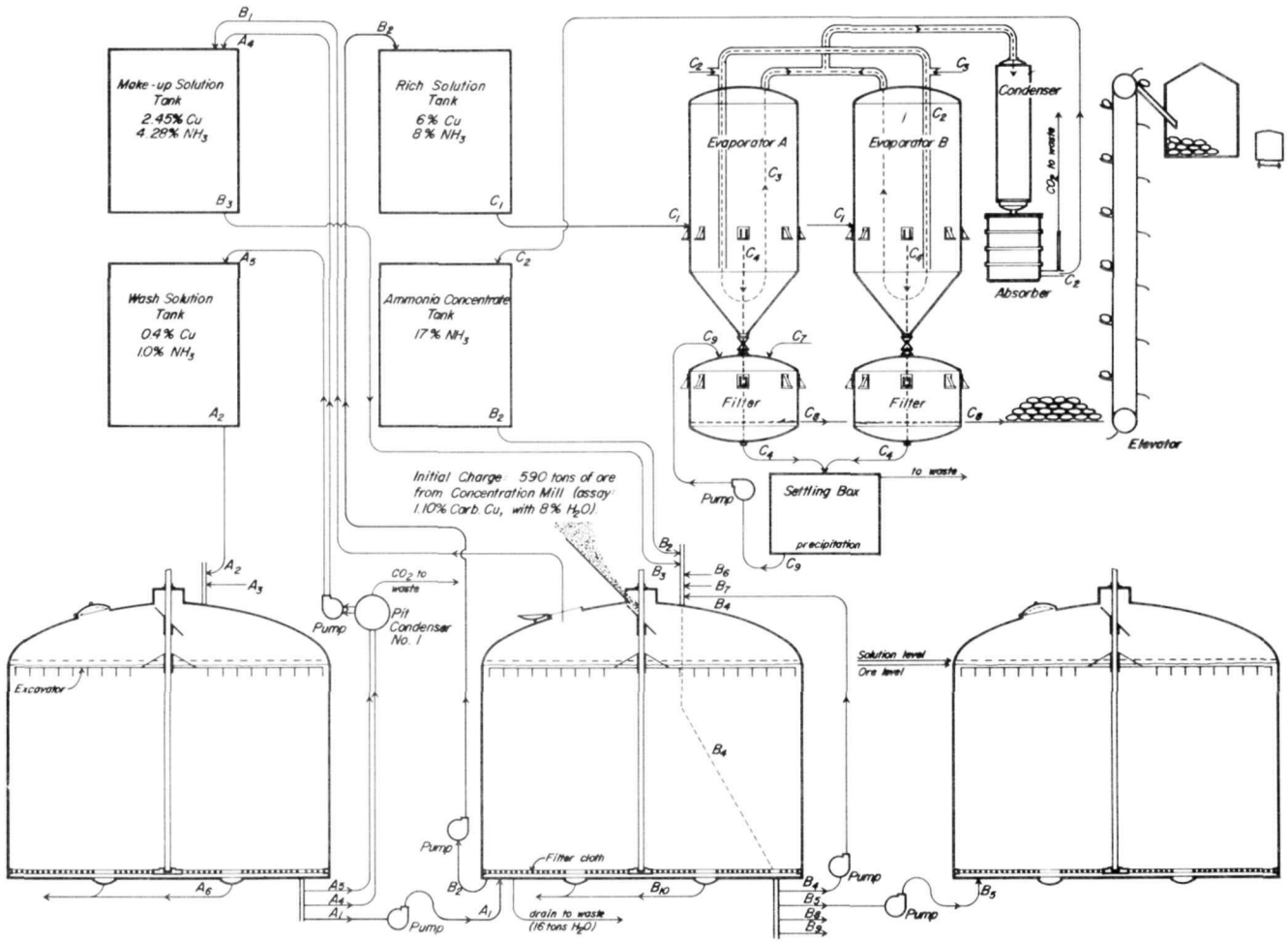
SOLUTION SECTION
(Showing 1 set of Evaporators, designated "A" & "B")

C_1 21 tons of rich solution to A & B.
C_2 Steam into A – vapors from A into B to condensers. Ammonia concentrates to storage tank (assay: 17% NH_3).
C_3 After boiled out, solution assays .03% NH_3 in A. Steam off A turned directly into B.
C_4 Solution from A dumped into filter. Filtrate pumped to settling box. Precipitates in filter assay 75% Cu (with 28% H_2O).
C_5 A recharged - same as C.
C_6 Same as C (reversed).
C_7 Filter steamed after receiving 3 dumps of 15 lb. for 4 to 5 hours. Condensate to settling box.
C_8 Precipitates (assay: 75% Cu with 18% H_2O) sacked and sent up to storage room for shipment to smelter.
C_9 Precipitates from settling box pumped into filter at end of each month.

LEACHING SECTION
(Showing 4 of 7 solution storage tanks and 3 of 8 leaching tanks - Leaching tank No. 1: "A"
Leaching tank No. 2: "B")

A_1 End of 32 hr. circulating leach and start of pumping direct to L.T. No. 2. 164 tons solution (assay: 4.5% Cu, 8.0% NH_3).
A_2 24 tons of wash solution pumped on top of charge after start of A_1 solution (assay: 0.4% Cu, 1% NH_3).
A_3 35 tons of steam at 110 lbs. pressure.
A_4 After charge in L.T. No. 2 is covered completely, 45 tons of solution (assay: 2.45% Cu, 4.28% NH_3) is pumped off via pit condensers to make-up tank.
A_5 16 tons of wash solution (assay: 0.4% Cu, 1.0% NH_3).
A_6 Tailings to waste.

B_1 8 tons of diluted solution syphoned to wash tank by gravity (assay: 0.4% Cu, 1.0% NH_3). If syphoned to waste, which is not always practical owing to varying amounts of H_2O in tails, assay not to exceed 0.1% NH_3.
B_2 At end of 12 hour still leach, 84 tons of rich solution is pumped to storage tank for distillation (assay: 6% Cu, 8% NH_3). At same time 40 tons of ammonia concentrate is pumped on top of charge (assay: 17% NH_3).
B_3 After concentrate is pumped on, 45 tons of make-up solution is added to recover charge as before B_2 (assay: 2.45% Cu, 4.28% NH_3).
B_4 32 circulating leach (assay at start: 1.81% Cu, 8.0% NH_3).
B_5 Same as A_1 (Leaching tank No. 1).
B_6 24 tons of wash solution pumped on top of charge after start of B_5 to leaching tank No. 3.
B_7 35 tons of steam at 110 lbs. pressure, same as A_3 (L.T. No. 1).
B_8 Same as A_4 (Leaching tank No. 1) via pit condenser No. 2.
B_9 Same as A_5 (Leaching tank No. 1) via pit condenser No. 2.
B_{10} Same as A_6 (Leaching tank No. 1).



Note: This drawing represents one complete cycle in the leaching plant.

Based on K.C.C. Leaching Plant Flow Diagram, 1921.

DELINEATED BY: Orvil C. Anderson, Nancy Adair Anderson, 1962

HISTORIC AMERICAN ENGINEERING RECORD
UNITED STATES DEPARTMENT OF THE INTERIOR

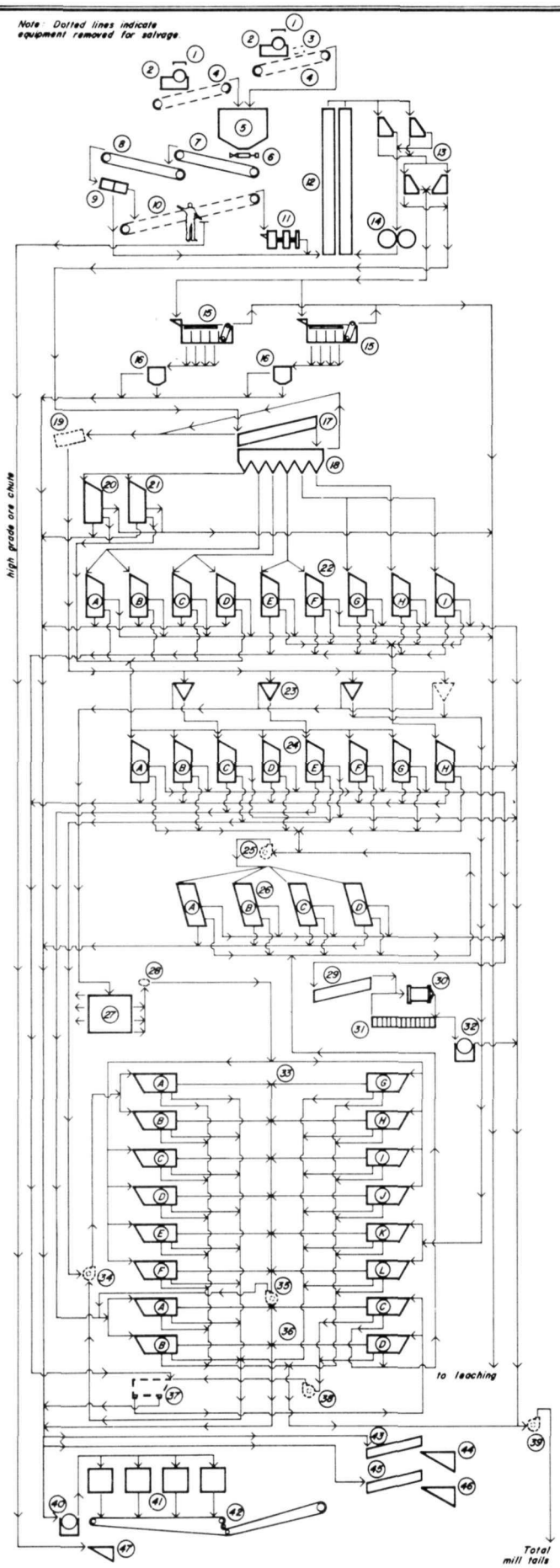
KENNECOTT COPPER CORPORATION: AMMONIA LEACHING FLOW DIAGRAM
KENNICOTT — WRANGELL-ST. ELIAS NATIONAL PARK and PRESERVE — ALASKA

SHEET 10 of 15

HISTORIC AMERICAN ENGINEERING RECORD
AK-1

Tailings below Leaching Plant and Mill.

Note: Dotted lines indicate equipment removed for salvage.



CONCENTRATION MILL - 1938 FLOW SHEET

1. 2 Grizzlies
2. 2 Buchanan jaw crushers: 13" x 24"; 250 rpm; 3 1/2" opening
3. Cobbing magnet
4. 2 Conveyors: Jumbo & Bonanza - 22" width; 5 ply
5. Ore bin: 400 ton; 32' width; 32' length; 20' depth
6. Stevens - Adamson apron feeder
7. Conveyor: 40' length; 32" width; 5 ply; 60 fpm
8. Conveyor: 52' length; 32" width; 5 ply; 60 fpm
9. Trommel: 4' diameter; 27"-11mm; 30"-1" mesh; 16 rpm
10. Sorting conveyor: 40' length; 32" width; 5 ply; 50 fpm
11. Symons disc crusher: 36"; 335 oscillations; 135 rpm; 1" opening
12. 2 Elevators: 58' length; 18" width; 10 ply; 380 fpm; 54 cups
13. 4 Vibrating screens
14. Traylor rolls: 54" x 20"; 83 rpm
15. 2 Hancock jigs: 195 rpm; 1/8" lift; 3/8" throw; 3'-1 1/2" depth of pocket; 3'-7 1/2" width of pocket
16. 2 Harz jigs: 265 rpm; 3/4" stroke; 4 mm screen
17. Drag dewaterer: 32' length; 30" width; no. 830 chain, 3 7/8" in 12"
18. Richards hindered settling classifier; 6 spigots; 30' water head
19. Chip trommel: 5' length; 3' diameter; 16 rpm; 4mm screen
20. Wilfley table: 15/16" stroke; 3/4" in 12" slope; 258 rpm
21. Plat-O table: 13/16" stroke; 11/16" in 12" slope; 304 rpm
22. 9 Wilfley tables:

	rpm	slope per foot inches	stroke, inches
A	256	13/16	3 1/4
B	270	7/8	1
C	248	7/8	7/8
D	276	5/8	1 1/16
E	258	13/16	1 1/4
F	257	15/16	1 1/4
G	259	13/16	15/16
H	256	13/16	15/16
I	260	13/16	7/8

23. 4 Callow cones: 8' diameter
24. 8 Plat-O tables:

	rpm	slope per foot inches	stroke, inches
A	335	9/16	1/2
B	335	9/16	5/8
C	335	1/4	3/4
D	261	7/8	7/8
E	320	7/8	3/4
F	262	13/16	5/8
G	315	9/16	7/8
H	318	9/16	7/8

25. Wilfley centrifugal pump: 2"
26. 4 James tables:

	rpm	slope per foot inches	stroke, inches
A	245	5/8	3/4
B	247	5/8	3/4
C	230	5/8	3/4
D	230	5/8	11/16

27. 2-tray Dorr thickener: 20' diameter; 16' height
28. Dorr pump
29. Drag dewaterer
30. Ball mill: 4' x 4'; 30 rpm
31. Esperanza classifier
32. Frenier pump
33. 12 Plat-O slime tables: each 305 rpm; 7/8" in 12" slope; 9/16" stroke
34. Frenier pump: 48" x 6"
35. Frenier pump: 48" x 6"
36. 4 Plat-O slime tables:

	rpm	stroke, inches
A	305	9/16
B	305	9/16
C	280	7/8
D	280	7/8

37. 2 spigot classifier
38. Byron Jackson centrifugal pump: 2" x 9"
39. Wilfley centrifugal pump: 4"
40. Frenier pump: 48" x 6"
41. 4 Table concentrate tanks: 9' diameter; 5' height
42. 2 Conveyors: 25' length; 22" width; 5 ply; 14 fpm; 5 7/8" in 12" slope
43. Drag dewaterer (from Hancock jig concentrate): 26' length; 40" width; 3 7/8" in 12" slope; 12 fpm
44. Bin: 110 ton capacity
45. Drag dewaterer (from bull jig concentrate): 26' length; 14" width; 3 7/8" in 12" slope; 12 fpm
46. Bin: 140 ton capacity
47. High grade ore bin

Based on 1928 flow sheet from "Flotation and Leaching", E. J. Duggan, Engineering and Mining Journal, 1928, and on 1985 field observations

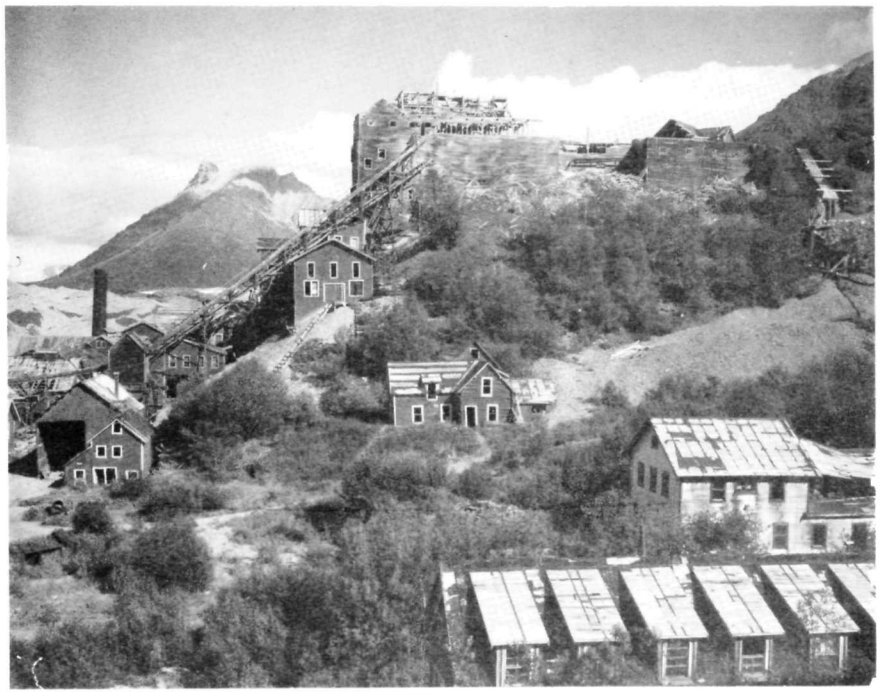
DELINEATED BY Nancy Adair Anderson & David C. Anderson, 1985

HISTORIC AMERICAN ENGINEERING RECORD
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

KENNECOTT COPPER CORPORATION; CONCENTRATION MILL FLOW SHEET 1938
KENNICOTT — WRANGELL-ST. ELIAS NATIONAL PARK and PRESERVE — ALASKA

SHEET 8 OF 15

HISTORIC AMERICAN ENGINEERING RECORD
AK-1

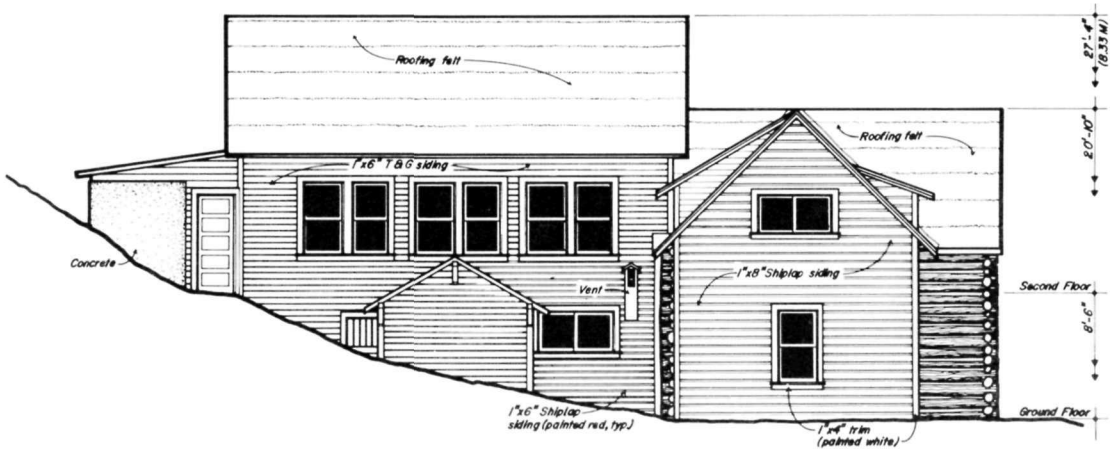


General Manager's Office below Mill.

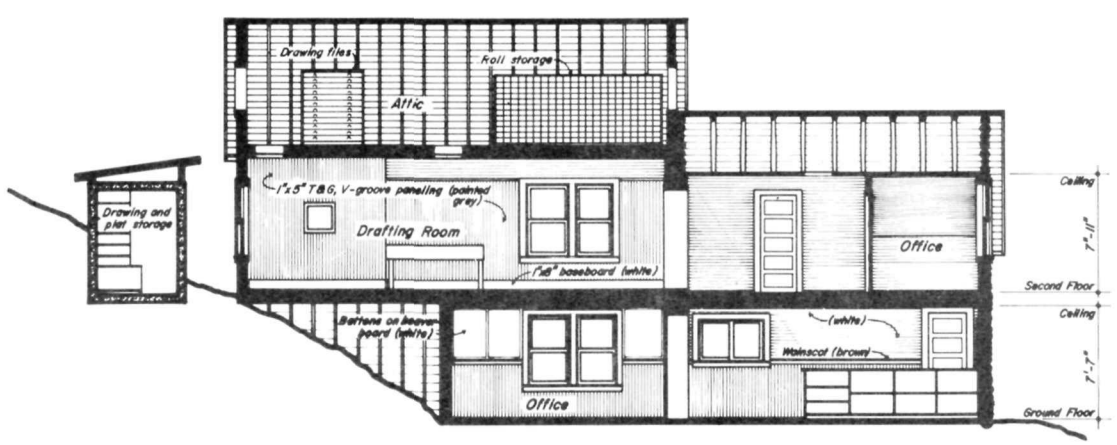
GENERAL MANAGER'S OFFICE

Note: The 1907 log structure was expanded into the General Manager's Office. It is the oldest standing structure in Kennicott. The building is in deteriorated condition.

SOUTH ELEVATION



WEST ELEVATION



SECTION A-A

Scale: 1/4" = 1'-0"

0 1 2 3 4 6 8 10 feet

0 1 2 3 meters

DELINEATED BY: David C. Anderson, Nancy Adair Anderson, 1985

HISTORIC AMERICAN ENGINEERING RECORD
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

KENNICOTT COPPER CORPORATION: GENERAL MANAGER'S OFFICE

KENNICOTT — WRANGELL-ST. ELIAS NATIONAL PARK and PRESERVE — ALASKA

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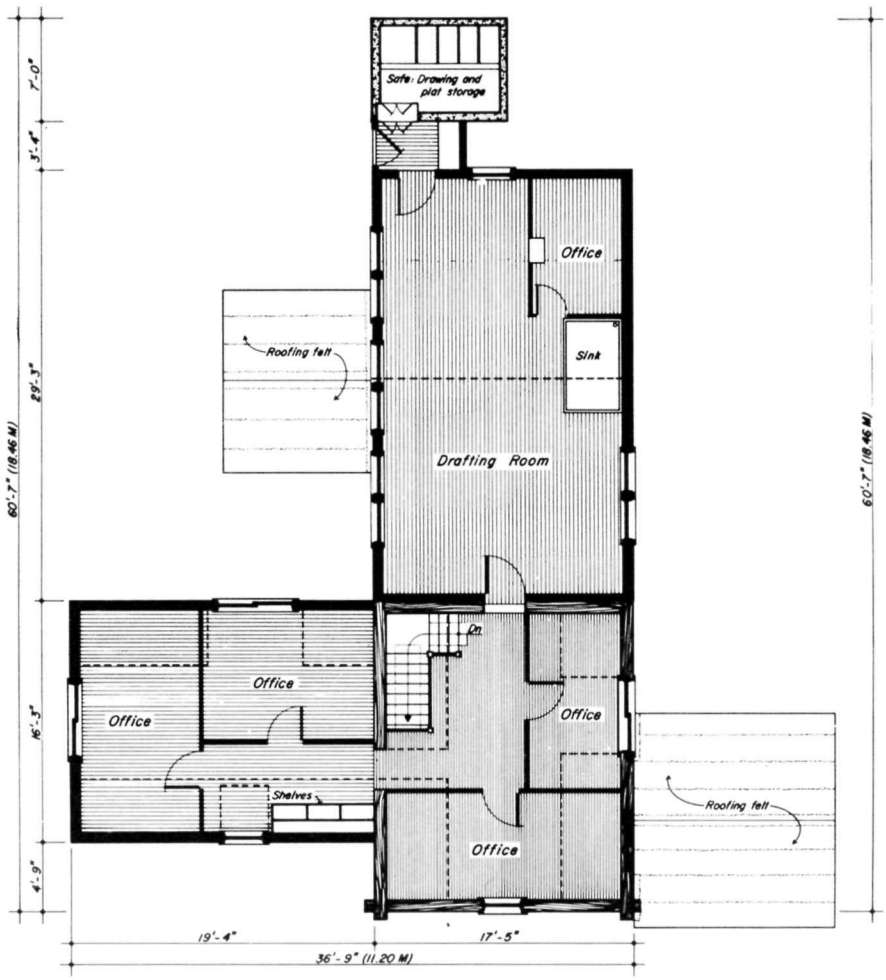
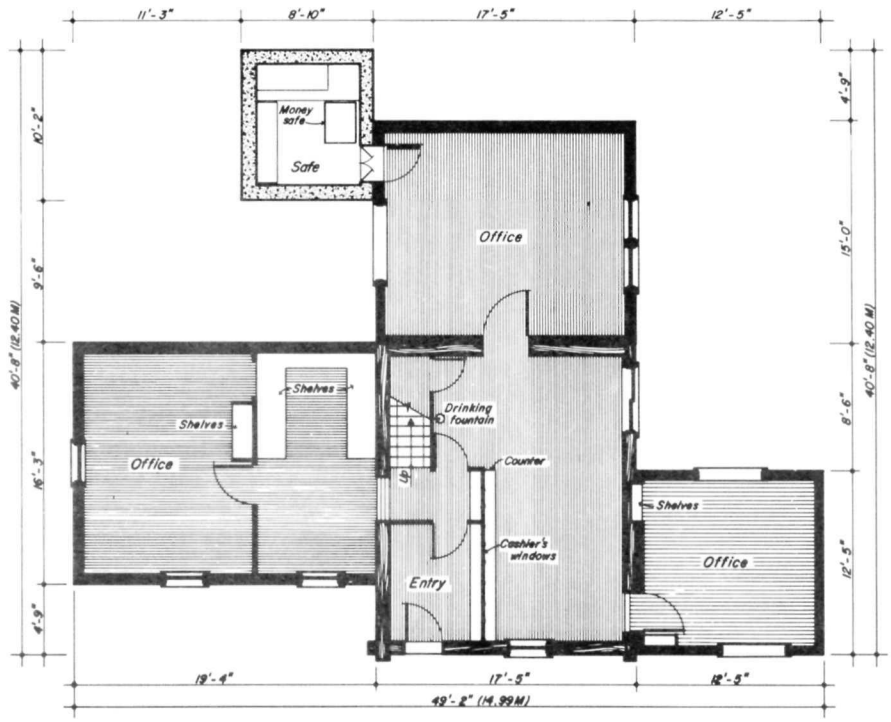
HISTORIC AMERICAN ENGINEERING RECORD
AK-1



SECOND FLOOR PLAN



GROUND FLOOR PLAN

Scale: $\frac{1}{4}$" = 1'-0"

0 1 2 3 4 6 8 10 feet

0 1 2 3 meters

DELINEATED BY David C. Anderson, Nanon Adair Anderson, 1985

HISTORIC AMERICAN ENGINEERING RECORD
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

KENNICOTT COPPER CORPORATION: GENERAL MANAGER'S OFFICE

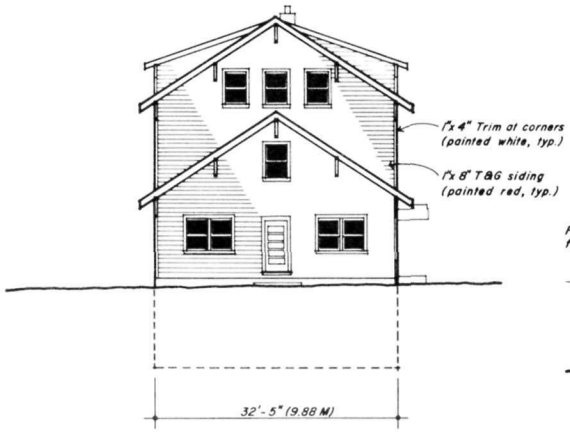
KENNICOTT — WRANGELL-ST. ELIAS NATIONAL PARK and PRESERVE — ALASKA

SHEET 11 of 15

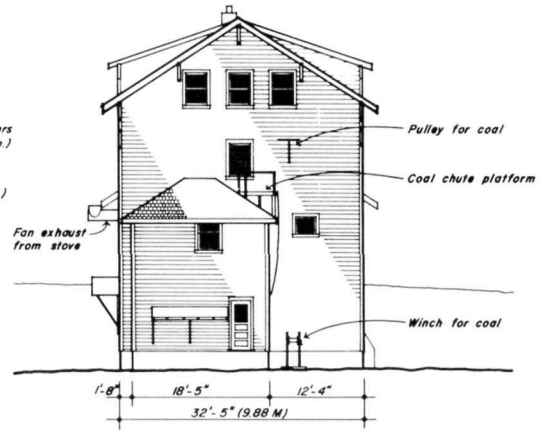
HISTORIC AMERICAN ENGINEERING RECORD
AK-1

National Creek Bunkhouse (left), Company Store, and West Bunkhouse from Mill. 1982.

WEST BUNKHOUSE



EAST ELEVATION



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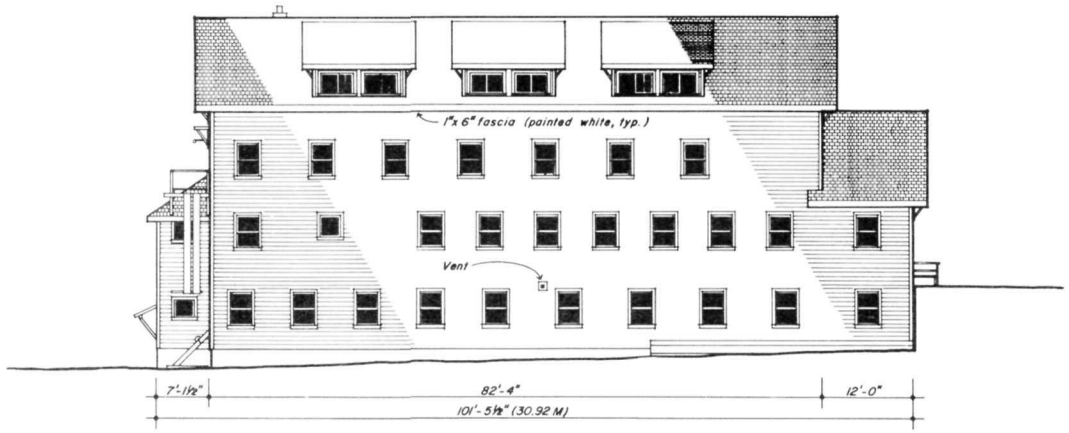
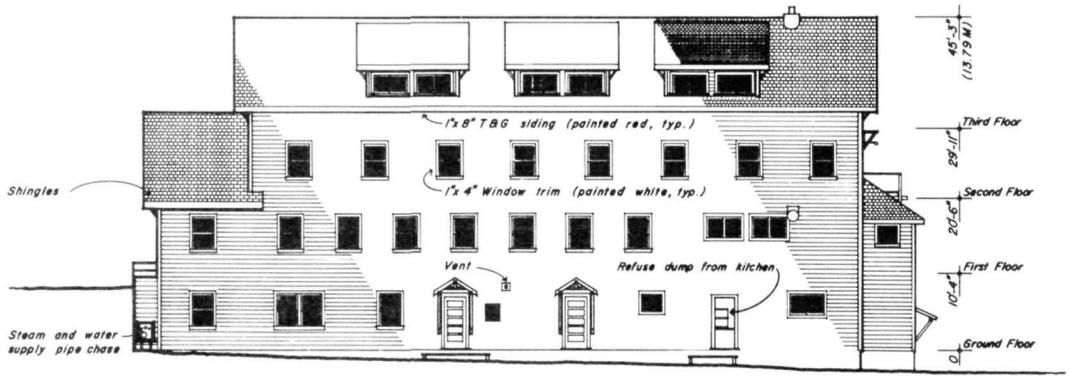
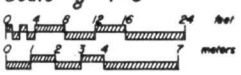


SOUTH ELEVATION



NORTH ELEVATION

Scale: $\frac{1}{8}$" = 1'-0"



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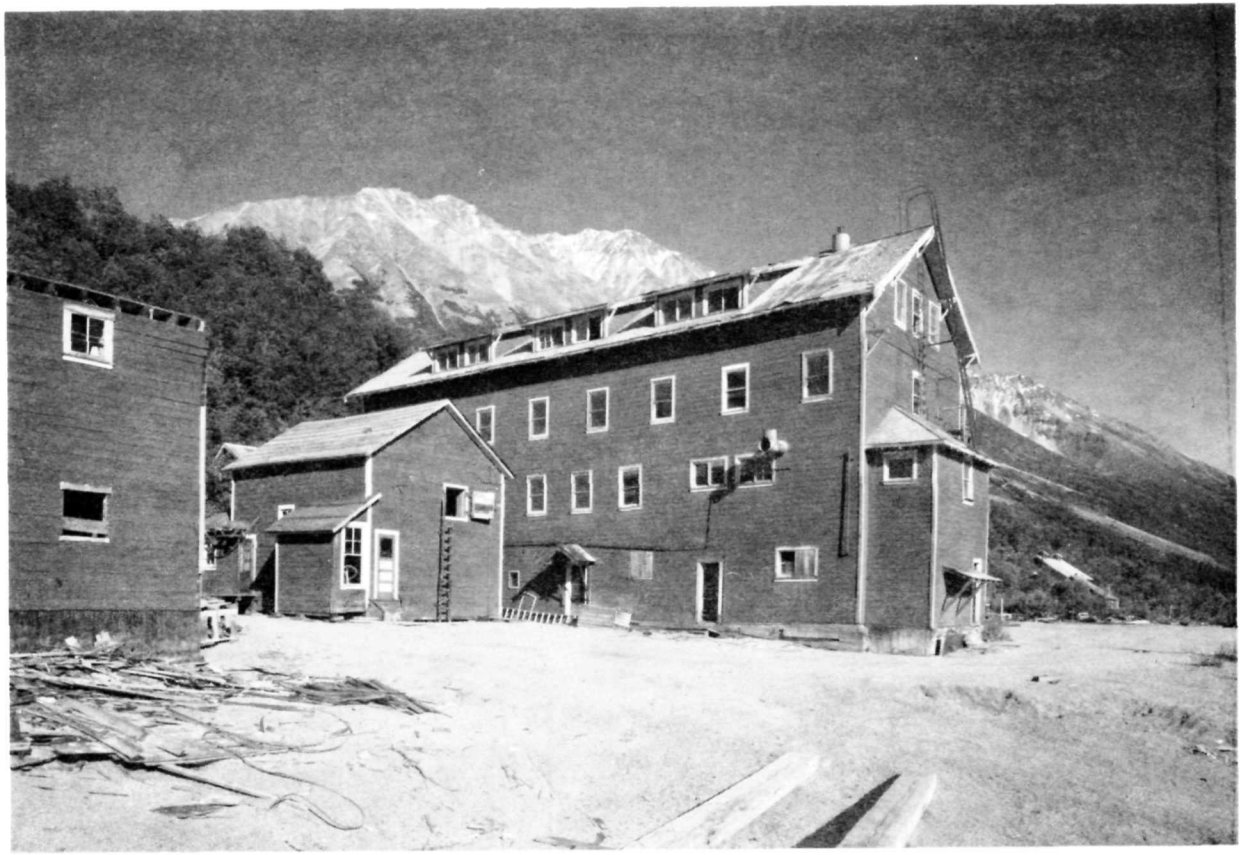
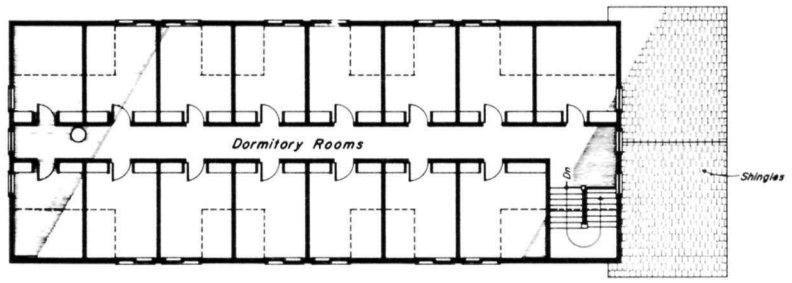
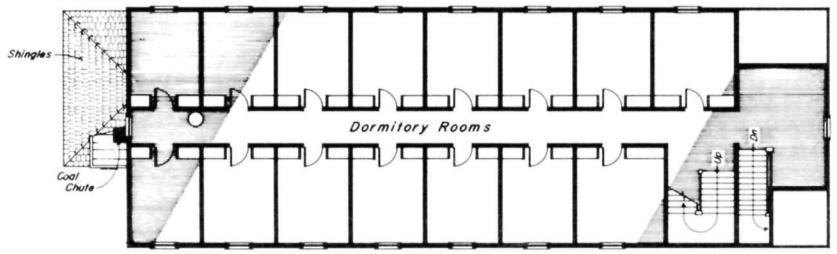
HISTORIC AMERICAN ENGINEERING RECORD NATIONAL PARK SERVICE UNITED STATES DEPARTMENT OF THE INTERIOR	KENNECOTT COPPER CORPORATION; WEST BUNKHOUSE KENNICOTT — WRANGELL-ST. ELIAS NATIONAL PARK and PRESERVE — ALASKA	SHEET 14 OF 15	HISTORIC AMERICAN ENGINEERING RECORD AK-1	LIBRARY OF CONGRESS PHOTO NUMBER



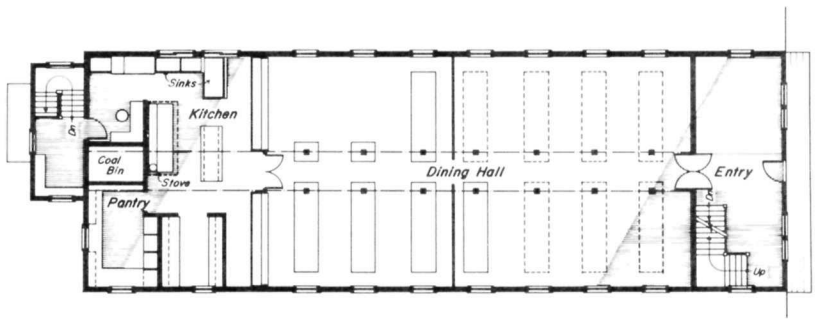
West Bunkhouse and Refrigeration Plant.



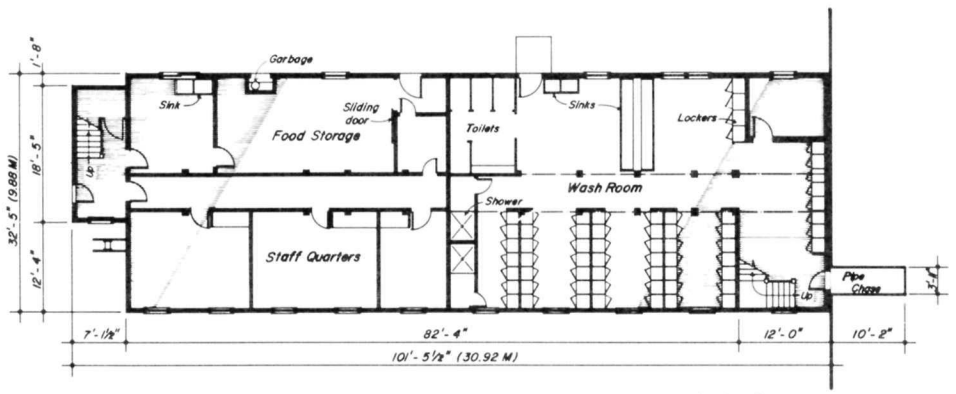
THIRD FLOOR PLAN



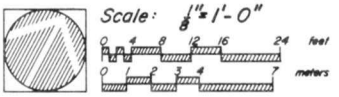
SECOND FLOOR PLAN



FIRST FLOOR PLAN



GROUND FLOOR PLAN



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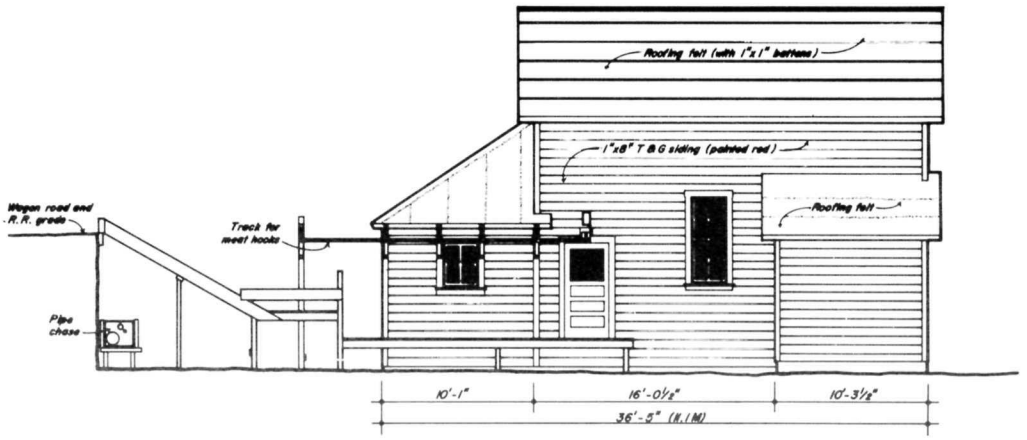
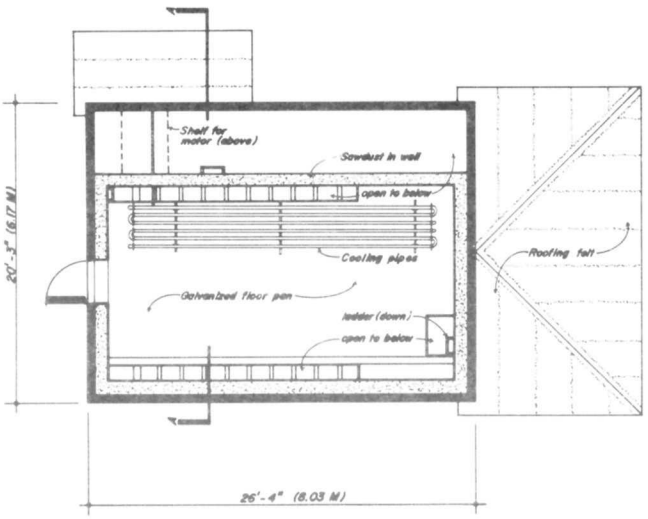
HISTORIC AMERICAN ENGINEERING RECORD NATIONAL PARK SERVICE UNITED STATES DEPARTMENT OF THE INTERIOR	KENNECOTT COPPER CORPORATION: WEST BUNKHOUSE KENNICOTT — WRANGELL-ST. ELIAS NATIONAL PARK and PRESERVE — ALASKA	SHEET 13 OF 15	HISTORIC AMERICAN ENGINEERING RECORD AK-1	

REFRIGERATION PLANT



NORTH ELEVATION



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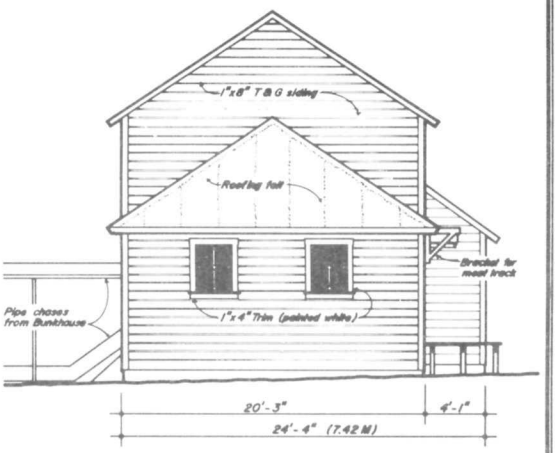
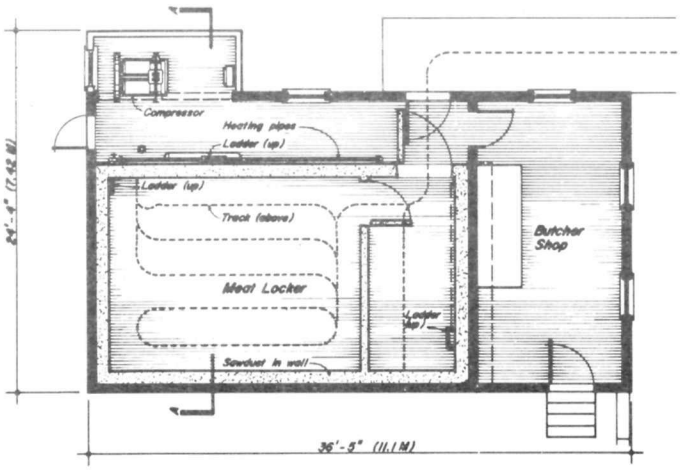
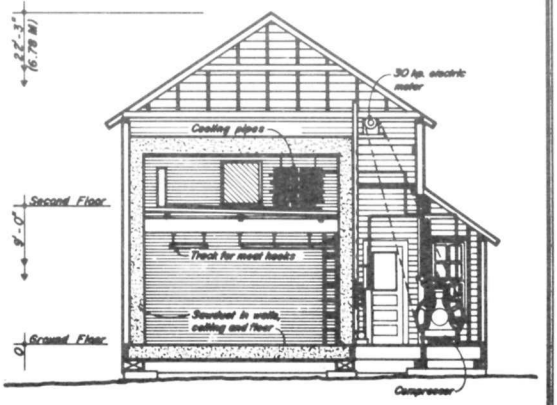


EAST ELEVATION



GROUND FLOOR PLAN



Scale: ¼" = 1'-0"

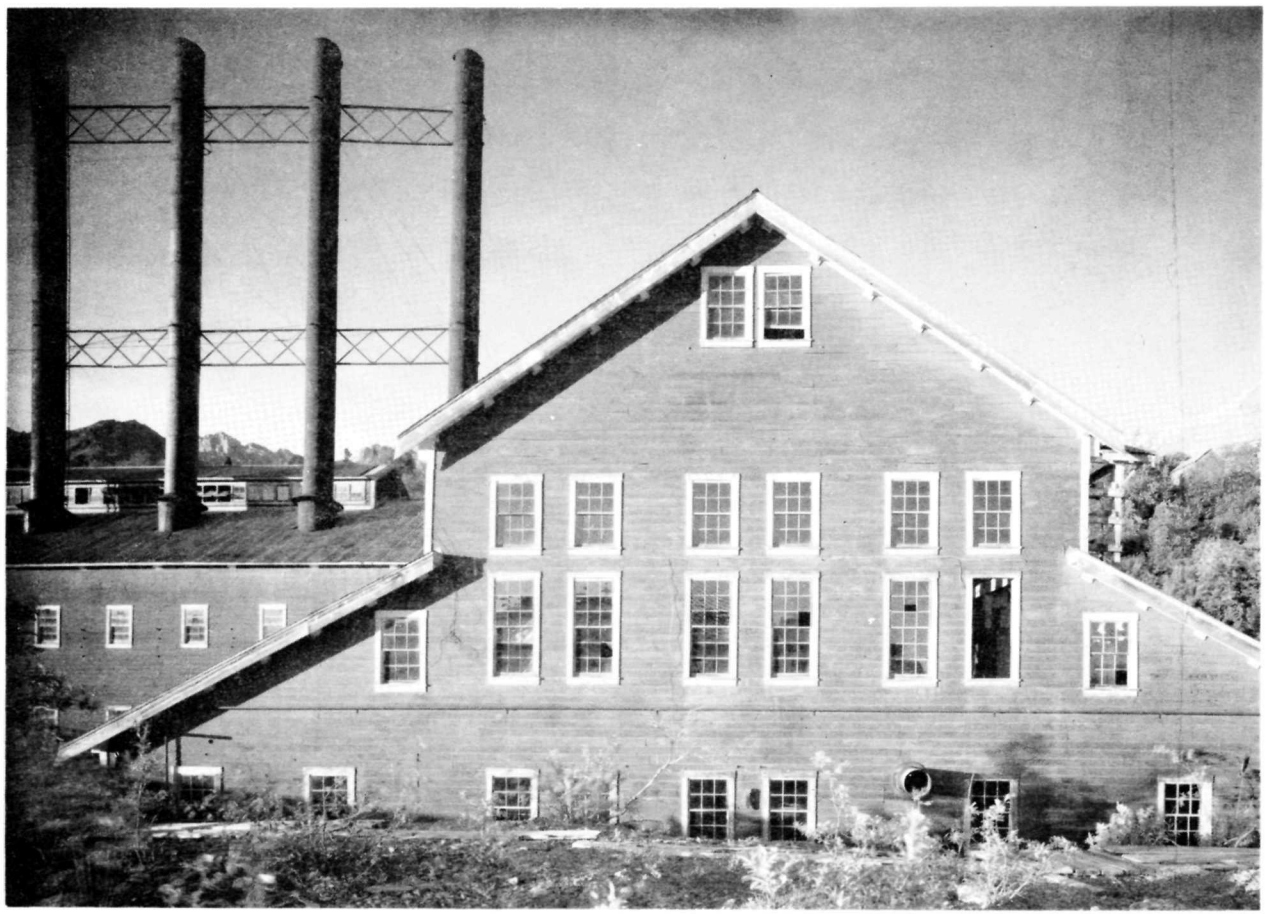
0 2 4 6 8 10 feet

0 1 2 3 meters

SECTION A-A

DELINEATED BY: Hanon Adair Anderson, David C. Anderson, 1985

HISTORIC AMERICAN ENGINEERING RECORD NATIONAL PARK SERVICE UNITED STATES DEPARTMENT OF THE INTERIOR	KENNECOTT COPPER CORPORATION: REFRIGERATION PLANT KENNICOTT — WRANGELL-ST. ELIAS NATIONAL PARK and PRESERVE — ALASKA	SHEET 10 of 15	HISTORIC AMERICAN ENGINEERING RECORD AK-1	



Powerhouse. 1985.

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