REPORT OF THE STATE BUREAU OF MINES

DENVER, U. S. A.

E. L. WHITE, COMMISSIONER.

COLORADO

[redacted]

FOR THE YEARS 1905-6

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LETTER OF TRANSMITTAL.

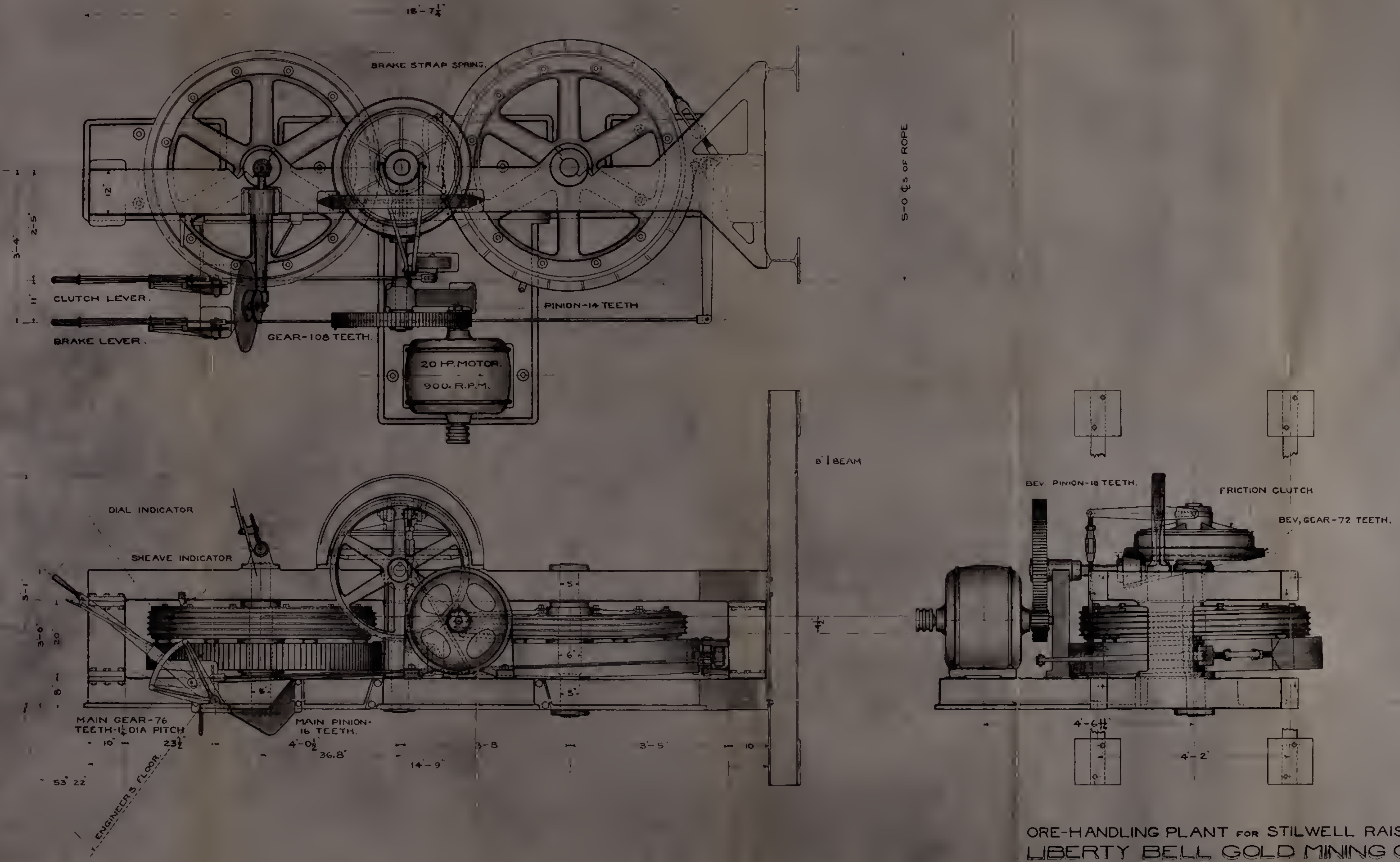
GOVERNOR H. A. BUCHTEL.

Sir: I have the honor to transmit report of the Bureau of Mines for the biennial period of 1905 and 6, being statistical tables of routine work of the inspectors comprised in examinations made, recommendations to operators by inspectors, number of accidents and classification of same, mineral production for these years, with tables of previous years for purposes of comparison. In the nature of field work report of mineral recognizance undertaken by department through Dr. Herman Fleck and Prof. W. G. Haldane, of School of Mines, in Montrose and San Miguel Counties during summer of 1905, similar recognizance through Rio Blanco and Routt Counties in 1906, and description of underground hoisting equipment designed by S. A. Worcester and being installed in Liberty Bell mine at Telluride, Colo., by C. A. Chase.

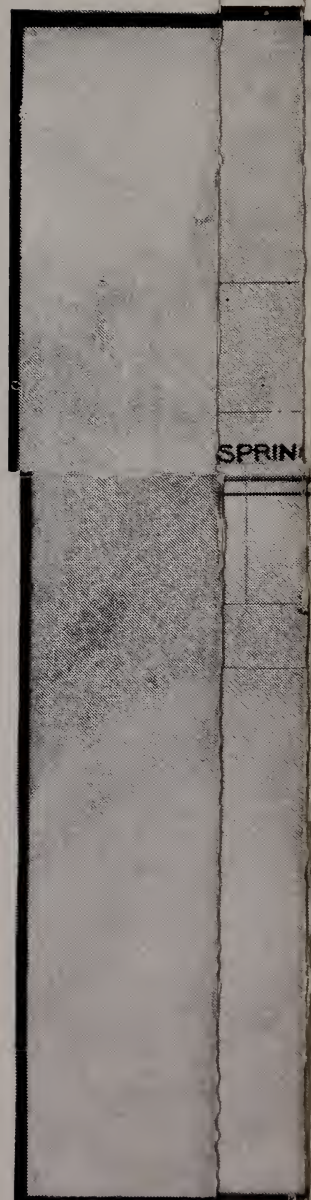
Respectfully yours,

E. L. WHITE,
Commissioner of Mines.

Denver, Colo., ~~November~~ March 27, 1907.



ORE-HANDLING PLANT FOR STILWELL RAISE.
LIBERTY BELL GOLD MINING Co.
GEN'L. ARRANGEMENT OF ELECTRIC HOIST.


SPRIN

Report

OF THE

State Bureau of Mines

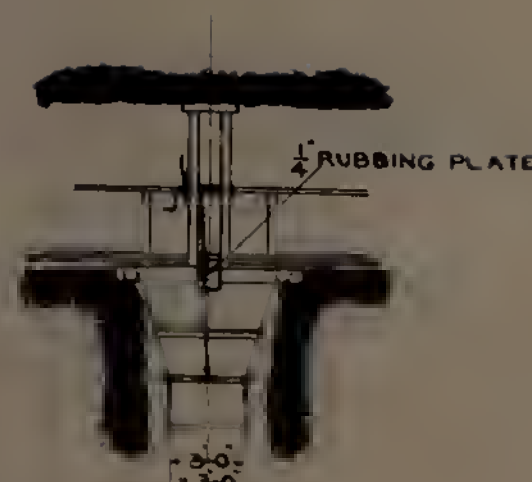
For the Years 1905-6

ORE-HANDLING PRACTICE AT COLORADO MINES.

By S. A. Worcester.

The various operations which are included in the general proposition of transporting ores from the working faces of the mines to the reduction works form an interesting study. Each mining district has its own peculiar characteristics which determine the form of its ore-handling apparatus. In the San Juan district the majority of the mines are operated through tunnels. The ore is drawn from chutes into the tunnel cars, which are hauled in trains by mules or motors to the surface. The stamp mill is in many cases several thousand feet from the tunnel, and connected with it by an aerial gravity tramway. Electric power is used for nearly all purposes requiring power, current being furnished by power companies operating hydro-electric plants or by hydro-electric or steam plants owned by mining companies. In the Leadville region vertical shaft mining, with steam hoists, is almost invariable. In the Cripple Creek region vertical shaft mining is the rule and electric hoists are much used by the smaller mines. The two-power companies operating in the district, one having hydro-electric and the other steam plant, have on hand, and rent, small electric hoists, from 5 to 30 horsepower at reasonable rates. The larger mines use steam hoists and cages or skips. Several mines are working at depths of 1,000 or more feet. In the Central City region shaft mining with steam hoists and buckets is the rule, the shafts following the pitch of the vein in many cases, and the bucket sliding on skids for the greater part of its travel. In one case, the California mine, very large buckets have been used, hoisting balanced in two compartments, from a depth of 2,200 feet or more. In cases where the vein pitches thirty degrees or more from the perpendicular, self-dumping skips are used. Assuming in general that the greater portion of the ore is broken above the levels on which it is trammed to either the hoisting shaft or the surface, the first operation after breaking is that of conveying the ore by gravity to the car below. If the stope is nearly vertical above the level, the ordinary planked chute works well, for a distance of perhaps several hundred feet, excepting for occasional jams. But when the pitch of the vein approaches forty degrees from the perpendicular, and the length of chute becomes 1,000 feet or more, jams become frequent and serious and the great wear on the chute necessitates almost constant repairs. The Gem mine, for instance, at Idaho Springs, has used for some time a chute about 2,000 feet long, floored with heavy tee-rails and pitching perhaps thirty degrees from the perpendicular. The repairs and annoyances connected with the working of this chute, substantial as it is, are so great that the management is about to install a hoist, with cage or skip for lowering the ore, to replace the chute. The hoist can, of course, be used for raising men, timbers and supplies, for which purposes the chute is useless. The Old Town mine, not far distant from the Gem, while at present working from the surface, will eventually work through the Newhouse Tunnel and will install a skip arrangement for lowering ore, etc., a distance of about 2,000 feet. The Liberty Bell mine, at Telluride, has a very uniform fissure vein, with a pitch of about 53 degrees from the perpendicular, and carrying ore which is a mixture of talcy, sticky mud and quartz. Water is present in large quantities, in nearly all parts of the mine, and, mixing with the talc in the chutes, it seals all openings and accumulates in such a way as to burst the longer chutes by hydrostatic pressure. This finally became scuch an expense and annoyance that the general superintendent, Mr. Chas. A. Chase, finally abandoned the main chute and installed in its place a bottom-dumping skip. After the skip dumps its load it is hoisted by an over-balance weight which balances about one-half the ore-load, in addition to the weight of the skip. The speed is controlled by a brake, and this skip now lowers a large portion of the mine's output with good economy and satisfaction. A new tunnel, about 2,600 feet long, has been cut at a vertical distance of about 800 feet below the present main working level and will later become the working outlet of the mine. A raise is now being made on the vein, from this tunnel, and a skip, of five and one-half tons capacity, is to be installed for lowering ore from the present working level and from intermediate levels as they may be opened, to the new or Stilwell Tunnel. The skip is attached by links to a cage, and the two travel together. The cage deck is to come to the level of the upper station when the skip is in position for loading from the filler or pocket, which holds one skip-load or four mine cars of ore. The cage can thus be loaded or unloaded at the same time that the skip is being loaded. While the skip makes its trip of 1,150 feet, dumps automatically, closes its door, and returns, the skip tender is busy dumping mine cars into the filler, and on the return of the

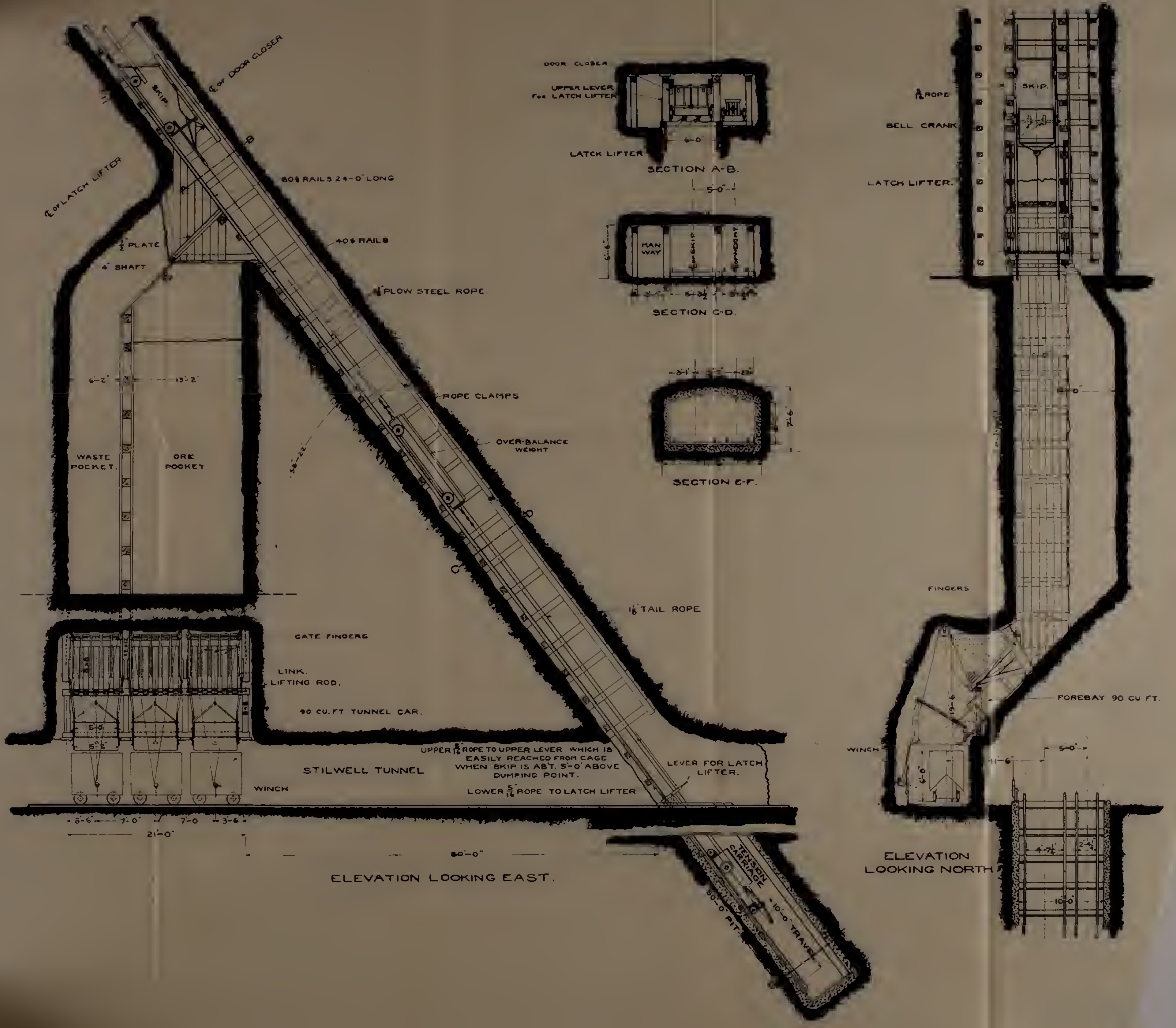
ELEVATION
LOOKING EAST.

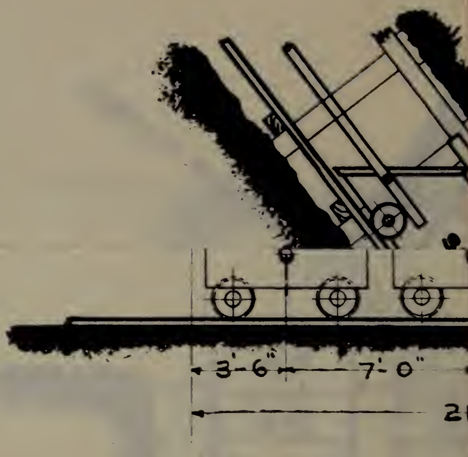


ELEVATION OF
SKIP FILLER,
LOOKING NORTH.

skip it is filled quickly at one operation by dropping the filler door. The ropes have a large safety factor for lowering a load of fourteen or more men in the cage, in addition to a full skip-load of ore. The over-balance weight of 14,500 pounds, balancing cage and skip plus one-half the average ore-load, or 5,500 pounds, gives an effective pull of 5,500 pounds for hoisting loads of men, timbers, etc., when the skip is emptied. The motor is used only when it is desired to lower the cage from its usual stopping place above the ore pocket, to the Stilwell level, for timbers, etc. As these trips are short and infrequent, a speed of 95 feet per minute is sufficient and a 20-horsepower motor is ample for hoisting 5,500 pounds of over-balance weight at fifty-three degrees inclination. The special cable system, with tail-rope and tension carriage, gives constant rope balance. A special feature of the ore and waste bins will be noticed in the finger gates made of 12x12 and 8x8 timbers. In operating these gates the winch is used to lift five fingers at once and allow ore enough to pass to fill the forebay which holds one ninety-foot tunnel car load. When released any fingers having no ore under them swing down to the bin floor, while those which have ore under them hold it from passing. This finger gate, which was originated at the Liberty Bell, has given good satisfaction in handling the mixture of talcose clay and very large rocks, which gave much trouble by jamming with any form of sliding gate. When the forebay has been filled the apron gate is lowered and the car filled quickly without danger of overfilling. The crusher plant which was originally located at the present mine outlet, the upper tramway terminal, but was carried away by a snow-slide and afterward re-located at the mill, is to be placed at the storage bins, of several thousand tons capacity, at the month of the Stilwell tunnel. Before the construction of the raise was begun, this ore-handling plant was designed by the writer, in collaboration with Mr. Chase, to whom acknowledgment is due for a number of its original features. Several advantages of the single over-balanced skip over the double balanced skip arrangement, for either hoisting or lowering ore, may be noted here. The "peak of load" for two balanced skips is the weight of rope (1,150 feet), plus the skip and ore, because it is necessary, when changing levels, to hoist unbalanced. A motor of forty or fifty horsepower would be needed to do this at a reasonable speed. The monthly difference in current in favor of the single skip is about $120 to $180. As the great majority of accidents with two-compartment hoists result from the difficulty of watching both sides at once, the single skip avoids this danger. The single skip is always ready to move on signal, but the double-compartment skips are rarely both ready to move at the same instant, and for this reason the single skip has much more than half the capacity of the other arrangement. In the present instance the skip and weight allow the use of the sheave hoist and tail rope, giving, as before stated, constant rope balance and making the hoist materially smaller and cheaper than a double drum hoist. To use this system with two balanced skips it would be necessary to have a cumbersome and expensive arrangement for lengthening or shortening the ropes for different levels.

For hauling trains of mine cars both electricity and compressed air are used in this State. The El Paso mine at Cripple Creek uses an air locomotive carrying 600 pounds, for hauling trains of mine cars on the 500-foot level, a distance of about 2,000 feet from stopes to the main shaft. The Moffat tunnel at Cripple Creek also uses a compressed air locomotive. In the larger mines of the San Juan district, the Smuggler-Union at Telluride, the Camp Bird, and the Revenue Tunnel at Ouray, electric locomotives are used for hauling mine cars through main tunnels to the surface. The Yak tunnel at Leadville, and the Newhouse Tunnel, at Idaho Spring, also use electric locomotives. Much of the ore taken from shaft mines in this State is hoisted in buckets. The bucket is set on a four-wheeled mine truck, and, after being shoveled full in the stope or drift, is trammed to the hoisting shaft, hooked to the hoist rope, hoisted to the surface and dumped, usually into a car or bin. Two different patented devices are in use in the Cripple Creek district for dumping buckets, and are operated by the engineer without leaving the hoist. In the larger mines the ore is usually thrown into chutes, having at the bottom wooden gates of the simplest character, usually a piece of two by ten or twelve-inch plank which is raised by using a light crow-bar and pushed down by hand when enough ore has been drawn off into the mine car, which is then trammed to the cage and after being hoisted to the surface is run off and dumped into the proper bin. Self-dumping skips, for hoisting ore and waste, are gradually coming into use in this State, in both vertical and inclined shafts, but not as rapidly as their merits would suggest. The skip, although by no means a new device, saves much labor, is freer from accidents than either cage or bucket, and has much larger hoisting capacity and much less dead weight than the cage. In this State the mine car is usually dumped directly into the skip, without the use of a pocket at the shaft. This dumping is much quicker than changing cars on a cage, and the skip can be stopped more quickly than the cage because it does not rest on chains or landing dogs. Many mining men seem to have the impression that the skip is adapted only to inclined shafts, whereas the fact is that it is fully as satisfactory and fully as simple in the vertical form. There are at present four skip-hoisting plants in the Cripple Creek district and a fifth is now under construction. But one of the five has an inclined shaft and the other four have vertical shafts. In the majority of Colorado mines all ore-sorting and separation from waste is done before the ore leaves the mine, but in the Cripple Creek district, which includes Anaconda, Elkton, Victor, Goldfield, Independence, Altman and Cameron,


DOOR CLOSER
UPPER LEVER FOR LATCH LIFTER
LATCH LIFTER
SECTION A-B.
MAN WAY
SKIP
SECTION C-D.
SECTION E-F.
SKIP.
BELL CRANK
LATCH LIFTER.
FINGERS
FOREBAY 90 CU FT.
WINCH
ELEVATION LOOKING NORTH
℄ OF DOOR CLOSER
℄ OF LATCH LIFTER
80# RAILS 24-0" LONG
½" PLATE
4" SHAFT
40# RAILS
PLOW STEEL ROPE.
ROPE CLAMPS
OVER-BALANCE WEIGHT
WASTE POCKET.
ORE POCKET
1⅛" TAIL ROPE
GATE FINGERS
LINK.
LIFTING ROD.
90 CU. FT TUNNEL CAR.
UPPER 5/16 ROPE TO UPPER LEVER WHICH IS EASILY REACHED FROM CAGE WHEN SKIP IS AB'T. 5'-0" ABOVE DUMPING POINT.
LEVER FOR LATCH LIFTER.
STILWELL TUNNEL
WINCH
LOWER 5/16 ROPE TO LATCH LIFTER
TENSION CARRIAGE
10'-0" TRAVEL
50'-0" PIT
ELEVATION LOOKING EAST.


3'-6"
7'-0"

there is very little sorting done in the mines. Nearly every producing mine has an ore-house in which the mixed ore and waste are first passed over a grizzly, beneath which is a wire screen of three-fourths to one inch mesh. The screenings carry much higher values than the coarse rock and are shipped separately. In some ore-houses the coarse rock is then sorted dry, the ore thrown into bins and the waste trammed to the dump. In a number of cases washing is the next operation after screening and the washed product is sorted, while still wet, into waste and several classes of ore. At Shaft No. 2 of the Portland mine, which has the most extensive mechanical equipment in this district, the rock is hoisted in three-ton balanced vertical skips and dumped into a three-ton side dump ore car with a five-horsepower direct current motor on its frame. This car travels to the ore-house and discharges its load of mixed ore and waste on grizzlies which protect the screens beneath them. After sorting, throwing ore into shipping bins, the waste is thrown to the washer, which is of the type most common in the district and includes an inclined chute or trough, with bottom of perforated plates, about fourteen feet long and three and one-half to four feet wide. From four to six perforated spray pipes above the trough throw a large number of water jets on the rock and the slimes which are washed off pass through the perforated bottom into large settling tanks. The slimes are shoveled out periodically and dried in steam-heated pans and shipped to the Portland chlorination mill at Colorado City. The slimes carry still higher values than the screenings. At the lower end of the washer is a gate through which a workman regularly withdraws the washed waste-rock onto a flat belt conveyor made of old flat hoisting ropes sewed together. This conveyor delivers the waste to a large elevator which deposits it in a bin from which it is drawn through an air-operated gate into the seven-ton side-dumping ore car. This car, drawn by a return cable arrangement, including tension carriage and winding drums, etc., takes the waste a distance of 1,000 feet or more, to the dump. The mine product, it will be observed, is separated into four classes—screenings, ore, slimes and waste. Companies which do not own mills separate the ore into several different classes and wash the entire product before sorting. With the spray washer a pump is used, usually a centrifugal pump, returning the same water from the last settling tank to the spray pipes. The Crane washer, a revolving perforated cylinder, partly immersed in a settling tank, is used at several mines and is followed by picking belt conveyors, on which the sorting is done. With this machine the screening is also done by a revolving perforated cylinder, instead of the grizzly and wire cloth. An interesting plant is now under construction, from the writer's designs, for the Golden Cycle mine, at Goldfield, Colorado. It includes balanced two-ton skips, a bin of five skip-loads capacity into which the skips dump, and an air-operated gate at the bottom of the bin. A side-dump ore-car, operated by a motor on its frame, receives ore from the bin and takes it to the ore-house. Balanced double-decked, specially designed cages will handle all waste rock, men, and timbers, through a near-by shaft, and the main shaft will be used only for hoisting ore. The bin mentioned is a feature of importance, for maximum capacity. Where skips dump directly into an ore-car, experience shows that the skips regularly lose time waiting for the car, and *vice versa.* The bin is an effective equalizer, and when the skips make short trips from upper levels, it nearly fills, and when longer trips are made from lower levels, it nearly empties, but allows both car and skips to be busy without either waiting for the other.

TABLES

Men Employed in Mining, Milling and Smelting During Years 1898-1906

NUMBER ENGAGED IN MINING, MILLING AND SMELTING.

COUNTY	1898	1899	1900	1901	1902	1903	1904	1905	1906
Arapahoe	1,604	2,032	2,092	1,810	1,615	1,382	......	......	......
Archuleta	23	10	6	6	18	7	10	4	6
Boulder	1,687	1,539	1,597	1,610	1,556	1,310	1,087	975	1,042
Chaffee	722	938	944	792	725	470	680	742	615
Clear Creek	1,816	1,981	2,012	1,975	2,010	1,748	1,936	1,860	1,985
Conejos	7	35	15	23	18	20	15	6	4
Costilla	85	62	44	25	35	30	32	10	14
Custer	363	340	419	325	350	566	625	647	521
Delta	......	......	......	5	5	10	12	8	6
Denver	......	......	......	......	......	......	1,175	1,210	1,175
Dolores	414	485	497	415	352	325	378	418	396
Douglas	86	43	5	6	7	5	7	3	7
Eagle	241	316	302	391	305	240	265	340	376
El Paso	5,764	......	85	162	830	792	742	518	785
Fremont	395	410	495	500	725	630	763	610	630
Garfield	12	10	6	8	15	12	20	10	15
Gilpin	2,517	3,017	3,124	2,664	2,322	1,985	1,860	1,990	1,837
Grand	53	24	35	26	75	90	100	36	28
Gunnison	624	560	585	450	630	537	687	590	672
Hinsdale	397	576	538	516	580	332	420	432	395
Huerfano	11	8	37	40	35	10	12	8	12
Jefferson	37	57	45	26	85	52	115	185	76

Lake	3,780	6,736	7,470	6,420	5,772	6,300	6,380	6,425	6,911
La Plata	419	360	307	387	475	525	784	792	642
Larimer	92	110	86	74	45	82	85	77	96
Las Animas	17	12	10	....	....	....	....	....	....
Mineral	867	1,040	992	1,075	920	918	1,010	873	964
Montrose	22	162	115	204	152	110	132	80	75
Mesa	12	55	28	70	65	35	146	168	210
Montezuma	55	125	109	85	143	190	185	170	148
Ouray	1,214	1,878	1,897	1,918	1,609	1,465	1,586	1,626	1,510
Pueblo	1,712	2,054	2,084	1,975	1,485	1,500	1,945	1,744	1,867
Park	374	448	374	360	406	420	635	690	682
Pitkin	1,363	1,635	1,560	1,692	1,355	900	1,252	1,035	1,108
Rio Blanco	14	5	6	8	25	12	10	11	15
Rio Grande	156	186	75	110	145	110	131	120	94
Routt	124	191	115	138	135	200	233	190	217
Saguache	247	315	378	425	310	280	385	375	348
San Juan	1,087	1,347	1,405	1,688	1,595	1,647	1,860	1,740	1,836
San Miguel	1,344	1,612	1,723	1,840	1,625	1,250	1,190	1,233	1,320
Summit	474	568	574	532	623	570	814	860	851
Teller	....	7,925	7,920	6,484	5,940	5,200	5,667	5,480	5,196
TOTAL	30,231	39,210	40,111	37,260	35,118	32,267	35,376	34,287	34,790

EMPLOYES ABOVE AND UNDERGROUND.

	1898	1899	1900	1901	1902	1903	1904	1905	1906
Number of men engaged in mining, milling and smelting.......	30,231	39,210	40,111	37,260	35,118	32,267	35,376	34,278	34,790
Number of men engaged above ground....................	12,092	15,684	16,040	14,904	14,047	12,907	14,150	13,754	13,916
Number of men engaged underground......................	18,139	23,526	24,071	22,356	21,071	19,360	21,226	20,533	20,874

ACCIDENTS.

CAUSE OF ACCIDENT.

ABOVE GROUND	1905		1906	
	Fatal	Non-Fatal	Fatal	Non-Fatal
Machinery accidents	5	15	1	11
Mill accidents	1	12	2	8
Smelter accidents	1	3	....	12
Overwinding cage or bucket	....	2	1	3
Falling from gallows frame or staging	....	....	....	3
Gravity tram	....	10	1	5
Tramming or dumping cars	....	11	1	1
Handling loose rock or ore	2	22	....	11
Falls while carrying tools or material	....	5	....	2
Falling down shaft from surface	....	1	....	1
Getting on or off cage or bucket at surface	....	2	....	....
Falls in chute or bin or caught with running ore	....	1	....	2
Falling into uncovered prospect hole	....	....	1	....
Operating hydraulic machine	2	....	1	....
Came in contact with live wire	....	1	4	1
Miscellaneous	....	18	....	12
TOTAL	11	103	12	72

SHAFT ACCIDENTS	1905		1906	
	Fatal	Non-Fatal	Fatal	Non-Fatal
Getting on or off cage or bucket in motion at station	1	....	....	....
Falls from bucket or cage while being hoisted or lowered	9	7	5	2
Caught in shaft while being hoisted or lowered	2	6	4	2
Falls from ladder	3	3	2	7
Material falling from level or side of shaft	4	8	....	3
Struck by descending cage or bucket	3	6	2	3
Pushing car into open shaft, going down with same	1	....	....	....
Falls of rock or earth in shaft	3	8	1	3
Falling down shaft from level	10	7	5	6
Material falling from overloaded bucket	....	3	....	2
Cable becoming detached, letting cage down shaft	1	....	....	....
Miscellaneous	....	....	3	4
TOTAL	37	48	22	32

ACCIDENTS—Concluded.

UNDERGROUND ACCIDENTS	1905		1906	
	Fatal	Non-Fatal	Fatal	Non-Fatal
Falls of rock	21	124	20	105
Falls of timber while timbering	....	18	1	15
Falls from ladder	2	6	....	5
Falls from overloaded staging	4	10	....	3
Falls in chute, winze, upraise or manway	6	9	2	2
Caught in chute with running ore	1	7	2	5
Injured by tram car	1	41	....	25
Struck by flying rock or steel from hammer or pick	....	12	....	4
Struck with hammer by helper, or by self	....	3	....	2
Injured handling loose rock	1	30	1	16
Falls while carrying tools or material in mine	....	6	....	4
Suffocation, burning shaft house or tunnel bldg	....	....	5	1
Suffocation, bad air or powder smoke	5	2	....	1
Operating machine drill	....	33	....	9
Miscellaneous	1	8	1	6
TOTAL	42	309	32	203

EXPLOSIVES	1905		1906	
	Fatal	Non-Fatal	Fatal	Non-Fatal
Thawing powder over candle, in stove, hot water or sand	....	2	....	3
Picking out missed shot	1	2	2	2
Drilled into hole that missed fire	6	8	2	5
Blast exploded while loading	2	5	4	11
Remaining too long after lighting fuse	7	2	....	1
Returned before blast exploded	1	....	....	....
Struck unexploded powder or caps with pick or shovel while cleaning away muck	....	2	....	1
Hit with flying rock from blast, not being in place of safety	....	3	1	3
Explosion, cause unknown	2	2	7	3
TOTAL	19	26	16	29
GRAND TOTAL	109	486	82	436

SUMMARY OF ACCIDENTS 1905-1906, INCLUSIVE.

	1898	1899	1900	1901	1902	1903	1904	1905	1906
Number of men engaged in mining, milling and smelting.......	30,231	39,210	40,111	37,260	35,118	32,267	35,376	34,287	34,790
Number of accidents investigated..........................	292	584	633	754	643	561	640	595	518
Number of non-fatal accidents............................	184	481	526	633	561	494	539	486	436
Number of fatal accidents................................	108	103	107	121	82	67	101	109	82
Number of non-fatal accidents above ground................	12	150	156	181	106	109	105	103	72
Number of fatal accidents above ground....................	9	15	15	11	13	6	13	11	12
Number of non-fatal accidents under ground.................	172	341	360	452	455	385	434	383	364
Number of fatal accidents under ground....................	99	88	92	110	69	61	88	98	70
Proportion non-fatal accidents per 1,000 men employed........	6.09	12.26	13.11	17.00	15.97	15.31	15.24	14.14	12.53
Proportion of fatal accidents per 1,000 men employed.........	3.57	2.62	2.66	3.24	2.30	2.08	2.86	3.18	2.37
Per cent. non-fatal accidents per 1,000 men above ground......	.99	9.56	9.72	12.14	7.55	8.45	7.42	7.49	5.17
Per cent. fatal accidents per 1,000 men above ground..........	.74	.96	.93	.74	.92	.47	.92	.8	.86
Per cent. non-fatal accidents per 1,000 men underground......	9.48	14.53	14.95	20.22	21.59	19.88	20.45	18.65	17.44
Per cent. of fatal accidents per 1,000 men underground........	5.45	3.74	3.82	4.92	3.27	3.15	4.15	4.77	3.35

DURING THE FISCAL YEARS OF 1905 AND 1906, THE FOLLOWING ORDERS WERE ISSUED BY THE DEPARTMENT.

	1905	1906
Regarding timbers and timbering	62	19
Regarding explosives	44	51
Regarding amount of powder kept in storage	13	47
Use of steel or iron tamping bars	13	14
Removing old timbers from mine	2	8
Regarding employment of hoisting engineer	2	....
Regarding indicator on hoisting machinery	15	23
Posting uniform code of signals	48	43
Regarding fire protection	16	27
Prohibit riding on skip or cage with tools, or upon loaded bucket	4	18
Timber shaft or stope	4	10
Partitioning shaft or dividing into compartment	8	11
Placing ladders in shaft and repair same	27	26
Provide or repair ladders in upraise, winze or manway	49	17
Provide connection to surface with suitable ladders	17	21
Provide chain ladders in shaft or incline while sinking	6	3
Provide shaft collar with cover, bonnet or doors	3	2
Equip cage with safety clutches or repair same	4	1
Make passageway around working shaft	4	4
Provide guard rails at shaft stations	23	13
Cover winzes or mill holes or surround with guard rails	26	27
Leave pillar ground standing on side of shaft	2	....
Cover or fence abandoned mine, shaft or pits	7	3
Notice of number of men permitted to ride upon cage, skip or bucket	15	33
Repair, replace or test cable	4	10
Repair machinery	1	3
Place fire doors at mouth of tunnel	13	22
Sanitary and ventilation	4	4
Provide chairs or overwinding device	4	15
Miscellaneous	6	9

APPOINTMENTS.

M. J. McCarthy was appointed mine inspector for a term of two years, beginning June 1st, 1905.

Wm. B. Cox was appointed mine inspector for a term of two years, beginning June 1st, 1905.

Geo. W. Schneider was appointed mine inspector for a term of two years, beginning June 1st, 1905.

STATEMENT OF DISBURSEMENTS OF THE BUREAU OF MINES APPROPRIATION FOR THE FISCAL YEARS 1905-1906.

Appropriation		$27,400.00
Commissioner of Mines E. L. White, salary	$4,999.96	
Commissioner of Mines E. L. White, expense account	1,999.30	
Inspector M. J. McCarthy, salary	3,000.00	
Inspector M. J. McCarthy, expense account	1,714.55	
Inspector S. B. Edwardes, salary	1,250.00	
Inspector S. B. Edwardes, expense account	769.25	
Inspector W. B. Cox, salary	1,750.00	
Inspector W. B. Cox, expense account	1,119.65	
Inspector G. W. Schneider, salary	3,000.00	
Inspector G. W. Schneider, expense account	1,846.15	
Clerk and Assistant Curator J. C. Langley, salary	3,000.00	
Stenographer A. M. Nickerson, salary	2,400.00	
Balance	551.14	
	$27,400.00	$27,400.00

ANNUAL PRODUCTION

1897-1907

INCLUSIVE

THE BUREAU OF MINES OF THE STATE OF COLORADO.

PRECIOUS METAL PRODUCTION BY COUNTIES FOR THE YEAR 1897.

COLORADO	GOLD		SILVER		LEAD		COPPER		TOTAL
Name of County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	
Arapahoe	102	$ 2,108.34	14	$ 8.35	....	....	....	....	$ 2,116.69
Archuleta	34	702.78	348	207.58	....	....	....	....	910.36
Boulder	24,802	512,657.34	138,715	82,743.50	309,115	$ 10,448.09	58,474	$ 6,139.77	611,988.70
Chaffee	10,979	226,935.93	53,859	32,126.89	1,686,391	57,000.02	172,891	18,153.55	334,216.39
Clear Creek	37,864	782,648.88	1,442,583	860,500.76	5,263,116	177,893.32	516,034	54,183.57	1,875,226.53
Conejos	51	1,054.17	98	58.46	....	....	....	....	1,112.63
Costilla	262	5,415.54	482	287.51	50,048	1,691.62	502	52.71	7,447.38
Custer	103	2,129.01	26,842	16,011.25	2,101,041	71,015.19	874	91.77	89,247.22
Delta	14	289.38	....	....	....	....	....	....	289.38
Dolores	2,103	43,469.01	179,901	107,310.95	1,093,840	36,971.79	39,654	4,163.67	191,915.42
Douglas	23	475.41	10	5.96	....	....	....	....	481.37
Eagle	1,682	34,766.94	46,046	27,466.44	1,144,013	38,667.64	2,200	231.00	101,132.02
El Paso	490,172	10,131,855.24	59,879	35,717.82	5,492	185.63	1,625	170.58	10,167,929.27
Fremont	623	12,877.41	1,525	909.66	....	....	....	....	13,787.07
Garfield	15	310.05	42	25.05	....	....	....	....	335.10
Gilpin	100,942	2,086,471.14	374,417	223,339.74	2,007,698	67,860.19	1,018,595	106,952.48	2,484,623.55
Grand	94	1,942.98	85	50.70	....	....	....	....	1,993.68
Gunnison	1,972	40,761.24	103,941	62,000.81	1,013,114	34,243.25	2,770	290.85	137,296.15

Hinsdale	8,136	168,171.12	243,437	145,210.17	5,550,058	187,591.96	8,085	848.93	501,822.18
Huerfano	35	723.45	167	99.62	1,067	36.06	92	9.66	868.79
Jefferson	399	8,247.33	1,614	962.75	10,093	341.14	1,602	168.21	9,719.43
Lake	99,848	2,063,858.16	5,451,317	3,251,710.59	23,700,908	801,090.69	3,146,802	330,414.21	6,447,073.65
La Plata	1,426	29,475.42	1,409	840.47	857	28.97	420	44.10	30,388.96
Larimer	144	2,976.48	97	57.86	....	....	....	....	3,034.34
Las Animas	31	640.77	9	5.37	....	....	....	....	646.14
Mineral	2,967	61,327.89	3,070,576	1,831,598.58	6,080,673	205,526.75	1,500	157.50	2,098,610.72
Montrose	317	6,552.39	851	507.62	....	....	....	....	7,060.01
Mesa	....	....	....	....	....	....	....	....	....
Montezuma	371	7,668.57	105	62.63	....	....	....	....	7,731.20
Ouray	26,746	552,839.82	2,776,394	1,656,119.02	7,784,212	263,106.37	2,185,084	229,433.82	2,701,499.03
Park	7,432	153,619.44	199,945	119,267.19	4,517,614	152,695.35	58,002	6,090.21	431,672.19
Pitkin	7,955	164,429.85	4,599,946	2,743,867.79	4,456,478	150,628.96	8,360	877.80	3,059,804.40
Rio Grande	1,093	22,592.31	8,168	4,872.21	12,006	405.80	627	65.84	27,936.16
Routt	473	9,776.91	7,805	4,655.68	88,736	2,999.28	958	100.59	17,532.46
Saguache	665	13,745.55	2,482	1,480.51	9,266	313.19	2,975	312.38	15,851.63
San Juan	33,591	694,325.97	1,101,907	657,287.53	8,021,414	271,123.79	1,435,203	150,696.32	1,773,433.61
San Miguel	70,544	1,458,144.48	869,079	518,405.62	4,143,767	140,059.32	354,781	37,252.00	2,153,861.42
Summit	13,239	273,650.13	514,107	306,664.83	1,748,761	59,108.12	133,482	14,015.61	653,438.69
TOTAL	947,249	$19,579,636.83	21,278,202	$12,692,447.47	80,799,778	$ 2,731,032.49	9,151,592	$ 960,917.13	$35,964,033.92

NOTE—In the above table the calculation is on the average market price of the metal for the year See page 46.

THE BUREAU OF MINES OF THE STATE OF COLORADO.

PRECIOUS METAL PRODUCTION BY COUNTIES FOR THE YEAR 1898.

COLORADO	GOLD		SILVER		LEAD		COPPER		TOTAL
Name of County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	
Arapahoe	34	$ 702.78	7	$ 4.08	....	....	....	....	$ 706.86
Archuleta	7	144.69	40	23.30	....	....	....	....	167.99
Boulder	28,123	581,302.41	91,432	53,259.14	8,967	$ 325.50	22,452	$ 2,694.24	637,581.29
Chaffee	11,008	227,535.36	85,273	49,671.52	2,522,554	91,568.71	114,202	13,704.24	382,479.83
Clear Creek	29,295	605,527.65	1,569,012	913,949.49	5,843,767	212,182.74	317,423	38,090.76	1,749,696.64
Conejos	888	18,354.96	29,777	17,345.10	....	....	....	....	35,700.06
Costilla	267	5,518.89	993	578.42	....	....	983	117.96	6,215.27
Custer	35	723.45	24,319	14,165.82	996,877	36,186.64	1,475	177.00	51,252.92
Delta	28	578.76	16	9.32	....	....	....	....	588.08
Dolores	4,271	88,281.57	463,346	269,899.05	686,597	24,923.47	149,647	17,957.64	401,061.73
Douglas	6	124.02	....	....	....	....	....	....	12.02
Eagle	1,479	30,570.93	70,783	41,231.10	1,851,512	67,209.89	71,049	8,525.88	147,537 80
El Paso	653,476	13,507,348.92	67,799	39,492.92	1,030	37.39	168	20.16	13,546,899.39
Fremont	421	8,702.07	1,270	739.78	2,101	76.27	....	....	9,518.12
Gilpin	95,961	1,983,513.87	305,687	178,062.68	1,216,338	44,153.07	633,707	76,044.84	2,281,774.46
Grand	39	806.13	11	6.41	....	....	....	....	812.54
Gunnison	3,919	81,005.73	152,800	89,006.00	1,996,560	72,475.13	119,072	14,288.64	256,775.50
Hinsdale	2,481	51,282.27	186,456	108,610.62	9,828,482	356,773.90	104,038	12,484.56	529,151.35

Huerfano	7	144.69	40	23.30	....	....	....	....	167.99
Jefferson	89	1,839.63	102	59.42	....	....	....	....	1,899.05
Lake	100,292	2,073,035.64	7,068,727	4,117,533.48	35,945,006	1,304,803.72	5,543,954	656,274.48	8,160,647.32
La Plata	1,470	30,384.90	4,348	2,532.71	....	....	2,568	308.16	33,225.77
Larimer	540	11,161.80	60	34.95	....	....	24,484	2,938.08	14,134.83
Las Animas	6	124.02	....	....	....	....	....	....	124.02
Mineral	2,244	46,383.48	4,177,184	2,433,209.68	5,453,104	197,947.68	14,729	1,767.48	2,679,308.32
Montrose	131	2,707.77	6,290	3,663.93	....	....	34,664	4,159.68	10,531.38
Mesa	8	165.36	20	11.65	....	....	....	....	177.01
Montezuma	400	8,268.00	871	507.36	8,407	305.17	....	....	9,080.53
Ouray	41,246	852,554.82	1,420,330	827,342.23	2,799,936	101,637.68	1,035,562	124,267.44	1,905,802.17
Park	7,716	159,489.72	198,711	115,749.16	1,953,001	70,893.94	20,957	2,514.84	348,647.66
Pitkin	3,435	71,001.45	3,977,270	2,316,759.78	15,903,682	577,303.66	4,553	546.36	2,965,611.25
Rio Grande	180	3,720.60	1,568	913.36	2,393	86.87	9,794	1,175.28	5,896.11
Routt	617	12,753.39	2,173	1,265.77	15,477	561.82	600	72.00	14,652.98
Saguache	952	19,677.84	2,618	1,524.99	132,462	4,808.37	21,711	2,605.32	28,616.52
San Juan	54,794	1,132,591.98	1,048,499	610,750.68	14,659,999	532,157.96	2,252,421	270,290.52	2,545,791.14
San Miguel	76,085	1,572,676.95	2,129,082	1,240,190.27	6,699,712	243,199.55	360,831	43,299.72	3,099,366.49
Summit	16,634	343,824.78	415,687	242,137.68	4,889,204	177,478.11	9,825	1,179.00	764,619.57
TOTAL	1,138,584	$23 534 531 28	23,502,601	$13,690,265.15	113,417,168	$ 4,117,043.24	10,870,862	$ 1,304,504.28	$42,646,343.95

NOTE—In the above table the calculation is on the average market price of the metal for the year. See page 46

THE BUREAU OF MINES OF THE STATE OF COLORADO.

PRECIOUS METAL PRODUCTION BY COUNTIES FOR THE YEAR 1899.

COLORADO	GOLD		SILVER		LEAD		COPPER		TOTAL
Name of County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	
Arapahoe	13	$ 268.71	2	$ 1.19	....	....	....	....	$ 269.90
Archuleta	5	103.35	43	25.62	....	....	....	....	128.97
Boulder	26,505	547,858.35	76,371	45,501.84	28,043	$ 1,253.52	78,816	$ 13,879.50	608,493.21
Chaffee	10,482	216,662.94	147,339	87,784.58	1,193,074	53,330.41	696,736	122,695.21	480,473.14
Clear Creek	26,455	546,824.85	1,502,900	895,427.82	7,216,260	322,566.82	292,966	51,591.31	1,816,410.80
Conejos	303	6,263.01	22,987	13,695.65	....	....	....	....	19,958.66
Costilla	39	806.13	126	76.07	....	....	....	....	881.20
Custer	51	1,054.17	6,004	3,577.18	836,894	37,409.16	923	162.54	42,203.05
Delta	10	206.70	10	5.96	....	....	....	....	212.66
Dolores	3,234	66,846.78	257,052	153,151.59	2,046,232	91,466.57	44,509	7,838.03	319,302.97
Douglas	4	82.68	24	14.30	....	....	....	....	96.98
Eagle	2,230	46,094.10	44,393	26,449.35	1,187,930	53,100.47	5,876	1,034.76	126,678.68
Huerfano	6	124.02	5	2.98	....	....	....	....	127.00
Fremont	455	9,404.85	3,974	2,367.70	11,443	511.50	6,698	1,179.52	13,463.57
Gilpin	96,568	1,996,060.56	340,652	202,960.46	1,312,312	58,660.35	1,037,421	182,689.84	2,440,371.21
Grand	6	124.02	13	7.75	....	....	....	....	131.77
Garfield	35	723.45	17	10.13	....	....	....	....	733.58
Gunnison	3,392	70,112.64	132,983	79,231.27	1,399,336	62,550.32	46,186	8,133.35	220,027.58

Hinsdale	1,855	38,342.85	155,902	92,886.41	10,572,353	472,584.18	49,676	8,747.94	612,561.38
Jefferson	66	1,364.22	351	209.13	770	34.42	254	44.73	1,652.50
Lake	106,265	2,196,497.55	7,230,118	4,307,704.30	48,598,720	2,172,362.76	3,202,828	564,018.01	9,240,582.64
La Plata	1,242	25,672.14	3,162	1,883.92	3,176	141.97	211	37.16	27,735.19
Larimer	100	2,067.00	135	80.43	....	....	2,474	435.67	2,583.10
Las Animas	10	206.70	3	1.79	....	....	....	....	208.49
Mineral	4,435	91,671.45	3,796,899	2,262,192.42	5,677,162	253,769.14	20,223	3,561.27	2,611,194.28
Montrose	35	723.45	46,119	27,477.70	....	....	75,006	13,208.56	41,409.71
Mesa	6	124.02	4,120	2,454.70	....	....	4,650	818.87	3,397.59
Montezuma	746	15,419.82	227	135.25	....	....	....	....	15,555.07
Ouray	82,000	1,694,940.00	2,346,194	1,397,862.39	7,556,386	337,770.45	305,177	53,741.67	3,484,314.51
Park	7,404	153,040.68	72,137	42,979.22	540,849	24,175.95	7,903	1,391.72	221,587.57
Pitkin	2,527	52,233.09	4,158,708	2,477,758.23	25,458,380	1,137,989.59	19,351	3,407.71	3,671,388.62
Rio Grande	929	19,202.43	2,718	1,619.38	1,635	73.08	336	59.17	20,954.06
Routt	559	11,554.53	1,271	757.26	3,405	152.20	....	....	12,463.99
Saguache	188	3,885.96	14,306	8,523.51	441,095	19,716.95	35,319	6,219.68	38,346.10
San Juan	48,199	996,273.33	1,191,857	710,108.40	16,011,677	715,721.96	1,197,661	210,908.10	2,633,011.79
San Miguel	66,604	1,376,704.68	1,208,395	719,961.74	3,918,883	175,174.07	160,239	28,218.09	2,300,058.58
Summit	12,606	260,566.02	264,872	157,810.74	4,032,431	180,249.67	65,531	11,540.01	610,166.44
Teller	776,902	16,058,564.34	82,299	49,033.74	....	....	275	48.43	16,107,646.51
TOTAL	1,282,471	$26,508,675.57	23,114,688	$13,771,731.10	138,048,446	$ 6,170,765.53	7,357,245	$ 1,295,610.85	$47,746,783.05

NOTE—In the above table the calculation is on the average market price of the metal for the year. See page 46

THE BUREAU OF MINES OF THE STATE OF COLORADO.

PRECIOUS METAL PRODUCTION BY COUNTIES FOR THE YEAR 1900.

COLORADO	GOLD		SILVER		LEAD		COPPER		TOTAL
Name of County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	
Arapahoe	12	$ 248.04	....	....	....	....	....	....	$ 248.04
Archuleta	7	144.69	30	$ 18.43	....	....	....	....	163.12
Baca	5	103.35	102	62.64	....	....	8,900	$ 1,470.28	1,636.27
Boulder	29,367	607,015.89	90,327	55,469.80	76,076	$ 3,598.39	20,371	3,365.29	669,449.37
Chaffee	8,354	172,677.18	125,330	76,965.15	833,462	39,422.75	753,677	124,507.44	413,572.52
Clear Creek	22,518	465,447.06	1,358,143	834,035.62	4,994,263	236,228.64	244,092	40,324.00	1,576,035.32
Conejos	137	2,831.79	1,014	622.70	2,200	104.06	4,527	747.86	4,306.41
Costilla	100	2,067.00	314	192.83	....	....	107	17.68	2,277.51
Custer	1,008	20,835.36	82,605	50,727.73	709,349	33,552.22	2,301	380.13	105,495.44
Delta	47	971.49	97	59.57	....	....	....	....	1,031.06
Dolores	2,425	50,124.75	159,318	97,837.18	210,380	9,950.97	36,009	5,948.69	163,861.59
Douglas	3	62.01	24	14.74	....	....	....	....	76.75
Eagle	5,012	103,598.04	234,674	144,113.30	3,679,828	174,055.86	359,054	59,315.72	481,082.92
El Paso	95	1,963.65	....	....	....	....	....	....	1,963.65
Fremont	402	8,309.34	2,199	1,350.40	8,282	391.74	6,725	1,110.97	11.162.45
Gilpin	80,092	1,655,501.64	236,400	145,173.24	735,773	34,802.06	799,478	132,073.77	1,967,550.71
Grand	182	3,761.94	21	12.90	....	....	....	....	3,774.84
Garfield	25	516.75	13	7.98	....	....	....	....	524.73

Gunnison	4,057	83,858.19	146,746	90,116.72	1,583,320	74,891.04	42,790	7,068.90	255,934.85
Hinsdale	2,732	56,470.44	155,485	95,483.34	9,377,062	443,535.03	29,180	4,820.54	600,309.35
Huerfano	6	124.02	20	12.28	....	....	....	....	136.30
Jefferson	34	702.78	51	31.32	....	....	....	....	734.10
Lake	122,376	2,529,511.92	6,967,279	4,278,606.03	62,599,654	2,960,963.63	2,728,553	450,756.96	10,219,838.54
La Plata	726	15,006.42	7,084	4,350.28	14,500	685.85	350	57.82	20,100.37
Larimer	79	1,632.93	126	77.38	....	....	13,806	2,280.75	3,991.06
Las Animas	....	....	....	....	....	....	....	....	....
Mineral	10,130	209,387.10	2,280,038	1,400,171.34	14,951,956	707,227.52	2,614	431.83	2,317,217.79
Montrose	79	1,632.93	19,652	12,068.29	....	....	32,026	5,290.70	18,991.92
Mesa	6	124.02	311	313.80	....	....	2,150	355.18	793.00
Montezuma	480	9,921.60	103	63.25	....	....	....	....	9,984.85
Ouray	69,565	1,437,908.55	1,985,267	1,219,152.46	9,478,657	448,340.48	352,368	58,211.19	3,163,612.68
Park	5,639	116,558.13	43,138	26,491.05	682,107	32,263.66	15,000	2,478.00	177,790.84
Pitkin	651	13,456.17	4,119,116	2,529,549.14	27,452,260	1,298,491.90	6,082	1,004.75	3,842,501.96
Pueblo	12	248.04	9	5.53	....	....	....	....	253.57
Rio Grande	5,207	107,628.69	3,075	1,888.36	26,260	1,242.10	8,599	1,420.55	112,179.70
Routt	159	3,286.53	477	292.93	....	....	5,765	952.38	4,531.84
Saguache	386	7,978.62	15,793	9,698.48	316,061	14,949.69	16,129	2,664.50	35,291.29
San Juan	36,633	757,204.11	681,317	418,396.77	17,579,177	831,495.07	1,972,087	325,788.77	2,332,884.72
San Miguel	88,406	1,827,352.02	1,136,692	698,042.56	3,353,425	158,617.00	311,045	51,384.63	2,735,396.21
Summit	16,361	338,181.87	403,330	247,684.95	5,610,710	265,386.58	53,030	8,760.56	840,013.96
Teller	877,972	18,147,681.24	80,792	49,614.37	....	....	134	22.14	18,197,317.75
TOTAL	1,391,287	$28,762,036.29	20,336,712	$12,488,774.84	164,274,762	$ 7,770,196.24	7,826,949	$ 1,293,011.98	$50,314,019.35

NOTE—In the above table the calculation is on the average market price of the metal for the year. See page 46.

THE BUREAU OF MINES OF THE STATE OF COLORADO.

PRECIOUS METAL PRODUCTION BY COUNTIES FOR THE YEAR 1901.

COLORADO	GOLD		SILVER		LEAD		COPPER		TOTAL
Name of County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	
Arapahoe................	16	$ 330.72	....	....	....	....	....	....	$ 330.72
Archuleta................	6	124.02	18	$ 10.61	....	....	....	....	134.63
Baca....................	4	82.68	80	47.16	....	....	590	$ 97.67	227.51
Boulder..................	37,460	774,298.20	113,782	67,074.49	191,987	$ 8,320.72	22,186	3,672.89	853,366.30
Chaffee..................	7,677	158,683.59	76,286	44,970.60	209,768	9,091.35	576,251	95,398.35	308,143.89
Clear Creek..............	26,172	540,975.24	1,271,227	749,388.32	3,890,216	168,601.96	374,534	62,004.10	1,520,969.62
Conejos..................	57	1,178.19	102	60.13	1,200	52.01	210	34.77	1,325.10
Costilla.................	47	971.49	153	90.19	....	....	235	38.90	1,100.58
Custer...................	538	11,120.46	50,394	29,707.26	400,481	17,356.85	40,528	6,709.41	64,893.98
Delta....................	25	516.75	10	5.90	....	....	....	....	522.65
Dolores..................	1,079	22,302.93	111,632	65,807.06	367,057	15,908.25	13,106	2,169.70	106,187.94
Douglas..................	5	103.35	10	5.89	....	....	....	....	109.24
Eagle....................	4,711	97,376.37	175,181	103,269.20	2,775,291	120,281.11	157,914	26,142.66	347,069.34
El Paso..................	78	1,612.26	15	8.84	....	....	....	....	1,621.10
Fremont..................	312	6,449.04	933	550.00	33,945	1,471.18	15,907	2,633.40	11,103.62
Gilpin...................	79,292	1,638,965.64	271,638	160,130.60	670,018	29,038.58	731,194	121,049.17	1,949,183.99
Garfield.................	17	351.39	13	7.66	....	....	....	....	359.05
Grand....................	50	1,033.50	30	17.68	....	....	....	....	1,051.18

Gunnison	4,037	83,444.79	93,243	54,966.75	656,631	28,458.39	53,396	8,839.71	175,709.64
Hinsdale	3,684	76,148.28	152,122	89,675.92	7,588,675	328,893.17	12,532	2,074.67	496,792.04
Huerfano	4	82.68	10	5.90	....	....	....	....	88.58
Jefferson	15	310.05	20	11.80	....	....	....	....	321.85
Lake	85,928	1,776,131.76	6,830,084	4,026,334.51	56,359,708	2,442,629.94	1,930,556	319,603.55	8,564,699.56
La Plata	1,316	27,201.72	5,528	3,258.76	6,197	268.58	132	21.85	30,750.91
Larimer	45	930.15	73	43.03	....	....	18,140	3,003.08	3,976.26
Mineral	4,974	102,812.58	1,816,023	1,070,545.56	10,519,895	455,932.25	1,007	166.71	1,629,457.10
Montrose	75	1,550.25	101,359	59,751.13	....	....	55,944	9,261.52	70,562.90
Mesa	99	2,046.33	155	91.37	....	....	7,795	1,290.46	3,428.16
Montezuma	175	3,617.25	60	35.37	....	....	....	....	3,652.62
Ouray	74,810	1,546,322.70	1,633,725	963,080.89	7,904,724	342,590.74	652,937	108,093.72	2,960,088.05
Park	4,660	96,322.20	69,175	40,778.66	421,955	18,287.53	9,657	1,598.72	156,987.11
Pitkin	227	4,692.09	3,532,863	2,082,622.74	32,749,511	1,419,363.81	50,786	8,407.62	3,515,086.26
Pueblo	8	165.36	52	30.65	....	....	210	34.77	230.78
Rio Grande	1,593	32,927.31	6,926	4,082.88	677	29.34	65,603	10,860.58	47,900.11
Routt	215	4,444.05	239	140.89	2,193	95.04	500	82.77	4,762.75
Saguache	3,869	79,972.23	20,507	12,088.88	235,750	10,217.40	15,253	2,525.13	104,803.64
San Juan	46,588	962,973.96	784,218	462,296.51	15,473,187	670,607.92	2,740,042	453,613.95	2,549,492.34
San Miguel	99,152	2,049,471.84	916,245	540,126.43	3,309,517	143,434.47	308,322	51,042.72	2,784,075.46
Summit	16,387	338,719.29	368,887	217,458.89	4,342,437	188,201.22	17,062	2,824.62	747,204.02
Teller	833,705	17,232,682.35	89,545	52,786.78	....	....	....	....	17,285,469.13
TOTAL	1,339,112	$27,679,445.04	18,492,563	$10,901,365.89	148,111,020	$ 6,419,131.61	7,872,529	$ 1,303,297.17	$46,303,239.71

NOTE—In the above table the calculation is on the average market price of the metals for the year. Gold, 20.67 Silver .5895. Lead, .04334. Copper, .16555

THE BUREAU OF MINES OF THE STATE OF COLORADO.

PRECIOUS METAL PRODUCTION BY COUNTIES FOR THE YEAR 1902.

COLORADO	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Arapahoe	11	$ 227.37	....	....	....	....	....	....	....	....	$ 227.37
Archuleta	4	82.68	10	$ 5.22	....	....	....	....	....	....	87.90
Baca	5	103.35	59	30.77	....	....	1,929	$ 229.30	....	....	363.42
Boulder	26,062	538,701.54	82,710	43,141.54	13,493	$ 549.03	11,090	1,318.27	....	....	583,710.38
Chaffee	20,199	417,513.33	114,155	59,543.25	456,889	18,590.81	173,538	20,628.46	220,500	$ 10,672.20	526,948.05
Clear Creek	45,016	930,480.72	1,279,050	667,152.48	3,282,270	133,555.57	473,754	56,315.14	317,705	15,376.92	1,802,880.83
Conejos	61	1,260.87	81	42.25	....	....	78	9.27	....	....	1,312.39
Costilla	57	1,178.19	205	106.93	....	....	....	....	....	....	1,285.12
Custer	1,147	23,708.49	28,189	14,703.38	94,662	3,851.80	32,945	3,916.17	40,500	1,960.20	48,140.04
Delta	20	413.40	12	6.26	....	....	....	....	....	....	419.66
Dolores	2,296	47,458.32	121,311	63,275.82	388,806	15,820.52	15,054	1,789.47	248,680	12,036.11	140,380.24
Douglas	3	62.01	10	5.22	....	....	....	....	....	....	67.23
Eagle	1,546	31,955.82	45,336	23,647.26	832,846	33,888.50	150,134	17,846.43	....	....	107,338.01
El Paso	35	523.45	....	....	....	....	....	....	....	....	723.45
Fremont	357	7,379.19	515	268.62	2,836	115.40	22,300	2,650.80	22,825	1,104.73	11,518.74
Gilpin	75,038	1,551,035.46	303,638	158,377.58	497,366	20,237.82	765,516	90,996.89	....	....	1,820,647.75
Garfield	8	165.36	5	2.61	....	....	....	....	....	....	167.97
Grand	63	1,302.21	24	12.52	....	....	....	....	....	....	1,314.73

Gunnison........	5,009	103,536.03	123,138	64,228.78	728,935	29,660.37	28,686	3,409.90	131,975	6,387.59	207,222.67
Hinsdale.........	4,758	98,347.86	117,177	61,119.52	6,213,763	252,838.02	8,314	988.29	319,000	15,439.60	428,733.29
Huerfano........	41	847.47	260	135.62	....	....	....	....	....	....	983.09
Jefferson.........	25	516.75	3	1.56	....	....	2,978	353.99	....	....	872.30
Lake...........	58,245	1,203,924.15	5,641,857	2,942,792.61	39,450,178	1,605,227.74	2,611,167	310,389.42	47,637,490	2,305,654.52	8,367,988.44
La Plata.........	6,030	124,640.10	7,387	3,853.06	2,156	87.73	3,143	373.61	....	....	128,954.50
Larimer.........	39	806.13	49	25.56	....	....	24,888	2,958.44	....	....	3,790.13
Mineral..........	5,459	112,837.53	1,923,973	1,003,544.32	9,291,358	378,065.36	....	....	2,047,555	99,101.66	1,593,548.87
Montrose........	288	5,952.96	3,149	1,642.52	64	2.60	2,505	297.77	....	....	7,895.85
Mesa...........	26	537.42	32	16.69	....	....	15,000	1,783.05	....	....	2,337.16
Montezuma......	123	2,542.41	29	15.13	....	....	....	....	....	....	2,557.54
Ouray...........	117,113	2,420,725.71	789,855	411,988.37	4,262,063	173,423.34	526,541	62,589.95	....	....	3,068,727.35
Park...........	6,892	142,457.64	49,968	26,063.31	261,046	10,621.96	8,113	964.39	....	....	180,107.30
Pitkin..........	237	4,898.79	3,063,450	1,597,895.52	24,973,816	1,016,184.57	10,654	1,266.44	....	....	2,620,245.32
Rio Grande......	690	14,262.30	3,171	1,653.99	166	6.75	1,260	149.78	....	....	16,072.82
Routt..........	733	15,151.11	136	70.93	....	....	....	....	....	....	15,222.04
Saguache........	243	5,022.81	10,486	5,469.50	454,995	18,513.75	13,669	1,624.83	267,100	12,927.64	43,558.53
San Juan........	73,741	1,524,226.47	838,102	437,154.00	7,699,883	313,308.24	3,012,283	358,070.08	....	....	2,632,758.79
San Miguel.......	97,129	2,007,656.43	1,056,640	551,143.42	4,296,849	174,838.79	454,790	54,060.89	....	....	2,787,699.53
Summit..........	11,736	242,583.12	274,571	143,310.12	3,092,387	125,829.22	93,609	11,127.30	1,329,180	64,332.31	587,182.07
Teller...........	819,153	16,931,892.51	62,780	32,746.05	6,547	266.40	....	....	....	....	16,964,904.96
TOTAL.......	1,379,638	$28,517,117.46	15,941,703	$8,315,192.29	106,303,374	$4,325,484.29	8,463,938	$1,006,108.31	52,582,510	$2,544,993.48	$44,708,895.83

NOTE—In the above table the calculation is on the average market price of the metals for the year. See page 46.

THE BUREAU OF MINES OF THE STATE OF COLORADO.

PRECIOUS METAL PRODUCTION BY COUNTIES FOR THE YEAR 1903.

COLORADO	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Arapahoe........	8	$ 165.36	....	....	....	....	....	....	....	....	$ 165.36
Archuleta........	3	62.01	6	$ 3.21	....	....	....	....	....	....	65.22
Boulder..........	20,879	431,568.93	61,833	33,049.74	115,100	$ 4,876.79	6,154	$ 814.48	....	....	470,309.94
Chaffee..........	8,192	169,328.64	129,900	69,431.55	249,308	10,563.18	79,581	10,532.55	3,000	$ 162.00	260,017.92
Clear Creek......	22,838	472,061.46	851,638	455,224.56	3,451,849	146,254.84	289,876	38,365.09	656,000	35,424.00	1,147,329.95
Conejos..........	59	1,219.53	46	24.59	....	....	....	....	....	....	1,244.12
Costilla..........	48	992.16	179	95.68	....	....	....	....	....	....	1,087.84
Custer...........	4,006	82,804.02	160,175	85,613.54	387,301	16,409.92	52,242	6,914.23	....	....	191,741.71
Delta............	12	248.04	8	4.28	....	....	....	....	....	....	252.32
Dolores..........	2,093	43,262.31	103,096	55,104.81	143,417	6,076.58	147,588	19,533.27	....	....	123,976.97
Douglas.........	2	41.34	2	1.07	....	....	....	....	....	....	42.41
Eagle............	776	16,039.92	27,054	14,460.36	677,730	28,715.42	32,863	4,349.42	....	....	63,565.12
Fremont.........	307	6,345.69	223	119.19	2,091	88.60	20,777	2,749.84	....	....	9,303.32
Garfield..........	5	103.35	3	1.60	....	....	....	....	....	....	104.95
Gilpin...........	65,124	1,346,113.08	375,238	200,564.71	945,975	40,080.96	611,988	80,996.61	....	....	1,667,755.36
Grand...........	69	1,426.23	12	6.41	....	....	....	....	....	....	1,432.64
Gunnison........	2,348	48,533.16	65,447	34,981.42	127,661	5,409.00	15,000	1,985.25	55,600	3,002.40	93,911.23
Hinsdale.........	799	16,515.33	33,139	17,712.80	459,462	19,467.40	11,263	1,490.66	106,000	5,724.00	60,910.19

Jefferson.........	12	248.04	5	2.67	....	....	218	28.85	....	....	279.56
Lake............	64,827	1,339,974.09	4,973,033	2,658,086.14	36,353,239	1,540,286.74	2,556,583	338,363.76	76,566,000	4,134,564.00	10,011,274.73
La Plata.........	6,807	140,700.69	7,627	4,076.63	3,017	127.83	810	107.20	....	....	145,012.35
Larimer.........	79	1,632.93	10	5.35	....	....	56,700	7,504.24	....	....	9,142.52
Mineral..........	8,658	178,960.86	1.608,788	859,879.19	8,600,646	364,409.37	133	17.60	2,634,000	142,236.00	1,545,521.02
Montrose........	136	2,811.12	2,061	1,101.60	....	....	10,920	1,445.26	....	....	5,357.98
Mesa............	17	351.39	8	4.28	....	....	....	....	....	....	355.67
Montezuma......	224	4,630.08	89	47.57	....	....	....	....	....	....	4,677.65
Ouray...........	105,056	2,171,507.52	417,343	223,069.83	3,350,569	141,963.61	380,409	50,347.13	....	....	2,586,888.09
Park............	6,593	136,277.31	52,128	27,862.42	802,489	34,001.48	5,895	780.20	....	....	198,921.39
Pitkin...........	230	4,754.10	2,569,862	1,373,591.24	33,269,852	1,409,643.63	11,683	1,546.25	....	....	2,789,535.22
Rio Grande......	626	12,939.42	3,410	1,822.63	....	....	5,098	674.72	....	....	15,436.77
Routt...........	1,008	20,835.36	117	62.54	....	....	....	....	....	....	20,897.90
Saguache........	143	2,955.81	22,424	11,985.63	376,711	15,961.25	67,410	8,921.71	44,600	2,408.40	42,232.80
San Juan........	82,758	1,710,607.86	781,358	417,635.85	6,969,093	295,280.47	2,939,018	388,979.03	....	....	2,812,503.21
San Miguel.......	56,933	1,176,805.11	737,028	393,941.47	3,704,201	156,947.00	466,264	61,710.04	....	....	1,789,403.62
Summit..........	10,753	222,264.51	220,543	117,880.23	1,523,703	64,559.30	41,447	5,485.51	550,800	29,743.20	439,932.75
Teller...........	572,824	11,840,272.08	41,605	22,237.87	....	....	....	....	....	....	11,862,509.95
TOTAL.......	1,045,252	$21,605,358.84	13,245,483	$7,079,710.66	101,513,414	$ 4,301,123.35	7,807,920	$1,033,642.90	80,616,000	$4,353,264.00	$38,373,099.75

NOTE—In the above table the calculation is on the average market price of the metals for the year. See page 46

THE BUREAU OF MINES OF THE STATE OF COLORADO.

PRECIOUS METAL PRODUCTION BY COUNTIES FOR THE YEAR 1904.

COLORADO	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Arapahoe........	12	$ 248.04	....	....	....	....	....	....	....	....	$ 248.04
Archuleta........	6	124.02	10	$ 5.72	....	....	....	....	....	....	1829.74
Boulder..........	19,912	411,581.04	57,424	32,858.01	62,111	$ 2,670.77	26,115	$ 3,348.73	....	....	450,458.55
Chaffee..........	3,113	64,345.71	69,045	39,507.55	652,238	28,046.23	263,239	33,755.14	294,440	$ 15,016.44	180,671.07
Clear Creek......	30,799	636,615.33	873,949	500,073.62	3,961,976	170,364.97	401,180	51,443.31	906,705	46,241.95	1,404,739.18
Conejos..........	40	826.80	52	29.75	....	....	....	....	....	....	856.55
Costilla..........	42	668.14	151	86.40	....	....	....	....	....	....	954.54
Custer...........	2,586	53,452.62	87,373	49,994.83	126,593	5,443.50	15,068	1,932.17	....	....	110,823.12
Delta............	17	351.39	9	5.15	....	....	....	....	....	....	356.54
Dolores..........	2,602	53,783.34	108,301	61,969.83	181,229	7,792.85	25,392	3,256.02	18,196	928.00	127,730.04
Douglas..........	14	289.38	5	2.86	....	....	....	....	....	....	292.24
Eagle............	1,455	30,074.85	27,348	15,648.53	375,207	16,133.90	32,409	4,155.81	....	....	66,013.08
El Paso........ ..	15	310.05	....	....	....	....	....	....	....	....	310.05
Fremont..........	226	4,671.42	208	119.02	1,071	46.05	1,024	131.31	....	....	4,967.80
Gilpin...........	67,918	1,403,865.06	318,406	182,191.91	859,293	36,949.60	638,945	81,931.92	....	....	1,704,938.49
Garfield..........	25	516.75	14	8.01	....	....	....	....	....	....	524.76
Grand...........	31	640.77	13	13.16	....	....	1,114	142.85	....	....	796.78
Gunnison........	1,259	26,023.53	115,153	65,890.55	200,462	8,619.87	16,233	2,081.56	20,010	1,020.50	103,636.02

Hinsdale.........	509	10,521.03	46,585	26,655.94	1,041,222	44,772.55	13,187	1,690.97	59,089	3,013.54	86,654.03
Jefferson.........	17	351.39	12	6.87	....	....	538	68.99	....	....	427.25
Lake............	57,419	1,186,850.73	5,085,151	2,909,723.40	47,180,865	2,028,777.20	3,734,593	478,886.86	58,254,353	2,970,972.00	9,575,210.19
La Plata.........	6,164	127,409.88	31,033	17,757.08	2,177	93.61	1,473	188.88	....	....	145,449.45
Larimer.........	57	1,178.19	11	6.29	....	....	23,028	2,952.88	....	....	4,137.36
Mineral..........	10,782	222,863.94	1,664,633	952,503.00	13,346,436	573,896.75	1,337	171.44	4,402,697	224,537.55	1,973,972.68
Montrose........	72	1,488.24	1,067	610.54	....	....	7,476	958.65	....	....	3,057.43
Mesa............	12	248.04	9	5.15	....	....	....	....	....	....	253.19
Montezuma......	135	2,790.45	53	30.33	....	....	....	....	....	....	2,820.78
Ouray...........	104,367	2,157,265.89	294,028	168,242.82	2,044,525	87,914.58	420,191	53,881.09	4,332	220.93	2,467,525.31
Park............	9,433	194,980.11	50,013	28,617.44	757,703	32,581.23	5,920	759.12	....	....	256,937.90
Pitkin...........	113	2,335.71	2,129,618	1,218,567.42	18,882,901	811,964.74	9,862	1,264.60	593,661	30,276.71	2,064,409.18
Rio Grande......	194	4,009.98	2,281	1,305.19	....	....	650	83.35	....	....	5,398.52
Routt...........	1,172	24,225.24	181	103.57	....	....	....	....	....	....	24,328.81
Saguache........	267	5,518.89	60,506	34,621.53	699,312	30,070.42	48,722	6,247.62	15,585	794.83	77,253.29
San Juan........	67,569	1,396,651.23	1,042,044	596,257.58	9,288,643	399,411.65	3,467,124	444,589.31	317,254	16,179.95	2,853,089.72
San Miguel.......	74,072	1,531,068.24	667,710	382,063.66	5,704,708	245,302.44	239,520	30,713.65	....	....	2,189,147.99
Summit..........	10,069	208,126.23	180,554	103,313.00	2,178,182	93,661.82	7,510	963.00	89,913	4,585.56	410,649.61
Teller...........	699,397	14,456,535.99	47,817	27,360.89	....	....	63	8.08	....	....	14,483,904.96
TOTAL.......	1,171,892	$24,223,007.64	12,960,777	$7,416,156.60	107,546,854	$4,624,514.73	9,401,913	$1,205,607.31	64,976,235	$3,313,787.97	$40,783,074.25

NOTE—In the above table the calculation is on the average market price of the metals for the year. See page 46. The zinc is figured on actual spelter recovered.

THE BUREAU OF MINES OF THE STATE OF COLORADO.

SHOWING BY COUNTIES THE MINERAL PRODUCTIONS OF COLORADO FOR THE YEAR ENDING DECEMBER 31, 1905.

COLORADO	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Arapahoe........	22	$ 454.74	....	....	....	....	....	....	....	....	$ 454.74
Archuleta........	4	82.68	15	$ 9.05	....	....	....	....	....	....	91.73
Boulder..........	17,191	355,337.97	98,252	59,295.08	18,236	$ 857.09	14,106	$ 2,199.13	....	....	417,689.27
Chaffee...	1,915	39,583.05	96,822	58,432.08	994,133	46,724.25	869,507	135,556.14	849,963	$ 49,977.82	330,273.34
Clear Creek......	27,692	572,393.64	739,985	446,580.95	3,262,540	153,339.38	355,740	55,459.87	1,102,301	64,815.30	1,292,589.14
Conejos..........	21	434.07	25	15.09	....	....	....	....	....	....	449.16
Costilla..........	34	702.78	15	9.05	....	....	44	6.86	....	....	718.69
Custer...........	424	8,764.08	2,619	1,580.57	3,391	159.38	862	134.39	....	....	10,638.42
Delta............	12	284.04	15	9.05	....	....	....	....	....	....	257.09
Dolores..........	2,275	47,024.25	88,374	53,333.71	564,256	26,520.03	71,122	11,087.92	556,266	32,708.44	170,674.35
Douglas.........	24	496.08	6	3.62	....	....	....	....	....	....	499.70
Eagle............	2,155	44,543.85	67,695	40,853.93	349,850	16,422.95	65,179	10,161.40	605,612	35,609.99	147,612.12
El Paso.........	....	....	....	....	....	....	....	....	....	....	....
Fremont.........	1,947	40,244.49	53,868	32,509.34	30,373	1,427.53	635	99.00	97,639	5,741.17	80,021.53
Gilpin...........	72,466	1,497,872.22	337,536	203,702.98	819,592	38,520.82	638,597	99,557.27	33,090	1,945.69	1,841,598.98
Garfield.........	21	434.07	1	.60	....	....	....	....	....	....	434.67
Grand...........	101	2,087.67	26	15.69	....	....	....	....	....	....	2,103.36
Gunnison........	1,313	27,139.71	88,307	53,293.27	184,481	8,670.61	36,997	5,767.83	17,905	1,052.81	95,924.23

Hinsdale.........	740	15,295.80	61,262	36,971.62	891,888	41,918.74	24,532	3,824.54	235,178	13,828.47	111,839.17
Huerfano........	13	268.71	617	372.36	....	....	....	....	....	....	641.07
Jefferson.........	770	15,915.90	95	57.33	....	....	....	....	....	....	15,973.23
Lake............	56,839	1,174,862.13	4,494,967	2,712,712.58	52,848,413	2,483,875.41	4,486,117	699,385.64	70,238,634	4,130,031.68	11,200,867.44
La Plata.........	12,096	250,024.32	88,085	53,159.30	610	28.67	425	66.26	....	....	303,278.55
Larimer.........	50	1,033.50	35	21.12	....	....	4,336	675.98	....	....	1,730.60
Las Animas......	....	....	....	....	....	....	....	....	....	....	....
Mineral..........	10,493	216,993.66	1,193,442	720,242.25	11,880,797	558,397.46	107	16.68	2,515,628	147,918.93	1,643,568.98
Montrose........	54	1,116.18	395	238.38	....	....	2,440	380.40	....	....	1,734.96
Mesa............	25	516.75	11	6.64	....	....	....	....	....	....	523.39
Montezuma......	100	2,067.00	....	....	....	....	....	....	....	....	2,067.00
Ouray...........	115,742	2,392,387.14	758,107	457,517.57	5,348,264	251,368.41	524,199	81,722.62	102,812	6,045.35	3,189,041.09
Park............	15,889	328,425.63	42,647	25,737.46	560,417	26,339.60	38,374	5,982.50	....	....	386,485.19
Pitkin...........	205	4,237.35	2,384,542	1,439,071.10	21,975,972	1,032,870.68	127,094	19,813.95	3,854,339	226,635.13	2,722,628.21
Rio Grande......	196	4,051.32	1,055	636.69	....	....	123	19.18	....	....	4,707.19
Routt...........	486	10,045.62	133	80.27	....	....	....	....	....	....	10,125.89
Saguache........	189	3,906.63	66,337	40,034.38	131,132	6,163.20	2,988	465.83	2,917	171.52	50.741.56
Jan Suan........	40,035	727,523.45	739,363	446,205.57	6,445,583	302,942.40	2,274,106	354,533.13	163,845	9,634.09	1,940,838.64
San Miguel.......	91,013	1,881,238.71	1,174,900	709,052.15	7,100,640	333,730.08	272,513	42,484.78	17,214	1,012.18	2,967,517.90
Summit..........	8,149	168,439.83	194,843	117,587.75	2,275,344	106,941.17	44,033	6,864.74	805,601	47,369.34	447,202.83
Teller...........	756,737	15,641,753.79	56,951	34,369.93	26,996	1,268.81	....	....	....	....	15,677,392.53
TOTAL.......	1,237,443	$25,577,946.81	12,831,348	$7,743,718.51	115,712,908	$5,438,506.67	9,854,176	$1 536,266.04	81,198,944	$4,774,497.91	$45,070,935.94

NOTE—In the above table the calculation is on the average market price of the metals for the year. See page 46. The zinc is figured on actual spelter recovered.-

THE BUREAU OF MINES OF THE STATE OF COLORADO.

SHOWING BY COUNTIES THE MINERAL PRODUCTIONS OF COLORADO FOR THE YEAR ENDING DECEMBER 31, 1906.

COLORADO	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Arapahoe........	12	$248.04	....	....	....	....	....	....	....	....	$248.04
Archuleta........	5	103.35	10	$6.68	....	....	....	....	....	....	110.03
Boulder	12,290	254,034.30	51,028	34,082.11	59,738	$3,194.19	22,656	$4,367.62	....	....	295,678.22
Chaffee..........	2,753	56,904.51	66,473	44,397.98	791,075	42,298.78	743,310	143,295.30	623,955	$38,672.73	325,569.30
Clear Creek......	22,183	458,522.61	610,699	407,891.97	2,877,077	153,837.31	272,411	52,515.39	1,733,477	107,440.90	1,180,208.18
Conejos..........	17	351.39	20	13.36	....	....	....	....	....	....	364.75
Costilla..........	38	785.46	34	22.71	....	....	83	16.00	....	....	824.17
Custer...........	795	16,432.65	76,266	50,938.82	120,389	6,437.20	10,975	2,115.76	971	60.18	75,984.61
Delta............	15	310.05	13	8.68	....	....	....	....	....	....	318.73
Dolores..........	1,001	20,690.67	46,709	31,197.41	643,336	34,399.18	204,041	39,335.02	883,533	54,761.38	180,383.66
Douglas.........	21	434.07	4	2.67	....	....	....	....	....	....	436.74
Eagle............	2,167	44.791.89	83,059	55,475.94	407,203	21,773.14	45,610	8,792.70	1,426,029	88,385.28	219,218.95
El Paso.........	....	....	....	....	....	....	....	....	....	....	....
Fremont.........	254	5,250.18	153	102.19	200	10.69	365	70.36	....	....	5,433.42
Garfield..........	13	268.71	3	2.00	....	....	....	....	....	....	270.71
Gilpin...........	57,353	1,185,486.51	241,491	161,294.25	474,254	25,358.36	681,151	131,312.29	46,000	2,851.08	1,506,302.49
Grand...........	30	620.10	210	140.26	....	....	....	....	....	....	760.36
Gunnison........	4,001	82,700.67	91,625	61,197.25	245,421	13,122.66	14,357	2,767.74	158,198	9,805.11	169,593.43

Hinsdale	1,051	21,724.17	72,177	48,207.74	883,315	47,230.85	55,487	10,696.78	38,387	2,379.23	130,238.77
Huerfano	23	475.41	56	37.40	....	....	37	7.13	....	....	519.94
Jefferson	15	310.05	30	20.04	....	....	....	....	....	....	330.09
Lake	51,063	1,055,472.21	4,487,251	2,997,079.82	47,836,328	2,557,808.46	4,028,497	776,613.65	70,198,462	4,350,900.67	11,737,874.81
La Plata	14,908	308,148.36	121.912	81,426.24	1,763	94.27	188	36.24	....	....	389,705.11
Larimer	5	103.35	10	6.68	....	....	....	....	....	....	110.03
Las Animas	....	....	....	....	....	....	....	....	....	....	....
Mineral	8,522	176,149.74	1,254,058	837,597.88	14,886,356	795,973.46	....	....	2,892,061	179,249.94	1,988,971.02
Montrose	15	310.05	12	8.01	....	....	....	....	....	....	318.06
Mesa	103	2,129.01	697	465.53	....	....	6,000	1,156.68	....	....	3,751.22
Montezuma	34	702.78	10	6.68	....	....	....	....	....	....	709.46
Ouray	47,627	984,450.09	912,099	609,200.04	5,721,599	305,933.90	662,111	127,641.76	54,883	3,401.65	2,030,627.44
Park	19,810	409,472.70	66,376	44,333.19	628,289	33,594.61	76,234	14,696.39	....	....	502,096.89
Pitkin	316	6,531.72	2,160,736	1,443,177.18	17,562,565	939,070.35	285,346	55,009.00	3,276,711	203,090.55	2,646,878.80
Rio Grande	420	8,681.40	1,293	863.61	....	....	1,432	276.06	....	....	9,821.07
Routt	333	6,833.11	175	116.88	....	....	....	....	....	....	6,999.99
Saguache	149	3,079.83	17,286	11,545.49	181,878	9,725.02	18,530	3,572.24	74,302	4,605.24	32,527.82
San Juan	40,363	834,303.21	688,894	460,119.19	4,139,588	221,343.77	2,094,066	403,694.04	718,192	44,513.54	1,963,973.75
San Miguel	122,965	2,541,686.55	1,476,977	986,487.71	7,039,046	376,377.79	319,692	61,630.22	....	....	3,966,182.27
Summit	8,208	169,659.36	130,093	86,890.42	1,482,060	79,245.75	22,740	4,383.82	3,363,740	208,484.61	548,663.96
Teller	673,949	13,930,525.83	67,943	45,379.82	3,060	163.62	....	....	....	....	13,976,069.27
TOTAL	1,092,827	$22,588,734.09	12,725,882	$8,499,743.83	105,984,540	$5,666,993.36	9,565,319	$1,844,002.19	85,488,901	$5,298,602.09	$43,898,075.56

NOTE—In the above table the calculation is on the average market price of the minerals for the year. See page 46.
Gold, 20.67; Silver, .66791; Lead, .05347; Copper, .19278; Zinc, .06198. The Zinc figured on actual spelter recovered.

Production of

PRECIOUS METAL

To December 31, 190~~4~~6.

THE BUREAU OF MINES OF THE STATE OF COLORADO.

PRECIOUS METAL PRODUCTION OF COLORADO TO DECEMBER 31, 1904.

YEAR	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Previous to 1870.	1,316,550	$27,213,081.00	250,000	$ 330,000.00	....	....	200,000	$ 40,000.00	....	....	$27,583,081.00
1870...........	145,864	3,015,000.00	500,000	660,000.00	....	....	97,088	20,000.00	....	....	3,695,000.00
1871...........	175,808	3,633,951.00	779,590	1,029,058.00	....	....	90,909	30,000.00	....	....	4,693,009.00
1872...........	128,034	2,646,463.00	1,524,207	2,015,001.00	80,000	$ 5,000.00	155,172	45,000.00	....	....	4,711,464.00
1873...........	88,788	1,835,248.00	1,683,370	2,185,014.00	112,000	7,078.40	28,172	65,000.00	....	....	4,092,340.40
1874...........	99,932	2,065,595.00	2,415,435	3,086,926.00	624,000	37,502.40	400,876	90,197.00	....	....	5,280,220.40
1875...........	112,291	2,321,055.00	2,306,253	2,873,591.00	1,636,000	95,706.00	428,571	90,000.00	....	....	5,380,352.00
1876...........	131,897	2,726,311.00	2,552,125	2,950,256.00	1,334,000	81,774.20	376,244	70,000.00	....	....	5,828,341.20
1877...........	145,138	3,000,000.00	3,480,548	4,180,138.00	1,794,000	98,490.60	504,283	93,796.64	....	....	7,372,425.24
1878...........	162,864	3,366,404.00	4,172,744	4,807,001.00	13,338,000	481,501.80	539,393	89,000.00	....	....	8,743,906.80
1879...........	156,023	3,225,000.00	9,049,424	10,162,503.00	47,348,000	1,960,207.20	766,082	131,000.00	....	....	15,478,710.20
1880...........	154,814	3,200,000.00	13,148,735	15,055,302.00	71,348,000	3,595,939.20	915,422	184,000.00	....	....	22,035,241.20
1881...........	159,652	3,300,000.00	13,272,488	15,104,092.00	81,094,000	3,900,621.40	889,503	161,000.00	....	....	22,465,713.40
1882...........	162,554	3,360,000.00	12,707,866	14,436,136.00	110,000,000	5,401,000.00	1,494,000	276,390.00	....	....	23,473,526.00
1883...........	198,355	4,100,000.00	13,434,915	14,912,756.00	141,114,000	6,096,124.80	1,153,000	182,750.50	....	....	25,291,631.30
1884...........	205,612	4,250,000.00	12,375,280	13,984,066.00	126,330,000	4,724,742.00	2,013,000	278,800.50	....	....	23,237,608.50
1885...........	203,193	4,200,000.00	12,220,589	13,014,927.00	111,000,000	4,345,000.00	1,146,000	127,435.20	....	....	21,687,362.20
1886...........	215,288	4,450,000.00	12,375,280	12,313,404.00	118,000,000	5,463,400.00	409,000	44,990.00	....	....	22,271,794.00

1887	193,517	4,000,000.00	11,600,826	11,345,608.00	126,000,000	5,670,000.00	2,012,000	226,350.00	....	....	21,241,958.00
1888	181,809	3,758,000.00	14,695,645	13,813,906.00	131,000,000	5,790,200.00	1,621,000	270,058.60	....	....	23,632,164.60
1889	187,898	3,883,859.00	18,375,519	17,199,486.00	138,000,000	5,423,400.00	3,100,000	426,250.00	....	....	26,932,995.00
1890	200,774	4,150,000.00	18,800,425	19,665,245.00	109,000,000	4,883,200.00	6,000,000	945,000.00	....	....	29,643,445.00
1891	222,545	4,600,000.00	21,160,480	20,906,554.00	128,000,000	5,568,000.00	7,000,000	883,400.00	....	....	31,957,954.00
1892	256,410	5,300,000.00	26,350,000	23,082,600.00	123,000,000	5,030,700.00	7,250,000	837,375.00	....	....	34,250,675.00
1893	364,151	7,527,000.00	25,838,600	20,205,785.00	84,396,000	3,147,970.80	7,12[illegible] 157	765,535.13	....	....	31,646,290.93
1894	462,009	9,549,731.00	23,236,025	14,638,696.00	97,264,000	3,200,000.00	6,528,214	624,097.26	....	....	28,012,524.26
1895	656,021	13,559,954.00	17,891,626	11,683,232.00	91,477,214	2,954,714.00	6,125,000	659,050.00	....	....	28,856,950.00
1896	738,618	15,267,234.00	21,547,743	14,458,536.00	82,018,000	2,321,109.30	7,539,245	820,269.86	....	....	32,867,149.26
1897	947,249	19,579,637.00	21,278,202	12,692,448.00	80,799,778	2,731,032.49	9,151,592	960,917.13	....	....	35,964,034.62
1898	1,138,584	23,534,531.28	23,502,601	13,690,265.15	113,417,168	4,117,043.24	10,870,869	1,304,504.28	....	....	42,646,343.95
1899	1,282,471	26,508,675.57	23,114,688	13,771,731.10	138,048,446	6,170,765.53	7,357,245	1,295,610.85	....	....	47,746,783.05
1900	1,391,487	28,762,036.29	20,336,712	12,488,774.84	164,274,762	7,770,196.24	7,826,949	1,293,011.98	....	....	50,314,019.35
1901	1,339,112	27,679,445.04	18,492,563	10,901,365.89	148,111,020	6,419,131.61	7,872,529	1,303,297.17	....	....	46,303,239.71
1902	1,379,638	28,517,117.46	15,941,703	8,315,192.29	106,303,374	4,325,484.29	8,463,938	1,006,108.31	52,582,510	2,544,993.48	44,708,895.83
1903	1,045,252	21,605,358.84	13,245,483	7,079,710.66	101,513,414	4,301,123.35	7,809,920	1,033,642.90	80,616,000	4,353,264.00	38,373,099.75
1904	1,171,892	24,223,007.64	12,960,777	7,416,156.60	107,546,854	4,624,514.73	9,401,913	1,205,607.31	64,976,235	3,313,787.97	40,783,074.25
1905	1,237,443	25,577,946.81	12,831,348	7,743,718.51	115,712,908	5,438,506.67	9,854,176	1,536,266.04	81,198,941	4,774,497.91	45,070,935.94
1906	1,092,827	22,588,734.09	12,725,882	8,499,734.83	105,984,540	5,666,993.36	9,565,319	1,844,002.19	85,488,901	5,298,602.09	43,898,075.56
TOTAL	19,452,364	$402,080,376.02	492,175,637	$402,698,925.92	3,117,019,478	$131,848,173.71	154,077,781	$21,259,713.85	364,862,587	$20,285,145.45	$978,172,334.90

NOTE—In the above table the calculation is on the average market price of the metal for each year. See page 46.

THE BUREAU OF MINES OF THE STATE OF COLORADO.

AVERAGE MARKET VALUE OF METALS PER ANNUM.

YEAR	Gold Per Ounce	Silver Per Ounce	Lead Per Pound	Copper Per Pound	Zinc Per Pound
Previous to 1870	$20.67	$1.32	....	$0.20	....
1870	20.67	1.32	....	.206	....
1871	20.67	1.32	....	.33	....
1872	20.67	1.322	$0.0625	.29	....
1873	20.67	1.298	.0632	.232	....
1874	20.67	1.278	.0601	.225	....
1875	20.67	1.246	.0585	.21	....
1876	20.67	1.156	.0613	.186	....
1877	20.67	1.201	.0549	.186	....
1878	20.67	1.152	.0361	.165	....
1879	20.67	1.123	.0414	.171	....
1880	20.67	1.145	.0504	.201	....
1881	20.67	1.138	.0481	.181	....
1882	20.67	1.136	.0491	.185	....
1883	20.67	1.11	.0432	.1585	....
1884	20.67	1.13	.0374	.1385	....
1885	20.67	1.065	.0395	.1112	....
1886	20.67	.995	.0463	.11	....
1887	20.67	.978	.0450	.1125	....
1888	20.67	.94	.0442	.1666	....
1889	20.67	.936	.0393	.1375	....
1890	20.67	1.046	.0448	.1575	....
1891	20.67	.988	.0435	.1262	....
1892	20.67	.876	.0409	.1155	....
1893	20.67	.782	.0373	.1075	....
1894	20.67	.63	.0329	.0956	....
1895	20.67	.653	.0323	.1076	....
1896	20.67	.671	.0283	.1088	....
1897	20.67	.5965	.0338	.105	....
1898	20.67	.5825	.0363	.12	....
1899	20.67	.5958	.0447	.1761	....
1900	20.67	.6141	.0473	.1652	....
1901	20.67	.5895	.04334	.16555	....
1902	20.67	.5216	.01069	.11887	.0484
1903	20.67	.5345	.04237	.13235	.054
1904	20.67	.5722	.043	.12823	.051
1905	20.67	.6035	.047	.1559	.0588
1906	20.67	.66791	.05347	.19278	.06198

Figure 1.
Uranium Mill of the R. M. and M. Co.

A STUDY OF THE URANIUM AND VANADIUM BELTS OF SOUTHERN COLORADO.

By Herman Fleck and Wm. G. Haldane.

Preface.

In no place is lack of information concerning the reported values of uranium and vanadium of the southwestern and western part of Colorado, more keenly felt than in the State Bureau of Mines. Since the reported discovery of these values in the mineral carnotite in 1899, a rising interest has grown which gave a stimulus to inquiry, and, as is shown elsewhere, those more bold than the rest made determined, though up to the present perhaps, unsuccessful attempts to wrest this information from the region. Due partly to this, and largely to a vigorous policy in the Bureau of Mines of Colorado, Commissioner E. L. White requested the co-operation of the Colorado School of Mines. The latter detailed the authors to carry on this work, which was briefly outlined as a study of the uranium and vanadium belt of Southwest Colorado from a scientific and commercial standpoint.

Under this comprehensive title the report is respectfully submitted, with regrets that the pleasure of investigating problems outlined in the last chapter could not be crowded into an otherwise busy year.

The field work was begun in the early part of June, 1905, and included the four well developed regions, McIntyre Canon, or Snyderville, Roc Creek, Hydraulic and Vixen, with their several sub-divisions. A month was given to these and it was only with the realization that time for laboratory work would not warrant further field work for this exploration, that the other carnotite regions less developed and regions of special interest, like the vanadium deposits of Placerville, were not investigated. However, it so happens that just these regions were visited and investigated by Messrs. Hillebrand and Ransome and were reported on in the American Journal of Science for August, 1900. This latter paper is the result of the only scientific investigation of the rare metal region up to 1906, and will be referred to from time to time as occasion requires.

It is not out of place to add that much of the discomfort of traveling in the arid region of these deposits was lessened by the kind assistance of owners of claims and neighboring ranches, who freely accompanied the authors over long distances and were always ready with supplies, transportation and shelter. Our thanks are due them, and to others who have provided data.

History.

That these deposits were known for a long time by early settlers in San Miguel and Montrose counties, Colorado, and in Mesa county, in Utah, and that the Ute and Navajo Indians made several uses of the yellow pigment seems reasonably sure from statements of the present inhabitants, and from data gathered from the Navajos by one of us.

No identification of them as containing a new and valuable mineral species occurred, however, until Messrs. Poulot and Voilleque, two French gentlemen, engaged in chemical business in Denver, Colorado, conducted a personal investigation and placed rich material from the Roc Creek district in the hands of M. M. C. Friedel and E. Cumenge, who in the spring of 1899 announced a new uranium mineral described by them as urano-vanadate of potassium, which they named carnotite.

In the meantime an investigation was being conducted by W. F. Hillebrand of the United States Geological Survey.

The high uranium contents and the general distribution gave rise to immediate activity in the Hydraulic and Roc Creek regions and, somewhat later, in the McIntyre region. A small shipment of ore was made from McIntyre Canon at this time, the returns on which were not made public. It is stated that Mr. Gordon Kimball shipped five carloads, 200 tons, of ore as oxide of iron from the Copper Prince mine at Roc Creek. The returns on the Roc Creek shipment are stated to have been twenty-four hundred dollars. The percentage of uranium oxide is said to have been 5 per cent., and vanadium oxide 15 per cent. There is considerable doubt to be cast on these high values for such a large tonnage of ore. If correct, they have not been equalled at any other time. Granted that the values are quoted correctly, the return was small and efforts at concentration followed. These, constituting the early metallurgy of this peculiar ore, will be discussed with other methods under the heading Metallurgy.

First in the line of concentration was the work of Messrs. Poulot and Voilleque, who began experimenting in 1900 at the copper mine in Cashin, Montrose county, where they worked up 120 tons of ore, making concentrates for test sales which represented 7,600 pounds uranium oxide. During this period the ore was obtained in part from the Hydraulic region. The experiments of these gentlemen were sufficiently successful to urge the formation of a company, which then became known as the Rare Metals Mining & Mfg. Co., of Cashin, Colo., and the building of a mill in 1901 for the extraction of uranium and vanadium oxides from these ores. The locality selected, for various reasons, was the McIntyre district, where at an estimated cost of $8,000 was built the mill shown in Fig. 1. Mr. James McBride, of Burton, Michigan, and part owner of the Cashin copper and silver mine, interested himself with Messrs.

Poulot and Voilleque. From this time to the present the commercial interests, aside from the mere changing of hands of claims in other districts, centers around the McIntyre district. A brief outline of the operations of the Rare Metals Mining & Mfg. Co. may be of interest.

The mill as originally built was three stage, containing on the upper stage a large floor for storage of ore and the feeder of a ten-ton Krupp ball mill. The second stage contained three low leaching tanks about ten feet diameter, the Krupp ball mill, a thirty-horsepower boiler and a ten-horsepower engine, both upright. The lowest floor contained one low and three high precipitation tanks, and a small chemical laboratory. Some slight changes in arrangement have been made since. The company at that time owned several of the best, and in consequence of operation, some of the well worked claims. Ore from there was placed in the mill at $7.00 per ton, by contract.

The total amount mined and milled was:

Franklin	40 tors
Alice	250 tons
Uranium	25 tons
Bluebell	40 tons

NOTE.—The claims are described under the heading Description of Claims, pp. 66 to 69. About 100 tons of ore from the Franklin and St. Louis uranium claims were in the mill in the fall of 1902. The mill became the property of Messrs. McBride and Voilleque in 1901, Mr. Poulot retiring, and it has not been a producer but once for a brief run since then.

A shipment of 51½% uranium oxide ore made by the company in November, 1899, brought 2013 M. per 3365 Kgs. ($500 per 6730 pounds.) Another made in October, 1900, of ½ ton of concentrates containing 45 to 50% uranium oxide and 15 to 17% vanadium brought $1.75 per pound of uranium oxide, and 85 cents per pound of vanadium oxide f. o. b. New York. Another, made September, 1900, to the same firm, of one ton of concentrates, same strength as before, brought the same price f. o. b. New York.

The total output of uranium oxide, in form of concentrates ranging from 7% to 15% uranium oxide, at the McIntyre mill, was was 7500 pounds, making the total output by the company about 15,000 pounds uranium oxide valued at about $30,000 gross. These complete the operations of the original firm.

With the exception of some additional experimenting, the mill practically closed in the summer of 1901.

In the fall of 1902 experiments were conducted with considerable success on several tons of low grade ore. This work was discontinued in the severe winter of 1902-3 and was not resumed.

In the spring of 1903 operations were conducted by a company known as the Western Refining Company, using the Engle-

Haynes process of extraction. It is estimated that during the year of operation, ending in the spring of 1904, about 140 tons of ore were extracted. The ore was taken from the Alice and Bluebell claims as follows:

Alice	100 tons
Bluebell	40 tons
TOTAL	140 tons

It is estimated that about 2500 pounds of concentrates were obtained. According to the claims of the inventors an 80.85% concentrate is obtained. The mill has been idle since the spring of 1904. At present the only active efforts are being put forth by the Dolores Refining Company, using the Engle-Haynes process. The company has erected a new plant about one and one-half miles east of the old mill on the banks of the Dolores river.

The new mill has four stages, crushing outfit, engine and boiler and tanks provided with agitators. The first shipment is about to be made of an 80% concentrate.

Several shipments of ore have been made, partly for direct sale to the manufacturer, and partly for experimental purposes. Forty tons of picked ore were shipped from Dolores by Messrs. Voilleque, Snyder and Stevens in the fall of 1903. Fifteen tons of this brought $2100 gross in 1901, while 44 sacks shipped to Mr. Woodbury, of Denver, for a test of the process of Dr. Julius Ohly, came from the Mountain Beauty, of Hydraulic. It is known to have run 3.5% of uranium oxide. From the D. U. No. 6, ten sacks of high grade, said to have run 17.5% uranium oxide, were shipped by Mr. Woodbury, of Denver.

Between 7 and 10 tons of ore taken from the Georgetown claim at McIntyre were shipped to New York as a test shipment in 1900. It is said to have run a little better than 4%, and to have brought $47.50 a ton at the railroad.

THE METALS URANIUM AND VANADIUM.

It is not out of place in this report to give a description of these two elements of the rare metal class. Were they of more common occurrence, their description here would be out of place, but under the circumstances their description is not alone instructive, but serves as a brief reference, at once at hand.

Uranium A. W. 239:

Historical—

Compounds first isolated, Klaproth 1789, out of pitchblende and autunite. Metal isolated 1840, Peligot.

Occurrence, principally in

Uraninite (Pitchblende) Black velvety; very heavy; solid or in seams.

Carnotite. Yellow powder or slightly cohering mass or yellow stain in rock crevices or on sandstone.

Preparation of metal.

I. Reduction of trichloride by fusion with metallic sodium using potassium chloride as flux (Peligot).

II. Electric furnace reduction of the oxide by carbon.

Properties. Silver white when fused; grey black when powdered; somewhat malleable; nearly hard as steel. S. G. 18.685.

Oxidizes in air; more vigorously upon heating. Soluble in dilute sulphuric acid and hydrochloric acid.

Uranium Oxides:

Principal oxide is U_3O_8. Pitchblende consists of 40.50% of this oxide. Prepared by heating uranium and decomposable products of same in air. Soluble in hydrochloric, sulphuric and nitric acids—contains 84.85% uranium.

S. G. 7.193.

Vanadium A. W. 51.1:

Historical—

Found in 1801 by Del Rio in lead ores of Zimapan. Identified as an element by Von Säfstrom in 1830 in iron ores of Taberg; metal first isolated 1867, Roscoe.

Occurs principally in

Mottramite. Copper-lead-vanadate hydrated.

Vanadinite. Lead-chloro-vanadate.

Roscoelite. (Vanadium mica.) Aluminum-potassium-silico-vandate. (Placerville, Colorado.)

Preparation of metal.

I. Reduction of dichloride in hydrogen.

II. Electric furnace reduction with carbon.

Properties.

Light grey powder, or steel grey mass when fused. S. G. 5.5.

Oxidizes very slowly in air, more rapidly on heating.

Soluble in concentrated sulphuric and nitric acids.

Soluble in fused alkalies.

Vanadium Oxide.

Vanadium pentoxide most important.

Dark red powder, usually, and other modifications.

CHARACTER OF CARNOTITE MINERAL.

As stated in the preface, M. M. C. Friedel and E. Cumenge (loc cit), show a simple constitution for the mineral from their analysis. This constitution is accepted by Dana in the 6th edition of his mineralogy, appendix 1, as the following quoted paragraph shows:

"Carnotite. C. Freidel and E. Cumenge. C. R. 128, 532, 1899, and Bull soc. Min. 22. 26. 1899; occurs as a yellow crystalline powder or in loosely cohering masses, easily separated by the fingers; intimately mixed with quartzose and sand."

Comp. perhaps K_2O. $2U_2O_3$. ||. V_2O_5. $3H_2O$.

Analysis of air dried material after separation of silica:

V_2O_5	U_2O_3	K_2O	H_2O	Fe_2O_3	Total
Calc. 20.12	63.54	10.37	5.95	...	99.98
20.31	64.70	10.97	5.19	.96	102.13
19.95	62.46	11.15	....	.65	......

The radiant power has been investigated by the Curies. Occurs in Montrose county associated with malachite and azurite. Some samples show 60% SiO_2. The purest 2.6—7.2%. Separation is accomplished by nitric acid. Named after M. Adolphe Carnot.*

||Old notation equivalent to UO_3.

*J. Ohly, Mining and Metallurgy Apl. 15, 1901, ascribes the name to "the discovery by French scientist, Carnot."

Hillebrand and Ransome (loc cit) do not confirm this simplicity of constitution, as the following analyses of high grade ores, probably from the same locality, show:

	I.			II.		III.
	a‖	b+	c‡	a†	bk	c¶
Insol	7.10	8.34	19.00	10.33	....	....
UO_3	54.89	52.25	47.42	54.00	52.28	20.15
V_2O_5	18.49	18.35	15.76	18.05	17.50	7.20
P_2O_5	.80	.35	.40	.05	tr	none
As_2O_5	tr	.25	none	none	none	none
Al_2O_3	.09	....	.08	.29	....	.08
Fe_2O_3	.21	1.77	.72	.42	3.36	.25
CaO	3.34	2.85	2.57	1.86	1.85	1.64
SrO	.02	....	....	tr	tr	....
BaO	.90	.72	.65	2.83	3.21	.29
Mgo	.22	.20	.24	.14	.17	.07
K_2O	6.52	6.73	6.57	5.46	5.11	1.51
Na_2O	.14	.09	.07	.13	.02	.01
Li_2O	tr	....	....	tr	....	....
H_2O 105°	2.43	2.59	1.85	3.16	4.52	Total 1.85

	I.			II.		III.
H_2O 350°	2.11	3.06	2.79	2.21	H_2O in Ore 3.49	300° 1.64
H_2O 350°+	none	none	none	none	....	300°+ .19
PbO	.13	.25	.18	.07	....	.09
CuO	.15	.20	.22	tr	....	tr
SO_3	none	.12	.18	none	....	none
MoO_3	.18	.23	.18	.05	....	.04
SiO_2	.15	.06	.13	.20	....	.07
TiO_2	.03	.10	....	....	....	.06
CO_2	.56	.33	none	none	....	....
TOTAL	98.46	98.84	99.01	99.25	....	....

*Containing .54 H_2O. 09 V_2O_3.

The insoluble matter had the following composition:

SiO_2	5.18
V_2O_3	.21
P_2O_5	.09
K_2O	.26
Na_2O	.04
H_2O (105°)	.56
H_2O (350°)	.32
H_2O (+350°)	.48
Al_2O_3 TiO_2 Cr_2O_3 by diff	1.20

I. Copper Prince Claim, Rock Creek, Montrose County, Colo.
II. Yellow Boy Claim, La Sal Creek, Montrose County, Colo.
III. Yellow Boy Claim, La Sal Creek, Montrose County, Colo.
(Probably of same lot as analyses of Friedel & Cumenge.)

‡This material was obtained by floating off the finer matter, allowing it to settle, collecting on a Gooch filter and drying it in a current of air drawn through the crucible. The insoluble matter held in addition to 16.41 quartz and silicates including .39 V_2O_3 and a little UO_3, H_2O (105°) .83, (300°) .73, (†300°) 1.03: total H_2O. 2.59.

†Containing .16 V_2O_3 and 1.90 H_2O.

kThe insoluble matter contained besides quartz and silicates, .25 V_2O_3, .21 K_2O, .05 Na_2O.

¶This analysis was made purposely on a relatively poor ore furnished by Messrs. Poulot and Voilleque, with the object of determining, if possible, the composition of the vanadiferous silicate which it contained. The data calculating the H_2O values of both analyses are as follows;

	Ore a	After Extraction of Carnotite by Cold Dilute Nitric Acid b	After Extraction of Residue by Hot Nitric Acid, Sod. Carb., Etc. c
H_2O 105°	3.53	1.68	.02
H_2O 300°	2.11	.47	.03
H_2O +300°	.83	.64	.02
	6.47	2.79	.07

a-b. Furnishes the values for carnotite as shown in analysis III.

b-c. Gives those for the less soluble silicate.

After recalculating these results on a basis of simplicity of combination, and taking into account the effect of probable losses on the empirical formula derived from these analyses, the authors conclude that "the results show a great lack of agreement and wide variation.' It is plain that no probable formula can be calculated for the yellow body. The variations are of such a nature as to indicate in the plainest manner that it is a mixture of several substances." In the opinion of these authors there are several reasons why the formula of M. M. C. Friedel and E. Cumenge lies in doubt.

This conclusion concurs perfectly with that of the authors of the present paper. Although no samples of said high uranium and vanadium contents were analyzed there are many facts observed in the study of the ore bodies of the numerous specimens, to indicate that there is little more reason for selecting the yellow specimen from the Copper Prince as an individual, than there is for selecting any of the whimsical compounds made of the varying ratios of uranium and vanadium oxide of different states of oxidation, associated with arsenic and phosphoric acid and numerous bases including oxides of copper, lead, bismuth, barium, lime and others.

GEOLOGY.

Owing to the almost entire absence of stratigraphic work in this region it is impossible to give detailed information on the geological formation, and this feature of the districts was not studied to any extent by the authors, owing to the limited amount of time spent in each.

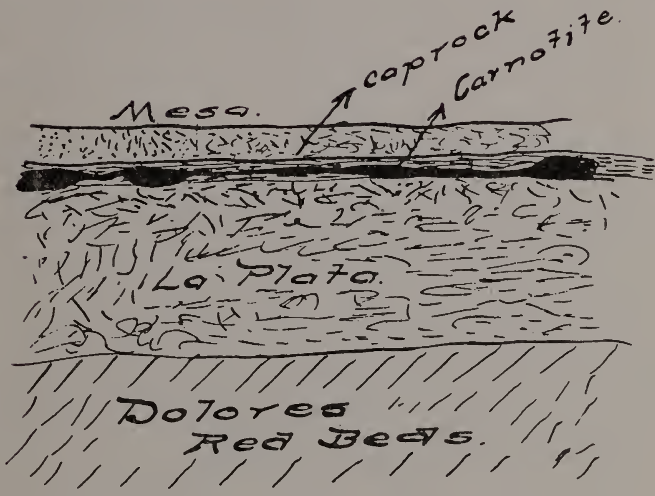
About the only literature at hand on this subject is contained in the report of Hillebrand and Ransome (loc cit) entitled "Vandiniferous Minerals in Western Colorado," which report deals primarily with the La Sal and Roc Creek deposits, and in substance is as follows:

The lowest formations visible in the canons are the Dolores, or Red Beds, followed by the La Plata sandstone, which is of much greater thickness here than between Placerville and Telluride. Above the La Plata comes a series of thin-bedded sandstones with shales, and at times, conglomerates, the carnotite occurring in this upper series, which is practically horizontal.

The nature of the Roc Creek deposit is described in chapter on Description of Claims.

ORE DEPOSITION.

There is practically nothing in the entire carnotite problem so far that will give a clue to the ancestral minerals of both uranium and vanadium. Nor has there been much of anything



Section showing the pockety occurence of Carnotite in the Upper Series of shale + sandstone.

observed in the vicinity, nor within a considerable radius, to give a hint as to the origin of these deposits. Were this fact fairly solved, then a solution might result from the study of the problem from two points of view, i. e., granted a source, say a highly vanadiferous pitch blende within a reasonable area, then two methods of distribution would be:

I. Solution of the values at the original location by action of sulphuric acid, or perhaps acid sulphates arising from decomposition of sulphides, and the passage of such solution finally through a layer of fairly porous sandstone containing a precipitating agent.

II. The concentration of vanadiferous pitch blende particles by action of water currents and subsequent decomposition.

As regards the premises, is there any reason for assuming a highly vanadiferous pitch blende?

It is reasonable, judging from the formations in which pitch blende occurs in Colorado, that the rocks which yielded the silica, alkali, alumina and iron which constitute the sand stones of the region, also yielded their uranium contents in form of pitch blende. Pitch blende quite frequently carries vanadium oxide.

NOTE. Patera (Ding. Poly. Jour., 141, 373.) V. Haner (Jour. Prak. Chem., 69, 118.) Handling of residues of pitch blende for vanadium oxide after extraction of the uranium.

Throughout the entire uranium area vanadium is a constant companion of the former metal, and as the results show the ratio of uranium to vanadium is never constant, not even on the same claim, the results ranging from a ratio of:

$$U_3\ O_8 : V_2\ O_5 :: 1 : .16$$

to the ratio of

$$U_3\ O_8 : V_2\ O_5 :: 1 : 50$$

Instead of the above ratios, which show minimum and maximum vanadium ratios, the following tables containing selected results may better serve for comparison:

Sample	% U_3O_8	U_3O_8	V_2O_5
8 b	.41	1	.5
8 d	8.06	1	.56
10 e	.98	1	.6
11 c	21.88	1	.4
16 a	5.07	1	.6
30 c	1.26	1	.55
30 a	.76	1	.16
30 b	3.02	1	.38
23 x	9.45	1	.68
45 b	3.18	1	.4

Sample	$\%U_3O_8$	U_3O_8	V_2O_5
64 b	1.31	1	.21
3 b	.74	1	4.4
5 a	.41	1	9.6
5 d	.34	1	5.
12 a	.05	1	50.
25 a	.66	1	4.4
30 d	3.04	1	6.
43 a	.79	1	7.6

These results show wide differences in their uranium contents, and represent the two extremes. All other results fall between these.

Premises correct, one or the other constituent must have been removed from one place and subsequently deposited in another. Both elements possessing acid higher oxides, the one forming the more soluble alkaline and alkaline earth salts would be the more mobile. Naturally this is the property of vanadium, and it is not surprising, therefore, that in various places such as Placerville, Colorado, there should be found a concentration of vanadium values. Due to these soluble salts, vanadium in very small amount has been found by Hillebrand in sand stones. It is undoubtedly at present widely disseminated throughout the vast sandstone areas of San Miguel and Montrose counties. Nothing has been reported of a similar nature regarding uranium, and, clearly, the explanation lies in the insolubility of the uranates, even of the alkali metals, and the ready solubility of the alkali vanadates and vanadates of the alkaline earths.

Natural solutions of uranium are not hard to imagine. The pitch blende and alteration products are soluble in carbonate of soda and sulphuric acid—both natural possibilities. It is difficult to imagine, from facts observed, any substances which would deposit uranium compounds from the former solution, whereas it is quite possible to precipitate the uranium completely from uranyl salts by various carbonates, and the authors have leaned strongly toward some such mode of deposition of uranium by the cementing carbonates of lime and iron in a porous sandstone, the liquids taking the course of least resistance, being prevented from broader dissemination than that actually shown by the size and shape of the ore bodies, by impervious rock, shales, etc. F. L. Ransome (loc. cit.) announces this, with perhaps more than warranted positiveness, from the observations made by him on La Sal and Roc Creek. To quote:

"The carnotite of La Sal Creek occurs as irregular, bunchy 'pockets' in the sandstone. or along the contact of the sandstone with the underlying shale. These have all the appearance of being impregnation deposits, the solution carrying the uranium compounds, having deposited the ore wherever they found ready passage through the rock—usually along the bedding planes.

"That the deposits of carnotite and roscoelite were formed subsequently to the deposition of sandstones is evident from facts presented in preceding pages. It is equally plain that the minerals could not have resulted from the alteration in place of other compounds of vanadium and uranium originally deposited with the sands. The shape and position of the deposits indicate clearly that the ores have been deposited in their present position only after transportation from a greater or less distance. Moreover, the recency of the deposits, and the fact that they are sometimes directly connected with faults and dislocation in the sandstone, shows that the vanadium and uranium compounds could not have been the original cementing material of the quartz grains, but have in all probability replaced the calcite which acts as matrix to the ordinary light colored sandstone in which the ore bodies occur. The deposits of roscoelite appear to be comparable to the impregnations of the sandstone with cupriferous solutions observed in many places in the region, particularly on La Sal Creek, near Cashin, and in the Sinbad valley, whereby the sandstone becomes bright green with carbonate of copper. In these cases, however, the copper appears to have been previously deposited as chalcocite."

"In all these cases the actual sources of the materials which have been deposited in their present position are not known. Dr. Hillebrand has shown, however, that vanadium in small amounts is widely distributed in limestones, sandstones and igneous rocks. It is perhaps present in very small amounts, in the bulk of the sandstone, and the deposits described may simply represent a concentration of this material under certain favorable conditions of solution and redeposition. The roscoelite, as seen near Placerville, appears, however, to be more persistent than the carnotite. The carnotite, on the other hand, appears to be a much more superficial occurrence, and, in fact, to have a not yet fully understood connection with the present surface of the ground. This would indicate that the carnotite results from a local concentration of material already existent in the sandstone, and the deposition of this material in the form of carnotite under conditions determined by proximity to surface, and partly dependent upon a semi arid climate."

It is to be regretted that Dr. Ransome's investigations did not extend into the Hydraulic and McIntyre regions, so that the data there presented might have been added to his valuable opinions.

Regarding the second hypothesis, there is nothing to conflict with the same in the remarks of Dr. Ransome. The high specific gravity of pitchblende makes its concentration by water currents in depressions on a sandy bottom very possible and perhaps this was in mind when the above statements, somewhat contradictory to a preceding one, was made, namely: That the carnotite resulted from a local concentration of material already existent in the sandstone. It is true that every effort has been bent upon discovering pitchblende or another primary uranium compound in these deposits by all concerned, but without positive result. If this mineral played a preliminary part it has long since been completely altered. This alteration is not at all uncommon. A newly discovered deposit of pitchblende near Golden, Colorado, has yielded specimens of the ore showing incrustations like carnotite in appearance. In the above quotation the hypothesis is not contradicted by a single fact, although these facts are unquestionably correct. That a subsequent leaching of valuses and deposition took place from the original pockets, thereby preserving the data mentioned, is quite likely. The deposits of the La Sal Creek and Roc Creek are largely of this kind, and causes for assuming deposition in sandstone by lime precipitation are well taken. Some of the deposits in the lower group at McIntyre are also of this kind. A striking instance lies on the Silvey claims, same region, where the main deposit lies considerably above a streak of stained sandstone carrying uranium and vanadium values and containing nodules of calcarerous material. In this, and similar cases observed in cliff sides, the upper and perhaps original deposit was probably the cause of the lower deposition formed by subsequent leaching. The lower stratum sandstone contains the values disseminated, whereas above they are largely in form of shale pockets. In one instance on the lower group, carnotite of high percentage was noticed in several pockets of coal near the surface. The latter can hardly have been the cause of precipitation, and the values appear to have been deposited with organic matter. In numerous instances pockets of shale, rich in carnotite, were surrounded by white sandstone stained with carnotite. The phenomenon of the stain appearing above the rich pockets as well as below can be explained by the action of capillary attraction. The general persistent form of these pocket deposits, flat, long and about 2 to 3 feet in depth along the bedding planes of what appears to be a definite bench, or bed, through the region, would point to the second hypothesis.

The absence of calcium carbonate cement in many of the deposits might indicate absence of deposition from solution.

Again, in some instances there is lack of evidence, at present at least, of a course of least resistance having been followed. In one shaft-like opening on the Maggie C. at Naturita the carnotite lies in the middle of a sandstone stratum of homogeneus nature. In this there is no reason to assign to the solution having been deposited in the particular spot of occurrence.

The decomposition of pitchblende into hydrated oxides of uranium and vanadium and subsequent combination with various bases—potassium, lime, and baryta, is a clear-cut result of this hypothesis.

If the deposits were wholly precipitates from solution, greater dissemination of uranium, comparable to that of vanadium, might be looked for. This is contrary to observation. The presence of many of the elements which accompany the uranium in pitchblende is also noteworthy. Zirconium, lead, arsenic, copper and perhaps bismuth, are found in these deposits, and often the copper appears as a partly altered chalcocite imbedded in sandstone discolored by chalcocite alteration products.

As a result of the correctness of such a hypothesis as the above, the carnotite deposits, in part at least, would be much older than supposed. It appears to the authors that the latter hypothesis is suggestive and certainly worthy of further investigation, and they have therefore added this to the new problems.

PREPARATION OF ORE.

Method of Analysis and Comments.

Since most of the sales of ore and concentrates have been subject, and will continue to be subject, to retest by Ledoux & Co., New York City, the method proposed by this company is unquestionably the one to employ.

At the same time the authors have satisfied themselves that the method is not free from error, and have added one or two modifications and propose to add more.

The method is fully described in "Technical Methods of Ore Analysis," by Albert H. Low, B. S., pages 204, 263. "Pulverize the ore to 80 mesh (a) or finer. Weigh one gram of the dry ore, (b) place in a small beaker and add 25 ccs. of dilute nitric acid (1:3). Digest at a gentle heat for a few minutes, let the insoluble matter settle and filter off the liquid which contains the uranium and vanadium, washing with hot water. Pass hydrogen sulphide through the filtrate to remove copper, etc. Filter from the precipitated sulphides and wash with hydrogen sulphide water. Boil the filtrate until the hydrogen sulphide is expelled, and then add 1 or 2 ccs. of hydrogen peroxide to oxidize iron and vanadium to the highest state. Boil to decompose the excess of hydrogen peroxide, allow to cool a little and add an excess of ammonia and ammonium carbonate solution, whereby the iron, etc., is precipitated, but the uranium and vanadium held in solution. The iron precipitated will, however, retain some uranium and vanadium, especially the latter. Digest the liquid containing the ferric hydroxide at a very gentle heat for a short time, say ten minutes, but avoid decomposing the ammonium carbonate by boiling. Allow to settle and filter and then re-dissolve the precipitate in the least possible quantity of dilute nitric acid. Reserve the filtrate which contains the greater part of the uranium and vanadium. Precipitate the iron, etc., with ammonia and ammonium carbonate as before, and then filter and wash well with hot water (c). Unite the filtrate with the one previously reserved—test the precipitate for any vanadium still retained by dissolving it in dilute nitric acid and adding a drop or two of hydrogen peroxide. A reddish or brownish tint indicates vanadium, and the precipitation must again be repeated and the filtrate united to the other two. Boil the united filtrates, contained in a larger beaker, rapidly, to decompose and expel the ammonium carbonate, together with the excess of ammonia. When this is effected the liquid will become cloudy from the precipitation of uranium and vanadium. Now add nitric acid, drop by drop, to the boiling liquid until the solution is again perfectly clear (d). Remove the beaker from the heat, and add to the hot liquid 10 ccs. of a saturated solution of lead acetate. If the excess of nitric acid is not too great, a precipitate of lead vanadate will form at once. Hence, it is necessary to also add a few grams of (e) sodium acetate to insure the complete neutralization of the nitric acid, and the absence of any free acid, except acetic. The lead vanadate is insoluble in dilute acetic acid (f), but it dissolves readily in nitric acid. Digest the mixture on a water bath for a short time until the precipitate settles well, then filter and wash with hot water containing a little acetic acid. The filtrate will contain no vanadium, but the precipitate is likely to contain a little uranium. Therefore, rinse the bulk of the precipitate into a beaker, place the latter under the funnel and pour through the filter sufficient dilute nitric acid to dissolve the precipitate remaining thereon. Add more nitric acid to the mixture in the beaker if necessary, but only just enough to dissolve the lead vanadate. Dilute the liquid if necessary, add 2 or 3 ccs. lead acetate solution and then a little sodium acetate as before. The lead vanadate resulting from the second precipitation will be free from uranium. Unite the filtrate from it to that obtained from the first precipitation and reserve for the uranium determination.

Dissolve the lead vanadate (which is not of constant composition) in dilute nitric acid as before—add to the solution in a beaker, 25 ccs. of sulphuric acid 1:1 and filter off the lead sulphate, washing with cold water. Receive the filtrate in a 6-oz. flask. Boil the solution in the flask over a free flame until copious white fumes of boiling sulphuric acid are evolved. Cool, take up with water and transfer to a 10-oz. flask. Add 10 ccs. of a strong solution of sulphur dioxide (see notes below), which reduces the vanadium from V_2O_5 to V_2O_4. The liquid will turn deep blue. Boil briskly until the excess of sulphur dioxide is expelled, and then titrate the hot liquid with standard potassium permanganate. 1 cc. of this should equal about 0.005 grams of iron. The iron value of the permanganate multiplied by $1.632=V_2O_5$, or if multiplied by $0.916=V$.

The liquid, reserved above, containing the uranium, contains quite an excess of lead and sodium acetates. Add to it

10 ccs. of strong sulphuric acid and filter off the lead sulphate. Make the filtrate slightly alkaline with ammonia, which will precipitate the uranium as ammonium uranate (g). Boil for a short time and let the precipitate settle. Filter, but do not wash. Dissolve the precipitate on the filter in dilute sulphuric acid (1:6). Receive the filtrate in a 6-oz. flask, add 10 ccs. of strong sulphuric acid and boil to strong white fumes over a free flame, allow to cool, dilute sufficiently, add some pieces of pure zinc and allow the uranium to reduce from the uranic to the uranous condition. The zinc should, of course, be pure and free from iron, and the evolution of hydrogen should be allowed to continue at least a couple of hours to insure complete reduction (h). It is advisable, also, to make a blank test, using the same amount of zinc and dilute acid and standing for the same length of time, and determine the quantity of permanganate required to produce a tint; this quantity to be deducted from the amount of permanganate used in the titration of the uranium. Titrate the reduced uranium solution with standard permanganate at the room temperature. The iron value of the permanganate multiplied by 2.134 = uranium. Uranium multiplied by 1.179 = U_3O_8.

"The solution from which the uranium is precipitated as ammonium uranate should be dilute (700 to 800 cc.) (g) as the excess of acetates in the solution is prejudicial to the complete precipitation of the ammonium uranate."

"Notes on the above method. Having obtained the final solution of purified lead vanadate in dilute nitric acid, I prefer to transfer it to a 6-oz. flask, add about 7 cc. of strong sulphuric acid and boil over a free flame to strong white fumes, then cool and dilute sufficiently and filter into a 10-oz. flask for the reduction and titration."

"See 260 relative to the use of sulphur dioxide solution. I have found that the use of 10 cc. old SO_2 solution gave a correct result if the first pink tint was taken as the end point, but this is rather unsatisfactory, as the color soon vanishes and more permanganate must be repeatedly added."

"Instead of determining the uranium volumetrically, I prefer, if the quantity is small, to dissolve the ammonium uranate on the filter in ammonia and ammonium carbonate, boil to expel these to a large extent, acidify with nitric acid, boil again to expel carbon dioxide, then re-precipitate with ammonia, filter, washing with dilute ammonia and ignite and weigh as U_3O_8 which multiplied by .8482 = uranium."

"If the quantity of ammonium uranate is so large as to filter badly, it is best to precipitate the uranium as phosphate. Proceed as in the last paragraph, but instead of re-precipitating with ammonia add $\frac{2}{5}$ grams microcosmic salt and continue as described in 257.

"It is probably not safe to ignite the original precipitate of ammonium uranate at once, after washing, without further purification."

In the analysis of carnotite ore the following modifications were introduced:

(a) Since even very rich ores are sand stones or clay masses, impregnated with carnotite stain, no finer mesh than the sand grain is necessary. This may be 80 or coarser. Mere crushing and sieving through 40 mesh is often sufficient and quicker.

(b) The color of the ore determines the relative value in carnotite roughly (there are some marked exceptions), and in case of a very poor ore as high as 10 grams may be used; medium poor, 5 grams; medium rich, 2 to 2.5 grams, and rich, 1 to 2 grams.

(c) The precipitate is rendered more soluble to the action of wash water than that which commonly is boiled. Considerable quantities of iron may be found in the filtrate. The water had better be limited to the smallest amount necessary.

(d) At times the addition of the nitrite acid, even drop by drop, decomposes the yellow film adhering to the beaker after boiling, with formation of red vanadic acid, which can only be gotten into solution by protracted boiling with more acid. This quantity of acid may cause a large addition of sodium acetate in the subsequent operation.

(e) The amount depends on the quantity of nitric acid necessary to dissolve the above precipitate completely, and is best determined by slowly adding a saturated solution of sodium acetate (free from sodium sulphate) until a permanent floculent precipitate is formed. After the settling of the precipitate a few drops more sodium acetate are added to ascertain the completeness of the operation. If the sodium acetate is impure with sodium sulphate, a white precipitate is formed which does not settle rapidly, especially when the quantity of vanadium present is small, and which can be enclosed and settled in a relatively large quantity of lead vanadate precipitate only by prolonged stirring.

(f) When the operation above has been conducted with a very small quantity of nitric acid the addition of acetic acid is necessary to keep the lead uranate in solution.

(g) At this point the solution contains free acetic acid and usually much ammonium sulphate and sodium sulphate. The quantity of the former depends upon the nitric acid originally used in dissolving the ore and redissolving the first precipitate formed by ammonium hydrate and ammonium carbonate, and the completeness with which the ammonia and ammonium carbonate are expelled in the boiling before separation of the vanadium from the uranium. The quantity of sodium sulphate depends on the quantity of sodium acetate required to overcome the solvent action of the nitric acid present in the solution during the precipitation of lead vanadate.

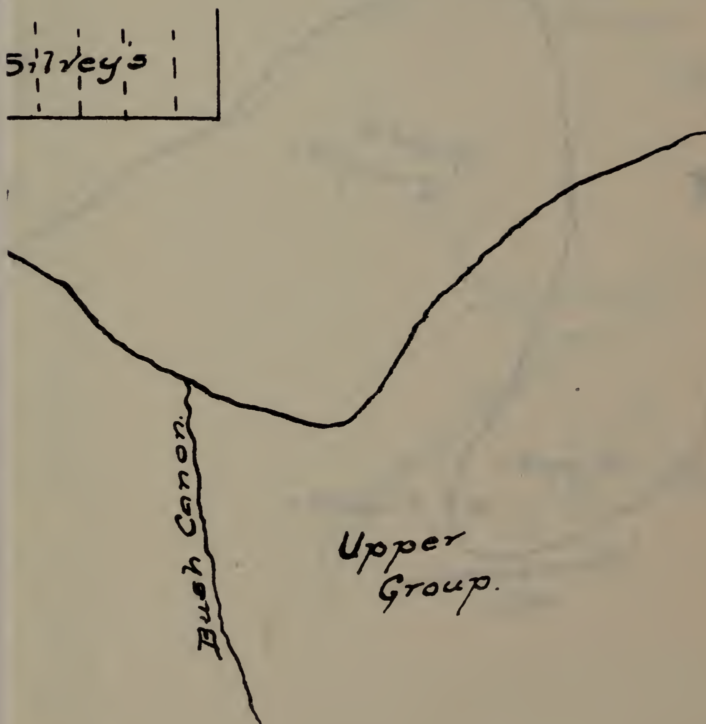
Experiments conducted in this laboratory show considerable quantities of alkaline sulphate in presence of uranyl sulphate retard, or prevent to a large degree, the precipitation of uranium compounds by ammonia, barium carbonate, calcium carbonate, etc. Whether the free ammonium acetate present in the above solution, after ammonia is added, has effect or not, the precipitation of ammonium uranate at this point, even in dilution of 700-800 cc. is not advisable. It is better to add 50 cc. strong sulphuric acid, filter off the lead sulphate, receive the filtrate in half a liter flask, which it should not half fill, and rapidly boil to copious white fumes. Cool and dilute to 200-250 cc.

(h) About ten strips of zinc, ½ in. x 4 in., coiled or twisted, to prevent floating on surface of solution during violent evolution of hydrogen, should be used. A thick foam of hydrogen bubbles should cover the surface, and to obtain this, heat may be necessary. A funnel or Bunsen valve should be inserted in the neck of the flask. The reduction is complete in 20 minutes to one-half hour. If a check on the zinc be desired, the difference between the amount of zinc used at the beginning and the end of the operation, which need be only roughly weighed, will give a hint as to the amount of permanganate used, due to the zinc—this was not necessary in the present instance. Care should be taken to observe the color of the zinc strips when reduction is complete. If stained yellowish or encrusted with a greenish layer, the strips must be warmed with dilute sulphuric acid after separating from the reduced liquid. The latter is done by pouring through glass wool.

Finally it is necessary to check the iron which finds its way into the uranium sulphate solution and to which the consumption of some of the permanganate must be attributed. Here lies a source of error, since the iron value is naturally doubled in calculating to uranium oxide and figures as uranium oxide. It appears that the greater the quantity of uranium present, the greater the error due to iron. This source of error the authors were compelled to meet by a not entirely satisfactory method.

It was found that pure uranyl sulphate does not give a coloration with potassium sulpho-cyanide. Nor is zinc sulphate affected in strongly acid solution. Tests were made with aliquot portions of the titrated solutions by measuring the contents of the reduction flask, placing 50 cc. of same in a 50 cc. Nessler tube, adding 2 to 3 grams finely powdered crystals of potassium sulpho-cyanide and measuring the intensity of color against 50 cc. standard ferric sulphate, whose permanganate value was known. The corresponding number of ccs. permanganate solution was deducted then from the original number.


Georgetown Group
Silvey's
Middle Group
Wm Snyder
Cougar Canon
Lower Group
Geo Snyder
C.H Snyder
Carpenter's Mill.
Bush Canon
Upper Group


Bush Canon.
Upper Group.

Sulphur dioxide does not affect uranyl sulphate, whereas ferric sulphate is readily reduced. It is proposed to reduce with sulphur dioxide after the first titration, boil off excess of reducing agent and titrate the iron present with permanganate.

NOTE. It was found advisable to use a weaker solution of permanganate than proposed—about one-half strength is advisable, i. e., 1 cc. permanganate=.003 grs. iron.

Thus conducted the authors find the method of Ledoux a convenient one and fairly accurate.

LOCATION.

The uranium-vanadium bearing areas, or better, the uranium-vanadium bearing area, in southwestern Colorado, may, for convenience of description, be divided into four districts, namely, the Snyderville, or McIntyre Canon district, the Hydraulic, the Roc Creek and the Vixen or Naturita district.

Whether these districts are but parts of one large area, or are quite distinct, is a mooted question, owing to the entire lack of development or investigation regarding the scope of the deposits except in the immediate vicinity of the Rio Dolores and San Miguel river, where the ore deposits are exposed along the cliffs, or outcrop on the surface. The Silvey Pocket region is of minor importance, but will be mentioned in chapter on "Description of Groups."

The Snyderville Region—This district, commonly known as the McIntyre Canon district, and one of the most important, is located in the western part of San Miguel county on the Rio Dolores between Disappointment creek and McIntyre Canon, and shown on the general map of the district.

It can be reached either from Placerville or Dolores, both on the Denver & Rio Grande Railroad, and from which points it is practically equidistant. From Placerville, the route leads by stage twenty miles to Norwood, thence fifty-five miles by stage again to Cedar, via Lavender.

The trip from Cedar to Snyder's ranch, a distance of some twenty miles, must be made by wagon or horseback, preferably the latter, although the wagon trip may be made during the low water season of the Dolores, without great difficulty.

Where the trip from the railroad to the district is made wholly by private conveyance, entering from the town of Dolores seems to be preferred. This route is the one used for freighting to and from the district to the railroad, the distance being approximately eighty miles.

Hydraulic District—This district lies to the north and west in Montrose county at the intersection of the Dolores and San Miguel rivers, and about six miles south of Mesa Creek. The most available route, at present, is from Whitewater via Copper City, and thence down Mesa Creek.

The nearest railroad point to Placerville, 70 miles, transportation by stage to Norwood, to Naturita, from which point arrangements can be made for stage accommodations to Hydraulic. A contemplated railroad spur, the survey (see Roc Creek district) of which is about completed, will bring this country within close range.

Roc Creek District—The Roc Creek district is situated in the extreme northwest corner of Montrose county, close to the Utah line, some 12 miles northwest of the Hydraulic group of claims, and 15 miles N. E. of Cashin. May be reached by stage from Placerville to Norwood to Naturita, to Paradox, 75 miles, thence on horseback to Roc Creek, 12 miles, or by a better, though somewhat longer route, from Naturita via Hydraulic.

It can also be reached without great difficulty by horseback from Snyderville district, by way of Cashin and Paradox.

A survey is being made at the present time with a view to putting in a railroad spur from Grand Junction, Colorado. This will bring the railroad within two miles of the Copper Prince mine, the route being via East Creek, thence down West Creek to the Dolores river (25 miles below Hydraulic). From this point the road will follow the Dolores on a water grade to Bedrock.

Naturita District—Sometimes known as the Vixen district.

This is probably the most readily accessible district of those considered, being about fifty-seven miles by stage from Placerville.

The deposits here are found along the San Miguel river about 17 miles northwest of Naturita, seven miles south of the junction of Dolores and San Miguel rivers, and present no difficulties in freighting by means of wagons.

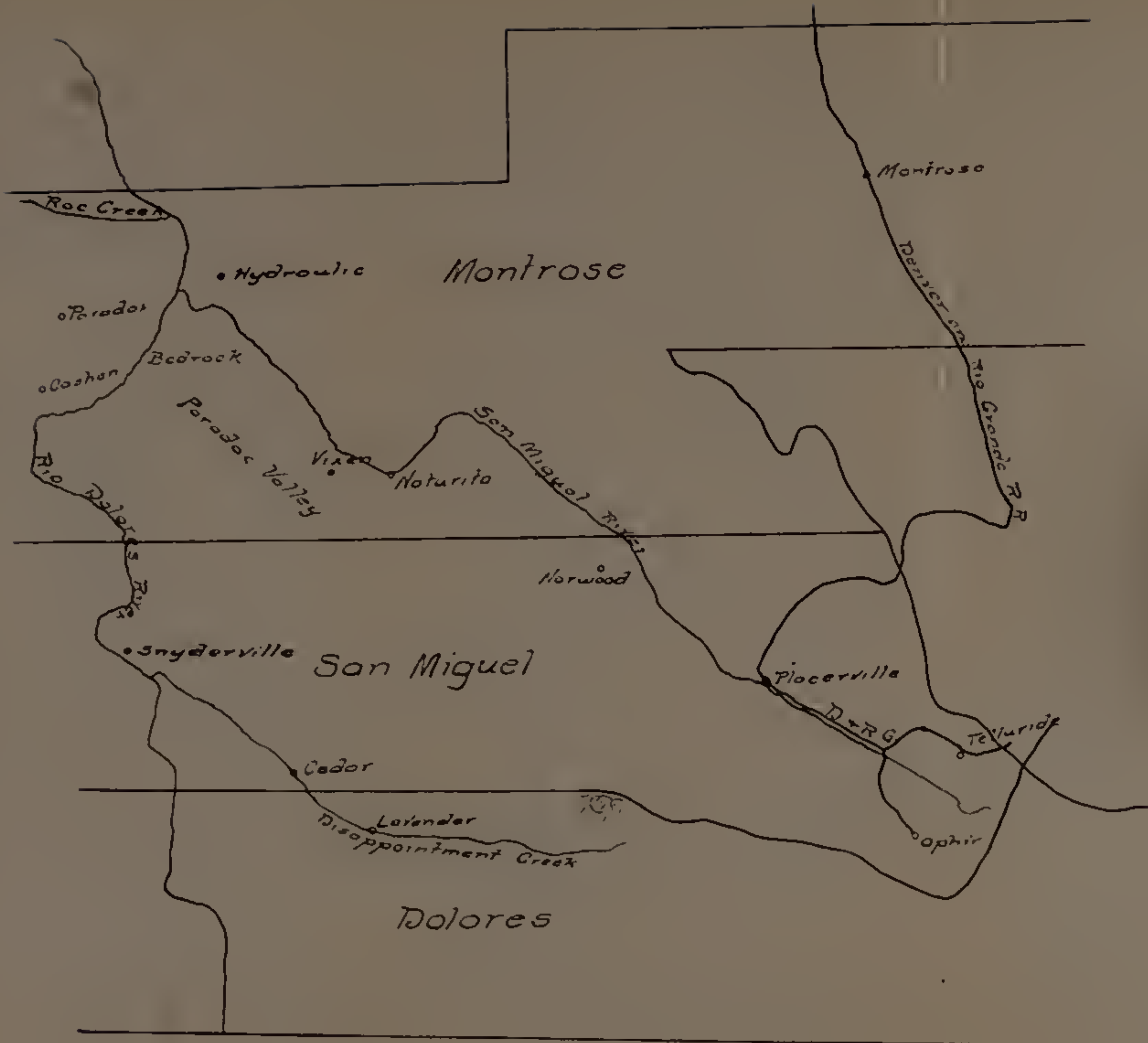
The route from Placerville is by stage to Norwood, to Naturita via Coventry and Pinon.

DESCRIPTION OF CLAIMS.

The deposits of the McIntyre Canon district are divided into three groups, the Lower, the Middle and Upper group of claims. Taking H. C. Snyder's ranch as a central point, the Lower Group, the largest of the three, lies about five miles down the Dolores, the claims lying on the south side of the river and reached therefrom by trail.

LOWER GROUP.

The names of the claims and their principal owners are given in the following:



Roc Creek
Hydraulic
Montrose
Paradox
Bedrock
Coshon
Paradox Valley
Rio Dolores River
Vixen
Naturita
San Miguel River
Montrose
Denver and Rio Grande R R
Norwood
Snyderville
San Miguel
Placerville
D+RG
Telluride
Cedar
Lavender
Disappointment Creek
Ophir
Dolores

Westcott	Carpenter	Crepo	L. Crepo	Silvey
Cougar..............	Dogie..............	Alice...............	Jack Rabbit.........	Buckhorn
Little Joe............	Blue Bell...........	May Day...........	....	....
Maidens Dream.......	Little Sadie.........	Cactus.............	....	....
Last Chance..........	Ruby	Red Cloud..........	....	....

May Day lode. Owner, Crepo.

Located on Jack Rabbit Canon. Shows outcropping of carbonaceous shale bearing carnotite 15 inches thick. This outcropping is capped by 10 feet of sandstone.

The underlying red sandstone shows considerable carnotite stain.

Shale also outcrops near surface in a 5-inch streak.

Several surface workings show the character of the ore and work done.

A discovery shaft 15 feet deep shows the shale to be 12 inches thick. A second opening, 20 feet x 6 feet x 2 feet, shows outcrop again. A 5-ton pile of ore was sampled, No. 4b, giving the following results:

U_3O_8...	1.13%
V_2O_5...	3.29%

A hole 5x3x2, from which a ton of ore had been removed, assayed as follows:

U_3O_8...	3.12%
V_2O_5...	3.15%

Another hole exposed the breast of some low grade ore from which no sample was taken.

Passing around the hillside a small opening exposed the vein for ten feet with small patches of shale varying in width from 12 to 24 inches, and containing considerable values.

The upper contact of white sandstone was slightly streaked with blue and green copper and some vanadate.

Lower contact is white sandstone.

A small tunnel running southwesterly into the hill shows ore 25 to 30 feet below the top.

No. 1 *a* represents sample of ledge and showed following values:

U_3O_8...	.71%
V_2O_5...	2.52%

No. 1 *b* average shale of two small pockets ran:

U_3O_8	.35%
V_2O_5	1.337%

No. 1 *c* average ore across breast not including shale:

U_3O_8	1.67%
V_2O_5	1.98%

Blue Bell. Owner, Carpenter.

This claim shows large open workings in the side of the ledge, the vein 2-3 feet wide showing along the ledge with indications of rich ore.

A number of shallow surface holes all show ore in varying amounts and varying degrees of richness. One large working, 100x40x8 feet deep from which 80 tons of ore had been taken, shows vein one to two feet thick. Sample 4 *d:*

U_3O_8	1.1 %
V_2O_5	2.16%

Alice. Owner, Crepo.

This claim has produced more ore than any other in this group, large open workings covering a space 100x100x8 feet deep indicating that considerable ore has been removed.

A drift 4x3 feet in section follows along the vein of shale in a northwesterly direction 15 feet, thence turns northeast 10 feet.

The vein starting out about three feet in thickness pinches out shortly into two rich streaks.

The ore in the vein shows some copper.

Reference has been made elsewhere in this report relative to the deplorable condition in which the work has been left in the removal of ore in these districts. This claim furnishes an excellent example of this fact.

No. 7 *a*, a sample of the vein in the drift ran:

U_3O_8	.73%
V_2O_5	.56%

Jackrabbit. Owner, Lon Crepo. Located on Jackrabbit Canon.

The streak, which varies from a thin seam to 2½ feet in thickness, shows green and blue copper and uranium stains, the shale showing very little organic matter.

Sample 2 a. shale:

U_3O_8	.07%
V_2O_5	Slight

Greengoods. Owner, A. J. Holmes.

Outcrops on east side of Jackrabbit Canon, showing copper and uranium stain.

Another outcrop lies about two feet thick under a 25-foot sandstone cap, but nearly covered by debris.

Sample 3 a. of vein showed:

U_3O_8	..00%
V_2O_5	2.31%

Just above this vein a ledge of copper vanadate was seen, but no sample was taken.

A pile of ore aggregating 5-6 tons taken from lower vein, represented by sample 3 *b*, gave the following value:

U_3O_8	.74%
V_2O_5	.324%

Cougar. Owner, Westcott.

Located on Cougar Canon.

Surface prospect 4-5 feet deep shows that vein bottom had not been reached.

A pile of 4-5 tons of ore taken from this hole and showing some copper was sampled in 5 *a*, giving:

U_3O_8	.41%
V_2O_5	3.93%

Other workings as follows:

Hole, 5x15x3 and 5 tons ore sampled 5 *b* ran:

U_3O_8	.86%
V_2O_5	1.65%

Two tons high grade ore, 5*c* showed:

U_3O_8	3.94%
V_2O_5	4.35%

Hole containing 12 sacks ore, not sampled, and a fourth hole, 6x5x3, carrying ore which was sampled in 5 *d,* showing:

U_3O_8	.34%
V_2O_5	1.697%

Aside from these a dozen small holes, about two feet deep, were found in a space 100 feet square, all of them exposing ore.

LOWER GROUP, NORTHEAST SIDE.

Georgetown Claim. Owner, P. Dentinger.

These claims running east and west, easily accessible, show ore in the same stratum as the claims on the south side of river.

This shows 5 feet of ore on the top of edge of cliff.

The formation, as would be expected, is the same as on opposite side of river, tho somewhat lower, due to the dip of the strata to the north. Large pieces of float, weighing several tons each, are to be seen on hillside below, as far down as the lower bench.

Just above the cliff a hole 6x6x2½ feet shows a foot of quite rich ore with some copper, with a capping of 1½ feet of white sandstone.

Another hole 20x12x5 feet, sunk on the vein from the outcrop, discloses several very rich pockets.

About 10 tons of ore have been taken from this point, part of which was shipped to Mr. Morrison, and returned a little better than 4%, bringing $47.50 at the railroad.

This ore also carries a little copper.

Samples taken were as follows:

No. 8 *a* average sample of vein at surface of cliff:

U_3O_8	1.07%
V_2O_5	1.49%

No. 8 *b* sample of low grade ore:

U_3O_8	0.41%
V_2O_5	.23%

No. 8 *c* sample of average ore for commercial test:

U_3O_8	2.07%
V_2O_5	1.84%

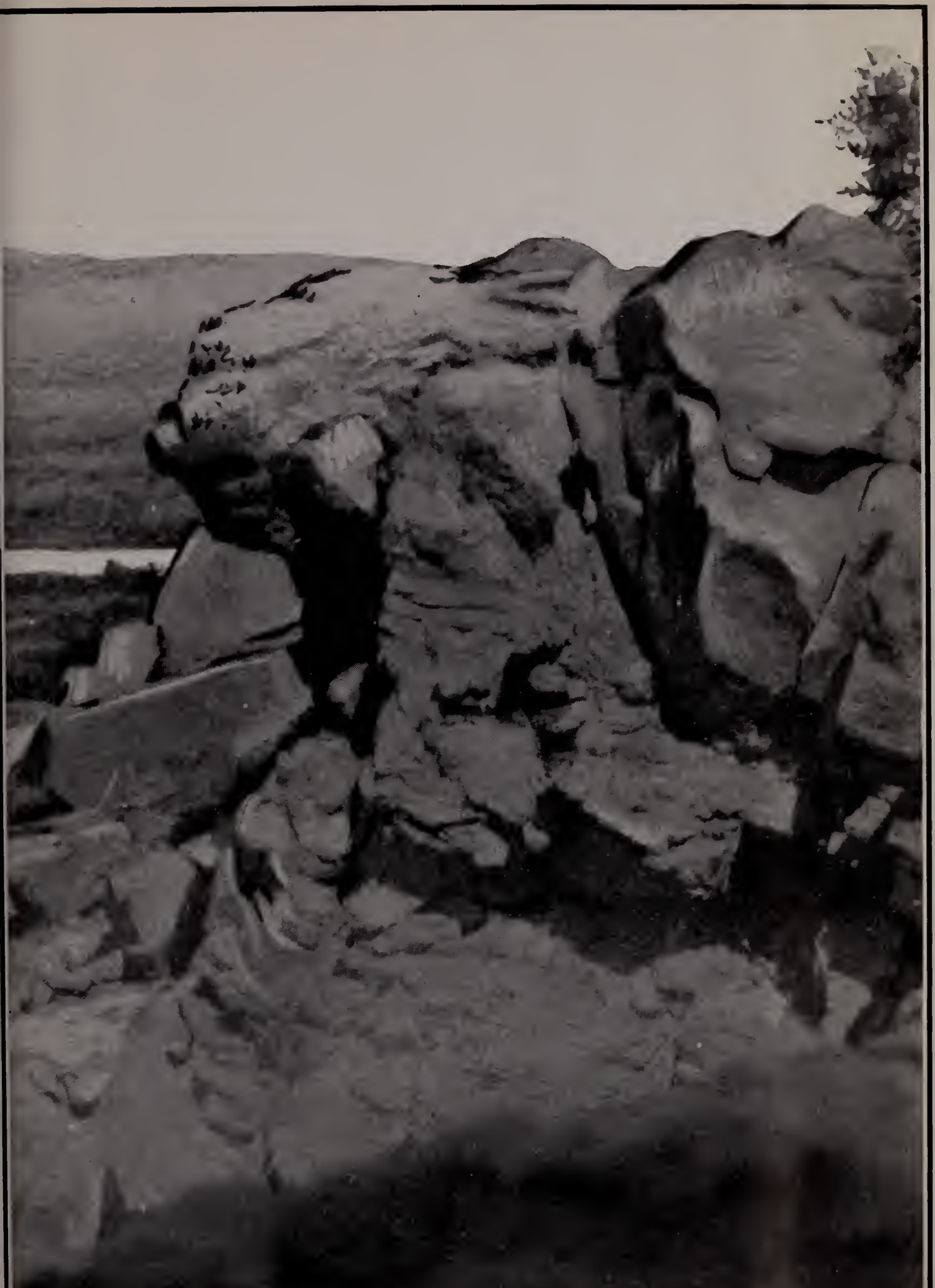


Figure 2.
Five-Foot Ore Body on Top Edge of Cliff.

No. 8 D Sample of high grade:

U_3O_8	8.06%
V_2O_5	4.57%

No. 8 e Sample to be tested for vanadium:

U_3O_8	.53%
V_2O_5	.905%

About 100 feet around the ledge to the east about 3 feet of good ore appears, which pinches out a little farther east.

Four other claims lie on the same ledge to the north of the Georgetown. These show practically nothing but assessment work under the ledge.

The vein at these points is about 18″ to 24″ thick, with 20 feet of sandstone above it.

This gives an approximate idea of the dip of the vein.

Twenty feet below the cliff, on the claim to the north of the Georgetown, the vein shows three feet thick, but breaks off abruptly into the hill, a small seam of shale continuing and carrying values—an excellent illustration of the pinching, splitting and pocketing of these carnotite deposits.

Sample 9 a, from a 2-ton lot on the same vein on claim to north and adjacent to Georgetown, gave:

U_3O_8	1.91%
V_2O_5	2.33%

UPPER GROUP, EAST SIDE.

June Bug. Frank Silvey, Owner.

Fifteen feet above the base of the cliff, one-fourth mile back from the river, and about 60 feet below the upper workings, good looking ore outcrops in sandstone for about 25 feet in length, and 18″ thick at widest part. These claims run about east and west from river.

In the upper workings the breast is opened up about 60 feet. The south breast, about a foot in maximum thickness, shows up for ten feet, pinching to the north.

The ore body in the middle of the workings is about three feet thick, and shows only ten feet in length, ending abruptly.

In the north workings the body reaches a maximum thickness of 10 feet, pinching out to the center, barren sandstone projecting out between the two.

Claim shows about 25 tons of ore piled up for shipment.

Along the cliff, vein shows about 20 feet capping of sandstone.

No. 10 b sample of south workings:

U_3O_8	1.79%
V_2O_5	2.28%

No. 10 c sample of central workings:

U_3O_8	1.37%
V_2O_5	3.83%

No. 10 d north workings:

U_3O_8	.605%
V_2O_5	1.9 %

No. 10 e sample of dump:

U_3O_8	.98%
V_2O_5	.566%

UPPER GROUP, SOUTH SIDE.

Rattler. H. Snyder, Owner.

One-half mile back and 200 feet above river.

Opened up on surface, showing about two feet of good ore.

Sample 16 a, giving

U_3O_8	5.07%
V_2O_5	3.39%

shows average ore from a hole 12x12x3.

Vein is seen outcropping all over the claim.

The discovery shaft shows ore 1 foot wide across the breast.

A hole from which 20 tons of good ore were packed to the mill shows the ore exposed for 20 feet, other points showing ore 4 feet thick at the surface.

Silver Tip. ———, Owner.

Shows croppings and a circular excavation 20 feet diameter, 4 feet deep. Dump shows 12-15 tons waste and low-grade ore.

Map
Lower Group
Claims

sto

$\frac{U_3O_8}{V_2O_5}$

$\frac{U_3O}{V_2O}$

$\frac{U_3O}{V_2O}$

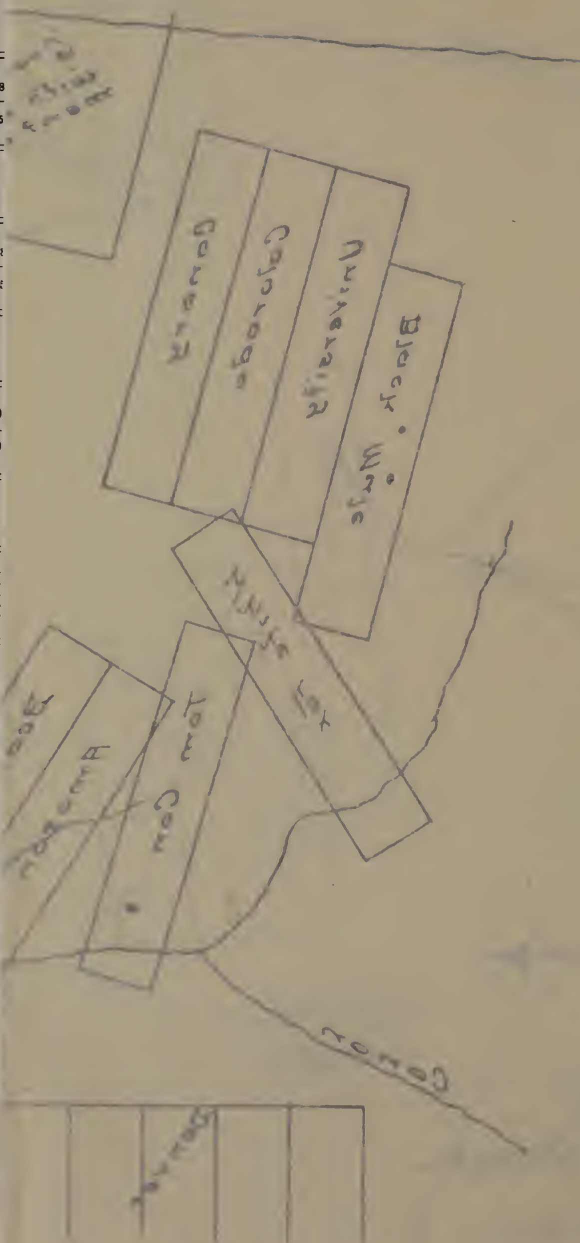
$\frac{U_3C}{V_2C}$

$\frac{U_3}{V_2}$

s]

n
4

4



Sample 17 *a* represents about the best of the ore taken out.

U_3O_8	2.07%
V_2O_5	2.24%

Baby. Owner, H. Snyder.

Vein outcrops at east end, dipping toward the east.

A capping of hard sandstone increases in thickness toward the west.

Ore shows up on both north and south sides, but appears to be of quite low grade, and no sample taken.

Grand View. Owner, Dolores Refining Company.

This claim, adjoining the Baby, has a southeast opening 8x10x3, showing ore.

The vein here has a strong dip to the east.

An opening on the surface about the center shows a streak 1 foot thick.

On a line with the center opening a cut 15 feet long x 5 feet x 6 shows a cropping of ore stained with iron. This, which is merely a topping streak, then dips down under capping.

No. 18 *a* A sample of this ore ran:

U_3O_8	.76%
V_2O_5	1.64%

Bear Cat. Owner, C. H. Snyder.

Ore shows at several points on the surface.

A cut 2 feet wide and 12-15 feet long, shows where good ore had been removed.

The largest opening, 20x10x3, from which 4 tons of sorted ore, said to run 4.4% U_3O_8 and 5% V_2O_5, were shipped, still shows good ore exposed.

Several piles aggregating 15-20 tons of low grade to medium grade ore were noticed.

No. 19 *a* Sample of dump carried:

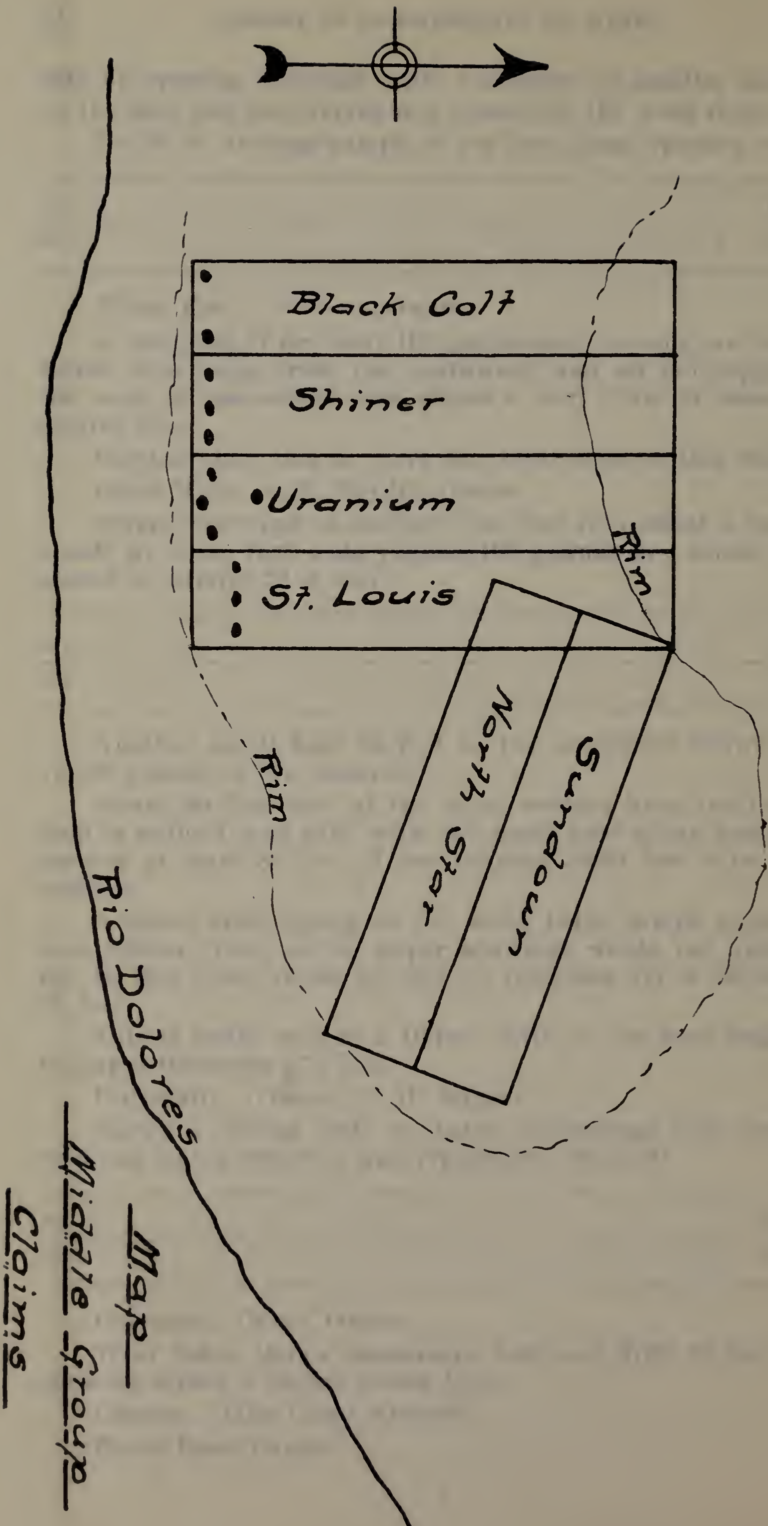
U_3O_8	2.23%
V_2O_5	2.59%

Tom Con. ————, Owner.

Assessment hole 20x6x5 shows no ore, but vein outcrops a short distance away.

10-12 tons of fair ore on dump.

An opening 15 feet in diameter and 5-6 feet deep, showing ore 2 feet thick with a small pocket of rich material on the south


Black Colt
Shiner
Uranium
St. Louis
North Star
Sundown
Rim
Rim
Rio Dolores
Map
Middle Group
Claims

Assessment hole shows streak 12 inches across face.

Above this a split followed by 2 feet of ore.

Ore outcrops on surface.

A second vein shows 20 feet above the one mentioned.

MIDDLE GROUP.

Sundown. Wren Crepo, C. H. Snyder, Owners.

Vein outcrops in several places from 6 to 10 feet below surface along a west exposure, one outcrop showing small pocket 15 inches thick, of very irregular ore, which branches out into two distinct streaks with barren rock between.

8-10 sacks of high grade have been taken out at this point.

Ore almost pinches out at a distance of 10 feet, widening again a few feet to north.

An outcrop on the surface 30 feet back from river, above opening just described, shows some copper stain.

Sample 11 *a*, so-called vanadium ore, ran:

U_3O_8	2.07%
V_2O_5	2.41%

Sample 11 *b* showing spar:

U_3O_8	.82%
V_2O_5	.67%

Sample 11 *c*, representing sacks noted above, ran:

U_3O_8	21.88%
V_2O_5	8.79%

Sample 11 *d* outcrop on surface gave:

U_3O_8	2.38%
V_2O_5	2.675%

North Star. Stevens, W. Snyder, Hall, owners.

Ore opened upon east face for several feet, at point about 100 feet below top, very irregular for 30 feet, consisting of stains and streaks of varying thickness, in sandstone and one or two small shale pockets.

Some high grade ore showing; about 5 tons of ore on the dump; sample 12 *a* running:

U_3O_8	.05%
V_2O_5	2.41%

St. Louis. H. Snyder, T. Francis, owners.

Shows several openings on the top edge of east rim; hole, 10x10x10, made by following the outcrop, which is 2 feet wide in widest part, and from which sample 13 *a* showed:

U_3O_8	.78%
V_2O_5	.85%

The cap rock varies from 5-10 inches in thickness.

The material from the outcrop, 50 feet south of these workings, will average about the same.

From an outcrop 100 feet south of the main workings 10-15 sacks of high grade ore were removed.

The outcrop on the rim on the opposite side of all the claims here seems to prove the continuity of the deposit throughout the bench.

Seventy-five tons of ore lying at the mill in 1902, taken out of 8 holes on these claims, show some carbonate of iron.

Uranium. Crepo, owner.

The opening, beginning on the east rim at the surface, runs back some 200 feet into openings from which considerable high grade ore was taken. The sandstone capping varies from 1-3 feet in thickness.

No. 14 *a* running U_3O_8, 2.03%, V_2O_5, 2.05% represents an average of the ore.

In some places the ore was just uncovered, none of it being worked, except 8 sacks sent to Morrison. The ore will average 2 feet, running in some places as high as 4 feet in thickness.

Shiner. Stephens, W. Snyder, Hall, owners.

This claim shows largest amount of workings of any in this group. The vein dips slightly from the Uranium toward the east rim, at which point the workings begin some 5 to 12 feet below the surface. Here the vein is about 6 feet thick, narrowing to a pinch at a point 35 feet back from the edge and 40 feet south of this point.

No. 15 *a* is a sample of the first ore pile consisting of 20 tons:

U_3O_8	.87%
V_2O_5	1.08%

The workings cover a distance of some 125 feet in an east and west direction and 60-70 feet in a north and south direction, considerable barren rock showing up in spots.

No. 15 *b*, to be tested for vanadium, contained:

V_2O_5	1.41%
U_3O_8	1.06%

A second pile of some 50 tons of ore showed a number of pieces of rich stuff, of which 16-20 tons were shipped to New York.

A pile of eight tons of good grade, coming from the apex of the workings 125 feet back from the vein, was sampled in 15 *c*, showing:

U_3O_8	2.89%
V_2O_5	3.98%

Black Colt. Stevens, W., Snyder, Hall, owners.

This is opened at two points on the surface in the east rim.

From the workings, which are insignificant, about one ton of 2 per cent. ore has been taken out.

The vein outcrops again on a crag facing the south, an opening 10x15 showing mostly stained sandstone.

The Ethel and Martha claims.

Located on the Horse Range, eight miles south of H. Snyder's ranch.

Show a vein 4 feet wide with vertical walls and filled with drift. Strike of vein N. 50° E.

A big hole in the southeast wall show a split in vein, which at this point has a width of ten feet, with one wall not uncovered.

In and around the Ethel claim were several small openings, disclosing uranium stains and also the golden plates of copper uranate.

Dolores. G. and H. Snyder, owners.

Located on the west cliff of the east side of Horse Range canon, and about six miles west of the other groups.

On this same rim were four more outcrops, while another outcropping, about one and one-half miles east, was sampled in 23x, giving:

U_3O_8	9.45%
V_2O_5	6.43%

SILVEY POCKET DISTRICT.

Located about twenty miles northwest of Snyderville and ten miles south of La Sal district.

The veins, two in number, were about four feet apart, and in a hog back formation, in which the strata sandstone and shale were uptilted to an angle of 45°.

The hogback runs about northwest and southeast.

A ten-foot drift exposed the two veins mentioned above.

A shaft on the property, 50 feet deep, was not examined.

The dump material and surface showings disclosed a small amount of copper and green mineral incrustation.

Between Silvey's Pocket and the Hammond ranch several outcroppings of carnotite were noticed.

Sample 25 *a* average of the two veins gave:

U_3O_8	.66%
V_2O_5	2.90%

Sample 25 *b*, green mineral incrustation, gave:

U_3O_8	Trace
V_2O_5	.15%

ROC CREEK DISTRICT.

Mr. E. C. Hamilton has four claims—the Dewey, the Copper Prince, Vesuvius and Volcano.

Other claims are owned as follows: Three by Mr. Titcomb, four by Wm. Zowe, four by Mr. J. B. Manning.

This group lies in the third rim above the rolling ledge which characterizes the Snyderville region.

Six miles north of Roc Creek are to be found a number of carnotite croppings.

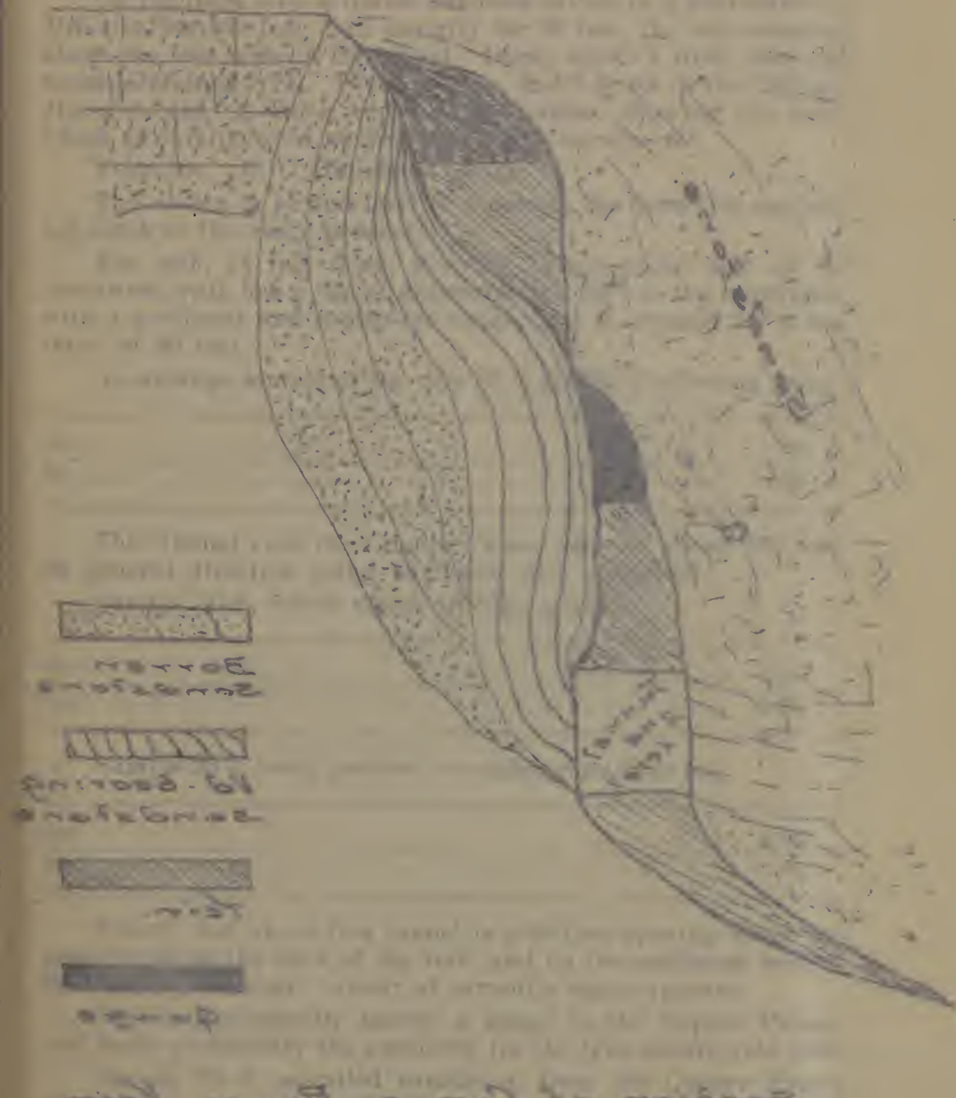
Copper Prince. E. C. Hamilton, owner.

The formation here is peculiar.

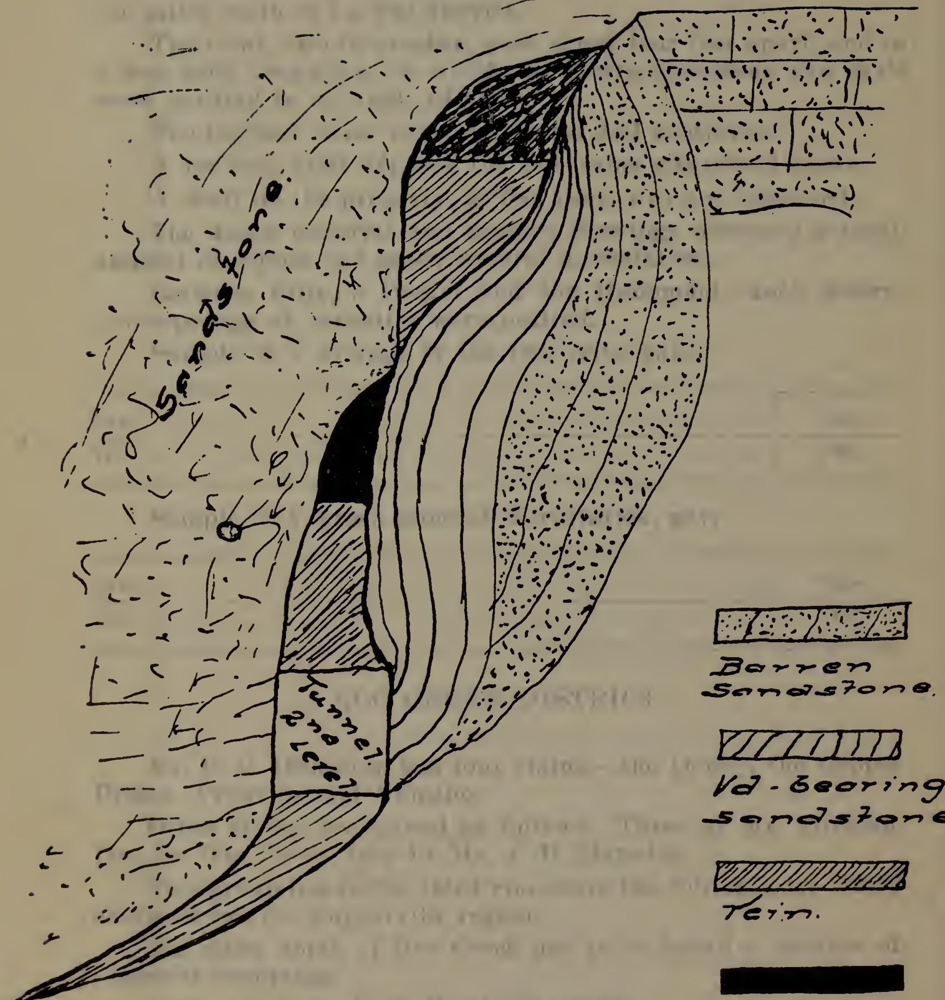
The nearly horizontal sandstone has been cut by a fault plane running nearly east and west.

The ore is found in the hanging wall intimately mixed with finely crushed sandstone, and is worked on four levels.

Outside of the fissure the uranium appears only as a stain on the sandstone.



Section of Copper Prince Vein



Section of Copper Prince Vein.

On the fourth level the vein is opened up by a ten-foot tunnel, in a green talcy formation, no values showing.

The vein here is shown in a small seam on one side, then a split, followed by another streak of soft vein matter.

On the third level a tunnel has been driven in a northeasterly direction for 100 feet, then easterly for 60 feet, the vein showing about one foot wide in the breast. Dump shows a little iron and uranium-stained rock. There are two small drifts in the 100-foot distance, one of which ends in an upraise, showing the vein, which at this point is narrow and shows no mineral.

Vesuvius. E. C. Hamilton, owner.

This shows in second level in a tunnel, the carnotite containing much of the rusty product.

The vein, 2½ feet thick, showing on the upper side of the northwest wall, has a dip of approximately 25° to the northwest, with a northeast and southwest strike, and is exposed for a distance of 50 feet.

An average sample of the vein 30 *a* gave the following assay:

U_3O_8	.76%
V_2O_5	.12%

This tunnel cuts the Copper Prince vein at about 200 feet, its general direction being northeast and southwest.

Sample 30 *b*, 5-inch streak of high grade:

U_3O_8	3.02%
V_2O_5	1.15%

Sample 30 *c*, rusty product, so-called vanadium ore:

U_3O_8	1.26%
V_2O_5	.70%

Twenty feet above this tunnel is a 60-foot opening which appears to be on the apex of the vein, and on the southeast wall of this opening the rusty variety of carnotite again appears.

This is undoubtedly merely a gouge in the Copper Prince, and in all probability the authority for the true fissure vein idea.

Sample 30 *d*, so-called vanadium, from the Copper Prince gave:

U_3O_8	3.04%
V_2O_5	1.95%

Workings on the northeast side of the hill, probably the Dewey claim, shows the vein to have the same general dip and strike, a ten-foot drift northeast and southwest, showing some copper, but apparently no uranium.

This sample, 31 *a*, on analysis ran:

U_3O_8	.09%
V_2O_5	.05%

A similar opening 10 feet long, about 25 feet away, shows nothing.

A 10-foot drift into the hill east of point just described and on same level showed a green stained sand rock, but no vein and apparently no uranium.

A sample of this green rock 32 *a* gave:

U_3O_8	Trace
V_2O_5	.11%

while 100 feet farther east and on same level a good looking green sand rock outcrops.

Going east 50 feet more and 20 feet below this point a dump from a 10-foot drift shows a great deal of blue and green copper stained sand rock; one hundred feet east and 30 feet lower than last point shows another prospect exposing copper and possibly uranium stained rock.

One hundred feet below this exposure, a 3-foot bed of shale was discovered in a 10-foot drift, while limestone rock in a blanket vein was also noted. Stake shows this to be on the Dewey lode.

Fifty feet below the above, a shaft was sunk for 10 feet and crosscut run, but nothing found.

At this point the strata dip sharply to the north with an east and west strike.

To the east of shaft about 40 feet is a drift 50x7x5, which exposes a vein 2½ feet thick dipping to the southwest 45°, and having a northwest and southeast strike, and which contains streaks of green fiber with blue and green nodules, but no uranium.

Sample 34 *a* of this vein ran:

U_3O_8	.38%
V_2O_5	.27%

Calvert Lode. This lode has a northeast and southwest strike and almost vertical, the uranium appearing on the southest hanging wall as a scale, and above this a crust of soda was noted.

Map
Upper Group
Claims

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Sample 35 *a* uranium ore gave:

U_3O_8	1.49%
V_2O_5	4.53%

Seventy-five feet above, a 10-foot drift, which had been subsequently filled in, gave no indications of ore.

On the opposite side of the Calvert draw, to the west, is to be found the Calvert lode tunnel, the dump showing green stained sand, and bearing some resemblance to the Placerville vanadium ore. The tunnel runs south 40 feet, then turns to southwest 110 feet, showing a green material in the breast.

One hundred feet above this, another tunnel (Sierra Grande mine), running south 15 feet, then southwest 60 feet, then 20 feet toward west, shows considerable copper and uranium on the dump, nothing but a streak of limestone being visible in the tunnel. Aside from the copper and uranium on the dump, ½ sack of sorted ore gave the only other indication of mineral at this point. Several shafts, 20-60 feet deep, on hill over the saddle and directly north of Sweitzer ranch, show good copper, but no uranium indications.

HYDRAULIC DISTRICT.

General habitus of these claims similar to upper and lower west side groups at McIntyre canon.

Belmont. C. R. Clark, owner.

Located about 6 miles from Hydraulic, on the west side of the rim about 1000 feet back from river and 200 feet above bench; several exposures on the ledge about 30 feet below the top; an irregular streak to the south, 60 feet long, by 2 feet in the widest part was sampled 36 *a*

U_3O_8	.89%
V_2O_5	.18%

About 60 feet farther on, and at the same level, the streak one foot wide is again exposed for 10 feet.

Sample 36 *b* of this streak ran:

U_3O_8	3.84%
V_2O_5	2.59%

About one ton of ore on the dump copper stained.

Bonnie Bell. C. R. Clarke, owner.

Located 1000 feet above, east of Belmont in a small draw; vein shows up around the rim 7 feet below top as a loose rich appearing drift, which at times runs into the solid formation; this vein shows for 35 feet or more, varying in width from 2½ to 3 feet; one hundred feet around rim to the south, vein outcrops, the sandstone showing considerable uranium stains.

Sample 37 *a*, gave:

U_3O_8	3.6 %
V_2O_5	3.16%

This claim shows several tons of rich ore in sight.

Boston. C. R. Clarke, owner.

Has a northeast and southwest direction, and directly over the San Miguel river, shows one opening on the side of the rim 20 feet below top, the ore occurring in a shale and impregnating the overlying and underlying strata of sandstone; vein, badly broken by splits, is 2½ feet at widest part, pinching out in about 25 feet, and showing some very rich ore in places.

Sample 38 *a*, average of vein:

U_3O_8	5.53%
V_2O_5	5.63%

30 feet farther on the vein widens, showing a pocket 10 feet by 2 feet wide on the average, then pinches again to open up a few feet distant into a streak 15 feet long.

Continuing around the ledge considerable float is noted.

Riverside. C. R. Clarke, owner.

Claim runs northeast by southwest. Outcrops and float can be seen at various points around the rim from the Boston to the Riverside opening, which shows assessment work in a 40-foot drift running northwest, at which place only a few pieces of ore appear.

D. U. No. 1.

Claim runs northeast and southwest, and is directly north of Belmont claim.

Ore outcrops in several places on the surface, appearing in rich pockets; but one of the outcrops is shaly in character.

Sample of this outcrop 39 *a:*

U_3O_8	3.93%
V_2O_5	4.5 %

Under this outcrop and 20 feet below the west rim is a showing of low grade shaly sandstone showing a pocket 10x1 ft.

thick; an outcrop on the ridge of ledge shows streaks and stains in the sandstone.

It should be mentioned that the 300-foot side faces the river, and the claims run back into the hill.

Great Bend. C. R. Clarke, owner.

This claim runs east and west, and is about ½ mile north of D. U. No. 1.

Shows ore in one place two feet thick, for a distance of 8-10 feet, about 20 feet below the rim; vein poor, almost barren, with no more than a few stains.

About 100 feet west and 12 feet below the rim, a showing 12 feet long by two feet wide was sampled in 40 *b*, giving:

U_3O_8	4.00%
V_2O_5	3.65%

Average of about 1000 lbs. ore 40 *a:*

U_3O_8	6.28%
V_2O_5	4.24%

Dolores.

Runs north and south facing river; shows ledge 50 feet long and 4-5 feet maximum width, with a good showing of ore body, while 30-40 feet below rim a great deal of heavy float can be found.

Sample 41 *a* of ore body ran:

U_3O_8	.69%
V_2O_5	.98%

Hydraulic.

Claim runs north and south, with 300 feet face on west rim toward river; the ore body, which is very irregular, is 4 feet wide in widest part and 20 feet long, showing the bright yellow ore and green ore (similar to Jackrabbit).

Sample 42 *a* main ledge ran:

U_3O_8	2.16%
V_2O_5	2.57%

Grand View. Three-quarters of a mile northwest of Hydraulic claim.

Runs N. E. and S. W., about 4 feet thick at maximum, but irregular, and showing for about 15 feet.

Sample 43 *a:*

U_3O_8	.79%
V_2O_5	6.035%

Talbert. C. R. Clarke, owner.

Faces northeast and southwest on river, and, like previous lode, is on a sloping hillside, probably 100 feet long, with a ledge above, and also sandstone ledge at foot of the 100-foot hill; the ore which is found in ledge about 15 feet below rim shows several sacks of high grade to have been removed; a main cut of 10 feet into the sandstone ledge shows up a rich pocket. From this point the ore runs irregularly to the southeast for 100 feet, the width reaching 1½ feet. The dump shows some rich stuff from a pocket carrying the green ore.

Sample 44 *a*, sample of face, including rich pocket, ran:

U_3O_8	5.71%
V_2O_5	4.29%

From this pocket on to the southeast the ore shows low grade.

EAST SIDE CLAIMS.

O. K. C. R. Clarke, owner.

Several hundred feet above river, facing east.

A 6x1 ft. showing of ore 15 feet under rim, carrying traces of copper, sample 45 *a:*

U_3O_8	2.21%
V_2O_5	4.83%

Sample 45 *b* gave:

U_3O_8	3.18%
V_2O_5	1.25%

From this point a streak of ore shows persistently around to the next claim.

Traces of copper noted around the rim, one opening showing copper ore, uranium ore and copper vanadate in a vein 20 feet by 12 inches; also a rich pocket.

Sample 45 *c* average from a 50-pound lump, ran:

U_3O_8	.90%
V_2O_5	1.64%

This ore is covered by a 5-foot cap rock, which increases in thickness due to slope of hill.

A number of outcrops can be seen in a small gulch about the center of the claim.

I. X. L. C. R. Clarke, owner.

Parallel to O. K. claim; ore shows up on east rim in streak, with a number of stringers; 40 feet away it widens to an irregular pocket, 6x1 foot. On the edge of a gulch, and on the surface, 20 sacks of high grade were taken from a hole 20x15x4, carrying some copper; gulch shows a great deal of float, and up near head a good outcropping.

Sample 46 *a*, green copper vanadate ore, ran:

U_3O_8	.37%
V_2O_5	1.18%

Another outcrop was noted on the surface at northwest corner of claim.

Valley View. C. R. Clarke, owner.

Located on a deep draw, running south from river, claim facing draw on the east.

First showing of ore is in a streak in sandstone and shale up the canon, and increasing from 4 to 20 inches in a distance of 12 feet.

Sample 47 *a*, picked sample ran:

U_3O_8	3.26%
V_2O_5	3.18%

The main workings, which are at the discovery point, run 70 feet south on the draw, and show two streaks, with split between, the upper streak, about 12 feet long, showing copper.

Sample 47 *b*, average:

U_3O_8	.71%
V_2O_5	2.47%

This sample includes a third streak a little above the other two and about 6 feet below the rim.

Good Luck. C. R. Clarke, owner.

Ore occurs under a mushroom of sandstone in a poor streak.

Sample 48 *a*, from southwest side, and 10 feet below rim of mushroom, ran:

U_3O_8	2.05%
V_2O_5	1.88%

Good Will.

Located on Hydraulic creek, facing east.

Runs east and west. Workings consist of a tunnel driven 12 feet along the vein, which shows at tunnel roof, and 4-6″ wide.

Shows about 10 feet of cap rock to rim.

Sample 49 *a:*

U_3O_8	1.01%
V_2O_5	1.9 %

High Point.

Runs north and south on a bluff dividing the canon, the only indications of ore being in a 12x5″ streak, 20 feet below the rim, and which carries a little copper and uranium.

Leap Year.

Shows very little, a 10-foot face exposing a streak of greenish ore, which material also forms a considerable part of dump.

Sample 50 *a* of ore, gave:

U_3O_8	.30%
V_2O_5	1.1 %

Gulch Lode.

East side of canon proper; shows a very little ore, but exposes a pocket of coal, from which sample 51 *a* was taken.

The ore itself is a greenish impregnated sandstone.

On the hillside a 5″ streak of greenish ore outcrops for 3 or 4 feet, while 50 feet north and lower, a similar showing occurs.

D. U. Claim No. 4.

Workings on this claim consist essentially of a tunnel 60 feet long, running northeast from the east side of Hydraulic creek canon.

To the north of the tunnel opening, ore shows along the irregular face of the rim for 10 feet, varying in thickness up to 1 foot.

The dump shows considerable waste mixed with some good ore.

Top of tunnel to north shows streak of excellent yellow ore one foot thick, the cap rock being about 50 feet thick.

Five years ago some 31,000 pounds of this ore were shipped to Cashin.

Sample 52 *a*, taken across the breast of the tunnel, ran:

U_3O_8	.69%
V_2O_5	2.15%

D. U. No. 5.

Northwest and southeast. A tunnel 50 feet under the rim runs in 10 feet, showing a pocket 1½ feet wide on either side, but pinching out in 10 feet into a low grade shale. Face of vein a talcy formation.

Sample 53 *a*, average of ore:

U_3O_8	2.52%
V_2O_5	2.798%

D. U. No. 6.

Northeast and southwest on east side Hydraulic Creek Canon.

Ten sacks high grade ore, 17½% U_3O_8, are said to have been taken out of this claim (Woodbury).

Blasting into the rim for 12 feet has exposed a splendid showing of ore for 20 feet in an irregular stratum 2 feet wide at widest part.

This lode is 75 feet above others on this rim.

Sample 54 *a*, taken across the breast, ran:

U_3O_8	1.87%
V_2O_5	2.85%

D. U. No. 3.

This property, just acquired by Haines, shows several 6-inch streaks several feet in length, and 15 feet below rim.

D. U. No. 2.

Northeast and southwest. Main workings show a 10-foot hole in rim 5 feet below surface, where the ore outcrops in two places, the vein showing about two feet wide, but pinching down shortly to two inches; sandstone above shows stains for several feet above vein.

Sample 55 *a* across breast:

U_3O_8	1.17%
V_2O_5	1.48%

To the north of the main workings, the cap rock has been removed, exposing a 7-inch shale carrying much yellow ore, while around the rim, for 100 feet, ore shows up in low grade streaks. Directly opposite on the other side of canon (100 feet east) and on same level, appears an 18-inch streak of low grade material.

Cave Lode.

Located about one-half mile back from river on a sloping hillside and running southeast and northwest, shows a tunnel driven 10 feet south and 16 feet southeast, with a low grade streak 18 inches wide showing at the mouth; several hundred pounds of low grade ore on dump.

Sample 56 *a*, taken across the face, ran:

U_3O_8	.45%
V_2O_5	.87%

Majestic.

Five feet of cap rock over a 5-10-inch streak, sample 57 *a* being made of ore across the breast; this sample assayed:

U_3O_8	1.87%
V_2O_5	2.85%

Five tons of medium grade ore on the dump and some workings on west rim of table constitute the showing on this claim.

Mountain Beauty. C. R. Clarke, owner.

This property shows workings on the east side of the table, 15 feet below rim; a working to the southeast which has two or three tons of good ore on the dump; a 10-foot drift sunk in 20 feet under rim, showing 2 feet of good ore, and from which place 44 sacks have been taken and shipped (Woodbury).

The material on the dump also came from this hole.

Streak varies in width from a thin seam to one foot thick for a distance of 50 feet southeast; 90 feet northwest of the main workings a tunnel driven in a westerly direction shows ore at the top of the north wall for a distance of 20 feet from mouth, while at the bottom of the same side a 2-foot streak shows only stains for some 10 feet. At a point 35 feet from entrance it widens again on both sides, only to pinch out some 25 feet farther on. The face of the drift shows a thin seam.

Map
Hydraulic
Claims

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V_2O_5.....	

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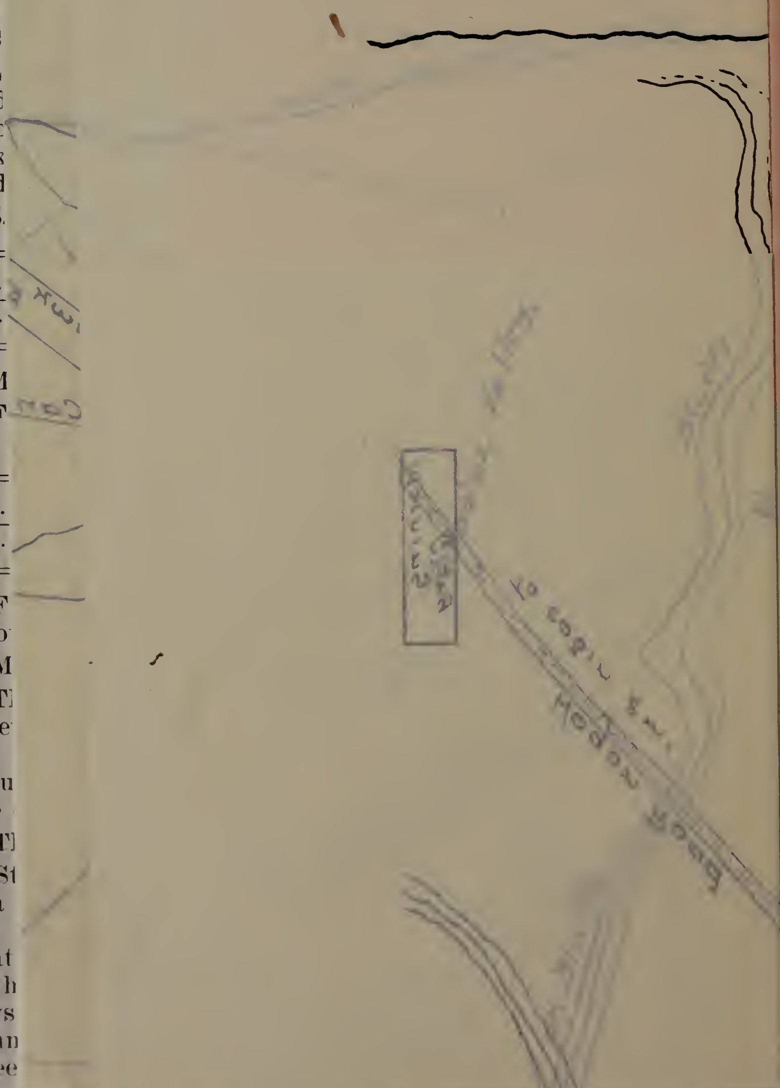

the continuation of the vein seen on both sides of tunnel. Seven and one-half tons of sorted ore from this tunnel formed part of an 8-ton lot shipped to Woodbury.

Sample 58 *a*, an average sample of the ore body and streaks, ran:

U_3O_8	3.49%
V_2O_5	6.19%

In addition to this showing, a number of outcroppings extending from the mouth of the tunnel to a point 150 feet north can be seen, several of which show good yellow ore.

Montrose. C. R. Clarke, owner.

Vein continues under a point projecting out about 300 feet, showing at one point a streak of ore 1 foot thick and 5-6 feet long, while at a second point it shows 18 inches thick and 7 feet long.

Sample 59 *a*, an average of two places, ran:

U_3O_8	3.21%
V_2O_5	3.72%

A 10-foot hole shows an ore pocket with 200 pounds on the dump; several surface croppings, croppings on face of ledge and a streak 25 feet long varying in width from a few inches to two feet and exposing several small pockets of high grade, constitute the remainder of the observations on this claim.

NATURITA OR VIXEN DISTRICT.

Maggie C. Marcus Peterson, owner.

Claim runs east and west. In some places a cap rock ten feet thick covers the ore body. On the south side five openings have been made, several running clear across the claim, and all of them showing ore which in places is two and three feet thick, and would pass for high grade; a hole 50 feet back from the south side shows three feet of cap rock removed, exposing good ore body one foot thick, while a similar opening 50 feet to the west of this also shows ore. All of the dumps show ore. A hole six feet deep, 100 feet back from south rim, shows four and five feet of good ore on the south side of hole, and two feet of shaly ore on the north side (bottom of vein not reached on this side); hole 150 feet back from south side exposes ore at grass roots, with 200 pounds of ore on dump, while another hole 6x6x2, near this, shows low grade ore at surface; hole 7x3x1-3 deep, 200 feet back from south rim, shows high-grade ore on the dump and in place, and 50 feet farther north another small opening reveals a little medium-grade ore.

One hundred feet east of this line of holes, which extends clear across the claim, is the main working, consisting of an open cut ten feet deep, into the face of the rock, which shows no ore on face, but on the floor of the cut considerable high grade ore can be seen, and one very rich pocket in particular, exposing a vein two and one-half feet thick.

Dump contains one-half ton of remarkably good ore.

Sample 60 *a*, average sample across the drift, ran:

U_3O_8	4.91%
V_2O_5	3.06%

An opening 150 feet east of the center, and 20 feet long in the south side of a small gulch, shows ore vein one-third feet thick all around the breast, and a ton of good ore on dump, while another hole, 10x5x4, to the west of center 50 feet, shows several hundred pounds high grade ore on the dump and two feet of ore around the hole, very rich in spots. A shaft in the center of the claim, twelve feet deep, shows the ore bearing sandstone five feet thick.

About 400 pounds of sorted ore at the surface was noted here, the dump being sand rock with uranium stain.

Sample 60 *b*, taken across the south face, gave:

U_3O_8	1 83%
V_2O_5	1.75%

A shallow hole 10x8x1½ feet, 50 feet south of center, shows one-half ton of very good ore; trench 6x2x3 feet deep, at a point 100 feet southwest of center, exposes three feet of ore; trench 125 feet southwest of center, 6x2½x2 deep, shows 200 pounds of good ore on dump and exposed three feet of ore on south side.

Sample 60 *c* represents grab sample from ten holes on this claim, and probably an average of the sortable ore.

This assayed:

U_3O_8	2.74%
V_2O_5	1.46%

Lucky Monday. Marcus Peterson, owner.

This is a prolongation of the Maggie C.

Ore shows in two places on the south ledge, with about eight feet of reddish stone between; the lower level is pockety and low grade; upper level has six feet of cap rock, and shows ore for a distance of 50 feet, which on the face of the drift shows about 15 inches thick.

Sample 61 *a*, average sample across face of drift, ran:

U_3O_8	.87%
V_2O_5	1.49%

From this point to the west on the claim, and at about the same level, good outcroppings can be seen at short intervals.

Homestead. Marcus Peterson, owner.

Runs southeast and northwest. Main workings show a ten-foot face in the rim of hill, about the center of the claim, which shows about three feet of cap rock and one foot of ore, the west side of the drift exposing a pocket four feet thick at thickest part, the east side pinching to six inches.

Most of the vein is slaty, and dump shows about three tons of slaty and slaked rock.

Sample 62 *a*, average across the west wall, ran:

U_3O_8	2.01%
V_2O_5	3.498%

Several workings east of the main workings all show ore on dump, but bottoms being generally filled with drift, very little ore in place was revealed. The farthest work to the east was done on a trench 2x5x12, which shows a ton of low-grade ore on the dump.

Thirty feet to the northwest of center shows a small hole with 100 pounds of high grade on dump.

Ida M. Marcus Peterson, owner.

Runs northeast and southwest. Located on a cliff which runs in same direction as claim. A ten-foot open cut into the cliff shows cap rock to be ten feet thick, below which is to be found two and one-half to three feet of more or less stained sandstone, then eight inches of shaly material, with interruptions caused by sandstone splits.

Sample 63 *a*, average across breast, ran:

U_3O_8	3.42%
V_2O_5	1.80%

Twenty feet north of the rim a shaft fifteen feet deep shows nothing, while thirty feet farther north the hill slopes in a northerly direction, and a five-foot cut shows eight inches to one foot of ore in the breast, which was sampled in 63 *b*, giving:

U_3O_8	2.50%
V_2O_5	2.49%

Hawk Eye. Owner, Hutchins.

Lies to northwest of this group in Saucer Basin.

According to Maitland, the claim is similar to the Ida M., but the ore is of a little better grade.

A sample obtained of the Hutchins ore was assayed and gave:

U_3O_8	2.24%
V_2O_5	2.05%

New Century. Marcus Peterson, owner.

Runs north and south on the east side of a gorge. At one point a pocket 3 feet thick shows under a rock, while 7 feet back from the rim of this rock appears a 2-foot streak of stained sandstone, capped by a flat sandstone rock. Another pocket of 2 feet of shaly ore is seen on the hillside, which slopes upward toward the east. The extent of this pocket was not determined, as terminals were covered with drift on one side and rock on the other, but a sample taken over the exposed surface (3x2 feet), 64 *a*, ran:

U_3O_8	2.85%
V_2O_5	3.42%

Other workings, 50 feet below on the slope, show very little ore.

The ledge of stained sandstone, mentioned above, is quite regular, and looks fairly good for the distance showing (15 feet).

A sample from this ledge, 64 b, ran:

U_3O_8	1.31%
V_2O_5	.28%

Morning Glory. Marcus Peterson, owner.

Runs east and west, and is located on wagon road two miles and southwest from Peterson and Maitland's cabin, on the Maggie C. claim.

Has one shaly carnotite showing on the south dip of ledge, which streak ends abruptly in a small trench; several hundred pounds of fair ore on the dump; 100 feet to the east, on the hillside, at same level, several outcrops, and considerable float were noticed:

Sample 65*a*:

U_3O_8	1.22%
V_2O_5	2.08%

A sample of supposed carnotite from the Sinbad valley, lying a few miles from Roc Creek, was received by the authors of this report in the fall of 1905. It showed a relatively large amount of copper, but only a trace of U_3O_8, and no test for V_2O_5.

U_3O_8	Trace
V_2O_5	None

SUMMARY OF ANALYTICAL RESULTS.

Sample	Claim	District	% U_3O_8¶	% V_2O_5*	Hydrogen Sulphide Precipitate†	Carbonates‡ Present
1 a	May Day	McIntyre	.71	2.52		
1 b	May Day	McIntyre	.35	1.337		None
1 c	May Day	McIntyre	1.67	1.98		Present
2 a	Jack Rabbit	McIntyre	.07	Slight	Black	None
3 a	Green Goods	McIntyre	1.00	2.31		None
3 b	Green Goods	McIntyre	.74	.324	Red Yellow	None
4 a		McIntyre	1.06	2.30		Present
4 b	May Day	McIntyre	1.13	3.29		None
4 c	May Day	McIntyre	3.12	3.15		
4 d	Bluebell	McIntyre	1.1	2.16	Red Yellow	None
5 a	Cougar	McIntyre	.41	3.93	Red Yellow	None
5 b	Cougar	McIntyre	.86	1.65	Red Yellow	Much
5 c	Cougar	McIntyre	3.94	4.35	Red Yellow	None
5 d	Cougar	McIntyre	.34	1.697	Black	None
7 a	Alice	McIntyre	.73	.56		
8 a	Georgetown	McIntyre	1.07	1.49		Much
8 b	Georgetown	McIntyre	.41	.23		Much
8 c	Georgetown	McIntyre	2.07	1.84		Present
8 d	Georgetown	McIntyre	8.06	4.57		None
8 e	Georgetown	McIntyre	.53	.905		None
9 a	Adjacent to Georgetown and to north	McIntyre	1.91	2.33		Present
10 a	Junebug	McIntyre	2.61	2.099		Much
10 b	Junebug	McIntyre	1.79	2.28		Present
10 c	Junebug	McIntyre	1.37	3.83		Present
10 d	Junebug	McIntyre	.605	1.9		Much
10 e	Junebug	McIntyre	.98	.566		Much

SUMMARY OF ANALYTICAL RESULTS—Continued.

Sample	Claim	District	% U_3O_8¶	% V_2O_5*	Hydrogen Sulphate Precipitate†	Carbonates‡ Present
11 a	Sundown...........	McIntyre.......	2.07	2.41	None...............	None
11 b	Sundown...........	McIntyre.......	.82	.67	....	Much
11 c	Sundown...........	McIntyre.......	21.88	8.79	....	Present
11 d	Sundown...........	McIntyre.......	2.38	2.675	....	None
12 a	North Star..........	McIntyre.......	.05	2.41	Red Brown.........	None
13 a	St. Louis............	McIntyre.......	.78	.85	....	Considerable
14 a	Uranium............	McIntyre.......	2.03	2.44	Brown..............	Much
15 a	Shiner..............	McIntyre.......	.87	1.08	....	Much
15 b	Shiner..............	McIntyre.......	1.06	1.41	Yellow.............	None
15 c	Shiner..............	McIntyre.......	2.89	3.98	....	....
16 a	Rattler.............	McIntyre.......	5.07	3.39	Red Yellow.........	Much
17 a	Silvertip............	McIntyre.......	2.07	2.24	....	None
18 a	Grand View.........	McIntyre.......	.76	1.64	Reddish............	None
19 a	Bear Cat............	McIntyre.......	2.23	2.59	Brown..............	Much
20 a	Tom Con...........	McIntyre.......	4.40	3.19	....	Much
21 a	Black Mule.........	McIntyre.......	1.84	1.75	Red Yellow.........	Much
22 a	University..........	McIntyre.......	3.47	3.56	....	Much
23 x	West cliff of east side of Horse Range.....	McIntyre.......	9.45	6.43	....	None
24 a	....	....	1.38	1.54	Yellow.............	Much
25 a	....	Silvey Pocket...	.66	2.90	Red Brown.........	Much
25 b	....	Silvey Pocket...	Trace	.15	Black..............	Present
30 a	Vesuvius............	Roc Creek......	.76	.12	Brown..............	Present
30 b	Vesuvius............	Roc Creek......	3.02	1.15	Yellow Brown	None
30 c	Vesuvius............	Roc Creek......	1.26	.70	Brown..............	None
30 d	Vesuvius............	Roc Creek......	3.04	1.95	Red Yellow.........	None
31 a	Dewey..............	Roc Creek......	.09	.05	Black..............	Much
32 a	Dewey..............	Roc Creek......	Trace	.11	Brown..............	Present
33 a	Dewey..............	Roc Creek......	....	....	....	....
34 a	Dewey..............	Roc Creek......	.38	.27	Black..............	Much
35 a	Calvert.............	Roc Creek......	1.49	4.53	Black..............	None
36 a	Belmont............	Hydraulic	.89	.18	....	Present
36 b	Belmont............	Hydraulic.......	3.84	2.59	....	Present
37 a	Bonnie Belle.	Hydraulic.......	3.6	3.16	....	Present
38 a	Boston..............	Hydraulic.......	5.53	5.63	....	....
39 a	D. U. No. 1.........	Hydraulic.......	3.93	4.5	....	Much
40 a	Great Bend.........	Hydraulic.......	6.28	4.24	....	Present
40 b	Great Bend.........	Hydraulic.......	4.00	3.65	....	....
41 a	Dolores.............	Hydraulic.......	.69	.98	....	Considerable

SUMMARY OF ANALYTICAL RESULTS—Concluded.

Sample	Claim	District	% U_3O_8¶	% V_2O_5*	Hydrogen Sulphate Precipitate†	Carbonates‡ Present
42 a	Hydraulic..........	Hydraulic.......	2.16	2.57	....	None
43 a	Grand View.........	Hydraulic.......	.79	6.035	....	Present
44 a	Talbert.............	Hydraulic.......	5.71	4.29	Black..............	Present
45 a	O. K...............	Hydraulic.......	2.21	4.83	Black..............	Present
45 b	O. K...............	Hydraulic.......	3.18	1.25	Black..............	None
45 c	O. K...............	Hydraulic.......	.90	1.64	Black..............	....
46 a	I. X. L............	Hydraulic.......	.37	1.18	Black..............	Much
47 a	Valley View.........	Hydrau c..... ..	3.26	3.18	....	Present
47 b	Valley View.........	Hydraul c.......	.71	2.47	Black..............	Considerable
48 a	Good Luck..........	Hydraulic.......	2.05	1.88	Yellow.............	Considerable
49 a	Good Will...........	Hydrauic.......	1.01	1.9	Black..............	Present
50 a	Leap Year..........	Hydraulic.......	.30	1.1	Black..............	Present
52 a	D. U. No. 4.........	Hydraulic.... ..	.69	2.15	Black..............	None
53 a	D. U. No. 5.........	Hydraulic.......	2.52	2.798	Black..............	None
54 a	D. U. No. 6.........	Hydraulic.......	1.87	2.85	Black..............	....
55 a	D. U. No. 2.........	Hydraulic.......	1.17	1.48	....	Present
56 a	Cave Lode..........	Hydraulic.......	.45	.87	....	Present
57 a	Majestic............	Hydraulic.......	1.87	2.85	....	Much
58 a	Mountain Beauty....	Hydraulic.......	3.49	6.19	....	Present
59 a	Montrose...........	Hydraulic.......	3.21	3.72	....	....
60 a	Maggie C...........	Vixen..........	4.91	3.06	....	....
60 b	Maggie C...........	Vixen..........	1.83	1.75	....	....
60 c	Maggie C...........	Vixen..........	2.74	1.46	....	....
61 a	Lucky Monday......	Vixen..........	.87	1.49	....	....
62 a	Homestead..........	Vixen..........	2.01	3.498	Red Yellow.........	None
63 a	Ida M..............	Vixen..........	3.42	1.80	....	Present
63 b	Ida M..............	Vixen..........	2.50	2.49	....	....
64 a	New Century........	Vixen..........	2.85	3.42	....	....
64 b	New Century........	Vixen..........	1.31	.28	....	....
65 a	Morning Glory......	Vixen..........	1.22	2.08	....	....
H	Hawkeye...........	Vixen..........	2.24	2.05	....	Present
	Copper Prince.......	Roc Creek......	.92	.41	Brown..............	Slight
S	....	Sinbad Valley...	Trace	None	Black..............	Much

¶Uranium oxide.
*Vanadium oxide.
†Gives some hint as to presence of other possible values. Black in probably all cases indicates copper, yellow indicates arsenic, and brown indicates mixtures of both in all probability. Further examination of these precipitates is intended.
‡Gives some idea as to acid consumption.

FREIGHT RATES.

Snyderville to Dolores	$20.00	per 2000 lbs.
Hydraulic to Placerville	25.00	per 2000 lbs.
Roc Creek to Placerville	25.00	per 2000 lbs.
Naturita to Placerville	20.00	per 2000 lbs

In connection with this, the railroad rates are as follows:

Placerville to Pueblo, on ores and concentrates value not over $100.00 per ton or so released	$10.00 per ton
Placerville to Pueblo, ores and concentrates actual value not over $70.00 per ton	9.00 per ton
Pueblo to Kansas City, value less than $100.00 per ton or so released	2.00 per ton
Kansas City to New York, value less than $100.00 per ton or so released	5.00 per ton

Note:—This data refers to carload lots, a minimum weight per carload being established at 16,000 pounds. On smaller shipments the rates are given as follows:

Dolores to Pueblo	$1.00	per 100 lbs.
Placerville to Pueblo	.90	per 100 lbs.
Pueblo to St. Louis	.92	per 100 lbs.
St. Louis to New York	.75½	per 100 lbs.

EXTENT OF ORE.

Elsewhere attention has been called to the "pockety," "bunchy," "streaky," nature of the deposits, independent of the locality in which they occur. This lack of continuity confronted previous investigators some years ago. Since then, however, considerable exploration has taken place and a fuller report might be expected. This is not possible, however, since the ore already mined allows very little certainty to be drawn therefrom. And this is due to mining, where outcrops of good quality appear, until the pocket, or pockets, were exhausted, without any systematic development having been done. This has been the common practice, easily followed, and will probably continue until outcroppings of good showing are wanting. None of the operators of the district has suffered from lack of ore at any time, and it is obvious that there is plenty of ore to be had at the present moment, judging from the surface indications.

In the cliff workings no observations of worth can be made. A tunnel which cuts a flat, somewhat lenticular body exposes its thickness usually 2-3 feet, along a direction which gives no clue as to the other dimension.

It is the surface deposits from which facts, if any, may be gathered. The barren zones between pockets vary greatly. Extremes are found in the Maggie C. in the Vixen group, and a claim some distance from the middle group, back from the river, in the McIntyre region. The former has been opened to expose ore every few feet, showing continuity of ore, with few barren zones. The latter has yielded 15 tons, only, of 5 per cent. ore to the Dolores Refining Company, after much exploration.

From the following, the unsatisfactoriness of the use of insufficient data may be observed:

Ore taken out for mill operations:

	R. M. M. & M. Co.	W. Ref. Co.	Totals
Franklin	40 tons		40 tons
Alice	250 tons	100 tons	350 tons
Uranium	25 tons		25 tons
Bluebell	40 tons	40 tons	80 tons

The ore removed from the Alice, 350 tons, averaging, perhaps, 3 per cent. uranium oxide, was taken from an almost continuous opening of 100x100x6 feet deep on the average, roughly estimated. All things being the same, the amount of ore on the claim would be 15,750 tons, which at 2 per cent. uranium oxide would be valued gross at $315,000. But what facts are there to support this?

I. There are a few openings showing ore at a few feet below surface, and a few outcroppings.

The facts to be arrayed against this are:

1st. Barren zones, undetermined.

2nd. Average thickness of ore, undetermined.

In other words, to assume all things the same is absurd, and when there are added to these:

3rd. Average value of ore, undetermined.

4th. Average depth of ore from surface, undetermined.

5th. Average composition of ore (how well adapted to methods in use), undetermined, it is evident that not the slightest value can be placed on an estimate made under the conditions imposed.

Exactly the same value must be placed on similar speculations made on the other claims in this or any other region visited.

A perusal of the "Description of Claims" is urged as an answer to any inquiry under this heading.

VALUES OF CLAIMS.

These fluctuate, depending on conditions. During favorable seasons of operations, prices usually rise to $500 per claim, as is the case now in the McIntyre region. In other regions a flat price is placed on a group of claims, irrespective of individual merit.

One of the early options given to the Rare Metals Mining & Milling Company (12th of September, 1899), on forty-four claims in the McIntyre district, sets a price of $500 per claim, or a total of $22,000. This price, therefore, is identical with the present day price. In periods of considerable depression, 1901-1902, some of the claims were offered for $200 apiece. They were not, however, of the most desirable. In the summer of 1905 the price asked for the groups of claims owned now by Mr. M. Peterson, of the Vixen district, Naturita, was fixed at $6,000. The Hydraulic properties were fixed by their owner, Mr. C. R. Clarke, at $10,000.

No values on the claims of the Roc Creek region can be placed.

TECHNICAL WORK.

Mining, Metallurgy, Shipments and Valuation.

The methods of mining employed are extremely simple. So far only the surface deposits have been worked, the cliff deposits, requiring tunneling, not having been drawn upon. Nor is it likely that, except for development or prospecting work, will much material be shipped from these sources for some time to come. The surface deposits are those lying on the benches which by erosion have been enlarged, the upper benches having been, so to speak, pushed back some distance. When these benches are worked out all the deposits will be upon an equal footing. They are broadest on the Upper Group, Middle Group and Lower Group claims on the southwest side of the Dolores river in the McIntyre region, and very narrow on the Georgetown group, and unimportant on the Silvey group, both on the northeast side under a cliff constituting the wall of the third bench. Again, in the Naturita region are found conditions approaching those of the southwest side of the group of the McIntyre region. They are perfectly flat and lie on the southwest side of the San Miguel river. Again, the conditions in the Hydraulic region are nearly the same for mining on the southwest side, but perhaps, on the whole, not quite so perfect as on the southeast side of the Dolores river in the McIntyre region. On the other hand, the northeast side of the river at this point shows the carnotite beds under considerable capping, which increases in height abruptly. In general, the best claims for mining lie on the most eroded slope toward the rivers, the southwest side.

Since the ore in many places on the southwest slope outcrops at the surface, prospecting is made easy. Nor does the float from these beds deteriorate so rapidly as to interfere with the search for the same in dry stream beds and hillsides. In mining, quarrying would perhaps be a more fitting term, the hole is usually driven at an angle through the cap rock until the waste is tinged yellow. The charge is usually large enough to lift and loosen the cap rock, which may then be carefully removed, exposing ore. Sorting to considerable extent is necessary. There is, nevertheless, some loss of values which fall to dust and loose particles among the debris. It is estimated that the cost of mining where the cap rock does not exceed several feet at the deepest part, is about $3 to $4 per ton. Where the claim lies near the cliff edge the disposal of waste is an easy matter. In other cases there can be little loss result where waste is filled into well stripped areas.

There are wagon roads leading to the Upper, Middle and Silvey groups and good pack trails to the others in the McIntyre region. The same holds good in the Vixen district. In the Roc Creek and Hydraulic districts there are good pack trails.

In the McIntyre district the manner of obtaining ore determines the cost put down at the mill. Ore may be purchased at ten dollars per unit, which is prohibitive. When the mining is contracted for, the contractor being owner of the claim mined, the price should not exceed five dollars per ton for two per cent. ore or better. Hauling to a mill on the river from any of these claims should not exceed $2 per ton, and, of course, depending on the distance from a mill, may be less. An average cost of 1.5 to 2 per cent. ore laid at the mill would be about $7 per ton, provided the ore is owned by the contractor.

Should the ore be taken from leased claims, the price of $2 per ton royalty should be added, this royalty being usual in the McIntyre district.

In the other districts the cost should not exceed the above, except in perhaps the Naturita region, where the distance to a mill site would not be less than six miles. On the other hand, the distance to a mill site in the Roc Creek region is trifling and the cost of hauling should be materially less.

The following is the common form of contract of the region:

This agreement, made the 1st day of November, 1901, between ...., party of the first part, and .... parties of the second part, witnesseth:

................................, party of the first part, agrees—

First. To take out in good mining fashion from the uranium claim, situated on the Dolores river (close to Hank Snyder ranch), San Miguel county, Colorado, from 50 to 60 tons of ore, carrying no less than 2% (two per cent) uranium oxide, and this inside of three months from the date above mentioned.

Second. To pile up the ore properly in such a way as not to interfere with further development of the claim.

Third. To pile up all ore of lower grade than 2% which may be mined in connection with the amount above mentioned.

Fourth. To dump all dirt, rock and material not carrying ore into such a place as not to cover unworked ground, and interfere with further development.

..........................., parties of the second part, agree—

First. To pay to the party of the first part, $5 (five) dollars per ton of ore after weighing and percentage being determined.

Second. To haul down to their mill all the ore mined for the purpose of weighing, sampling and testing, as soon as the quantity mentioned has been taken out.

Third. Not to discriminate in case the average percentage of the ore should be as low as 1.75% uranium.

Note—In all probability meaning uranium oxide. In figures this allowance of 25% means about $5 per ton gross.

Fourth. In case a reasonable amount of work done would demonstrate that there is no more ore to be mined out of the claim, the party of the first part shall be paid for whatever amount taken out.

Fifth. In case of disagreement about the percentage, Ledoux & Company, No. 99 John street, New York City, will make the umpire test, by which both parties will abide, the cost to be borne by the contestant.

The above illustrates to some extent the mining practice, with price of same, the percentage of uranium oxide to be expected on a considerable tonnage, and the settling of assays. The lack of confidence in article 4 (parties of the second part) was not well placed as to quantity, as reference to this claim will show. The material from this claim left in the mill in the fall of 1902 averaged only 1.29% uranium oxide.

METALLURGY.

Perhaps no method of ore dressing could be successfully applied. The extremely fine state of division of the mineral precludes this. Magnetic methods have been experimented with, but to no effect. A microscopic observation made on the ore showed, in a sample of ore from Hydraulic, carrying about 4.5 per cent uranium oxide, that the somewhat worn, but yet distinct quartz crystals composing the grains were cemented by carbonate of lime, and that the carnotite adheres to the face of the crystals after rubbing the grain free from the most of the carnotite dust. This suggested a method of preliminary sliming and subsequent attrition, whereby the values in the form of slimes might easily be filter pressed or settled. Machinery for the purpose of subjecting the sand grains to attrition could readily be devised. Experiments were conducted on two classes of ore.

Exp. 1. Ore above mentioned, 1,000 grams sand.

These were placed in a sack, so as to loosely fill, and then subjected under water to a kneading action, until the operation repeated in fresh water gave little or no turbidity on standing a few moments. The slimes were stirred, settled and drained, and subjected to a temperature of 120° C., after drying at ordinary temperature. The slimes cracked and peeled off, exposing fine grit beneath. The results are:

1,000 grs. ore gave—

	U_3O_8	U_3O_8
48 Grs. Fine Grit	5.07%	2.43 grs.
192 Grs. Slimes	12.00%	23.00 grs.
748 Grs. Coarse Sand	2.5 %	18.7 grs.
988 Grs.		
TOTAL		44.13 grs.

It is readily seen that somewhat more than one-third (42.5%) of the uranium present remained unslimed. A 12% slime may be shipped at a profit, but a loss of 50% makes a method producing the same result as the above prohibitive.

Exp. No. 2. Ore of the calcareous siderite variety of the McIntyre region of about 1.5% uranium oxide contents ground to 40 mesh. Treatment as above. 1095 grams gave:

	% of Fractions	% U_3O_8 Present	Grs. U_3O_8 Present
168 Grs. Slimes	15.34	7.30	12.26 Grs.
By Diff .... 927 Grs. Residue	84.66	.67	6.21 Grs.
TOTAL.......1095	100.00		18.47

In this case about one-third ((33.6%) of the uranium present remained unslimed—a prohibitive loss. A concentrate carrying 7.3% uranium oxide may be shipped at a profit.

NOTE. Comparing these results from ores of a widely different character and locality a decided similarity of proximate composition is shown, although chemically the ores are very different.

	% Slime	% Residue	U_3O_8 % Slimed Off	By Diff. % Remaining
1	19.2%	79.6%	42.5%	57.5%
2	15.34	84.66	33.6	66.4

The appearance under the microscope of yellow stains on the sand grains, here and there, show where the uranium in form of carnotite remains.

NOTE. For some reason not to be explained on the assumption of Hillebrand regarding the presence of vanadiferous silicate, there was considerable loss of V_2O_5.

NOTE. The experiment was conducted in the laboratory of the McIntyre mill. Facilities, especially proper drying facilities, were lacking. An excess of 2 grams U_3O_8 in the totals figured does not materially influence the final result.

These experiments prove conclusively that no wet or dry method of ore dressing could be employed using this ore, on account of the extreme fineness of the carnotite particles (the largest not over .25 M.M. in length).

NOTE. Microscopic observations by Dr. George P. Merrill on samples similar to those analyzed by Hillebrand (loc. cit.) Am. Jour. Science, volume 10, page 134. Also, "Much of the matter appears as a fine brownish clay stained yellow by an amorphous pigment."

No method depending on difference in specific gravities would commend itself.

Chemical treatment alone seems to be the correct form of treatment. Combined chemical and mechanical treatment does not recommend itself as economical. By chemical treatment higher extraction and rich concentrates result, commanding a much better price than low grade ore. These qualities are in measure offset by the expensive materials required to produce them.

The following methods suggest themselves:

Wet Methods—

I. Acid treatment (leach) and precipitation.

II. Alkaline treatment (leach) and precipitation.

Dry Methods—

III. Volatilization of values by heat and chemical agents.

IV. Roasting with material to change values to soluble form.

I. Acid treatment and precipitation.

Carnotite is completely soluble in common mineral acids. Of these nitric and hydrochloric acids are excluded on account of expense and difficulty of transportation. The production of these materials on the spot is practically out of the question. Sulphuric acid (chamber acid) of about 65′ B is available on account of its cheapness and ready transportability in iron vessels. The production of this acid on the spot is possible under governing conditions, only by the contact process.

The benefit derived in the use of this acid, outside of those already mentioned, depends on the subsequent treatment. For precipitation of values by carbonate of sodium (see below), the rendering insoluble of the lime present in the ore as sulphate is advantageous. On the other hand, freely formed calcium sulphate is a great hindrance to clarification of liquors and to free washing of the pulp. The action of the acid on the clay-like substances present also produces colloids with disagreeable consequences. Leaching without agitation has been proved to be impossible for reasons to be stated below.

The Rare Metals Mining & Milling Company, at Cashin, and subsequently at the McIntyre, used the following method of treatment, obtaining results shown in other chapters.

The ore was crushed to hand sized lumps by hand and fed to a Krupp ball mill of ten tons capacity, with the screens arranged for 40 mesh. The ore was then treated with water and crude sulphuric acid, 50 pounds acid to one ton of ore, in oblong vats. (Note. Heat generated by action of acid on water.) The hot mixture was constantly stirred by hand with wooden paddles until the pulp showed no yellow particles. The liquors containing slimes and values were then drained off into tall vats and directly precipitated with a solution of sodium carbonate and the combined precipitate containing values and slimes allowed to settle. The supernatant liquid was then drawn off and the washed and the settled greenish mud run off into a pit of about 30 feet by 8 feet, and two feet deep, with a level sandy floor, which acted as a filter bed, and there aided by the dry intense heat of the region, there resulted a yellowish mass containing generally about 12% uranium oxide and perhaps the same quantity, or a little more, of vanadium oxide. This was placed in bags and shipped. This is perhaps a lower percentage of uranium oxide than the sliming experiments would seem to indicate, since the slimes containing the total values in the form of a precipitate should, on a good extraction, be richer than the slimes resulting from an ore not chemically treated. (See Exp. 2, above.) If no values were left in the pulp then something valueless must have been added to the slimes, and vice versa. There appears to be something contradictory here, but there is not. Values were left on the pulp as the tailings dump shows by the greenish yellow color of same, and as is also shown along the banks of the river below the mill, where greenish sand bars have formed, carrying both uranium and vanadium. The tailings were free from slimes, showing that they consisted of treated ores. Their solutions with dilute acid showed the greenish yellow color and gave tests for both uranium and vanadium. But these values were not present as carnotite, because the ore was treated as stated above until the carnotite particles had been decomposed. They were precipitated in forms now being studied in this laboratory by the calcium and ferrous carbonate in the ore. Here lies the explanation of losses encountered by the use of this process. The more lime present as carbonate the more acid required, and the greater the cost of extraction. Any acid below the quantity required to neutralize the lime present, plus the quantity necessary to dissolve the values, resulted in a reprecipitation of values on the pulp.

With an increase in lime contents more calcium sulphate entered into the slimes, hence into the concentrates, thus lowering the percentage values of uranium and vanadium.

Were the carnotite the only material attacked then the extraction would be simple, but in all the analyses undertaken the extracted matter exceeded by far the few per cent. of value present.

On the average sample of the 100 tons of 1.3% ore lying in the McIntyre mill in 1902, the following was extracted by nitric acid:

Exp. No. 3	
Uranium, calculated as U_3O_8	1.3 per cent
Vanadium, calculated as V_2O_5 (Note below)	2.6 per cent
Iron, calculated as $FeCO_3$	3.63 per cent
Aluminum, calculated as Al_2O_3	2.38 per cent
Calcium, calculated as $CaCO_3$	6.23 per cent
Total extracted	16.14 per cent

Note—Siderite and calcite were plainly visible in the ore; 100 grams of ore extracted with nitric acid gave 83.9 grs. residue, 16.1 grs. extracted matter, by weight.

This agrees very nicely with the above calculated result. The required quantity of sulphuric acid necessary to combine with this quantity of extracted matter is as 16.14 to 21.83. It is at once seen that this is over 400 pounds acid. Acid of 65° B. laid down at the mill, costs $80.00 per ton. The quantity of acid required to dissolve the values would exceed in cost $16.00, which, with so low grade an ore, is prohibitive. Naturally, the cost of acid would not average this.

Using this method, therefore, the "extract," so called, becomes a very important matter. The cost of carbonate of soda (soda ash) is $100.00 to $125.00 per ton at the mill, and the quantity required to precipitate the values plus the iron and aluminum is about 300 pounds, at a cost of $61.00 or more. As a result, we have for this ore:

Cost of Ore per ton	$10.00
Cost of Acid	16.00
Cost of Alkali	15.00
	$41.00

Value of concentrate containing 26 pounds U_3O_8 at $1.50 per pound of U_3O_8, present as 12-15% of the mass—$39. A loss is apparent without taking into account shipment charges, cost of labor, sacking, grinding, wear and tear, and other customary items.

Leaching the ore without agitation is impossible. The clay present and the gases formed from the limestone form channels which are characterized by the colors left by secondary precipitation along their course. Experiments of this sort were abandoned at McIntyre in 1902.

Wet Method Using Alkaline Leach. Experiments in the spring of 1902 by one of us showed that when a solution of sodium bicarbonate is warmed gently with carnotite ores, the characteristic color of uranium and vanadium, double salts was obtained. The same held good for sodium carbonate. The results did not warrant further investigation. Since then, however, Prof. W. D. Engle and Mr. J. D. Haynes, of Denver, have patented a method based on this reaction, the method having been used for the extraction of uranium values by the Western Refining Company, in the spring and fall of 1903, at the McIntyre mill. During the last year a mill has been specially built in the same district, south of the old mill, by the Dolores Refining Co., for this process. No shipments have been made, however, up to date. The method is briefly as follows:

The ore is ground to 14 mesh, is boiled under agitation, with a 10% solution of sodium carbonate, until the values are in solution, as shown by the appearance of the pulp. The solution is now yellow, and contains the uranium as the soluble double carbonate, and the vanadium as sodium vanadate. Note—(Should there be any lower state of oxidation of either metal, as is quite probable in any event, a preliminary oxidization would be necessary.) From this solution, which is drained off, or filtered off, the uranium is precipitated with a solution of caustic soda, as sodium uranate, which settles quickly, and is filtered and dried. To the filtrate containing the vanadium, milk of lime is added, which precipitates the vanadium as calcium vanadate, and renders the sodium carbonate caustic, an equivalent of calcium carbonate being precipitated at the same time. The caustic solution, after filtration of the calcium vanadate, is recarbonated by the carbondioxide from the preparation of the caustic lime, and used over.

The uranium value of the concentrates is about 85% uranium oxide, and brings, in ton lots, 19 marks per kilogram (about $2.40 per lb.) The vanadium present is not being worked at present.

The method has the advantage of using a reagent, which is indifferent to the action of carbonates of lime and iron in the ore, and it possesses, furthermore, the advantage of producing a high grade uranium concentrate. Its disadvantage, however, lies in uncertainty of extraction in certain ores, probably, also, in the undesirable condition in which the vanadium is left.

The third class of method offers no advantages, at least in the light of present knowledge of volatile compounds of uranium and vanadium.

Mr. Poulot, of the Rare Metals Mining & Manufacturing Co., conducted a series of experiments on methods of the fourth class, using salt as a base, but without success.

The only other method proposed for the extraction of this ore is that of Dr. Julius Ohly, which appeared in Mining & Metallurgy, April 15, 1901, and which is reprinted in the U. S. Geological Survey, Min. Res., 1900, page 264. Briefly it is this:

The ore is treated with sulphuric acid to dissolve the carnotite values and sodium carbonate is added in excess to precipitate iron and aluminum hydrates. The uranium and vanadium remains in solution in the excess of sodium carbonate. Ammonia is added to precipitate the hydrated oxide of uranium, which is subsequently ignited to uranium oxide (Note—This can hardly be the case in the presence of so much alkali), or sodium hydrate is added to produce sodium uranate. The method does not commend itself as published, but still less with a proposed modification to wash the ore free from clay particles before milling. (Mining Reporter, July 25, 1901.)

COMMENT.

Fuel—

The fuel so far used in the region is wood, pinon and cedar, which can be contracted for at $3 per cord. There is coal in the region which has not been developed. Several outcroppings of coal lie on the road from Cedar to McIntyre. Near the Dolores river, several miles up the river from C. H. Snyder's ranch, another coal pocket has been observed. There is coal also known to be present near Hydraulic.

Limestone—

Excellent limestone, 95-98% calcium carbonate, is found at the McIntyre on both sides of the river. Good limestone is reported in the other regions.

Water—

Water is abundant in Dolores and San Miguel rivers during ten months of the year in all of these regions, while probably no difficulty would be encountered in obtaining a sufficient supply for mill purposes during the months of August and September, at which time the supply reaches a minimum, and is not enough for power purposes.

METHODS OF RADIUM EXTRACTION.

The residues from acid treatment of carnotite ore may contain radium values in form of insoluble sulphates. These are boiled with sodium carbonate solution, thus changing the values to carbonate, and after washing free from all sulphates are leached with hydrochloric acid free from sulphuric acid. The mixed chlorides in solution are then purified to desired degree of concentration by fractional crystallization.

The residues from an alkaline extraction return the barium and radium values as carbonates. After washing to free the residues from sulphates they may be extracted with nitric or hydrochloric acid and the radium and barium precipitated as sulphates. Further concentration could be undertaken by reconversion into carbonates, washing, re-extraction as chlorides or bromides and fractional crystallization.

OUTPUT AND VALUE.

The Mineral Industry reports the production of uranium in the United States, as follows:

	1900	1901	1902	1903	1904
Production of ore and concentrates in sh tons	153	375	810	No data	No data
Value at place of production	$45,900	$102.500	No data	No data	No data

The report of the State Commissioner of Mines of Colorado for 1900 attributes the following production to Montrose county (i. e. Carnotite):

	% U_3O_8
2,000 pounds	16
1,500 pounds	15
140,000 pounds	5
60.000 pounds	6
30,000 pounds	10
60,000 pounds	10
293.500 pounds	

The low values are probably ore directly shipped, and the higher values, concentrates from the Rare Metals Mining & Mfg. Co.

The total amount of uranium oxide represented by this is 20.145 pounds. This is probably more than has been taken out of the region since 1899, and is much too high for 1900.

The total of uranium oxide for carnotite mined is estimated:

	Lbs. U_3O_8	Approx. Value
Rare Metals Mining & Mfg. Co	15,000	$30.000
Western Refining Company (Estimated)	1,000	2,000
Dolores Refining Company (Estimated)	1,600	3,200
Shipped as ore (Estimated)	5,000	7,500
Total U_3O_8 produced	22,600	$42,700

The values given above show the average price of uranium oxide for 1900 at $2 per pound. This is too high for concentrates of the strength mentioned. (Note) J. Ohly, Loc. Cit.

The following is a table in which the values fluctuate somewhat from time to time, due to plentiful production from the Colorado or Joachmisthal pitch blende mines. The prices are f. o. b. New York City on shipments of not less than one ton:

% U_3O_8	Value per lb. of U_3O_8 Pres't
10	$1.25
15	1.39
20	1.40
25	1.55
30	1.60
50	1.75

A ton of ten per cent. concentrate would therefore bring $250 per ton in New York City.

The report of the Commissioner of Mines for 1900 gives the following:

% U_3O_8	Value Per Unit	Value Per Lb. U_3O_8
8–10	$17.50	$ .87
10–15	18.00	.90
15–20	19.00	.95
20%	20.00	1.00

These are much too low, as the following data from actual sales and quotations for this period show:

	% U_3O_8	Value Per Lb. U_3O_8
Nov. 3, 1899	5½	$1.33
July 10, 1900	80–100	1.90
Oct. 4, 1900	....	1.80
Oct. 8, 1900	40–50	1.75
Dec. 29, 1900	12–15	1.94
Jan. 19, 1901	8	1.50
Apr. 25, 1901	8–10	1.69

The last concentrates from this region sold by the Western Refining Company, in 1903, were in all probability 85% U_3O_8, judging from the method used. The present operations should yield a similar result. The present price for this product is 19 marks per kilo, which equals nearly $2.37 per pound U_3O_8 in ton lots f. o. b. Hamburg.

The prices for vanadium oxide are usually not taken into consideration by most buyers of uranium concentrates. In fact, some object to its presence. The prices in possession of the authors are:

$9.00 per pound vanadium oxide, J. Ohly, Min. & Met. loc. cit. This is probably retail for small lots of pure material and can not be considered.

50 cents per pound. An order in possession of J. McBride of the Rare Metals Mining & Mfg. Co., Cashin, Colorado, for 50 tons of vanadium concentrate by Hugo Krupp, 1901.

$1.50 per pound vanadium oxide in a concentrate of unknown strength, October 4, 1900.

$1.50 per pound metallic vanadium in a concentrate of about 10—15% V_2O_5, December 29, 1900.

85 cents per pound vanadium oxide in a concentrate carrying about 30—40% V_2O_5, October 8, 1900.

MARKET AND DEMAND.

Uranium, whether in form of carnotite ore, concentrates or pitch blende, finds a ready sale here and abroad. Just how far the market will hold has been, up to the present, untested. The greatest output of this country, probably all from Colorado, was in 1902, 810 tons, and the prices held well. This, of course, is not a large tonnage, and may be close to the demand for uranium oxide for present uses.

In 1903 the market was tested again and the products were eagerly sought for by buyers. The buyers are, however, without faith on account of interrupted dealings and fictitious offers in the past. Samples and reasonable assurance of output are now required. A market for cheaper uranium is practically assured. This means a wide spread use of uranium in the manufacture of ferro uranium alloys perhaps, but on the other hand it demands a guaranteed output of greater tonnage at low price. At present there are no indications that pitch blende will produce this uranium, and if produced at all, it must come from the more abundant carnotite deposits by much cheaper method than the present.

Vanadium is made to considerable extent from the slags of the Cruesot Steel Works in France—about 165,000 pounds of unknown percentage. This is largely used in mordanting.

As stated above, a guaranteed output of vanadium compound of greater tonnage at a reasonable price would no doubt insure enormous output for the production of ferro-vanadium alloys. Again, the vanadium ores can not be expected to produce this output, nor can slags from vanadiferous iron ores nor ashes of vanadiferous coals. The most reasonable source, at present, is the rare metal belt of southwest Colorado. The discovery of a cheaper method for uranium does not mean a cheaper method for vanadium necessarily. The search for a good method of extraction of one should take into consideration the other. A separation of the two is indispensable.

A list of buyers of the uranium and vanadium products is the following:

Roessler and Hasslacher, 100 William Street, New York.

Siegfried Pels, 10 Alsterthor, Hamburg, Germany.

Henry Kupfer & Co., 81 Green Street, New York.

†F. W. Bieber, Hamburg, Gr. Bleichen 32.

†Philip Bauer & Co., New York.

Fabrik Chemischer Producte Rheingönheim, Rheinpfalz, Bavaria, Germany.

†George Egestorff's Salzerke, Linden, Hanover, Germany.

E. de Haen, Hanover, Germany.

†August Blumenthal, Hamburg, Germany.

†These firms offer to buy vanadium in the concentrates. It is highly probable that most of them would buy vanadium concentrates separate.

USES.

The following uses for uranium have been noted:

Pigment; glass coloring material (fluorescent green); porcelain coloring (velvety black and orange); in the manufacture of Welsbach mantles.

Ferro-uranium added to molten steel increases the strength and toughness.

The following uses for vanadium have been noted:

As an oxidizer in certain processes.

Ferro-vanadium added to molten steel increases the tensile strength and ductility.

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Mining Reporter, July 25. 1901 (Julius Ohly).

U. S. Geo. Survey, Min. Res., 1900, page 264 (Julius Ohly).

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Report of Commissioner of Mines, Colorado, for 1900.

RADIO ACTIVITY OF CARNOTITE.

Some years ago, when M. and Mme. Curie were progressing toward their epoch making discovery of radium, the increased radio-activity over that demanded by the uranium contents was noted for a number of uranium ores, including carnotite, presumably from the Copper Prince mine, in the Roc Creek district, Colorado. Following is a table of comparative radio-activity values of pitchblende from various sources and carnotite. The magnitude of the values are expressed in am ix-10:

Metallic uranium		2.3
Pitchblende	Johangeorgenstadt	8.3
Pitchblende	Joachimsthal	7.0
Pitchblende	Pzibram	6 5
Pitchblende	Cornwal	1.6
Carnotite		6.2

The analysis of Hillebrand of high grade carnotite shows approximately the same uranium contents as a good grade pitchblende. It is not surprising, other conditions being the same, that the values of radio-activity are close. The pitchblende from Joachimsthal—from the residues of which the first specimens of radium salts were made—shows a ratio of activity, pitchblende to uranium, of 3.04:1, and that of carnotite to uranium from Roc Creek, 2.7:1, not a great difference in fact. Unfortunately bodies of carnotite of such high uranium contents are rarely found, and then only in very small pockets. One ton of such material should give, upon extraction, about 8 kg. (16 pounds) of mixed radium barium chlorides of a radio-activity of about 60. uranium equal to 1. According to this, even provided that no leaching of radium values has taken place, a thing not at all unlikely, the extraction of radium values from carnotite ores would hardly prove an inviting enterprise. By comparison a 2 per cent. carnotite would show a ratio of radio-activity to uranium of

.1: 1 or 1-27 of that contained in a ton of Joachimsthal blende.

(Mme. Sklowowska Curie Chem. News, Aug. 28th, 1903, p. 99.)

(Mme. Sklowowska Curie Chem. News, Sept. 11th, 1903, p. 135.)

It would take approximately thirty tons of average carnotite ore to produce the results of one ton of pitchblende, provided all other things were alike, which is probably not the case with low grade ores of carnotite, much to the depreciation of the latter. Sir William Crooks seems to be of this opinion certainly. (Note 1).

In a country in which the two reagents, made use of by the process described by Mme. Curie, cost respectively on an average of $100 (Note 2), and $80 per ton, the attractiveness is still further lessened. The radium value of about one pound of mixed barium and radium sulphate obtained from 800 pounds of McIntyre ore carrying 6 per cent. of uranium oxide gave a ratio of activity to uranium of 10:1 (Note 3), as against a calculated ratio of about 60: 1 in about 16 pounds of mixed sulphates from a ton of 50 to 60 per cent. uranium ore. In a thesis recently presented (Note 4), at the Colorado School of Mines, for the degree of Mining Engineer, the following results were obtained from carnotite ores of various localities:

Note 1. Private correspondence, Dr. Julius Ohly, Denver, Colo.

Note 2. At present sodium carbonate costs $126 per ton at McIntyre.

Note 3. Prof. W. D. Engle, University of Denver.

Note 4. Thesis, 1905, Messrs. Schlereth, Kell, Negebauer.

Recognizing a new prevalent theory of a definite ratio between the uranium contents of an ore and its radio-activity due to radium, provided that the natural radium increment is undisturbed during a calculated period of 5,000 years, the diagram above shows some interesting features.

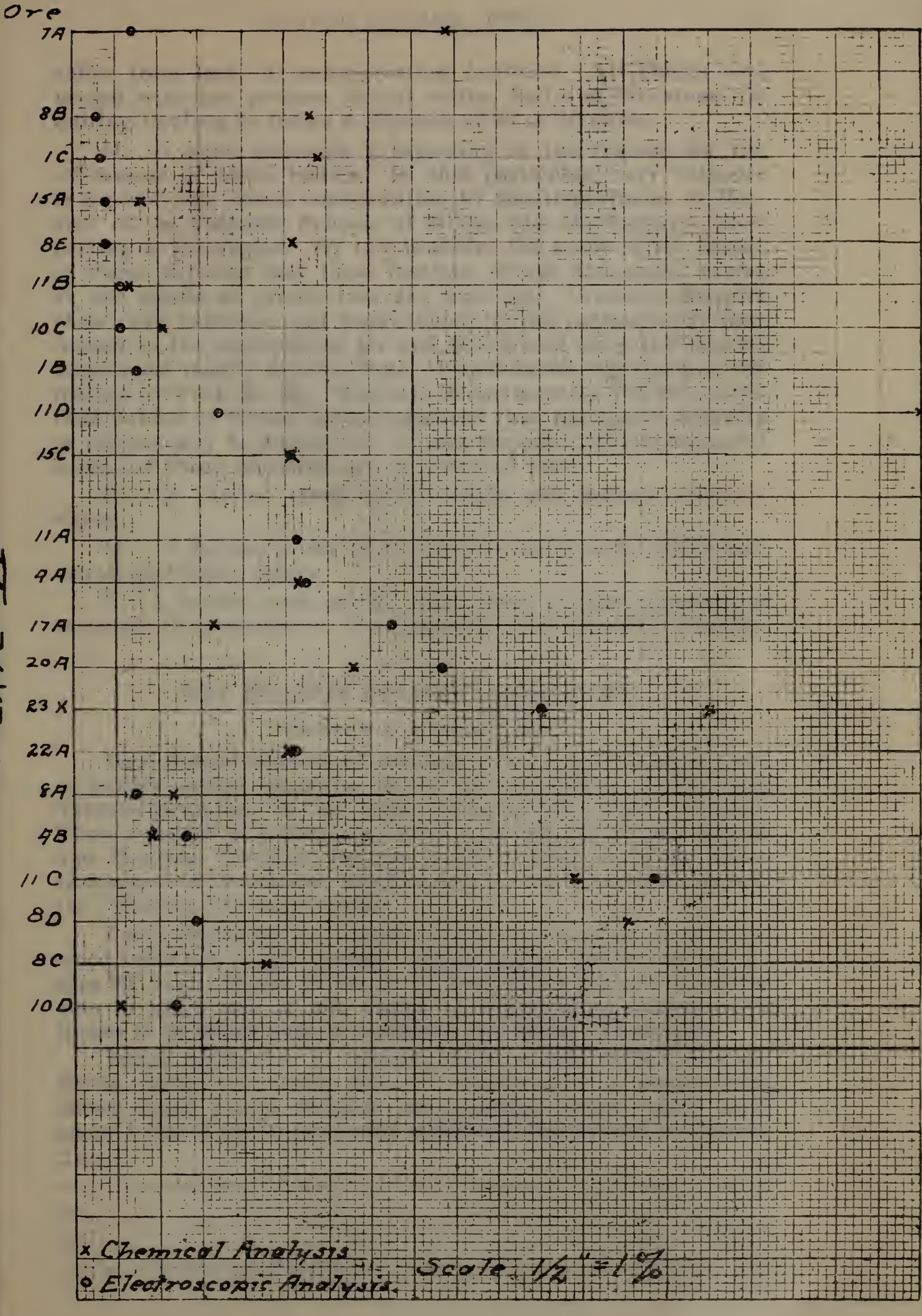
Of the twenty-two ores chemically and electroscopically determined, most of which are from the McIntyre region, coincident results exist only in the case of samples 15 a, 11 b, 10 c, 15 c, 4 a, 22 a, 8 a, and 4 b, or about 33 per cent. That is, the radium calculated as present from the uranium contents holds good in 33 per cent. of the cases investigated. Six samples, about 25 per cent., show added radio-activity, and 12 samples, or about 50 per cent., show leached out or otherwise extracted radium values.

It is not improbable that to a large extent the same conditions exist in the remainder of this region and in others containing carnotite.

NEW PROBLEMS.

I. First of these is a metallurgical problem, a cheaper extraction of the carnotite values. Those already described

PLATE VI


Ore
7A
8B
1C
15A
8E
11B
10C
1B
11D
15C
11A
9A
17A
20A
23X
22A
8A
9B
11C
8D
8C
10D
x Chemical Analysis
o Electroscopic Analysis.
Scale 1/2" = 1%

suffer from lack of transportation facilities. All things connected with the process, except water, fuel and limestone, requiring hauling by teams a distance of 80 or 90 miles.

II. A more thorough prospecting of the regions for the extensions of these bodies. In this particular, very valuable is a point now under consideration by the Department of Physics, of the Colorado Schools of Mines—the electroscopic prospecting of the region. By this is meant the study of the extent of these deposits and their location, where the usual means at the hands of prospectors are wanting. Uranium deposits show their existence and whereabouts by the radio-activity they impart to the surrounding air and water, and since the electroscope most readily detects (Note. Unpublished experiments conducted by Prof. E. Ray Wolcott, Department of Physics, Colorado School of Mines.) and determines this, unexposed deposits or regions may be discovered. It may happen that the unknown source of these deposits may be revealed also.

III. A further study of the origin and manner of deposition.

IV. A further study of the various samples for other rare metals and other values.

V. A further study of the constitution of these minerals to ascertain the existence or non-existence of the mineral carnotite.

RIO BLANCO COUNTY CARNOTITE.

URANIUM AND VANADIUM.

Well defined deposits of uranium and vanadium ore, in form of canary yellow carnotite, lie in the sandstones of the Jura Triassic formation on Coal Creek, about 15 miles east of Meeker. These resemble in general appearance the deposits of San Miguel and Montrose Counties, but are tilted, not flat, as in the above instances. Of the claims, which in general are not well developed, the following are represented:

Lucky Strike No. 2. Owners, A. H. Caywood, Sr., A. H. Caywood, Jr., and J. H. Riland. Strike nearly north and south; dips 90° east. Shows 12 feet by 12 feet face in 10 feet of excavation in south side of hill, streak of impregnated sandstone 12 inches to 20 inches wide in sandstone and shale. No sample.

Lucky Strike No. 1. Messrs. Caywood and Riland, owners. Strike north 51° west; dips 45° southwest. A 10-foot drift shows about 2 tons sortable ore on dump, which would yield about 1 ton of ore, impregnated sandstone, represented by sample 2 *a:*

U^3O^8	4.91%
V^2O^5	.8 %

One-half ton of sorted ore sampled in 2 *b:*

U_3O_8	1.9%
V_2O_5	1.96%

Twenty-five feet further west the same deposit outcrops, and is again exposed 25 feet farther.

John Mackey. Owners, Messrs. Caywood and Riland. Located on the hillside north 48° west of Lucky Strike No. 1, 1,000 feet distant, and three-quarters of a mile back from Coal Creek, shows three strata bearing values, in a 40-foot trench, the lower stratum being low-grade. Strike northwest; dip 30° southwest. 3 *a*, average sample from 40-foot trench:

U_3O_8	4.70%
V_2O_5	[illegible]

Three or four outcroppings to the west on the same vein complete a fairly continuous showing on these deposits.

In considering treatment of these ores the following facts are noteworthy:

Distance from Meeker to Rifle, 45 miles.

Freight from Meeker to Rifle, 50c per cwt.

Freight from Rifle to Denver, $6.00 per ton.

Routt County.—The uranium deposits lie in the region of Skull Creek, situated fifteen miles northeast of Rangely. The formation is similar to that of the Rio Blanco County deposits, but they are not as well defined, nor do they possess the continuity and value. It is true that at several points along the uptilted strata pockets of green and blue impregnated copper show along the bedding planes, but present development does not give them any pronounced value. Of the claims visited the following may be noted:

Standard No. 3. Owners, Nolan and Morrison. Situated three-quarters of a mile west, 23° south from Drew's Cabin. Located on the top of Sandstone Hill in the face of a draw; strike north 20° west; dip south 19° east. The values lie in a 1 to 2-foot seam of impregnated sandstone under 6 feet of cap rock. Seventy to eighty sacks of the sorted material are said to have been shipped to New York by Messrs. Nolan and Morrison. 16 *a*, average sample from the main working gave

U_3O_8	.38%
V_2O_5	.10%

Standard No. 2. Owners, Nolan and Morrison. This claim lies about 100 feet below Standard No. 3, somewhat southeast.

and shows considerable blue and green copper impregnation. Cap rock 12 to 15 feet thick. An opening about 10x10x4 feet shows the main work on the claim. The values lie in a thin seam in impregnated surrounding sandstone, making in all about 2 to 2½ feet. 17 *a*, average sample across a 2-foot face.

U^3O^8	1.01%
V^2O^5	.08%

The ore is capable of being sorted.

Little Emma. Owners, J. E. Calthary, J. Saby, A. H. Caywood. This claim, together with several more not developed at all, lies about 2 miles east of Drew's Cabin near Skull Creek. The work thereon consists of a circular opening at the apex of the sharply uptilted sandstone stratum. About 10 tons of ore were shipped from this point to New York in the Spring of 1906. The vein is about 2 feet thick at the breast, and shows around the contour of the opening. 102 *a*, average sample of this vein:

U^3O^8	.85%
V^2O^5	5.25%

COAL.

Rio Blanco County. Five miles east of Meeker, on Curtis Creek, about 200 yards above its junction with Coal Creek, Mr. W. H. Miller has opened a coal bank on a promising vein of coal. This vein has a strike of east 30° south and dips 12° north; elevation, 7,940 feet barometrical, and has an average of over 6 feet in thickness. Excavation on same has been made 70 feet into hill, and in the breast there is a chamber 20x10x6.5 feet, which was sampled vertically, cutting cross vein, dividing same into four samples. Sample 4 *a*, representing 1. 3 feet peacock coal; 4 *b*, 1.8 feet of so-called blacksmith coal; 4 *c*, 1.5 feet soft coal; 4 *d*, 1.95 feet hard coal at top of vein. Samples were crushed immediately, quartered and put into sealed bottles, so that results are reliable in the matter of moisture, except for the fact that the breast of coal was evidently more or less weathered from exposure to the atmosphere and consequently somewhat dried, though fresh faces were carefully exposed.

On Sulphur Creek, 3½ miles northeast of Meeker, The Sulphur Coal Company, A. Burnham, manager, have opened a coal vein through a tunnel 460 feet long, with coal characteristic of this area throughout the length of same. This vein has a strike of north 8° east and a dip of 15° west. The tunnel has been driven on generous proportions, which at the breast measures

7x12 feet. Sample 7 *a* is a sample cut across the thickness of the coal seam at the breast where the vein shows strong 7 feet thick. In this vein there shows a streak of about 2 inches of sandstone in the middle of vein with a streak of richer coal at the bottom not sampled. Along the creek, at about same level as above, a number of openings have been made.

At the head of West Fork Gulch, east of Lion Canon, 1 mile northwest of Meeker, the Jones Vein has been opened by a man named Pollard at an altitude of 7,700 feet barometrical. This vein has a strike of north 10° west and a dip of west 12° south. It is 8 feet thick and has been opened by tunnel for a distance of 540 feet. Sample 8 *a* represents fair average of the coal in this vein. Several other openings have been made on this vein by tunnels from 100 feet to 400 feet long on strike of same, but were filled with water.

At the head of the north fork of the gulch, east of Lion Canon, at an elevation of 7,880 feet barometrical, the Lord Bros. have opened the Black Diamond vein, which has a strike about north and south and a dip 18° west. This vein has been developed by tunnel 500 feet long. A large chimney has been excavated near the breast of tunnel which measures 40x10x14 feet, while breast measures 8x16 feet, with neither hanging nor foot walls exposed.

In Lion Gulch, 3½ miles west of Meeker, the Lion Coal Company, under the management of W. B. Blythe, has developed a very promising vein. This vein is opened by tunnel at an elevation of 7,335 feet barometrical and a strike north 10° east; it has a very decided dip 61° west and is opened for 1,100 feet. At intervals along this vein numerous chambers evidence the excavation of a very considerable volume of coal, and at breast of tunnel, where work was being done at time of our visit, there was an opening 8x12x15 feet. From this point sample 10 *b* was taken. The marked dip of this vein makes it very advantageous to operate by the methods in practice of tunneling and stoping in small chambers. There seems to be some variation in value of the coal at different points, as the coal vein is cut by a thin stratum of Laramie sandstone, though as depth is gained greater density is evident in the coal than is apparent at the surface. At about 100 feet vertically below this seam there is another outcrop which discloses a vein 11 to 12 feet thick, but no work was done at this point. At about 60 feet west of main opening there exists still another vein which shows from 6 to 8 feet of coal at its outcrop, on which a tunnel 200 feet long has been driven, but as the coal from this vein was of poorer grade than main opening, work here was abandoned.

At a point 2½ miles west of Meeker a gentleman named Fairfield is operating the Rio Blanco Coal Company, who own a coal claim which shows a vein that is 7 feet thick. The tunnel on this property is driven 400 feet along strike of vein north 15°

east, and the vein dips 39° west. At breast the tunnel is 7x20 feet, and sample 11 *a* shows average value of coal.

Throughout this district the coals lie in upper Fox Hills or Lower Laramie sandstone, which lay very flat except in Lion Canon and immediate vicinity, where same have been sharply uptilted, thus affording good opportunity for economically developing same through tunnel. These coals are generally marketed at the mine and bring a price of $1.75 to $2.00 per ton, F. O. B. mine.

Coal Analyses, Rio Blanco County	No.	H_2O	Fixed Carbon	Volatile Combustible Matter	Ash	Sulphur	Fuel Ratio
W. H. Miller, seam of Peacock coal, 1.3 ft. thick...............	4a	6.	49.6	37.	7.4	.55	1.34
W. H. Miller, 2 seams of Blacksmith coal, .8 and 1 ft. thick.......	4b	6.5	53.8	35.2	4.5	.50	1.53
W. H. Miller, 1.5 ft. seam of soft coal...	4c	5.5	54.	35.5	5.	.60	1.52
W. H. Miller, 1.95 ft. seam of hard coal..	4d	6.2	50.8	35.5	7.5	.65	1.42
A. Burnham, Sulphur Coal Co., 7 ft. vein.	7a	8.	47.	33.	12.	.50	1.42
Jones Vein, Pollard owner, 63 ft. thick..	8a	7.8	53.7	33.7	4.8	.60	1.59
Black Diamond, Lord Bros., 14 ft. thick..	2a	7.5	47.8	35.5	9.2	.52	1.34
Lion Coal Co., W. H. Blythe, 24 ft. thick.	10b	10.3	49.9	33.5	6.3	.60	1.34
Lion Coal Co., 5.7 ft. thick...........	11a	4.7	54.	36.8	4.5	.77	1.47

WHITE RIVER AREA.

The data found in traveling down the White River from Meeker to Rangely was of slight present importance, there being many mineral springs at many points along the river. At White River City a very interesting gas well exists. This was produced by the drilling of an oil well in 1888, since which date there has been a constant flow of gas approximately two hundred thousand cubic feet per day, the ebullition of which up through the eight-inch hole has broken down sides of hole till the same is about 15 feet across, and through the water which now fills the hole there is a strong boiling and bubbling of the gas. When lighted, the gas burns over the water and produces a flame 10 to 12 feet high. This gas is accompanied by petroleum, for the smell of same is distinctive, and the iridescent colors of petroleum are apparent. This flow of gas is a valuable resource to this area, and effort should be made to close well and control the flow of this gas, that it might be utilized in some practical manner at future time. The formation in which this development occurs is the Fox Hills Group, along a northwest faulting evident at this point, and which fault was the guide to the location of well. To the south of this point, and extending west to the Colorado-Utah line, there are many small fissure veins and springs of asphalt and mineral oil.

In this immediate vicinity there are many mineral springs, evolving gases, that have composition mainly CO_2 and H_2S. From this point down the river there was little of interest except the existence of coal banks, which are being operated as required for domestic consumption, the development being very slight, due to the sparse settlement throughout this area and small demand. Some thirty miles west of White River City, and about sixty-four miles west of Meeker, that is, following the river, lies Rangely, in the southern portion of Raven Park, which is a very interesting area about 8 miles north and south and 15 miles east and west, which was described by Prof. F. V. Hayden in 1876 as follows: "Raven Park. A comparatively small uplift, which is separate from, but accessory to, the Uinta uplift, crosses the Valley of the White River at a point southward from Blue Mountain (Midland Ridge), where it has brought up the shales of the Colorado Group, and out of these shales Raven Park has been excavated. The Park lies mainly upon the north side of the river; and, since the Raven Park uplift has a quaquaversal dip, the Park is wholly surrounded by an escarpment of Fox Hills strata. Aside from the action of the White River, the excavation of Raven Park has been accomplished by an extensive dry drainage creek that has its rise many miles to the northward, upon the slopes of Midland Ridge." From the fact that oil was developed in this area, and upon the theory that underlying the Colorado shales in the Dakota Sandstones would be found basins of oil, much practical work has been done. Many holes have been sunk, but up to date no development of oil in quantity has been made.

In the northwest corner of field, at an altitude of 6,015 feet (barometrical), a group of Meeker men have sunk what is called the Union well. This well had been sunk 2,865[1] feet in July, 1906, and at date of visit preparations were being made to continue the sinking of same. From reports of the men engaged in work at this well, oil was developed at a depth of about 400 feet, in amount of about 12 barrels per day.

[1]Since above, work was resumed and the well sunk to a depth of 3,310 feet, at which point fire destroyed the plant and work has been abandoned.

About one mile west of Union, and at an altitude of 5,920 feet (barometrical), the Missouri-Colorado Oil Company sunk a well 2,500 feet in depth, with no result, except that at depth of 80 feet water was developed, which was the exception in this field, no other well having this experience. A total number of 8 wells have been sunk in an area of not to exceed 4 miles, ranging in depth from 600 feet to 3,310 feet, in all of which some oil has been found, but in none of which has been found enough to be of present commercial value. On Skull Creek, about 15 miles northeast (5 or 6 miles as the crow flies), the Midland Ridge is apparent, and along the creek is to be seen sandstone, presumably Dakota, showing saturation with petroleum compounds. At this point the altitude is from 900 to 1,000 feet higher than at the centre of operations in the oil field, and the Colorado shale and Fox Hills overlie the Dakota sandstone. The oil developed in the field has apparently been found entirely in the Colorado shale, which has been proven to have a thickness of over 3,300 feet, and the Midland uplift corroborates the relation between these two groups of rocks, for the Colorado Group is exposed for a thickness of from 2,000 to 3,500 feet. This relation between these two groups gives strength to the theory and hope of the operators in this field in expecting flowing wells on penetrating the Dakota sandstone, for the pressure of water following down the contact between these two groups, from outcrop on Skull Creek to the oil basin, would be very large, in that the difference in altitude between this outcrop of the Dakota sandstone and its position in the oil field is approximately 4,500 feet. It is to be hoped that the men having this development in hand may succeed in obtaining the financial aid requisite to demonstrate this fact.

In traveling from Blue Mountain on Skull Creek to Yampa River and to Lay there was seen no mineral of practical importance, except coal, which was found in the Fox Hills Group, as was apparent in and around Meeker. Development of other minerals was absent in this area, and no effort was made to leave the beaten track, due to the lack of encouragement, in that we saw nothing in the line of samples except copper ores, which were from deposits in sedimentary rocks and showed no large volume. North of Lily Park, on Douglass Mountain, there is development of both copper and iron, but the conditions existant there preclude their being of present commercial importance.

Up the Yampa River from Maybell and on the south side of the river is Juniper Springs, which is sure to be a valuable asset in the near future. At this point there are 6 springs, which are flowing about 5,000 gallons per hour of warm mineral water, which has a temperature of 102° F. These springs are beautifully located in the valley of the Yampa River, and have been developed quite thoroughly, and are equipped with bath houses and facilities, the waters being especially potent for rheumatism. One of the most interesting mineral conditions seen on the trip is apparent at a point about 12 miles north of Juniper Springs, or about 6 miles north of Lay, on Lay Creek. Here is apparently the southern edge of a very large sedimentary area, which extends east almost to Fortification Creek and north to the Little Snake River, in many portions of which lie beds of workable placer gravel. At a point about midway between the 2 rivers a ridge has been uplifted, south of which toward the Yampa River and north of which toward the Little Snake there is a gradual slope of about 1,800 feet. Throughout this area there are many dry creek beds, along which there is heavier deposition of gold in the gravel. On Lay Creek, about 6 miles above Lay postoffice, the Blevins Mining Company were operating a small 60-horsepower dredge at the time of our visit. This dredge equipment was composed of a 60-horsepower boiler, engine and dredge equipped with very light buckets, which were capable of handling about 1,200 yards per day. Water to the amount of about 700 gallons per minute was being pumped from Jackrabbit Springs. The bed of gravel being cut varied from 5½ feet to 10 feet, and they were saving in gold from 35 cents to 50 cents per yard. The area of this immediate vicinity is characterized by the absence of boulders, and by value about 35 cents per cubic yard, which occurs in rather thin flakes of clear, bright gold, which is disseminated through the gravel uniformly, and appears as well in the surface soil or loam, which overlays the gravel to a thickness of from 1 to 3 feet. Within about a mile of the operation of this dredge is a coal bank, on which opening has been made and from which very cheap fuel is obtained for the operation of the machinery. A number of samples of gravel taken from various claims located near Jackrabbit Springs gave, from careful amalgamation tests, the following results:

Convict	$ .20
Emerson	1.09
Board Gulch	.04
Myra K	.10
Milwaukee	Trace
Edith	.15
Grassroots	1.25

These results calculated to a cubic yard, assuming a yard of gravel to weigh 1½ tons.

This gold-bearing gravel appears to be continuous throughout a very large area, extending east along both the south and north slopes of this Jackrabbit ridge almost to Fortification Creek, a distance of about 24 miles. This area is also characterized by a dearth of 'water, but with the increase of the specific knowledge of the value here existant plans for pumping water will be feasible and practical. The gradual slope of the country makes dredging perhaps the only practical way of recovering this gold.

From Lay our course took us east along the Yampa River to Craig, Hayden and Steamboat Springs, in the Yampa coal field. No stops were made in this territory, as we were in quest of data not covered by other parties in the field.

Steamboat Springs is a beautifully located little town on the northeast bank of the Yampa River, near the juncture of the Archean, which comprise the main range extending north and south at this point, and the sedimentaries lying west of the main range, and in and around this town are a large number of mineral springs, from one of which the town takes its name. These springs are of a great variety, and will prove of great benefit to the outside world when made accessible by railroad communication, for their curative properties are perhaps equal to any known mineral springs. At a point 7 miles north of Steamboat Springs, in Hot Springs Gulch, there is a mineral spring that has a temperature of 152° F., which has 2 openings, one on either side of the creek, and from each of which there is a discharge of about 1,200 gallons per minute. Immediately southwest of the town raises a large body of Dakota sandstone, in which there exist two very interesting developments. On the northeast exposure of the southwest bank of the Yampa River, about 1½ miles southwest of Steamboat Springs, there is a sandstone quarry that produces a white sandstone, that is fairly hard when freshly cut and hardens materially on exposure, and has a clean, good cleavage. The stone from this quarry has been used somewhat in building in the town. About 1,000 perch have been removed from this quarry. Samples of this stone gave following tests:

Maximum stress, per square inch..............4,900 lbs.
Minimum stress, per square inch..............3,300 lbs.
Average stress, per square inch................3,975 lbs.

The best exposure for working this quarry lies about 400 to 500 feet above the river. This quarry is being operated by Jno. Wiley & Son. At a point at about 100 feet above river and about half a mile south of the town, also on southwest bank of the river, The Colorado Onyx Company have a quarry from which a moderate quantity of very beautiful onyx has been produced. This lays in horizontal strata about 2 feet thick, but has been worked to but a moderate extent. From this quarry has been shipped a number of carloads of cream colored onyx that is very beautiful, but has not been developed to the point where sufficient pressure has produced a density in the rock requisite for sawing and turning. A beautiful effect was produced by the use of this stone at the Colorado mineral exhibits at both St. Louis and Portland, but the stone required considerable patching and filling.

Various mineral districts were visited around Steamboat Springs, among them the Copper Ridge District, which lies about 4 to 5 miles north of Steamboat Springs, between the Elk River and Soda Creek, in a low range rising about 2,500 feet above the Yampa Valley. This ridge trends north and south and is a part, geologically, with the main Park Range, which is the Continental Divide, composed of the Archean, coarse red granites, diorite bands and schists. On the west slope of the mountain is a small patch of sedimentaries; on the north half of the ridge several dikes of igneous rocks are evident, carrying iron-glance in contact with granite. Mineralization is everywhere evident at the surface in shape of copper oxides and carbonates, blending into sulphides below. The developments disclose small lenticular bodies of the granite with narrow seams and bands of quartz which conform to dip and strike of formation and which carry small amount of copper, but nowhere in workable quantity, and where developed to 50 feet in depth there is blending of the impregnated rocks into the country rock and total elimination of the mineralization.

The Greenville District lies about 20 miles north of Steamboat Springs, about 4 miles east of Clark, and is composed of another small range of mountains similar to Copper Ridge, which trends north. In the portion visited the coarse red granite is changed to metamorphosed schists, in which there are evident irregular lenticular masses and bodies in and lying with the formation and containing zinc in form, sphalerite, some galena and chalcopyrite, but nothing developed in paying quantity and showing very small value in either silver or gold. Various tunnels have been driven to develop continuity of ore shoots in depth, but, apparently, ore bodies at surface have given place to barren hornblend schists and country rock.

The Mt. Farwell District is located about 35 miles north of Steamboat Springs and 5 miles east of Hahn's Peak, and is also part of the Archean of Park Range. Here the rocks consist of pegmatites, diorites and metamorphosed schists, overlaid in some places by sandstone and cut in others by porphyry dikes, along the contact of which with the granite there have been developed lenses of small size, showing slight deposition of copper, but nowhere in shipping quantity was there developed any ore.

Hahn's Peak District lies north of Steamboat Springs 35 miles, and has been actively prospected for many years because of the rich placers that have been known on the south slope of the peak, but from the results that are evident the source of the placer gold has not yet been determined. The peak rises up from the surrounding country in the form of a regular shaped cone of white porphyry, which breaks up through the sedimentary rocks, carrying large masses of them up to a much higher elevation, where they are still in horizontal strata, and lay in relation to one another as they do in the country north of the peak at Columbine, viz., shale, limestone, conglomerate and quartzite. Throughout this vicinity there is evident much persistent effort to find the origin of the gold found in the placers, but, though there has been much prospecting done, both in the sedimentaries and in the porphyries, nothing has been developed of consequence. On the southwest side of the peak Messrs. Paulson and MacIntosh have driven a tunnel 625 feet north 33° east in the porphyry, which carries small crevices of pyrite and galena, very low grade, the value predominating being silver.

Eli Young, on the Conundrum claim, has driven a tunnel into the west side of the peak 500 feet on a course north 30° east. At 380 feet from portal a quartzite slate contact was cut, which showed marked impregnation of pyrites, but carrying little value.

The Hahn's Peak Gold Mining and Milling Company, on the Silent Friend claim, has driven a tunnel into the mountain, also from west side, 375 feet, on a course east 9° north, which was run through soft mineralized quartzite, in which was cut a sheet of porphyry. On this contact from this claim there is reported to have been shipped 150 tons of ore that gave returns of about $88.00 per ton. Near the apex of the mountain, on the north side, is located the Tom Thumb, which is also accredited with some shipments from small shoot of ore developed on similar contact.

At Columbine the condition is identical with that at the aforementioned properties, the property on which the most extensive work is evident being the Minnie D., on which claim a shaft had been sunk 300 feet deep on a vein, which has a course north 51° east and a thickness of about 4 feet. A general sample of this vein gave returns of gold, .16 ounce; silver, 82.52 ounces. In working this vein it was discovered that the same was intersected by a quartzite dike, and the work we saw being done was to determine, if possible, its continuity beyond this dike, in the form of a tunnel, which was driven from the gulch below collar of shaft. This tunnel was started at a point about 325 feet from shaft, and had been driven 276 feet on a course north 45° east, and apparently would intersect the vein a few feet north of level from shaft, probably in the dike.

Elkhorn District lies abont 50 miles north of Steamboat Springs, within 2 miles of the Wyoming line. This district is represented in practical work, mainly, in the work of the Primrose Mining and Development Company, who have a bond and lease on the Elkhorn and Westside claims, in which there is developed a small fissure in hornblend schist. This vein has a strike north 4° west and dips almost vertical, and is composed of galena, zincblend and chalcopyrite enclosed in hornblend schist. The vein has a thickness of about 3 feet, while the pay streak varies from 6 inches to 2 feet. It is metamorphosed diorite, which appears to be the country rock. Samples taken of this vein, from what they call their old shaft, gave, gold, .08 ounce; silver, 195.76 ounces, and from new shaft, where crosscut from same intersects vein, gold, .14 ounce; silver, 49.56 ounces. The ores carry galena, pyrite, chalcopyrite, sphalerite and malachite. In the immediate vicinity of this development, about 1,200 feet south and apparently on same vein, there is exposed a small streak, about 5 inches thick, of similar ore to above. Seventy-five feet west there is exposed another narrow streak, opened by a 60 foot tunnel. All the ore in this vicinity occurs in narrow shoots, that are expensive to operate, and the volume of water here evident will increase the cost of production materially.

Slavonia District lies about 35 miles north of Steamboat Springs, near the headwaters of the Elk River, in the western slope of the main Park Range, on Gilpin Creek, the middle fork of Elk River. The evidence of glacial action is here abundant in the striation lengthwise of the Archean formation, which is exposed on every side. The rocks of this district are amphibolites, epidot, tourmaline, pegmatites, the coarse biotite granites, diorites and schists. In this district there has been some considerable effort made to develop value. This effort, however, was confined to but few workers. The Ethel claim, owned by C. E. Blackburn and T. A. Brown, lays in northeast portion of district, and on side hill, facing east, there is exposed an 11-foot vein, which is composed of cyanite-schist and quartzite, containing galena and zinc, from which sample gave returns of trace in gold and 13.24 ounces in silver. On east side of Gilpin Creek, on the Martha Vranesich claim, considerable work has been done on a vein, which strikes east 24° south. Vein is opened on breast 25 feet high, showing apex about 6 feet wide at bottom. A tunnel has been driven about 105 feet at a point below breast above mentioned 70 feet. This tunnel is driven on a vein of mineralized schist, amphibole and gneiss, the minerals being galena, sphalorite, chalcopyrite and pyrite, sample of which gave .08 ounce gold, 1.22 ounces silver. The work done in this tunnel is very creditable work, it being well driven and exceptionally well timbered. The owners of this property are Peter Vranesich, Max Malich, Nicholas Rayakovich and Peter Smilyovich. The Slavonia No. 4 claim is located west of creek, and work consists of a tunnel driven almost due east on vein of similar character—mineralized schist, cyanite, amphibole and gneiss—which outcrops on the hill 30 feet above this tunnel, which has been driven 50 feet, and which shows at breast laminated strata, standing almost vertical, about 4 feet wide. These developments show the general conditions of this camp, though specimens were shown that indicated the existence of nickel and molybdonite, which, if proven to exist in quantity, would give to the district special interest.

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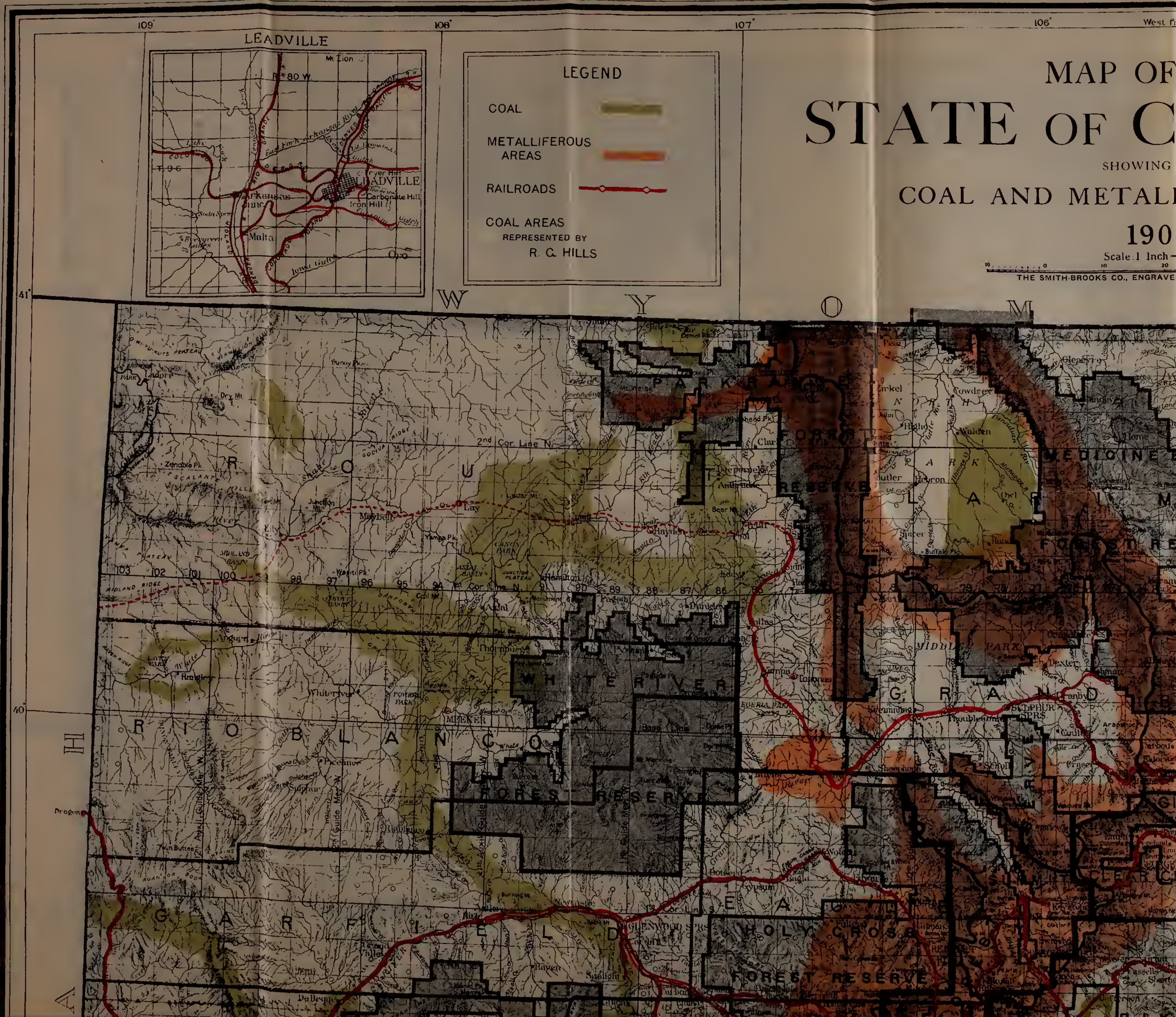
MAP OF
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190
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THE SMITH-BROOKS CO., ENGRAVER
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GARFIELD
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GRAND
LARIMER
WHITE RIVER FOREST RESERVE
HOLY CROSS FOREST RESERVE
PARK RANGE FOREST RESERVE
MEDICINE BOW
NORTH PARK
MIDDLE PARK
Meeker
Glenwood Sprs
Hayden
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Leadville
Malta
Iron Hill
Carbonate Hill
Fryer Hill


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ARAPAHOE
KIT CARSON
JEFFERSON
STERLING
HOLYOKE
GREELEY
DENVER
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Abbott
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Burdett
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Watkins
Bennet
Byers
Schley
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Elizabeth
KIOWA
Hilltop
Littleton
Golden
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Longmont
Hygiene
Akron
Three Buttes
Pawnee Buttes
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Platte River
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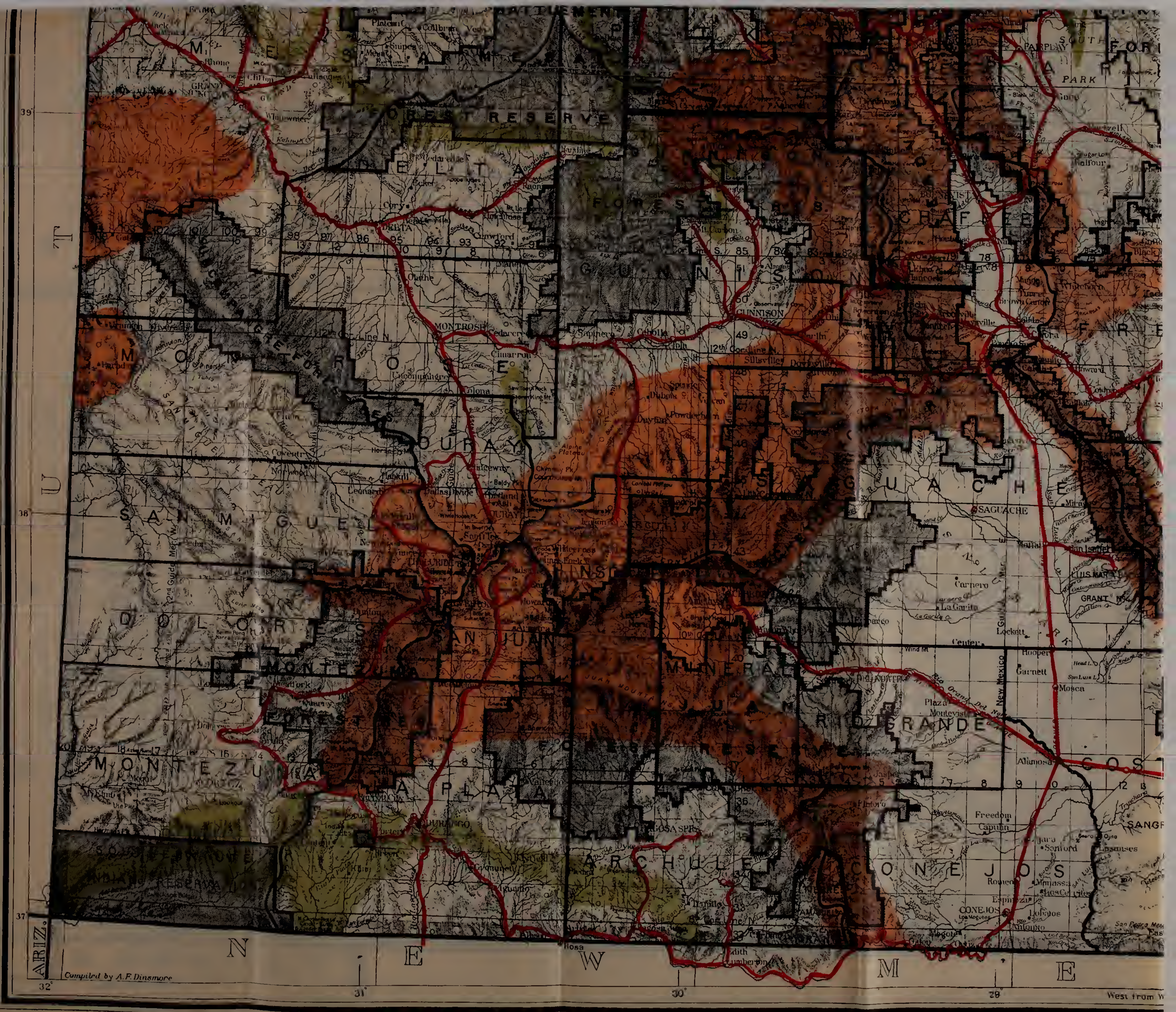

FOREST RESERVE
DELTA
GUNNISON
MONTROSE
OURAY
SAN MIGUEL
DOLORES
MONTEZUMA
SAN JUAN
MINERAL
RIO GRANDE
SAGUACHE
CHAFFEE
ARCHULETA
CONEJOS
LA PLATA
Delta
Montrose
Gunnison
Saguache
Alamosa
Durango
Grand Junction
Ouray
Del Norte
Conejos
Antonito
La Garita
Center
Mosca
Hooper
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Carnero
Pagosa Sprs.
South Park
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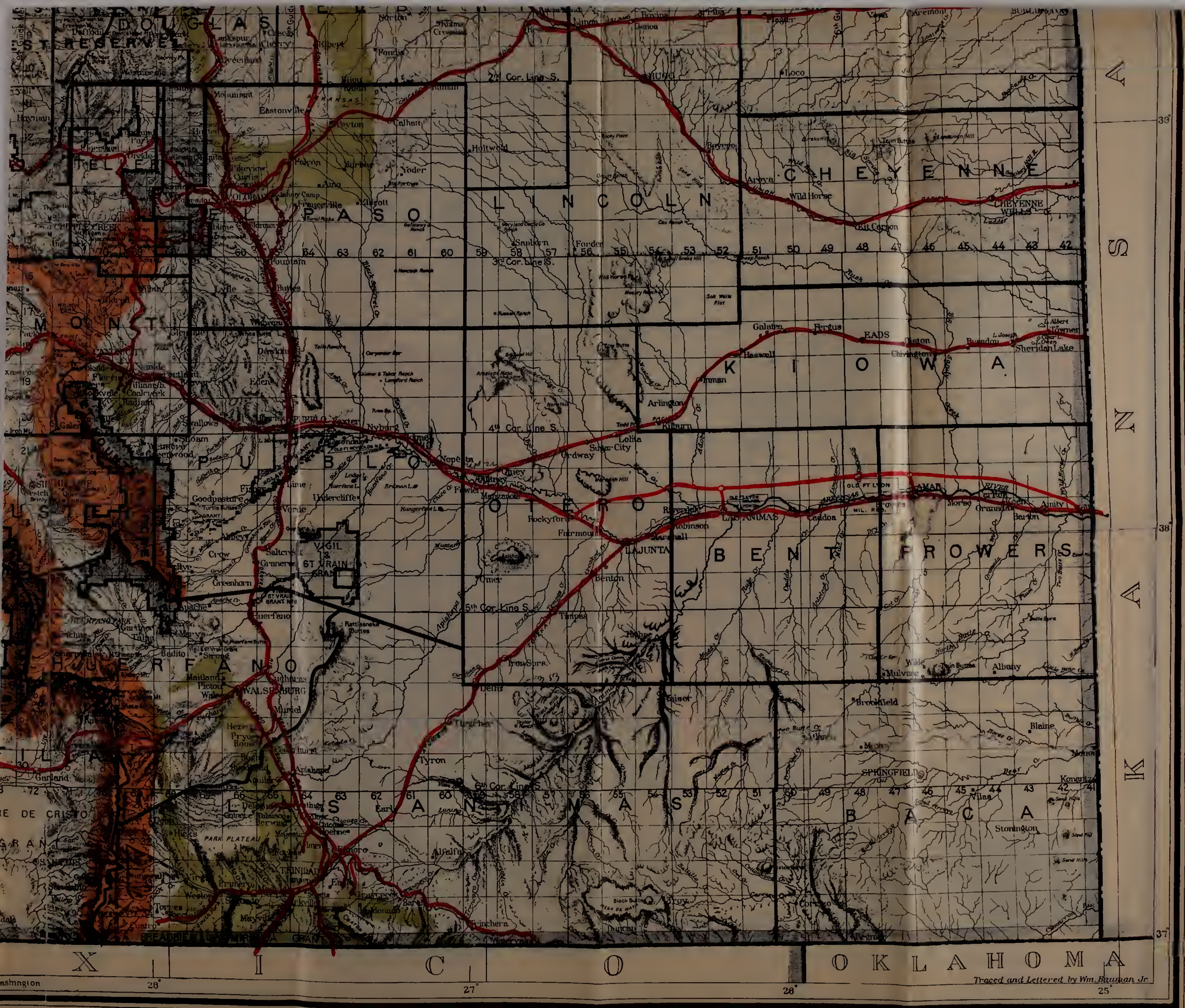
DOUGLAS
ELBERT
EL PASO
LINCOLN
CHEYENNE
KIOWA
PUEBLO
OTERO
BENT
PROWERS
HUERFANO
LAS ANIMAS
BACA
VIGIL & ST VRAIN GRANT
KANSAS
MEXICO
OKLAHOMA
Monument
Eastonville
Peyton
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Holtwold
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Falcon
Fountain
Buttes
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Limon
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Lolita
Sugar City
Ordway
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Olney
Fowler
Manzanola
Rockyford
Fairmount
Lajunta
Las Animas
Caddoa
Lamar
Granada
Holly
Amity
Barton
Benton
Timpas
Higbee
Delhi
Tyron
Springfield
Brookfield
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Vilas
Stonington
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Walsenburg
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Greenhorn
Aguilar
Trinidad
Weston
Primero
El Moro
Hoehne
Madrid
Apishapa
Goodpasture
Undercliffe
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Saltcreek
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Traced and Lettered by Wm. Bauman Jr.