

CASSITERITE IN SAN DIEGO COUNTY, CALIFORNIA.

By WALDEMAR T. SCHALLER.

A small handful of cassiterite crystals was found in the northern part of San Diego County, Cal. (fig. 22), in the spring of 1915, and the locality was visited by the writer in July, in order to see if it offered any hope of finding cassiterite in quantity. Mr. Roy Carson was kind enough to act as guide, and the writer wishes to thank him for his many courtesies. The locality lies in an arid region, best reached



FIGURE 22.—Index map showing position of cassiterite locality in San Diego County, Cal. The rectangle indicates the gem tourmaline field of southern California, throughout which are found pegmatite dikes similar to the one described in this paper.

by horseback from Oak Grove, although a wagon road, now in bad condition, leads from Oak Grove to a point within a mile of it. The present owners of the claims (Messrs. Roy Carson, E. L. Haney, and D. H. A. Fiske, of Pasadena), expect to do further development work in 1916.

The original material, extracted from a single pocket in a flat-lying pegmatite dike,¹ is all the cassiterite so far obtained, and an examination of the locality has failed to offer any hope of finding more in large quantities. The deposit illustrates well the irregular way in which the rarer minerals occur in the granitic pegmatites of southern California.

¹ The term dike as used in this paper carries no implication as to dip, which may be more nearly horizontal than vertical.

Although the present developments have been disappointing, the cassiterite found exceeds in quantity all the occurrences of tin ore in place previously known in San Diego County. These are as follows: F. J. H. Merrill¹ has stated that small grains of cassiterite have been obtained by placer miners from the black sand of the mountain gulches, chiefly from the east slope of Laguna Mountain, in the southern part of the county. Additional reported occurrences are in Pine Valley; on the south end of Viejas Mountain, east of Alpine; and in the Defiance copper district, north of the Santa Margarita grant. The writer² has described small black crystals of cassiterite, a few millimeters thick, associated with albite, quartz, stibioantalite, and green and pink tourmalines, obtained from the gem pegmatite dike at the Himalaya mine, Mesa Grande, and with topaz from the Little Three gem mine, Ramona. The original San Diego County included the tin mines at Temescal, now in Riverside County.

The pegmatite dike which yielded the cassiterite crops out on the east side of Chihuahua Valley, about 2 miles south of the boundary line between Riverside and San Diego counties and about 10 miles east of Oak Grove, in the SW. $\frac{1}{4}$ sec. 12, R. 3 E., T. 9 S., San Bernardino meridian. Three claims, the San Diego, Panama, and Exposition, cover the outcrop of the dike. There are at least two other parallel dikes on the claims which have not yet been developed. The place was discovered and located in 1905 by Mr. Bert Simmons, of Oak Grove. The claim, then called the Blue Tourmaline, was worked extensively in 1906, by open cuts and several short tunnels, the main object of search being gem tourmaline.

The country rock of the region is granitic and belongs to the group intermediate between granite and diorite. The specimens collected contain quartz, orthoclase, plagioclase, biotite, and hornblende, and pending further study may be termed granodiorite. Many of the hornblende and biotite crystals are from 0.5 to 1 centimeter across.

A system of parallel faults, of which the major ones are over 50 miles in length, cut across the country in a northwesterly direction (about N. 40°-50° W.), and the locality described lies about halfway between two of these larger faults. It is probable that other as yet undetermined dislocations lie between the two mentioned. A northwest fault line probably determines the east side of Chihuahua Valley, and the dike containing the cassiterite occurs less than a mile east of this supposed fault line. Numerous pegmatite dikes, striking parallel to the fault-lines, crop out on the east side of Chihuahua Valley.

¹ Merrill, F. J. H., *Geology and mineral resources of San Diego and Imperial Counties: California State Mineralogist's Rept., 1913-14*, p. 39, 1914.

² Schaller, W. T., *The gem tourmaline field of southern California: U. S. Geol. Survey Prof. Paper 92* (in preparation).

The western fault of the two mentioned determines the east side of Smiths Mountain, and extends from a point north of Aguanga, in Riverside County, southeastward through Oak Grove, Puerta Cruz, and Warners Hot Springs (Agua Caliente), probably forming the east side of the valley occupied by Warner's ranch. The eastern fault line, whose exact location is not known, passes through San Jacinto and Hemet, skirting the west and southwest edge of the San Jacinto Mountains, and through the Coahuila Valley and Coyote Canyon.

The remarkable parallelism of strike of nearly all the pegmatite dikes of this region with the larger fault lines is very suggestive of a possible genetic relation. Similar pegmatite dikes occur at Pala, and a detailed study of this locality has indicated that the fissures now filled with pegmatite are part of a large system of dislocations prominently developed in San Diego County.

The exposed length of the pegmatite dike in which the cassiterite was found is nearly half a mile, and the thickness from 6 to 8 feet. The pegmatite rock is more resistant to erosion than the granodiorite country rock, and the dike therefore projects slightly above the ground. It strikes about N. 35° W. At the north end of the claims the natural exposure of the dike seems to show it dipping slightly toward the northeast; at other places it lies almost horizontal, and at still other places a slight but decided dip toward the southwest is observable.

The pegmatite dike is of the type of the compound, unsymmetrical dikes whose different parts are thought to be due to differentiation processes rather than to multiple injections of material into reopened fissures.

The upper portion of the dike ("top rock"), from 2 to 3 feet thick, is a mixture of a coarse granular aggregate of quartz and feldspar with coarse graphic granite, in both of which occur biotite, muscovite, and black tourmaline. At one place a horizontal layer of graphic granite 4 inches thick was seen in the granular aggregate.

The lower portion of the dike ("bottom rock"), about 3 feet thick, is a finer-grained granular quartz-albite rock with numerous wavy bands of garnets, which in their general trend lie horizontal, being parallel to the dip of the dike.

The middle part, between the top rock and bottom rock, is called the pay streak by the miners, for it is in this part that the minerals of value are found. The pay streak ranges from 1 foot to 3 feet in thickness and is the coarsest part of the entire dike. In it occur numerous cavities or pockets which yield an abundance of large and well-crystallized minerals—quartz, feldspars, and micas—as well as other minerals found only in this part of the dike, such as lepidolite, transparent blue tourmalines, cassiterite, and columbite. The

pocket from which the cassiterite was obtained lies just above the banded bottom rock and is about a foot high and 3 feet wide. The irregular masses and imperfect crystals of cassiterite were found in one side of the pocket in a mass of partly broken, cleaved, and loose orthoclase, directly associated with albite. The loose crystals of cassiterite contain partly embedded tabular albite crystals. About a hatful of small blue tourmalines was also obtained from this pocket. In a similar pocket, about 25 feet distant, a few crystals of columbite were found.

INDEX.

	A.	Page.		Page.
			Bancroft, H. H., on early mining on Snake River, Idaho.....	274
Abbie claim on Sucker Creek, Oreg., description of.....		21-22	Bare Mountain, Nev., geology of quicksilver locality on.....	63-65
Alamo claims, description of.....		163-164	Barite, occurrence of, in Gilpin County, Colo. occurrence of, in the American Fork district, Utah.....	307 207, 208
Alamo district, Ariz., gold lodes in.....		160-163	Barry-Coxe mine, ore deposits in.....	206
Alonah claims, description of.....		164	Bastin, Edson S., and Hill, James M., Preliminary report on the economic geology of Gilpin County, Colo.	295-323
Alpine district, Utah, ore deposits of.....		223-224	Bay State mine, ore deposits in.....	208-209
Alpine-Galena mine, ore deposits in.....		224	Beatty, Nev., cinnabar prospects east of.....	62-67
Alta Consolidated mine, ore deposits in.....		210-211, 217	Bedded deposits, distribution and character of, in the Cottonwood-American Fork mining region, Utah.....	209-223
Alum. See Potash alum.			Beggs, Edward, acknowledgment to.....	45
Alumina, production of, from alunite.....		269-270	Bellevue, La., iron-bearing deposits at.....	143
Alunite, analyses of.....		246-248	Benton, La., iron-bearing deposits east of....	141
deposits of, character of.....		241-242	Big Cottonwood district, Utah, bedded deposits in.....	217-220
depth of.....		255-256	history and production of.....	191-194
locations of.....		240-241, 258	Big Horn prospect, description of.....	162-163
mode of developing.....		256-257	Bingham district, Utah, analyses of rocks from.....	228
origin of.....		253-255	Bismuth, occurrence of, in the Yellow Pine mining district, Nev.....	5
tonnage of.....		257-258	Bivins, Tex., iron-ore deposit northwest of..	78-79
exposures of, eastern zone of.....		250-252	Black Mountains, Ariz., potash in rocks of...	234
middle zone of.....		250	Blackfoot, Idaho, Snake River at.....	276
western zone of.....		248-249	Bodcau Lake, La., iron-bearing deposits near.	143
mineralogy of.....		242-244	Bolinger, La., iron-bearing deposits near...	136-140
occurrence of, with quicksilver ore.....		65	Bolinger Lumber Co., acknowledgment to...	131
products obtainable from.....		264-270	Bornite, occurrence of, in Gilpin County, Colo.....	311-313
American Fork district, Utah, bedded deposits in.....		220-223	Boron, occurrence of, in the Cottonwood-American Fork mining region, Utah.....	225
history and production of.....		195-198	Boss mine, development of.....	5-6
American placer, Oreg., salts from, analyses of salts from, description of.....		26 30-31	geology and ore deposits of.....	4-5, 6-12
Ankareh formation, distribution and character of, in the Salt River Range, Wyo.....		336	history of.....	1-3
Antimony compounds, occurrence of, in the Cottonwood-American Fork mining region, Utah.....		209, 212	location of.....	1
Arsenopyrite, occurrence of, in the Mazatzal Range, Ariz.....		126	Bossier Parish, La., iron-bearing deposits in.	134-143
Atlanta, Tex., iron-ore deposits northwest of.		78	Bostonite and bostonite porphyry, distribution and character of, in Central City quadrangle, Colo.....	301-302
Australia, production of alum in.....		268-269	Bournonite, occurrence of, in the Mazatzal Range, Ariz.....	126
Avinger, Tex., iron-ore deposit southwest of..		87-88	Bowie Hill, Nev., iron-ore deposit on.....	75-78
Aztec mine, discovery and development of.		325-326	Bowman, E. H., acknowledgment to.....	111
Azurite Mining Co., claims of.....		12	Bowman & Reynolds quicksilver claims, lodes and workings on.....	125-126
	B.		Bradley, F. H., on discoveries of gold on Snake River, Idaho.....	273
Babb, J. B., acknowledgment to.....		131	Branborg mine, ore deposits in.....	205-206
Bailey, R. K., analyses by.....		27		
Balcy Creek, Wyo., gold placers near mouth of.....		286-288 ¹		
Baldy, N. Mex., occurrence of gold ore at..		329-330		
Baldy Peak, N. Mex., copper mine on.....		325-326		
geography of.....		327		
geology of.....		327-329		
Bancroft, Howland, on placer workings in the Plomosa Mountains, Ariz.....		53-54		
on the Mariquita prospect.....		56		

Page.	Page.		
Brazer limestone, distribution and character of, in the Salt River Range, Wyo.	335	Clay ironstone, occurrence of, in northwestern Louisiana	143-144
Brighton, R. M., acknowledgment to	157	Claytonia claim No. 1, salts from	26, 30-31
Brochantite, occurrence of, in the Yellow Pine mining district, Nev.	10, 11	C. O. D. claims, description of	162
Buffalo Fork, Wyo., gold placers south of	277, 286	Colorado River Indian Reservation, Ariz., map showing geology of	46
Bulladelah, Australia, production of alum at	268-269	Columbus Consolidated mines, description of	204
Burchard, Ernest F., Iron-bearing deposits in Bossier, Caddo, and Webster parishes, La.	129-150	ore deposits of	216-217
Iron ore in Cass, Marion, Morris, and Cherokee counties, Tex.	69-109	production of	190, 199
Burlap table, construction and operation of	284-285	Contact deposits, distribution and character of	200-201
Burling, L. D., fossils determined by	170	Copper, enrichment of deposits of, in Gilpin County, Colo.	318-319
Butler, B. S., Potash in certain copper and gold ores	227-236	occurrence of, in Gilpin County, Colo.	307, 311-313
and G. F. Loughlin, A reconnaissance of the Cottonwood-American Fork mining region, Utah	165-226	in the Cottonwood-American Fork mining region, Utah	201-223
and H. S. Gale, on the process of producing potash alum from alunite	267-268	in the Kofa Mountains, Ariz.	163-164
Butte district, Mont., analyses of rocks from	232	in the Yellow Pine mining district, Nev.	4
Butte mine, description of	204	production of, in the Cottonwood-American Fork mining region, Utah	193-194, 197-198
C.		<i>See also</i> Bornite, Chalcocite, Chalcopyrite, Enargite, and Tennantite.	
Caddo Parish, La., iron-bearing deposits in	143-145	Cottonwood-American Fork mining region, Utah, geologic reconnaissance map of	166
Cahill, J. J., acknowledgment to	131	geology of	168-183
Cambrian rocks, distribution and character of, in the Cottonwood-American Fork mining region, Utah	169-171	metamorphism in	182-183
Carbonate Co.'s mines, ore deposits in	219-220	ore deposits of	183-226
production of	192	genesis of	224-226
Cardiff mine, ore deposit in	204-205, 218	previous work on	166-167
Carson, Roy, acknowledgment to	351	situation of	165-166
Cass County, Tex., analyses of iron ores from	86	structure of	177-182
iron-ore deposit in	75-86	topography of	167-168
Cassiterite, occurrence of, in San Diego County, Cal.	351-354	Cripple Creek district, Colo., analyses of rocks from	233
Cemitosa prospect, description of	163	Cuprite, occurrence of, on Baldy Peak, N. Mex.	326
Central City, Colo., and vicinity, map showing veins of	304	D.	
Central City quadrangle, Colo., ores of, classification of	322	Daingerfield, Tex., iron-ore deposits near	88-90
sketch map of	300	Dall, William H., fossils determined by	134
<i>See also</i> Gilpin County, Colo.		Dan Welsh prospect, description of	56-57
Cerargyrite, occurrence of, in Gilpin County, Colo.	316	Deussen, Alexander, acknowledgment to	70
Chalcocite, occurrence of, in Gilpin County, Colo.	312	Devonian rocks, distribution and character of, in the Cottonwood-American Fork mining region, Utah	172-174
occurrence of, in the Yellow Pine mining district, Nev.	10, 12	Dewey, F. P., cited	9
Chalcopyrite, occurrence of, in Gilpin County, Colo.	303, 310, 311-313	Dikes, occurrence and age of	302
Cherokee County, Tex., analyses of iron ores from iron-ore deposits in	90-94	Dome Rock Mountains, Ariz., placers in	52-53
Chrysocola, occurrence of, in the Kofa Mountains	163	Dorothy claim on Sucker Creek, Oreg., description of	22-23
occurrence of, in the Yellow Pine mining district, Nev.	5	Dorr, J. V. N., acknowledgment to	111
on Baldy Peak, N. Mex.	326	Dry Creek, Wyo., phosphate deposit on	338-341
Cinnabar, deposits of, east of Beatty, Nev.	62-67	sections of rocks on	341-343, 347-348
deposits of, east of Mina, Nev.	59-62	Dry-washer machines, description of	50
Cinnabar King prospect, description of	62	Dufoureq, E. L., acknowledgment to	45
Cinnabar prospect, description of	65-66	E.	
City Rocks and Utah claims, description of	187, 190	Eagle Bend, on Snake River, Idaho, gold placer at	277, 289-290
		Early Bird prospect, description of	66
		Ely, Nev., analyses of rocks from	231
		Emily mine, description of	187

	Page.		Page.
Emma mine, history of.....	184-185, 199	Gold-bearing wash, areas of, near Quartzsite, Ariz.....	50-51
ore deposits in.....	211-215	character of.....	51-52
Enargite, occurrence of, in Gilpin County, Colo.....	306	Gold Point, on Snake River, Idaho, placer at.....	277, 289-290
Enrichment, downward, processes of.....	314-319	Golden Hope claims, description of.....	55-56
F.		Goldfield district, Nev., potash in rocks of...	233
Featherstone, Col. L. P., acknowledgment to.	70	Goodman mine, description of.....	55
Ferberite, occurrence of, in Gilpin County, Colo.....	311	Granite gneiss, distribution and character of, in Central City quadrangle, Colo.....	297-298
Fertilizer, use of alunite as.....	270	Granite pegmatite, distribution and character of, in Central City quadrangle..	298-299
Finch, E. H., work of.....	331	Greenwood, La., iron-bearing deposits near.	144-145
Fissure deposits, distribution and character of, in the Cottonwood-American Fork mining region, Utah....	201-209	H.	
Flagstaff mine, history of.....	185, 190, 199	Heikes V. C., History and production in the Cottonwood-American Fork mining region.....	183-224
ore deposits in.....	215	Henderson, Charles W., acknowledgment to..	295
Florence Mining & Milling Co., alunite deposits of.....	248-250	Hill, James M., Notes on the fine gold of Snake River, Idaho.....	271-294
Fluorite, occurrence of, in Gilpin County, Colo.....	306, 310	Bastin, Edson S., and, Preliminary report on the economic geology of Gilpin County, Colo.....	295-323
Fort Hall Bottoms, on Snake River, Idaho, gold placers on.....	290-291	Homedale, Idaho, nitrate deposits near, description of.....	20-28, 29
Fossils from northwestern Louisiana, determinations of.....	134	nitrate deposits near, origin of.....	41-44
Fossils, occurrence of, in the Salt River Range, Wyo.....	335	Homedale region, Idaho, geography of.....	33-36
Fourth of July mine, ore of composite type from, plate showing.....	308	geology of.....	34, 36-39
Fuller mine, description of.....	187	Hornblendite, distribution and character of, in Central City quadrangle, Colo.	298
G.		Horse Island, Idaho, gold placers on.....	291
Gale, H. S., B. S. Butler and, on the process of producing potash alum from alunite.....	267-268	Hunter, J. F., jr., acknowledgment to.....	20
Galena. See Lead ores.		Huntley, D. B., on bedded deposits in the Big Cottonwood district.....	218-220
Geyser prospect, description of.....	160-161	on mining in the American Fork district, Utah.....	195-196
Gillan-Custer alunite claims, developments on.....	251-252	on mining in the Little Cottonwood district, Utah.....	184-190
Gillan's alunite claims, description of.....	252	on the ore deposit in the Maxfield mine.	218-219
Gilmer, G. E., acknowledgment to.....	131	on the ore deposits in the Emma mine...	211
Gilpin County, Colo., economic geology of..	303-323	on the ore deposits in the Flagstaff mine.	215
general geology of.....	295-303	on the ore deposits in the Prince of Wales mine.....	217-218
genesis of ore deposits in.....	319-323	on the ore deposits of the Vallejo and North Star claims.....	216
See also Central City quadrangle.		on the Wild Dutchman mine.....	208
Girty, G. H., fossils determined by.....	173	on veins in the Cottonwood-American Fork mining region....	202-203, 204, 208
Gold, enrichment of lode deposits of, in Gilpin County, Colo.....	315-316	Huntley's ranch, Oreg., prospect on, plate showing.....	21
lode deposits of, in the Kofa Mountains, Ariz.....	156-163	Hutchinson, W. Spencer, acknowledgment to.	111
near Quartzsite, Ariz.....	54-55	I.	
occurrence of, at Baldy, N. Mex.....	329-330	Idaho, potash in ores from.....	235
in the Sheep Rock mine.....	261	Idaho Springs formation, distribution and character of, in Central City quadrangle, Colo.....	206-207
in the Yellow Pine mining district, Nev.....	4, 5	Iddings, J. P., Weed, W. H., and Hague, Arnold, on the source of fine gold on Snake River, Idaho.....	294
ores of, in Gilpin County, Colo.....	305-310	Igneous rocks, distribution and character of, in the Cottonwood-American Fork mining region, Utah.....	174-177
placer deposits of, on Snake River, Idaho.....	277-283		
in the Kofa Mountains, Ariz.....	164		
production of, in gravels of Snake River, Idaho.....	281		
in the Cottonwood-American Fork mining region, Utah....	193-194, 197-198		

	Page.		Page.
Iron Blossom alunite claims, description of	252	Limonite, composition and occurrence of	131-133
Iron carbonate, occurrence of, in northwestern Louisiana	143-144	from northwestern Louisiana, analyses of	147-148
Iron ore, deposits of, in northeastern Texas, description of	69-109	Linden, iron-ore deposits near	79-85
occurrence of, in the Cottonwood-American Fork mining region, Utah	201-224	Little Cottonwood Canyon, fossils from	170
titaniferous, occurrence of, in Gilpin County, Colo	313-314	Little Cottonwood district, Utah, bedded deposits in	209-217
Iron-ore field of northeastern Texas, sources of information on	69-70, 109	history and production of	183-190, 193, 194
Ives, Eugene S., acknowledgment to	157	Live Yankee mine, ore deposits in	206-207
I. X. L. prospect, description of	161	Lost Horse alunite claims, description of	253
J.			
Jarbridge district, Nev., potash in rocks of	235	Lost Steers claims, description of	61-62
Jones, Edward L., jr., A reconnaissance in the Kofa Mountains, Ariz.	151-164	Loughlin, G. F., Recent alunite developments near Maryvale and Beaver, Utah	237-270
Gold deposits near Quartzsite, Ariz.	45-57	<i>See also</i> Butler, B. S., and G. F. Loughlin.	
work of	331	Louisiana, northwestern, iron-bearing deposits in	109, 129-150
Jump Creek, Idaho, discovery of nitrate on	19, 20	Lucky Chance mine, ore deposits in	223-224
K.			
Keg and Barrel prospect, description of	62	M.	
Kendall, H., acknowledgment to	131	McCoy, W. W., acknowledgment to	45
Kennebec claims, production of	192	Madison limestone, distribution and character of, in the Salt River Range, Wyo	334-335
Kessler Mining Co. <i>See</i> Carbonate Co.'s mines.		Magmatic segregations, occurrence of, in Central City quadrangle, Colo	306
Kimball, J. P., on the ore deposits in the Miller mine	220-222	Malachite, occurrence of, in the Kofa Mountains, Ariz	163
King Hill, Idaho, Snake River at	276	Mammoth claims, Nev., description of	66-67
King of Arizona mine, description of	156-158	Mammoth prospect, Ariz., description of	57
Kirk, Edwin, fossils determined by	63-64	Manganese ores, occurrence of, in the Cottonwood-American Fork mining region, Utah	203, 204, 211, 221
Knopf, Adolph, A gold-platinum-palladium lode in southern Nevada	1-18	occurrence of, in the Kofa Mountains, Ariz	162, 163
Some cinnabar deposits in western Nevada	59-68	in northwestern Louisiana	145
Kofa district, Ariz., gold lodes in	156-160	Mansfield, G. R., A reconnaissance for phosphate in the Salt River Range, Wyo	331-349
Kofa Mountains, Ariz., geography of	153-154	Nitrate deposits in southern Idaho and eastern Oregon	19-44
geologic reconnaissance map of	152	Maricopa quicksilver claims, lodes and workings on	123, 125
geology of	154-156	Marion County, Tex., analyses of iron ores from	88
ore deposits in	156-164	iron-ore deposits in	86-88
previous development in	151-152	Mariquita prospect, description of	56
situation of	151, 152	Maxfield mine, ore deposit in	218-219
L.			
L and N quicksilver claims, lode and workings on	125	production of	191, 199
La Paz, Ariz., history of the gold placers, near	49-50	Mazatzal Range, Ariz., cinnabar lodes in	119-120
La Paz district, Ariz., operations in	52	cinnabar lodes in, origin of	126-127
Lasater, Tex., iron-ore deposits near	85-87	discovery of cinnabar in	113-114
Lead, production of, in the Cottonwood-American Fork mining region, Utah	193-194, 197-198	geology of	114-119
Lead ores, occurrence of, in Gilpin County, Colo	306-308, 310, 311	mineral claims in	120-126
occurrence of, in the Cottonwood-American Fork mining region, Utah	203-224	quicksilver deposits in, economic possibilities of	127-128
in the Kofa Mountains, Ariz	164	situation of	111-113
in the Yellow Pine mining district, Nev	4	Merwin, H. E., cited	7
Lee, Willis, T., The Aztec gold mine, Baldy, N. Mex	325-330	Miami district, Ariz., analyses of rocks from	230
Limestone, occurrence of, in northwestern Louisiana	148-149	Michigan-Utah mine. <i>See</i> Utah mine.	
		Mill D South Fork, Utah, fossils from	173
		Miller mine, history of	195, 196
		ore deposits in	220-223
		Mina, Nev., cinnabar deposits east of	59-62
		Minden, La., iron-bearing deposits north of	146

	Page.
Mineral Products Co., alunite deposits of . . .	250-252
Mineral Products Corporation, operations of . . .	248, 264-266
Minerals, heavy, occurrence of, in gravels of Snake River, Idaho	283
of Central City quadrangle, Colo., classification of	322
Minidoka, Idaho, gold placers at	292
Mohawk alunite claims, description of	253
Molybdenite, occurrence of, in Gilpin County, Colo.	311
Molybdenum ore, occurrence of, in the Cottonwood-American Fork mining region, Utah	200, 203, 211, 214, 222
Montezuma claim, description of	203-204
Mooringsport, La., iron-bearing deposits at . . .	143-144
Moran, Wyo., Snake River at	276
Morenci district, Ariz., analyses of rocks from . .	231
Mormon Mining Co.'s claims, deposits and workings on	128
Morris County, Tex., analyses of iron ores from	90
iron-ore deposits in	88-90
Muscovite, extraction of potash from	235-236
N.	
Nabob mine, description of	186
Neely, Idaho, gold placers at	292-293
Snake River at	276
Nitrates, Chilean deposits of	40
composition and properties of	39-40
deposits of, near Homedale, Idaho, descriptions of	19-44
near Homedale, Idaho, commercial aspect of	29, 32
from Idaho and Oregon, analyses of	25-28
prices of	41
uses of	40-41
North Star mine, Ariz., description of	158-160
North Star mine, Utah, ore deposits in	215-216
production of	186
Nugget sandstone, distribution and character of, in the Salt River Range, Wyo.	337
O.	
Ocotillo, Ariz., claims southeast of, description of	162
O'Neal, H. A., acknowledgment to	70
Ophir mine, ore deposits in	219
production of	192
Ore formation, temperature and pressure of, in Gilpin County, Colo.	20-321
Oregon mine, description of	204
Oro Amigo mine, ores of	12
P.	
Pacific mine, ore deposit in	207
Palladium, occurrence of, in the Yellow Pine mining district	1, 3, 5
Patch, The, on Quartz Hill, near Central City, Colo., description of	304
Pearceite, occurrence of, in Gilpin County, Colo.	316
Phelps Lake, La., iron-bearing deposits near	136-139

	Page.
Phillips, William B., acknowledgment to	70
on processes for concentrating Texas iron ores	103-106
on the iron ores of northeastern Texas	95-98
Phillips Creek, Wyo., formations on	345-346
Phosphate deposits in the Salt River Range, Wyo.	338-341
Phosphoria formation, distribution and character of, in the Salt River Range, Wyo.	335-336
Pilot Mountains, Nev., deposits of cinnabar in . .	59-60
Pine Barr, Wyo., gold placer at	288-289
Pink spar. <i>See</i> Alunite.	
Pitchblende, occurrence of, in Gilpin County, Colo.	310-311
Placers, maps showing locations of, on Snake River, Idaho	274, 278
Plain Dealing, La., iron-bearing deposits west of	134-136
Platinum, American and foreign occurrences of	13-18
occurrence of, in the gravels of Snake River, Idaho	281-282
in the Yellow Pine mining district, Nev	1, 3, 5
Plomosa Mountains, Ariz., placers in	53-54
Plumbojarosite, occurrence of, in the Yellow Pine mining district, Nev	5, 11, 12
Polybasite, occurrence of, in Gilpin County, Colo.	316
Potash, extraction of, from muscovite	235-236
presence of, in copper ores and tailings . . .	227-232
in gold ores and tailings	232-235
Potash alum, production of	266-269
Potassium sulphate, extraction of, from alunite	264-266
Pre-Cambrian rocks, distribution and character of, in Central City quadrangle, Colo.	296-300
distribution and character of, in the Cottonwood-American Fork mining region, Utah	169
Prince of Wales mine, ore deposits in	217-218
production of	191-192
Proustite, occurrence of, in Gilpin County, Colo.	316
Pyrite, occurrence of, in Gilpin County, Colo.	306, 307-308, 309, 310, 311
occurrence of, in northwestern Louisiana . .	132
in the Kofa Mountains, Ariz	159
in the Mazatzal Range, Ariz	126
Q.	
Quartz, bands of, accompanying alunite, mineralogy of	244-245
Quartz diorite, distribution and character of, in Central City quadrangle, Colo.	298
Quartz monzonite and quartz monzonite porphyry, distribution and character of, in Central City quadrangle, Colo.	301
Quartzsite, Ariz., geography of the region near . .	45-47
geology of the region near	47-49
gold lodes near	54-55
map showing placers near	46

	Page.		Page.
Quicksilver belt of western Nevada, origin of	67-68	Shongaloo, La., iron-bearing deposits near	146
Quicksilver deposits of the Mazatzal Range, Ariz., geology and development of	111-128	Siderite, occurrence of, in northwestern Louisiana	132
R.			
Rand prospect, description of	161	Silliman, B., on the ores of the Emma mine	212-215
Ransome, F. L., Quicksilver deposits of the Mazatzal Range, Ariz.	111-128	Silver, enrichment of deposits of, in Gilpin County, Colo.	316-318
Ray district, Ariz., analyses of rocks from	230	occurrences of, in the Kofa Mountains, Ariz.	158, 159
Raymond, R. W., on the Emma mine	211-212	ores of, in Gilpin County, Colo.	305-310
on the Savage and Montezuma claims	203-204	production of, in the Cottonwood-American Fork mining region, Utah	193-194, 197-198
Reade & Benson mine, ore deposits in	219	in the Yellow Pine mining district, Nev.	4
Red Devil prospect, description of	62	Silver Dipper vein, description of	206
Regal claims, description of	161-162	Silver Plume granite, distribution and character of, in Central City quadrangle, Colo.	299-300
Reynolds, William, acknowledgment to	111	Skinner, J. J., acknowledgment to	70
Rhodochrosite, occurrence of, in Gilpin County, Colo.	307	Smith, E. K., acknowledgment to	131
Rhyolite on Sucker Creek, Oreg., structure of	20	Snake River, Idaho, course and tributaries of	275
Richmond and Theresa claims, production of	192	discharge of	276
Riddall, H. K., assays by	2, 12	gold placers on	277-283
Rocky Mount, La., iron-bearing deposits near	140-141	source of gold in	293-294
Roosevelt claim on Sucker Creek, Oreg., description of	23	gravels of, character of	278-279
Roundy, P. V., work of	331	methods of mining on	284-286
Rusk, Tex., iron-ore deposits near	90-94	sketch map showing tributaries of	274
S.			
St. John, Orestes, on early mining on Snake River, Idaho	273-274	Snake River gold field, Idaho, history of	273-274
Salt River, Wyo., narrows of, formations near	345	publications on	271-273
Salt River Range, Wyo., canyon sections in	341-349	Soldier, Idaho, nitrate deposits at	28-29
drainage of	332-333	South Star and Titus mine, description of	186, 199
geology of	333-338	Sphalerite, occurrence of, in Gilpin County, Colo.	306-308, 310, 311
industries in	333	Steiger, George, Note on muscovite	235-236
metalliferous prospects in	341	Stockworks, occurrence and character of, in Central City quadrangle, Colo.	304-305
phosphate deposits in	338-341	Strawberry Creek, Wyo., formations on	348-349
reconnaissance map and structure sections of	334	Structure of Central City quadrangle, Colo., outline of	303
structure of	338	Sucker Canyon, Oreg., contorted flow structure in rhyolite of, plate showing	20
topography of	332	Sucker Creek, Oreg., nitrate deposit on	20-28, 29
water power in	333	Sullivan, D. J., acknowledgment to	19-20
San Francisco district, Utah, analyses of rocks from	229	Sulphate deposits near Homedale, Idaho, commercial aspect of	32-33
Santa Kruze alunite claims, description of	253	Sulphur, production of, from alunite	270
Santa Rita district, N. Mex., analysis of rock from	229	Sulphuric acid, production of, from alunite	270
Savage claim, description of	203	Sunflower Cinnabar Mining Co., claims and workings of	121-122, 123-124
Schaller, Waldemar T., Cassiterite in San Diego County, Cal.	351-354	Swift Creek, Wyo., phosphate deposit on	338-341
process of, for the extraction of potassium sulphate from alunite	264	section of rocks on	343-345
Scheelite, occurrence of, in Gilpin County, Colo.	311	Sylvanite, occurrence of, in Gilpin County, Colo.	309, 310
Schultz, A. R., on a gold placer at Pine Bar, Wyo.	288-289	T.	
on gold placers at Minidoka, Idaho	292	Tatum claims, workings on	122-123, 124
on gold placers at Neely, Idaho	292-293	Telluride ores, distribution and character of in Central City quadrangle, Colo.	309-310
on gold placers near the mouth of Bailey Creek, Wyo.	286-288	Tennantite, occurrence of, in Gilpin County, Colo.	306, 309
Sheep Rock alunite deposit, composition and value of	263-264	Tertiary (?) intrusive rocks, distribution and character of, in Central City quadrangle, Colo.	300-303
location and character of	258-261	Texas, northeastern, blast furnaces in	107-108
origin of	262-263	northeastern, composition of iron ores from	94-98
		concentration of iron ore from	102-106

	Page.
Texas, northeastern, iron-ore field in, mineralogy of.....	74-75
northeastern, iron-ore field in, location and extent of.....	70-72
iron-ore field in, geology of.....	72-74
mining operations in.....	101-102
ores of, ways of utilizing.....	106-109
prospecting in.....	98-101
topography of.....	72
Thaynes limestone, distribution and character of, in the Salt River Range, Wyo.....	336
Tin. <i>See</i> Cassiterite.	
Titanium, effects of, in slag and steel.....	313-314
Toledo mine, description of.....	187, 202
Tonapah district, Nev., analyses of rocks from.....	234
Tracy, F. E., acknowledgment to.....	20
Tracy, W., acknowledgment to.....	20
Tungsten, ores of, in Gilpin County, Colo., distribution and character of....	311
Tunnels, situation of, in the Cottonwood-American Fork region, Utah. 188-190, 200	
Turner, A. D., acknowledgment to.....	131
Tushar Mountains, Utah, geology of.....	230-240
Twin Creek limestone, distribution and character of, in the Salt River Range, Wyo.....	337
U.	
Uranium ores, distribution and character of, in Gilpin County, Colo.....	310-311
Utah Centennial mine, ore deposit in.....	207-208
Utah mine, description of.....	187, 190, 202-203
V.	
Vallejo mine, ore deposits in.....	215-216
production of.....	186-187, 199
Vanadinite, occurrence of, in the Mazatzal Range, Ariz.....	126

	Page.
Vanadium, occurrence of, in the Yellow Pine mining district, Nev.....	4
Vaughan, E. E., acknowledgment to.....	70
Veins, distribution and character of, in Central City quadrangle, Colo.....	304
<i>See also</i> Fissure deposits.	
W.	
Wall rock, alterations of, in Gilpin County, Colo.....	308-309
Wall rock of alunite veins, mineralogy of. .	245-246
Wasatch mines. <i>See</i> Columbus Consolidated mine.	
Waterfall vein, description of.....	206
Webster Parish, La., iron-bearing deposits in.	146
Welch placer on Snake River, description of.....	277, 289
Wells, R. C., analyses by.....	8
Wells formation, distribution and character of, in the Salt River Range, Wyo.	335
Whitworth, J. E., acknowledgment to.....	131
Wild Dutchman mine, description of.....	208
history of.....	195
Willow Creek, Wyo., phosphate deposit on. section on.....	338-341, 346-347
Woodside shale, distribution and character of, in the Salt River Range, Wyo.	336
Y.	
Yellow Pine mining district, Nev., geology of.	3-3
ore deposits in.....	4
sketch map of.....	2
Z.	
Zinc, occurrence of, in the Cottonwood-American Fork mining region, Utah.....	205-224
occurrence of, in the Yellow Pine mining district, Nev.....	4