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ATLAS OF PENNSYLVANIA'S MINERAL RESOURCES

Part 3, Metal Mines and Occurrences in Pennsylvania

by Arthur W. Rose

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College of Earth & Mineral Sciences
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Part 3

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INTRODUCTION

The locations and basic characteristics of mineral occurrences are fundamental to mineral exploration, mineral economics and regional natural resource studies. Known prospects and mineral occurrences have always been favored localities for further mineral exploration, because at the known occurrences, one can "follow the ore," either literally or by geologic extrapolation. In recent years, increasing use has been made of mineral locality data in conjunction with regional geology and tectonics to predict favorable areas and regions for reconnaissance mineral exploration (Jerome and Cook, 1967; Bates, 1959; McCartney and Potter, 1962). The data summarized here should also be useful in the compilation of metallogenic maps of continents and large regions. Conflicts between mining and other uses, such as recreation and urbanization, have led to comprehensive evaluations of mineral resources, for instance in the wilderness areas. For all the applications described above, the data assembled here provide a basic reference and source of information for Pennsylvania.

The compilation includes all known occurrences of arsenic, antimony, bismuth, chromium, cobalt, copper, gold, lead, molybdenum, nickel, silver, tungsten, uranium and zinc for which any information could be found in the literature, plus some data for iron, vanadium, cadmium, and barium. Occurrences of iron, copper, lead, zinc, chromium and uranium comprise the bulk of the localities. Magnetite deposits of the "Cornwall type" are included because of their economic significance as mineral deposits, and because many contain accessory copper and other metals. Other types of iron deposits, such as residual limonite-hematite, and magnetite of the Reading Prong, have not been included because of the large number of occurrences and the considerably different origin. Manganese occurrences have been previously summarized by Foose (1945).

The data are presented in three main forms. Table 2 is a listing of all the known occurrences, accompanied by data on metals present, the degree of exploitation (mineral occurrence, prospect, low production and high production), the deposit type, and references. The occurrences are also plotted on a map (Plate 1) which is keyed to Table 2. In addition, the text includes a short description of each deposit type, and for productive and significant deposits, a short summary of history, geology, and production is given.

ACKNOWLEDGMENTS

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TYPES OF DEPOSITS

In any study of mineral occurrence data, the geologic characteristics and affinities of the occurrences are needed to understand the distribution and interrelationships of the deposits. The occurrences listed in Table 2 have therefore been assigned to deposit types based mainly on geologic and mineralogic features. Clearly there is considerable judgment involved in assigning these types, especially for deposits of uncertain origin or sketchy description; nevertheless, the deposit type should be valuable if used with discretion.

In arranging the deposit types into the listing of Table 2, the meagre information on age of ore formation has been combined with host rock ages to divide the deposits into three main groups. In general, the host rock age provides an older limit for the age of ore, but the younger limit must involve considerable geologic inference. Therefore the host rock age has served as the primary criterion unless good evidence to the contrary exists. The *Precambrian and Piedmont group* includes five deposit types which occur in Precambrian rocks or in metamorphic and igneous rocks of possible early Paleozoic age in the Glenarm Series of the Piedmont province. The pegmatite occurrences also may be Paleozoic in age. The *Paleozoic group* includes seven deposit types occurring in relatively unmetamorphosed Paleozoic rocks. For most of these deposits, an age younger than Paleozoic has not been established. The *Triassic group* includes six deposit types occurring in or cutting Triassic sediments and igneous rocks, or clearly associated with Triassic diabase. As with the Paleozoic group, a younger age limit is difficult to establish for some within the Triassic group. An unclassified group of five deposit types is not assigned to age groups because of diversity within types, lack of data, or post-Triassic age.

VALUE OF PRODUCTION

In Table 2, the occurrences are classified as mineral occurrences (M), prospects (P), deposits with low production (L, less than about $1 million) and deposits with high production (H, greater than $1 million). For productive deposits, all available data on the amount of production were compiled. Unfortunately, most of the productive deposits were mined before 1900, and production data are fragmentary and scattered. No previous attempt to compile production figures for Pennsylvania deposits is known, so the figures should be of some interest. The true production figures are undoubtedly higher than the values given for many deposits, but the values listed are believed to give a fair idea of the economic significance of the various deposits and deposit types.

A summary of the approximate dollar value of production at present-day metal prices (Table 1) shows that by far the most important type of deposit has been the Cornwall-type magnetite group (type N), with a production of about a billion dollars at present prices. About 85% of this value is from the Cornwall mine, but the ore body of the Grace mine near Morgantown appears to be approximately the same size. Another eight iron deposits have produced between one and fifteen million dollars worth of ore (Dillsburg, Boyertown, French Creek, Jones, Wheatfield, Fritz Island, Warwick and Bylers Mines).

Table 1. Approximate production of deposit types at 1968 prices

Type		Value
A	Chromite	$ 5,000,000
B	Gap nickel	7,000,000
E	Copper in metabasalt	10,000
F	Appalachian zinc	50,000,000
G	Silurian lead-zinc	110,000
L	Sandstone copper-uranium	10,000
N	Cornwall-type magnetite	1,000,000,000
O	Copper adjacent to diabase	1,000
P	Copper in Triassic redbeds	1,000
Q	Phoenixville type	1,000,000

The Friedensville zinc mine in type F is clearly the third largest mine in the state after Cornwall and Morgantown, with a continuing production already totalling over $50,000,000. A small production has come from the Bamford and Sinking Valley deposits of similar type. The Gap nickel mine and the chromite deposits of the State Line district follow at $5-7 million. The Phoenixville type with about $1,000,000 production is the lowest group of any significance.

REFERENCE INFORMATION

For each occurrence listed in Table 2, one or more references are given in the form of numbers keyed to the reference list. The references are not exhaustive, but have been selected to include the most complete or significant description of the deposits, and the most recent work. Additional references may be found by consulting the papers and reports given here.

Table 2. List of mineral occurrences, deposit types, production and references

Key to Deposit Types and Production Class

Deposit type	*No. of Deposits*	*Description of type*
		PRECAMBRIAN AND PIEDMONT HOST ROCK GROUP
A	31	Cr with minor Ni, Cu and Fe, associated with ultramafic rocks.
B	1	Ni and Cu sulfides with mafic to ultramafic rocks (Gap Nickel).
C	35	Mo, Cu, U and other elements in pegmatites, or associated with pegmatites.
D	16	Cu and other elements in gneiss, schist, metagabbro and related rocks.
E	15	Native Cu and Cu sulfides in metabasalt (Lake Superior type).
		PALEOZOIC HOST ROCK GROUP
F	21	Appalachian-type Zn-Pb deposits in Cambro-Ordovician limestone.
G	7	Zn-Pb sulfides in Helderberg-Tonoloway limestones.
H	16	Other Zn-Pb in sedimentary rocks.
I	8	Barite in limestone.
J	20	Zn-Pb-Cu sulfides as fracture fillings and veins in limestone.
K	15	Wurtzite and other sulfides in nodules.
L	36	Sandstone-type Cu-U, U, and Cu deposits.
		TRIASSIC HOST ROCK GROUP
M	5	Cu, Au and other elements in Triassic diabase.
N	47	Cornwall-type magnetite-copper deposits.
O	44	Cu in Triassic sediments adjacent to diabase, and related deposits.
P	19	Cu in Triassic sediments distant from diabase.
Q	17	Zn-Pb-Cu in quartz veins cutting Triassic and Precambrian rocks (Phoenixville type).
R	6	U in Triassic sediments.
		UNCLASSIFIED GROUP
S	3	Other Cu.
T	3	Other Ni.
U	4	Other barite.
V	6	Placer deposits.
W	5	Miscellaneous.
	380	Total

Production Class

M	Mineral locality
P	Prospect
L	Low production (less than $1,000,000)
H	High production (greater than $1,000,000)

No.	*Name or Location*	*Metal*	*Type*	*Production*	*References*
	ADAMS CO.				
1	Bonneaughtown	Cu	P	M	18 (p. 300)
2	Teeter's quarry	Cu	O	M	45
3	Gettysburg	Cu	O	M	81, 82
4	Hunterstown	Cu	O	P	81, 82
5	Near Heidlersburg	Cu	O	P	82
6	Center Mills	Fe	N	P	81
7	Near Center Mills	Fe	N	P	81
8	Near Center Mills	Fe	N	P	81
9	Idaville	Fe	N	P	81
10	Gargol	Fe	N	P	81
11	Buchanan Valley	W	W	P	28, 58c
12	Cashtown	Fe	N	P	61, 82
13	Orrtana	Fe	N	M	81
14	Carr Hill	Fe	N	P	81, 82
15	Fairfield (Mell's mine)	Cu, Fe	N?	P	18 (p. 301), 81, 82
16	McNair farm	Fe	N	P	81
17	Fairfield SW	Cu	O?	P	14, 18, (p. 302)
18	Jacks Mtn.	Cu	E	P	80, 81
19	Tunnel Hill and Haycock prospects	Cu	E	P	80
20	Eagle Metallic Mine	Cu	E	L	4, 80, 81
21	Headlight Mine	Cu	E	P?	4, 32, 80, 81
22	Bingham (Cu Furnace) Mine	Cu	E	L	4, 18, 32, 45, 80
23	Reed Hill Mine	Cu	E	L?	4, 18, 45, 80, 82
24	Russell Mine	Cu	E	L?	4, 18, 45, 80, 82
25	Bechtel Shaft	Cu	E	P	4, 18, 32, 45, 80
26	Culp (Deshler) shaft	Cu	E	P	32, 80
27	Snively (Musselman) Mine	Cu	E	L	4, 18, 32, 45, 80, 81, 82
28	Bigham	Cu	E	P	18, 32, 80, 81
29	Baker farm	Cu	E	P	32
30	West of Snively Mine	Cu	E	P	80
	ALLEGHENY CO.				
1	Abers Cr.	Zn	K	M	70
2	Springdale	Zn	K	M	70
3	Glassmere	Zn, Cu	K	M	45, 70
4	Creighton	Zn	K	M	70
5	Witmer	Zn, Cu	K	M	45, 70
6	Flaughtery Run	Zn	K	M	70
7	Sewickley Bridge	Zn	K	M	70
	ARMSTRONG CO.				
1	N. Vandergrift	Pb, Zn	H	M	45
2	Elderton	Zn	K	M	70
	BEAVER CO.				
1	Darlington	U	L?	M	40
2	Brighton	Ba	U	M	24
	BEDFORD CO.				
1	Woodberry	Pb, Zn	G?	P	49
2	Near Breezewood	U	L?	M	40
	BERKS CO.				
1	Fegley Mine	Fe	N	L	77
2	Gilbert Shaft	Fe	N	L	77
3	Boyertown	Fe(Cu)	N	H	8, 28, 30, 61, 77, 85
4	Brower	Fe	N	L	77
5	Pikesville	U, Fe	C	M	48
6	Rittenhouse Gap Mine	Mo	C?	M	58a
7	Flint Hill	Mo	W	M	8, 28
8	Pricetown	Mo	C?	M	58a
9	Valentine Hartman's mine	Mo	C	M	28, 58a
10	Antietam Reservoir	Mo	C	M	8, 28
11	Stonersville	Fe	N	P	77
12	Snydersville	Cu	O	M	28
13	Esterly mine	Fe	N	L	61, 77
14	South of Reading	Cu	O	M	28
15	Reading	Au, Ag	D	M	8, 28
16	Fritz Island mine	Fe, Cu, Pb, Zn, Sb	N	H	8, 28, 51, 77
17	Raudenbush mine	Fe	N	L	28, 61, 77
18	Wheatfield mine	Fe(Cu)	N	H	8, 28, 45, 61, 77, 75
19	Ruth mine	Fe	N	L	28, 77
20	Gickerville	As, Co	M	M	28
21	Jones & Kinney mines	Fe, Cu, Pb, Zn, W	N	H	1, 28, 51, 77
22	Grace mine	Fe, Cu, Zn, Pb	N	H	45, 72, 84
23	Bylers mine	Fe	N	H?	1
	BLAIR CO.				
1	Birmingham	Pb, Zn, Ba	F	L	6, 51, 56, 65, 93
2	Culp	Pb, Zn	F	L	6, 45, 51, 65, 67, 93
3	Scalp Level	Pb, Zn	F	L	65, 93
	BRADFORD CO.				
1	Carpenter mine	Cu, U	L	L	28, 40, 48, 85
2	Near New Albany	Cu(U)	L	P	40, 48
3	Near New Albany	Cu(U)	L	P	48
4	Near New Albany	Cu(U)	L	P	48
5	Near New Albany	Cu(U)	L	P	48
6	Near New Albany	Cu	L	L	85
7	Near New Albany	Cu	L	M	85
8	Canton	Cu, U	L	P	40
	BUCKS CO.				
1	Lodi	Cu	O	M	87
2	Tetemers mine	Cu	O	P?	87
3	Near Uhlerstown	Cu	O	M	87
4	Kintnersville	Cu	O	M	87
5	Ferndale	Cu	O	M	87
6	Bursonville	Cu	O	M	87
7	Durham mine	Ba(Fe)	U	M	91
8	Keller's Church	Cu	P	P	87
9	Hagersville (Keelersville)	Cu	P	M	87
10	Rocky Ridge	Cu	O	M	87
11	Diehl's mine	Au	M	P	2, 28, 87
12	Sellersville	Cu	P	M	28
13	New Galena mine	Pb, Zn, Cu, Ag	Q	L	13, 28, 51, 58c
14	¼ mi. NW Pipersville	U	R	M	40
15	1.5 mi. NE Pipersville	U	R	M	40
16	2.7 mi. NE Pt. Pleasant	U	R	M	40
17	Delaware quarry	U	R	M	40, 48
18	⅓ mi. NE Pt. Pleasant	U	R	M	40
19	Unnamed	U	R	P	40
20	New Hope	Cu	O	M	87
21	Ingham Spring	Cu, Ba	O	P	87, 91
22	Solebury mine	Cu	O	L	78, 87
23	Buckmanville mine	Cu, Ba	O	L	76, 78, 91
24	W of Buckmanville	Ba, Cu	O	P	87
25	Buckingham	Ba	O?	M	28
26	Bushington	Ba	O?	M	28
27	Yardley	Au	V	P	28
28	Vanartsdalen's quarry	Cu	S	M	28
29	Holland	Cu	D	M	28
30	Finney's quarry	Cu, Mo	D	M	28
	BUTLER CO.				
1	Butler	Pb	K	M	46
2	West of Parker	Pb	H	M	24
	CARBON CO.				
1	Mud Run	Cu	L	P?	41
2	Penn Haven Jct.	Cu	L	P?	41
3	Penn Haven Jct.	U, Pb	L	P	41, 45
4	Butcher Hollow	U	L	P	41

Table 2. Continued

No.	Name or Location	Metal	Type	Production	References
5	Mt. Pisgah	U	L	L	41, 45, 48
6	Mauch Chunk Ridge	U, Cu	L	P	41, 45
7	Nesquehoning	Pb	H	M	58c
8	Walcksville	Pb, Zn, Cu	H	M	41
9	Turnpike near Albrightsville	U	L	M	40
10	Turnpike near Albrightsville	U	L	M	40
	CENTRE CO.				
1	Milesburg Gap	Pb, Zn, Ba, Ag	H	P	7
2	Skytop	Pb, Ba	H	M	33
	CHESTER CO.				
1	Hopewell mine	Fe, Zn, Cu	N	L	1, 77, 87
2	Warwick mine	Fe, Cu	N	H	1, 77, 87
3	Leighton mine	Fe	N	L	1
4	Steels mine	Fe	N	L	1, 28
5	Pine Swamp deposit	Fe	N	P	23
6	Southeast of Hopewell	Fe	N	L?	1
7	French Creek mines (Kleim, Elizabeth)	Fe, Cu, Zn, Co	N	H	1, 28, 45, 61, 73
8	Knauertown	Fe	N	P	1
9	Keystone Quarry (Cornog)	Cu, Pb, V(?), Zn	D	M	45, 46, 58m
10	Chester Springs graphite	Cu	D	M	46
11	Phoenixville tunnel	Zn	Q	M	28
12	Morris Copper mine	Cu	Q	L?	51
13	Buckwater mine	Pb	Q	P	51
14	Charlestown mine	Pb	Q	L	51
15	Montgomery Co. mine	Pb, Zn, Ag	Q	L	51
16	Wheatley, Phoenix, Brookdale and Chester Co. mines	Pb, Zn, Ag, Cu, minor Au, Ni, Sb, As, Cd, Mo, V, Co, W?	Q	L	1, 51, 66
17	Napoleon mine	Pb	Q	P	51
18	Pennypacker mine	Pb	Q	P	51
19	Pethericks Penn mine	Pb	Q	P	51
20	Goshenville	Cr	A	M	28
21	Taylor's quarry	Cr	A	M	28
22	Brunton Quarry	Cr	A	M	28
23	Marshall's Mills	Cr	A	M	28
24	Corrine	Cr	A	M	28
25	Bailey's mine	Cr	A	L	63
26	Webb farm	Cr	A	L?	63
27	White Barrens area	Cr	A	L	63
28	Pine Grove mines	Cr	A	L	63
29	Smith-Hilaman's mine	Cr	A	L	63
30	Sparvetta (Tweed) quarry and vicinity	Mo	C	M	58a
31	Scott-Engine mines	Cr	A	L	28, 45, 63
32	Kirk mine	Cr	A	L	63
33	Hillside mine	Cr	A	L	63
	CLEARFIELD CO.				
1	LeContes Mills	U	L	M	40
	COLUMBIA CO.				
1	Grassmere area (8 occurrences)	Cu, U, Pb	L	P	45, 48
2	Almedia and Webb mines	Pb, Zn	G	L	11, 28, 51
	DAUPHIN CO.				
1	Hummelstown	Fe	N	L	28, 61, 77
2	Albright Church	Cu, U	L	M	40
	DELAWARE CO.				
1	Moro Phillips mine	Cr	A	L	28, 63
2	Battle farm	Cr	A	P?	28, 63
3	Worrel	Cr	A	M	28
4	Blue Hill	Cr	A	M	28
5	Smedley quarry	Zn	C	M	28
6	Crump's quarry	Cr, Cb, Ta	A, C	M	28
7	Hibbard's placer	Cr	V	L	28, 63
8	Scherz farm	Cr	A	P	28, 63
9	Fairlamb's placer	Cr	V	L	28, 63
10	Black Horse mine	Cr	A	L	63
11	Williamson School	Cr	A	M	28
12	Franklins Paper Mill	Mo, U	C	M	28
13	Morton	Mo, Sb	C	M	28
14	Strathhaven Inn	Cu	C	M	28
15	Leipers Quarry	Cu, Mo, U	C	M	28
16	Drexel quarry	Mo	C	M	28
17	Deshong quarry	U	C	M	28
18	Crozer quarry	U	C	M	28
19	Upland Sta.	Mo, Cu, Be	C	M	28
20	Chelsea	Zn	C	M	28
21	Bunting quarry	U	C	M	28
22	Bullock quarry	As	C	M	28
	FAYETTE CO.				
1	Victor Hollow	Pb, Zn	H	M	28, 49, 51
	FRANKLIN CO.				
1	Hayes Cr.	Cu	E	P	80, 82
2	Virgin mine	Cu	E	L	4, 45, 80
3	Roadside	Ba	I	M	28, 79, 80
4	Near Waynesboro	Ba	I	M	28, 79, 80
5	Near Waynesboro	Ba	I	M	28
6	Near Waynesboro	Ba	I	M	28
7	Knepper	Ba	I	M	28, 78, 79
8	Guilford Springs	Ba	I	M	28, 78, 79

No.	Name or Location	Metal	Type	Production	References
	FULTON CO.				
1	Fort Littleton (2)	Cu, Ba	S	M	28, 45, 76, 78
2	Hustontown	U	L	M	40
	HUNTINGDON CO.				
1	McConnellstown	Pb, Zn	G	M	51, 74, 90
2	Cooks	U, Cu	L	P	48
3	Orbisonia	Ba	U	M	28
4	Brownsville	Cu, U	L	P	48
5	West of Maddenville	U	L?	M	40
6	Mapleton (4 localities)	Pb, Zn	H	M	74
	INDIANA CO.				
1	Shelocta	Zn	K	M	70
	LACKAWANNA CO.				
1	Moosic Mtn.	Cu, U	L	P	48
	LANCASTER CO.				
1	Reinholds Sta.	Cu	P	M	3a, 28
2	Marietta	Pb	H	M	28
3	Glenwood Sta.	Cu	P	M	3a, 28
4	Showalter quarry	Cu, Zn	J	M	3a, 45, 74
5	Salisbury Twp. (Hermitage)	Pb	H	M	28, 58h
6	Gap Nickel mine	Ni, Cu, Co, Au, As	B	H(Ni)	18, 27, 39, 59a, 64
6a	North of Gap	Pb, Zn(?)	F?	P	22
7	E. Petersburg (Railroad)	Zn	F	L	18, 28, 51
8	E. Petersburg	Zn	F	P	22
9	Near Bamford	Zn	F	P	22
10	Bamford mine	Zn, Pb, Ag, Cu, As, Sb	F	H?	18, 22, 51, 59
11	Herr's mine	Zn	F	L?	14, 22
12	Flory's Mill quarry	Zn	F	M	22
13	Billmeyer quarries and Haldeman Riffles	Pb, Cu, Sb	J	M	3a, 58h
14	Lancaster	Pb	F	M	51
15	Pequea mine	Pb, Ag, Zn, Mo, Cu, Cr?	F?	L(Pb-Ag)	16a, 22, 28, 51, 64a, 92
16	Near Marticville	Pb	F	P?	22
17	Safe Harber	Zn, Ba	O?	M	3a, 58j
18	McCalls Ferry	Cu	D	M	3a
19	Brown's mine	Cr	A	L	63
20	Carter (Texas) mine	Cr, Ni	A	L	28, 50, 63
21	Wood mine	Cr, Ni, Cu	A	H(Cr)	3a, 18, 28, 45, 50, 63
22	Newbold mine	Cr	A	L	63
23	Cedar Hill quarry-Tyson Reynolds mine	Cr, Cu, Zn, Ni	A	L	45, 63
24	Red pit & vicinity	Cr, Ni	A	H	3a, 63
25	Line pit	Cr	A	L	63
26	Near Jenkins Corner	Fe, Cr	A	P	28
	LEBANON CO.				
1	Rexmont Reservoir	Fe	N	L	77
2	Doner mine	Fe	N	L	77
3	Cornwall mine	Fe,Cu, Co, Ni, Pb, Zn	N	H	25, 29, 45, 61, 77
4	Carper mine	Fe	N	L	61, 77
5	Mt. Pleasant	Fe	N	P	77
	LEHIGH CO.				
1	Lehigh Gap	Pb	H	M	58c
2	Ironton	Cu, Co, (Fe)	T	M	14, 28, 54
3	Allentown	Zn?	F?	P	54
4	Little Lehigh Cr.	Zn	F?	M	54
5	Greene mine	Zn(Fe)	F?	M	54
6	Friedensville	Zn, Cd, Cu	F	H	17, 28, 51, 52, 54, 75, 88
7	Vera Cruz	Mo, U (Fe)	C	M	28, 58a
8	Shimerville	Zn?	F?	P	54
9	Zionsville	Mo	C?	M	58a
10	Coopersburg	Cu	O	P	59b
	LUZERNE CO.				
1	Nanticoke	Ni	T	M	31
2	West Pittston	Zn, Ni	T	M	62
3	Laurel School	U	L?	M	40
	LYCOMING CO.				
1	Lycoming	Pb, Zn, Cu, Ni	L?	M	28, 51
2	Hughesville (3 localities)	U, Cu	L	P	48
3	Beaver Lake (5 localities)	Cu, U, Pb	L	P	40, 45, 48
	MONROE CO.				
1	Middle Smithfield Twp.	Cu, Zn	H	P	51
2	Ross Common	Cu	S	P	59b
	MONTGOMERY CO.				
1	Pennsburg	Cu	P	M	28, 87
2	Red Hill	Cu?	P	M	87
3	Young's mine	Cu, Au?	O	L?	2, 28, 61, 87
4	Kibblehouse quarry	Cu, Zn, Pb	O	M	45, 58k
5	Karl's mine	Cu	O	P?	2, 28, 61, 87
6	Hendricks Sta.	Cu	O	P	28, 87
7	Kober's mine	Cu, Pb	O	P?	2, 28, 61, 87
8	Sumneytown	Cu	O	M	28
9	Congo NE	Cu, Au	M	P	87
10	Bauman's Pt mine	Pt	W	P	28, 87
11	Congo NW	Cu, Au, Ag	P	M	28, 87
12	Congo W	Cu	M	P	77, 87
13	Brendlinger mine	Cu	O	P?	61, 87

Table 2. Continued

No.	Name or Location	Metal	Type	Production	References
14	Layfield	Cu	P	M	28, 87
15	Gilbertville	Cu	P	M	28, 87
16	Glasgow	Cu	P	M	28, 87
17	Bleim's mine	Cu	P	P	28
18	Penna. Copper Mine	Cu	O	L?	28
19	Sanatoga	Cu	P	P	1
20	Old Perkiomen mine	Cu	O	L	2, 61, 87
21	Schwencksville	Cu	O	P	87
22	Lederachsville	Cu	P	M	28, 87
23	Yoder farm	Au, Sn?	V?	P	28
24	Drakes Crossroad	Cu	P	M	28, 87
25	Graters Ford	Cu	P?	M	28, 87
26	Collegeville Sta.	Cu	P?	M	28, 87
27	Arcola	Cu	Q?	M	28
28	Perkiomen mine	Cu, Pb, Zn, Ag, Mo, Cd, As	Q	L	12, 28, 51, 87
29	Ecton mine	Cu, Pb, Zn, Ni, Mo, As	Q	L	4a, 12, 28, 51, 58d
30	Wetherill mine	Cu, Pb? Zn?	Q	L?	28
31	Shannonville mine	Cu	Q	P	28, 51
32	Port Kennedy mine	Cu	Q	P	28, 51
33	Fairview	Cu	P	M	87
34	Bridgeport quarry	Cu, Zn, Pb	J	M	45
35	Shainline	Cu	J	M	28
36	Henderson's quarry	Cu	J	M	28
37	Mogeetown	Cu, Ba	D, I	M	28
38	Bullocks quarry	As	W	M	28
39	Gladwyne	Cu	D	M	28
40	Marble Hall	Cu, Ba	J	M	28
41	Smith's quarry	U	W	M	28
42	Heacock's quarry	U	C	M	28
43	Ogontz	Cu	D	M	28
44	Paper Mills Sta.	Cu, Mo	D	M	28, 58a
	MONTOUR CO.				
1	Near Roaring Creek	Cu, U	L	P	40
	NORTHAMPTON CO.				
1	Easton	Pb, Zn, Cu, U, Mo, Ni, Ba	C, D?	M	28, 45, 51, 53, 58m
2	Dryland Sta.	Zn	H	M	14, 28, 51, 53
3	Leithsville S	Cu	P	L	14, 52
4	Leithsville SE	Cu	P	M	24
5	Hellertown	Mo	C	M	53
	NORTHUMBERLAND CO.				
1	Doughty mine	Pb, Zn, Cu	G	L	28, 51
2	Kneass	Cu, U	L	P	48
	PERRY CO.				
1	Saville	Cu	L	P	55
	PHILADELPHIA CO.				
1	Bell's Mill Rd. & Wissahickon Valley	Cu, Cr	D	M	28
2	McCrea's quarry	Cu, U	C	M	28
3	Comly's quarry	U	C	M	28
4	Stenton Ave., near Germantown Ave.	Cu	D	M	28
5	Fowlers quarry	Cu	C	M	28
6	East of Penn St.	Cu, U	C	M	28
7	Penn St. Quarry	Cu, Mo, U	C	M	28
8	Logan	Cu, U	C	M	28
9	Wayne quarry	Cu, Mo	D	M	28
10	Rittenhouse quarry	Cu	C	M	28
11	O'Neill's quarry	Cu	D	M	28
12	Wingohocking & L Sts.	Mo	C	M	28
13	Barber's quarry	Cu, Mo	D, C	M	28
14	Wingohocking Sta.	U	C	M	28
15	Bridesburg	Au	V	P	28
16	Fairmount Park	Mo, Bi, Cu, U	C	M	28
17	George's Hill	Cu	D	M	28
18	Falls of Schuylkill	Pb, Zn	Q?	M	28, 51
19	Penna. Ave.	Cu, Mo	C	M	28
20	11th & Market Sts.	Au	V	M	28
21	Hoffman's quarry	W	C	M	28, 58c
	PIKE CO.				
1	Westfall Twp.	Pb, Zn, Cu	H	M	28, 51, 87
	SCHUYLKILL CO.				
1	Pottsville	Pb	H	M	51
2	Hecla	U	L	M	40
3	Adamsdale	Pb	H	M	58m
	SULLIVAN CO.				
1	Millview	Pb, Zn	H	M	51, 74
2	Near Millview	U, Cu	L	P	48
3	Dushore	Cu	L	P	48
4	Sonestown	Cu, U, Pb	L	P	45, 48
5	West of Beech Glen (4 localities)	Cu	L	P	48
	UNION CO.				
1	Buffalo Valley	Pb	G	P	51
2	Winfield	Pb, Zn	G	M	45
3	Opposite Northumberland	Cu, (U?)	L	P	74
	WAYNE CO.				
1	Robinson Pond	Cu, U	L	P	48
	WESTMORELAND CO.				
1	Unnamed	Zn	K	M	70
2	Murraysville	Zn	K	M	70
3	Donohoe	Cu, Zn	K	M	45, 70
4	Valley Camp	Zn	K	M	45, 70
	WYOMING CO.				
1	Nicholson Twp.	Cu	L	M	89
2	Forkston	Cu	L	P	5, 48
	YORK CO.				
1	Union Stone quarry	Zn, Cu	J	M	36, 51
2	Beard's quarry	Cu	J	M	36
3	Stoner quarry	Pb, Cu Zn	J	M	36, 51
4	York Valley Lime	Zn, Cu	J	M	36, 51
5	Emigsville	Zn, Cu	J	M	36, 51
6	Le Crons Cu mine	Cu	P	P	19, 83
7	Weigelstown	Cu	P	M	19
8	Schum & Ruhl quarry	Cu	J	M	36
9	Ebert & Hake quarry	Cu	J	M	36
10	York Stone Co. quarry	Pb, Cu, Zn	J	M	36, 51
11	Miller's quarry	Cu	J	M	36
12	Cunningham quarry	Pb, Cu, Zn	J	M	36, 51
13	Medusa Cement quarry	Cu, Pb, Zn	J	M	45
14	Thomasville	Cu	J	M	45
15	Spring Grove	Cu	J	M	36
16	Roler	Fe	N	P	83
17	Smith prospect	Fe	N	P	20
18	Minebank Schoolhouse (2 localities)	Fe, Cu	N	P	14, 20, 61, 83
19	Lichte mine	Fe	N	L	20
20	Wellsville (5 localities)	Fe	N	L	20, 83
21	Wellsville NE (2 localities)	Fe	N	P	20, 83
22	Mt. Pleasant (2 localities)	Fe	N	P	20, 83
23	Dillsburg (3 localities)	Fe, Cu	N	H	20, 34, 60, 61, 83
24	Bender and vicinity	Cu, Zn	M	L	45, 77
25	Franklintown area (4 localities)	Fe	N	P	20, 77
26	Dillsburg N	Fe	N	P	83
27	Grantham (3 localities)	Fe	N	L	61, 83
28	Reeser's Summit	Cu	O	M	74

MINERAL OCCURRENCES NOT PRECISELY LOCATED

Location	Metal	Type	Production	Reference
Allegheny Co.				
Near Pittsburgh	Pb	K	M	51
Berks Co.				
Zion Church, near Alsace (Twp.?)	Mo	?	M	86
Alsace Twp.	Ni (in pyrrhotite)	?	M	24
Bradford Co.	Pb	H	M	51
Chester Co.				
E. Whiteland Twp.	Cu	?	M	24
Clearfield Co.				
On Clearfield Cr.	Pb, Ag	?	M	51
Franklin Co.				
Lancaster Sta.	Ba	I	M	28
Lackawanna Co.				
Near Scranton	Zn, Ni	T	M	28, 51
Lancaster Co.				
Conestoga Cr.	Pb, Zn	F	M	51
5 mi. S of Lancaster	Zn	F	L?	24
Conoy Twp.	Pb	F?	M	28
Dillerville, Manheim Twp.	Cu	J?	M	3a
Montgomery Co.				
Rose's quarry, L. Merion Twp.	Cu, Ni	A	M	28
Northampton Co.				
Flint Hill near Bingen	Cu	O	M	15
Philadelphia Co.				
Princes Soapstone quarry	Cu, Ni	A	M	28
Clarks quarry, W. of Frankford	Cr, Cu, Mo	C	M	28
York Co.				
Near Frystown	Pb	H?	M	51
Berks Co.				
Heidelberg	Ba	U?	M	24
Lycoming Co.				
Bald Eagle Valley	Pb	G?	M	28

DESCRIPTION OF DEPOSIT TYPES AND SIGNIFICANT DEPOSITS

PRECAMBRIAN AND PIEDMONT HOST ROCK GROUP

Type A. Cr, Ni and Cu Associated With Ultramafic Rocks

The main deposits of this type are the chromite deposits of the State Line district in Lancaster and Chester Counties. Similar but smaller deposits are known farther northeast in Chester and Delaware Counties. The recorded production between 1810 and 1900 from these deposits is at least 150,000 tons of chromite ore with a value at present prices of aproximately $5 million. Over half of this ore was from the Wood mine. For many mines production data are lacking and the total production may be nearly double the above figure.

The chromite deposits occur in serpentinite as massive sack-form bodies, as bands and lenses up to many inches thick, and as disseminated chromite. The ore body at the Wood mine was massive chromite in an irregular elongated pipe-like body plunging 45°. The larger deposits tend to be near the north margin of the large State Line serpentinite body. The chromite ore was high grade (mostly 40-60% Cr_2O_3) and the chromite contained 50 to 60% Cr_2O_3 and a moderate to high Cr/Fe ratio, between 2.5 and 3.5.

Nickel and copper occur in minor to trace amounts with the serpentinites.

Several attempts to re-open the mines were made in the period 1915-1940 with but little production. However, in view of the considerable soil and vegetation cover in the area, it seems possible that additional ore bodies or extensions of ore bodies may exist. Considerable opportunity exists for application of modern geophysical and geochemical methods to discover another ore body like the Wood mine, or a zone of moderate-grade disseminated chromite that could be concentrated.

The ultramafic bodies intrude the eastern facies of the Wissahickon schist and associated rock units of Precambrian or early Paleozoic age, and the deposits are therefore included in the Precambrian and Piedmont group. However, they may be early Paleozoic in age.

Bailey's mine (25, Chester Co.)

Location: 1½ to 2 miles northeast of Unionville.
History: Chromite was mined in this vicinity before 1840.
Production: 30-50 tons recorded.
Host rock: Serpentinite.
Structure:. Unknown.
Character of mineralized rock: Chromite in a serpentinite body about a mile long and ½ mile wide. Both lode and placer chromite were produced.
References: Pearre and Heyl, 1960, p. 788.

Webb farm (26, Chester Co.)

Location: ½ mile southwest of Unionville.
History: Chromite produced before 1840.
Production: Several tons of chromite.
Host rock: Serpentinite.
Structure: Unknown.
Character of mineralized rock: A small body of chromite ore in a small serpentinite body.
References: Pearre and Heyl, 1960, p. 788.

White Barrens area (27, Chester Co.)
(includes Pugh and Sidwell mines, and Collum property)

Location: 3 to 4 miles SSE of Oxford.
History: Leased by Isaac Tyson for chrome mining in 1835-1838. The deposits were mined sometime between 1835 and 1875. Several pits and workings were excavated in the area.
Production: 170 tons of lode chromite ore plus more than 3000 tons of placer chromite.
Host rock: Serpentinite body about 1.5 miles in diameter.
Structure: No information.
Character of mineralized rock: Chromite in lode and placer form.
References: Pearre and Heyl, 1960, p. 781-782.

Pine Grove mines (28, Chester Co.)
(Includes Moro Phillips and Stence mines)

Location: ½ mile south of Nottingham.
History: Operated in the late 1860's and early 1870's. Drilled in 1937 with negative results. The Moro Phillips shaft is reported as 110 or 300 feet deep, with 80 feet of workings from the shaft. The Stence mine had 2 shafts. Some chromite was sorted from the dump during World War I.
Production: 250 tons of chromite ore from Moro Phillips mine, and an unknown amount from the Stence mine.
Host rock: Serpentinite of large intrusive.
Structure: No information.
Character of mineralized rock: Massive and disseminated chromite in serpentinite with amphibole asbestos, talc, zaratite and kammererite.
References: Pearre and Heyl, 1960, p. 780-781.

Smith-Hilaman's mine (29, Chester Co.)

Location: A mile southeast of Nottingham.
History: One pit was mined in the period 1830-1850, and another in 1873-74. Minor work was done during World War I, but no ore was produced.
Production: 50 tons estimated.
Host rock: Large serpentinite body.
Structure: The ore occurs at the east end of the same long serpentinite body in which most of the State Line chromite district is located. The mines are in the northern part of the body but not at the contact.
Character of mineralized rock: There is some disseminated chromite of fair to good grade.
References: Pearre and Heyl, 1960, p. 781.

Scott-Engine mines (31, Chester Co.)

Location: 1½ miles SW of Nottingham.
History: A total of 6 shafts and numerous prospect pits in this area were opened during the period 1820-1850. The Scott shaft is reported to have reached at least 200-250 feet in depth. The dumps were re-worked during World War I, and minor exploration or development was done about 1945.
Production: 3000 to 6000 tons of chromite were produced from the Scott mine before 1850, and an additional 36 tons from the dump in 1918. The production of the Engine mine is unknown.
Host rock: The elongate serpentinite body in which most of the State Line chromite district is located.
Structure: The mines are near the north edge of the serpentine body. The group of shafts and pits lies on a N30E trend.
Character of mineralized rock: Rock on the dumps contains disseminated chromite with up to 36% chromite. Sorted ore shipments in 1918 contained 32-34% Cr_2O_3. Probably some massive chromite was mined. Kammererite and magnesite are reported.
References: Pearre and Heyl, 1960, p. 779.

Kirk mine (32, Chester Co.)

Location: About 2 miles southwest of Nottingham.
History: The mine was originally mined in the 1800's from a shaft 65-75 feet deep inclined southward. The mine was re-opened and examined in 1918 and 1941.
Production: 250 tons of chromite ore are recorded from the early period, plus possibly a few tons in 1918.
Host rock: The elongate serpentinite body in which most of the State Line district is located.
Structure: The ore is reportedly a small lens of disseminated chromite with some massive ore. Schlieren bands of chromite occur in the area. The ore zone apparently dips southward.
Character of mineralized rock: Disseminated chromite in serpentinized ultramafic rock plus small lenses and schlieren of massive chromite.
References: Pearre and Heyl, 1960, p. 780.

Hillside mine (33, Chester Co.)

Location: About 2 miles southeast of Wrightsdale and ½ mile north of the Maryland border; a quarter of a mile west of the Wood mine.
History: A large deposit of chromite was mined from surface workings before 1900. A small deposit was mined underground during World War I.
Production: Estimated at 4000-5000 tons before 1900, and 12 tons in 1918.
Host rock: The elongate serpentinite body in which most of the State Line district occurs.
Structure: The chromite deposits are near the north edge of the serpentinite body and occur in part as lenses and schlieren.
Character of mineralized rock: Both disseminated and massive chromite ore are present. Williamsite, picrolite, amphibole asbestos, magnesite, and kammererite are associated with the chromite.
References: Pearre and Heyl, 1960

Moro Phillips mine (1, Delaware Co.)

Location: 1.5 miles ENE of Newtown Square.
History: Chromite was mined here before 1900. Workings consist of 3 shallow pits and dumps.
Production: 25 tons of chromite were produced, probably unprofitably.
Host rock: A serpentinite body about 4 miles long and up to a mile wide.
Structure: The deposits are in the central part of the serpentinite body.
Character of mineralized rock: Serpentinite with blebs of coarse massive chromite can be found on the dump.
References: Pearre and Heyl, 1960, p. 789.

Hibbard's placer (7, Delaware Co.)

Location: On a small tributary of Chrome Run, ⅜ mile west of Black Horse.
History: Chromite was mined from this small placer before 1870.
Production: 75 tons of chromite concentrate.
Host rock: Stream gravels in serpentinite area.
Structure: No information.
Character of mineralized rock: Some large octahedral chromite crystals were present; brookite is also reported.
References: Pearre and Heyl, 1960, p. 790.
Gordon, 1922, p. 192.

Fairlamb's placer (9, Delaware Co.)

Location: ¼ mile west of Elwyn.
History: Mined before 1870.
Production: 200 tons chromite production reported.
Host rock: Stream gravels overlying serpentinite.
Structure: No information.
Character of mineralized rock: Chromite as placer concentrate; some large octahedra of chromite.
References: Pearre and Heyl, 1960, p. 790.
Gordon, 1922.

Black Horse mine (10, Delaware Co.)

Location: 2 miles west of Media. Exact location unknown; may be the same as Schertz' farm.
History: Chromite was mined before 1875 from a 75-foot shaft.
Production: About 50 tons.
Host rock: Serpentinite.
Structure: No information.
Character of mineralized rock: Disseminated chromite.
References: Pearre and Heyl, 1960, p. 789.

Brown's mine (19, Lancaster Co.)

Location: Approximately 2 miles ESE of Wakefield, 1¼ miles NE of Lyles.
History: Long abandoned and filled up.
Production: Some ore produced, but the amount is unknown.
Host rock: A small serpentinite body north of the main State Line district.
Structure: No information.
Character of mineralized rock: Disseminated chromite.
References: Pearre and Heyl, 1960, p. 783.

Carter (Texas) mine (20, Lancaster Co.)

Location: About 2 miles SE of Wrightsdale, and ¼ mile northeast of the Wood mine.
History: Opened about 1830. In 1867 the mine was 120 feet deep and producing good ore. It was closed before 1875 because of water problems. In 1915 the mine was reopened and produced briefly. Further surface exploration was done by the Bureau of Mines in 1941.
Production: At least 400-600 tons before 1875, and an additional 40 tons in 1915, probably from the dumps.
Host rock: Serpentinite of the main State Line district.
Structure: The deposit is near the north edge of the serpentinite, as is the nearby Wood mine.
Character of mineralized rock: Both massive chromite and disseminated material are present. Other reported minerals are serpentinite, deweylite, dolomite, magnesite, hydromagnesite, zaratite, brookite and magnetite.
References: Pearre and Heyl, 1960, p. 778-779.
Gordon, 1922
McIntosh and Mosier, 1948

Wood mine (21, Lancaster Co.)

Location: About 2 miles southeast of Wrightsdale and ½ mile north of the Maryland border.
History: The mine was opened about 1828 and produced until 1880 except for 1868 to 1873. The workings reached a depth of 700 feet down the plunge and drifts totaled at least 1000 feet. The mine was the largest producer of the State Line district. Later minor work was done during World War I and in 1937. In 1941 the U. S. Bureau of Mines carried out geophysical work and drilled ten holes in the vicinity, but did not discover any new ore.
Production: At least 96,000 tons of chromite, according to the best estimates for the period 1828-1880, plus a small amount of ore during World War I.
Host rock: Serpentinized dunite of the elongate intrusive in which most deposits of the State Line district occur.
Structure: The ore body was about 30 feet long and 6 feet wide at the surface. It plunged 40-60° to the south, approximately parallel to the schist-serpentinite contact just to the north. The size at depth was extremely variable, ranging from small stringers to 300 feet long and 35 feet wide. The total depth mined was 720 feet along the plunge, but this may not have been the bottom of ore. Numerous small stringers branched off the main body.
Character of mineralized rock: Most of the ore was massive chromite, and averaged 48% Cr_2O_3 in the chromite. About 5% of the ore was lower grade and required washing. Little or no disseminated ore occurs adjacent to the massive ore.

Other reported minerals include brucite, deweylite, magnesite, hydromagnesite, zaratite, genthite, vermiculite, olivine, vesuvianite, clinochlore, antigorite, kammererite, serpentine, penninite, calcite, dolomite, magnetite, millerite and chalcocite.
References: Pearre and Heyl, 1960
Gordon, 1922
McIntosh and Mosier, 1948
Sampson, 1942
Lapham, 1958

Newbold mine (22, Lancaster Co.)

Location: About 1¾ miles SSE of Wrightsdale, and about ⅔ mile west of the Wood mine.
History: Unknown. The workings are now represented by numerous pits and dumps.
Production: Estimated at 500-900 tons of ore.
Host rock: Serpentinite of the large body in which the other deposits of the State Line district occur.
Structure: Near the north contact of the serpentinite.
Character of mineralized rock: Material on the dumps contains some disseminated chromite. Tremolite, kammererite, and williamsite are also recognized.
References: Pearre and Heyl (1960)

Cedar Hill quarry, Tyson Reynolds mine, and Geiger pits (23, Lancaster Co.)

Location: 1¾ miles south of Wrightsdale; 1½ miles west of the Wood mine, just north of Octoraro Creek.
History: The Tyson Reynolds mine operated in the period 1830-1860 and is reported to be 200 feet deep. The Geiger pits operated first in 1844 and consist of several shallow pits and inclined shafts. At present the large Cedar Hill quarry is operated between the two old mines as a source of crushed rock. The Tyson-Reynolds mine is covered by waste serpentinite.
Production: 3000 tons of chromite ore at the Tyson Reynolds mine and an unknown quantity from the Geiger pits.
Host rock: The large serpentinite body in which the deposits of the State Line district occur.
Structure: The Tyson Reynolds mine is very close to the north contact of the serpentinite. Banded chromite approximately parallels the north contact. Chromite layers at the Geiger pit strike S82°W and dip 78° NW.
Character of mineralized rock: Disseminated chromite in faulted bands in serpentinite with talc, magnesite and williamsite. The chromite contains about 50% Cr_2O_3 and has a Cr/Fe ratio of about 2.5. Disseminated chromite ore at the Geiger pits contained 22% Cr_2O_3.
References: Pearre and Heyl (1960)
Lapham (1962)

Red Pit mine and vicinity (24, Lancaster Co.)
(includes Wet mine, North Rock Springs and Jenkins mines)

Location: 2 miles SW of Wrightsdale, near Rock Springs Church and north of Rock Springs, Maryland.
History: The Red Pit mine was closed by an explosion in 1868 after many years of operation and was at least 500 feet deep. Numerous surface pits exist nearby. The Jenkins and North Rock Springs mines were operated in the 1825-1850 period and in 1865-1875. Workings consist of 4 shafts, the deepest reported to be 240 feet deep. The Wet mine consisted of several short shafts. Minor additional work was done in the area in 1919.
Production: At the Red Pit mine, 25,000 to 150,000 tons of ore, plus 1000-3000 tons at the North Rock Springs mine, and an unknown amount at the Wet and Jenkins mines. 1000 tons of placer chromite was also produced in the vicinity.
Host rock: Serpentinite of the large body in which the deposits of the State Line district occur.
Structure: The Red Pit mine is about ⅓ mile south of the north contact of the serpentinite. Other occurrences are nearer the contacts. The occurrences at the Red Pit mine trend about N70W; at the Jenkins mine, pits are aligned along a N30E trend.
Character of mineralized rock: At the Red Pit mine, both massive and disseminated chromite occur on the dump. At the other properties, disseminated ore in lenses and schlieren are the main types of ore visible. Chromite at the Red Pit contains 60% Cr_2O_3 and a Cr/Fe ratio of 3. Other minerals include chalcedony, magnetite, genthite, amphibole asbestos, williamsite, hydromagnesite, chlorite, kammererite, and zaratite.
References: Pearre and Heyl, 1960, p. 768-773.
Gordon, 1922

Line pit (25, Lancaster Co.)

Location: On the Pennsylvania-Maryland line 2¾ miles SW of Wrightsdale and ¾ mile NW of Rock Springs, Md.
History: Mined in the period 1830-1874. Minor additional mining was done in 1917-19. Workings consist of a pit and 2 shafts, one about 200 feet deep.
Production: Probably 5,000-10,000 tons of ore before 1874 and 150 tons in 1917-19.
Host rock: Serpentinite of the State Line district.
Structure: The ore body at the surface plunged nearly vertically and had a dumbbell shape; at depth it was elliptical and plunged moderately eastward, with a diameter of 5-8 feet. Stringers of chromite extended out into the wallrock.
Character of mineralized rock: Coarse massive chromite averaging 50% Cr_2O_3 in the ore, 59% Cr_2O_3 in cleaned chromite, with a Cr/Fe ratio of 3.5. Some disseminated ore averaging 30% Cr_2O_3 was also present. Other minerals include williamsite (sheathing the ore), serpentine, chlorite, kammererite, antigorite and magnesite.
References: Pearre and Heyl, 1960

Type B. Nickel and Copper Sulfides with Mafic to Ultramafic Rocks (Gap Nickel Type)

The only known deposit in this class is the Gap Nickel mine in Lancaster County. The deposit consists of pyrrhotite, pentlandite and chalcopyrite on the margins of a small ultramafic body. Nickel ore worth about $7 million was produced between 1863 and 1893. Several other ultramafic to mafic intrusives are present in the nearby Precambrian metamorphic rocks. The deposit is almost certainly Precambrian.

Gap Nickel mine (6, Lancaster Co.)

Location: 4 miles southwest of Gap and 1.5 miles north of Georgetown, just southwest of Nickel Mines corner; 16 miles southeast of Lancaster.
History: Copper was recognized at this locality in 1718, and several unsuccessful attempts were made to mine and treat the copper in the following eighty to ninety years. The largest-scale attempt was made in 1849, when some ore was sold, but the enterprise was not profitable. The nickel was not recognized and discarded as worthless.

In 1852, the presence of nickel was recognized and confirmed by the chemist F. A. Genth. Nickel ore was mined from 1853 to 1860 and smelted at a plant about a mile to the north, but again with no profit. In 1862 the mine and smelter was bought by Joseph Wharton who also constructed a nickel refinery in Camden, N. J. Production started in 1863, and continued successfully through 1893, when competition from other ores forced closing. During most of this period the mine was the main source of nickel in the U.S. and in addition supplied considerable nickel for export. The property at present is owned by a major nickel company, which drilled 35 holes in the area in 1942.
Production: A total of about 8 million pounds of nickel worth approximately $7 million, plus about 135,000 pounds of cobalt worth several hundred thousand dollars. The value of copper recovered is uncertain but small. Present ore reserves are reported as 270,000 tons of 1.12% Ni and 0.68% copper, plus 480,000 tons of 0.45% Ni and 0.30% Cu.
Host rock: The ore occurs on the margins of a small body of locally gneissic peridotite, considerably altered to amphibole. The country rock is a mica schist intruded locally by granite rocks.
Structure: The ore occurs mainly on the contacts of the peridotite, which is elongated in an east-west direction. The maximum width of the gabbro is about 500 feet, and the length at least 2500 feet. The ore occurs as sulfide-rich zones up to 30 feet thick. According to the most recent work the ore zone is roughly bowl-shaped, with a depth of about 200 feet to ore in the central part of the gabbro. Near the south contact the ore dips gently to moderately to the north. Most of the ore has been mined from the east end of the gabbro. A depth of 235 feet was reached in mining.
Character of mineralized rock: Pyrrhotite, pentlandite and chalcopyrite are the main sulfides in the ore and are accompanied by hornblende as the major gangue mineral. Some pyrite is also present. Millerite, siderite, chalcocite, vivianite, native copper, scorodite, morenosite, melanterite, copiapite, glockerite, chalcanthite and possible arsenopyrite and marcasite are also reported. The grade of the remaining ore is reported as 1.12% Ni and 0.68% Cu. Ore mined in 1863-1894 contained 1-3% Ni. Cobalt content is about 1/20 of the nickel content.
References: Frazer, 1880, p. 163-176
Good, R. S., 1955
Kemp, J. F., 1894
Moyd, L. S., 1942

Type C. Mo, U, Cu and Other Elements in Pegmatites

About 35 metal occurrences in pegmatites are recorded, mainly in Delaware and Philadelphia Counties. Molybdenum, copper and uranium are the most common metals, but columbium, tantalum, zinc, beryllium, arsenic, antimony, bismuth and barium are also recognized. The pegmatites occur in metamorphic and igneous terranes of known or possible Precambrian age. None of the occurrences seems to be of significant size, although economic bodies of some rare minerals could be present. No production from this group is known.

Type D. Copper and Other Elements in Gneiss, Schist and Metagabbro

Minor occurrences of chalcopyrite and its oxidation products are common in the metamorphic and igneous terrane of southeastern Pennsylvania, especially in metagabbro. Representatives of this class are known in Bucks, Chester, Montgomery, Northampton and Philadelphia Counties. Molybdenum is associated at several occurrences, and a number of metals occur in the Easton locality, Northampton Co., where the host is serpentinized marble. Pegmatites may be present at some of these localities. Gold in quartz is reported at Reading. None of the occurrences appear to be of any economic significance.

Type E. Native Copper and Copper Sulfides in Metabasalt (Lake Superior Type)

This well-defined group of deposits is located mainly in western Adams County in late Precambrian metabasalt and adjacent metarhyolite. About 15 prospects and workings are on record, although Wherry (1911) estimated that about 200 pits, shafts, tunnels, trenches, etc. had been excavated. Production has been very small and was prior to 1920.

The characteristics are as follows:

1. Host rock is metabasalt, or, in one case, metarhyolite near metabasalt.
2. Native copper is the main primary copper mineral, accompanied by chalcocite and possibly bornite at some deposits.
3. Copper occurs as chalcocite in schistose chloritic greenstone, as native copper in epidote-quartz replacement zones, and as native copper in amygdules, accompanied by epidote and quartz.
4. The metabasalt has been altered to epidote, quartz, chlorite and calcite near the copper occurrences.
5. Most deposits occur at the metabasalt-metarhyolite contact or close to it. Most deposits are in schistose, faulted or brecciated zones, and are parallel to flows or foliation in the rocks.
6. The deposits are mainly in a narrow belt trending N20°E for about 8 miles. Similar deposits occur in an extension of the belt in Maryland, and in similar rocks in Virginia.

The deposits are very similar to the Lake Superior copper ores and to occurrences in the Copper River and White River drainages of Alaska and the Yukon.

The presence of grades of up to 2% Cu across widths up to 8 feet suggests that small ore bodies might be found in the area.

Jacks Mountain prospects (18, Adams Co.)

Location: On the road between Fairfield and Fountaindale, on the southeast slope of Jacks Mtn., about 2¼ miles west of Fairfield.
History: Noted by Stose in 1910 as several small pits.
Host rock: Metabasalt.
Character of mineralized rock: Native copper and specular hematite occur in amygdaloidal and massive metabasalt highly altered to epidote and quartz.
References: Stose, 1910, 1932

Eagle Metallic Mine (20, Adams Co.)

Location: One-half mile east of Charmian on a nose between branches of Minie Branch Creek.
History: Work was started about 1904. By 1909 the Eagle Metallic Copper Co. had driven an incline 450′ eastward (or southeastward) at a slope of 35° (or 47°) but in 1910 all the work at the mine had stopped. In 1913 the mine was taken over by the United Milling and Smelting Co., and preparations were being made to open the mine and dewater it. In addition to the incline, a 50′ square open cut is recorded, plus some cross cutting from the incline.
Production: None recorded, although there was probably a small amount of copper recovered.
Host rock: The copper occurs in a massive epidosite (epidote-quartz rock), in overlying massive greenstone and in a zone of chlorite schist which separates the epidosite and greenstone. The mine is within a large area of metabasalt containing several small metarhyolite bodies.
Structure: The mineralized zone lies immediately beneath a highly sheared zone in the metabasalt, as noted above.
Character of mineralization: Copper-staining (copper carbonates) of greenstone in and adjacent to the sheared zone is the main mode of copper occurrence, but fine specks of native copper are reported in greenstone on the lower levels. Chalcocite is questionably reported below 100 ft. and bornite and traces of gold and silver from greater depths. The greenstone contains vein quartz, chlorite, epidote and specular hematite.

The copper content of the mineralized rock is apparently low.
References: Wherry, 1911
Stose, 1910, 1952
Bevier, 1914
Stose, 1932

Headlight Mine (21, Adams Co.)

Location: One-half mile east of Charmian. The tunnel enters the hillside just below the old Waynesboro turnpike.
History: A 160′ tunnel was driven in about 1883 (Henderson, 1883). No further work appears to have been done.
Production: None recorded.
Host rock: Quartzose greenstone and greenstone.
Structure: The rocks are reported to dip at 30° to the southeast. An east-west fault cuts the mouth of the tunnel (Bevier, 1914).
Character of mineralized rock: "Bailey reported in 1883 that at a distance of 60 ft. from the mouth of the tunnel, an oblique impregnated chute was encountered exposing an area of 24 square feet of ore-bearing rock, in which copper was uniformly disseminated for a width of 5 feet running from 10 to 20% copper. Later a second strike of rich ore was reported, but development work was shortly afterward abandoned" (Stose, 1910).

Native copper is the main copper mineral and is accompanied by some copper carbonate. Quartz, epidote, chlorite and asbestos are reported as vein and alteration minerals. Rock on the dump contains a very low percentage of copper (Bevier, 1914).
References: Stose, 1910
Bevier, 1914
Henderson, 1883

Virgin Copper Co. Mine (2, Franklin Co.)

Location: One mile north of Charmian on the crest of a small hill. In 1967 the incline was on the west side of a greenstone quarry.
History: Several diamond drill holes were put down in 1907, and an incline started in 1908. Work continued several years, but the property was inactive by 1913. Workings consisted of an incline 310 feet deep, with short cross cuts, and several drillholes.
Production: Small.
Host rock: The ore is in greenstone converted to chlorite schist and impregnated with masses, layers and veins of epidote-quartz rock. Metarhyolite occurs 80 feet downhill west of the mine. Greenstone near the contact is amygdaloidal and brecciated.
Structure: The incline slopes 47° to the east, and this is apparently the dip of the contact between metarhyolite and greenstone. The ore is in a sheeted zone in chlorite schist.
Character of mineralized rock: Native copper, locally weathered to copper carbonates, impregnates the chlorite schist over widths of 2-7 feet. Wherry estimates 10% copper in a quartz-calcite vein making up 10% of the quartz-epidote rock. Asbestos is reported as a gangue mineral along with quartz, epidote, calcite and chlorite. Drillholes east of the outcrop cut the zone at depths of 308 and 600 feet.
References: Bevier, 1914
Wherry, 1911
Stose, 1910
Lapham and Geyer, 1965

Bingham or Copper Furnace Mine (22, Adams Co.)

Location: About 1 mile northeast of Charmian, on a southern tributary to Toms Run.
History: A small furnace was erected at this site in 1836 and operated 6 to 8 months. In 1883 a 40-foot shaft had been sunk and by 1909 an open cut 40′ long and up to 30′ deep had been excavated. The owner in 1909 was The National Copper Co.
Production: Some copper was probably produced in 1836 when the furnace operated, and 4-5 tons of float ore were shipped to a smelter in 1883.
Host rock: The copper occurs mainly in amygdaloidal rhyolite just above the contact with greenstone. Veins and patches of epidote and quartz occur in the rhyolite, and amygdules are composed of epidote.
Structure: The contact of metabasalt and metarhyolite was exposed in the open cut and dipped southeast at 35°-46°. An eastward-dipping crushed zone composed partly of red clay was also exposed in the pit and may have furnished a channel for circulating waters. The face of the open cut exposed many small faults.
Character of mineralized rock: Specks and blebs of native copper in quartz veins and in amygdules in amygdaloidal rhyolite and greenstone. A rim of cuprite commonly surrounds the native copper grains. The rhyolite is stained by azurite and malachite. Early reports indicated that the ore occurred in 3 thin distinct veins. Thin veins of quartz and epidote cut the rock, and patches are altered to quartz-epidote rock.

Samples from the mine are reported to have assayed 4% copper, but dump material contained mainly the copper staining noted above.
References: Bevier, 1914
Frazer, 1880
Henderson, 1883
Lapham and Geyer, 1965
Stose, 1910

Reed Hill mine (23, Adams Co.)

Location: On the north side of Toms Run, ½ mile west of the junction of Toms Run and Copper Run.
History: The mine was prospected in 1837 and in 1908 was worked by the Reed Hill Copper Co. Workings consist of a 100-foot-long open cut, trending north along the mineralized zone, and two 30′ tunnels from the open cut along the same direction. Several prospect pits are scattered over the property.
Production: None recorded, but may have produced a small amount of ore.
Host rock: The deposit lies within the greenstone belt, here including some dense massive greenstone and some scoriaceous metabasalt altered to epidote, quartz and chlorite.
Structure: The host rocks dip about 55° to the southeast and are highly sheeted and sheared.
Character of mineralized rock: Native copper and copper carbonates occur in thin veins of quartz and epidosite, and along fractures. At small pits on the property some rock is peppered with native copper and cuprite. Specimens of native copper up to a pound are reported from float in the mine area.
References: Bevier, 1914
Stose, 1910
Frazer, 1880
Lapham and Geyer, 1965
Stose and Bascom, 1929

Russel mine (24, Adams Co.)

Location: About a mile south of Mt. Hope, just above the forks of Copper Run.
History: Reported to have been worked intermittently between 1850 and 1910 although the older work was probably at the nearby Bechtel shaft. In 1909, it was developed by the Reed Hill Copper Co. Workings consisted of a 2-compartment shaft 300 feet(?) deep, with a level extending eastward at 115 feet. These workings also are reported to connect with an older incline from the west. At the bottom of the shaft, 150 feet of cross cuts were driven. Numerous small pits are scattered over the vicinity.
Production: None recorded, but may have produced minor amounts of ore.
Host rock: The ore is an amygdaloidal quartz-epidote rock, lying within walls of chlorite schist. The mine lies in the metabasalt belt a short distance west of the contact with the rhyolite.
Structure: The rocks dip 48° south-southeast.
Character of mineralized rock: Amygdaloidal quartz-epidote rock impregnated with specks of native copper and stained by copper carbonates makes up the ore zone. This zone is reported to be 8 ft. thick. Native copper also occurs in copper-stained quartz-epidote-calcite veins cutting the chlorite schist. Red jasper and chlorite are also present. A few samples of very rich ore containing native copper have been found on the dumps.
References: Bevier, 1914
Stose, 1910
Frazer, 1880
Lapham and Geyer, 1965
Stose and Bascom, 1929

Bechtel Shaft (25, Adams Co.)

Location: A few hundred feet northeast of the Russel mine (Bevier, 1914).
History: In 1883 one shaft was reported as 120 feet deep and a second abandoned shaft was inaccessible. No further activity is recorded.
Production: None recorded.
Host rock: The first shaft is in metabasalt near the contact with metarhyolite (schist?). The second shaft is evidently on the contact.
Structure: At the first shaft, the ore occurs within walls of "chlorite" (probably chlorite schist, with a dip of 34° to the east).
Character of mineralized rock: At the first shaft the mineralized zone is 8 feet thick, composed of "cupriferous rocks." Copper carbonate stain is noted on the dump.

At the second shaft, quartz veins containing specular hematite were noted.
References: Bevier, 1914
Frazer, 1880
Henderson, 1883
Lapham and Geyer, 1965
Stose, 1910

Snively (Musselman) mine (27, Adams Co.)

Location: Near the intersection of the metabasalt band with Middle Creek, just east of Mt. Hope. The mine is high on the hill above the stream.
History: In 1883, a 53-foot shaft on top of the hill was accessible. A large tunnel near stream level and trenches and a second 50-foot shaft on top of the hill are reported in 1910.
Production: Possible small production, but not definitely recorded. Henderson (1883) mentions several ore piles, the largest of which contained 12 tons averaging 1.82% copper.
Host rock: The copper occurs in amygdaloidal greenstone altered to epidote-quartz rock, occurring within walls of chlorite schist. Less altered rock is amygdaloidal greenstone with quartz and epidote amygdules. The nearby metarhyolite is altered to sericite schist.
Structure: At the surface the ore dipped to the west, but had regained its normal steep southeastward dip at the bottom of the 53-foot shaft. On the steep south slope of the hill, a dip of 52° ESE was found.
Character of mineralized rock: Native copper and cuprite occur in epidote-quartz rock and are altered to copper carbonates in some material on the dumps. The copper-bearing epidote-quartz rock is 8 feet thick at the bottom of the shaft. No copper was noted in the dump of the tunnel at stream level. Masses of native copper weighing several pounds are reported from this prospect.
References: Bevier, 1914
Henderson, 1883
Stose, 1910, 1932
Frazer, 1880
Lapham and Geyer, 1965
Stose and Bascom, 1929

PALEOZOIC HOST ROCK GROUP

Type F. Appalachian-Type Zn-Pb Deposits in Cambro-Ordovician Limestone

Friedensville is the most productive mine in this group, and the only one now being mined. Deposits in Sinking Valley, Blair County, and near Lancaster have also produced lead and zinc. Several occurrences are known near these localities. The value of Friedensville

production at present is over $50 million, and is increasing by many millions every year, making it one of the most productive deposits in the state.

Because of complex geology and lack of younger rock types in the vicinity, the age of the deposits is questionable. Ages of Ordovician through at least Triassic have been suggested. Along with the Appalachian-type Zn-Pb deposits of East Tennessee and Virginia, these deposits generally have the following characteristics:

1. Sphalerite and variable amounts of pyrite comprise the main sulfide minerals. Galena, barite and fluorite are locally present.
2. The host rock is lower Paleozoic limestone and dolomite.
3. The deposits are bedding replacements or occur in stratigraphically controlled breccias. Sinking Valley is an apparent exception, because the main deposit is apparently a vein.
4. No igneous source is obvious.
5. Thrust-faulting and close folding are typical of the host terrane.

Because of the similarities to other Appalachian Zn-Pb deposits, the Pennsylvania group is tentatively considered Paleozoic. In view of the size of Friedensville and the East Tennessee deposits, plus the extent of complexly-deformed carbonate rocks in the state, deposits of this type form an attractive exploration target in Pennsylvania.

Birmingham (1, Blair Co.)

Location: 0.9 mile west of Birmingham, and 2 miles southeast of Tyrone. Several minor occurrences are also known in this vicinity (see Zeller, 1949).
History: Mining in the area started in 1778 during the Revolutionary War, although the main production was apparently from the southern end of the valley near Culp (2, Blair Co.). In 1795, the Birmingham deposit underwent development and probably mining. Between 1864 and 1870 zinc mining was active, with a reduction plant at Birmingham. Since then only sporadic exploration has been done, most recently in the late 1940's when numerous holes were drilled. Workings consist of a 347-foot adit and numerous shallow shafts and pits.
Production: Several thousand tons of ore in 1864-1870, and possibly minor additional ore at other times. Grades of 8-30% zinc are recorded, accompanied by 1.6% lead.
Host rock: Ordovician limestone.
Structure: The deposits occur in a window of shattered Ordovician limestone exposed just beneath a large thrust fault (Birmingham fault) with several branches. The ore apparently occurs in veins trending northeasterly parallel to the strike of bedding.
Character of mineralized rock: Sphalerite and galena occur with barite, pyrite and dolomite in veins and disseminated in limestone near veins. Smithsonite, calamine, cerussite and limonite occur in the oxidized zone. Veins are reported to be up to 7 ft. wide, and were traced for up to 165 feet along strike.
References: Platt, 1881
Butts, 1939
Moebs and Hoy, 1949
Zeller, 1949

Culp area (2, Blair Co.)

Location: 8 localities ¼ to 1 mile south-southeast, west and northwest of Culp in the upper part of Sinking Valley; 4 miles southeast of Bellwood. Another prospect apparently was about 1 mile NE of Culp. Exact locations are given by Zeller (1949) and Platt (1881).
History: Mining was started in 1778 during the Revolutionary War. Some additional prospecting and mining was carried out in 1864-1875. Minor exploration was done between then and 1944-50, when a number of drill holes were put down by the U.S. Bureau of Mines and a mining company.
Production: At least 1500 pounds of lead were recovered in the 18th century, and at least 300 tons of ore were mined in the 19th century by the Keystone Zinc Co.
Host rock: Ordovician Bellefonte Dolomite, Carlim-Lowville and Trenton Limestones.
Structure: The deposits are on or near the axis of Sinking Valley anticline. Individual veins and mineralized zones trend N25-50W across the axis. The location is at the southwest end of the Nittany arch where a hypothesized imbricate thrust sheet may terminate, and give rise to a brecciated and faulted zone at depth.
Character of mineralized rock: Galena and barite with subordinate sphalerite occur in veins with calcite and disseminated in rock near veins. Limonite, smithsonite, and cerussite are also present.
References: Platt, 1881
Zeller, 1949
Reed, 1949

East Petersburg (7, Lancaster Co.)

Location: 1½ miles northeast of Bamford, near East Petersburg, in a cut on the Lancaster Branch of the Reading Railroad.
History: Discovered during construction of the railroad.
Production: "Considerable ore" was taken out before 1880.
Host rock: Cambrian Elbrook or Conococheague Limestone.
Structure: Probably closely folded, but no detailed information.
Character of mineralized rock: Hemimorphite apparently was the main ore mineral; sphalerite is also reported.
References: Frazer, 1880
Miller, 1924
Gordon, 1922

Bamford (8, Lancaster Co.)

Location: On state highway 722, 0.3 mile NE of highway intersection at Bamford, 6 miles northwest of Lancaster.
History: The ore was discovered in 1846 by a workman digging post holes. In 1855 a stock company erected a plant for producing zinc oxide but failed to make a profit. The mine was again opened from 1872-77 but was not a success. Further development and possibly mining took place in 1883 and 1900.
Production: 357 tons of zinc spelter was shipped in 1873-78, and $2000 of zinc oxide in 1855. A total production of 25,000 tons of ore has been estimated, but as the ore averaged 12% Zn, there is a considerable discrepancy between ore production and zinc production.
Host rock: Cambrian Ledger Dolomite just above the contact with the Kinzer Formation.
Structure: Rocks of the region are isoclinally folded with recumbent axial planes, and have been considerably faulted. The veins at the mine are parallel to bedding, with a strike of N75 E, and a dip of 72°NW. The hanging wall is brecciated siliceous limestone, and the footwall dark blue limestone.
Character of mineralized rock: The veins average 12-15 ft. wide and are composed of sphalerite and galena in a carbonate gangue. Tennantite and questionable tetrahedrite are reported, and hemimorphite, smithsonite, cerussite, aurichalcite and hydrozincite were present in the oxidized zone. The galena contains an average of $22 per ton (about 17 oz./ton) of silver. At 110 feet below the surface the veins were barren of lead and zinc minerals.
References: Miller, 1924
Frazer, 1880
Jonas and Stose, 1930
Freedman, J., 1968a, 1968b

Herr's Mine (9, Lancaster Co.)

Location: 3 miles northwest of Lancaster, and 1½ miles south of East Petersburg, just west of Flory's Mill.
History: Mined before 1889.
Production: Unknown, probably low.
Host rock: Cambrian limestone.
Structure: Unknown.
Character of mineralized rock: Contains sphalerite.
References: Eyerman, 1889, p. 4
Freedman, 1968a

Pequea Mine (12, Lancaster Co.)

Location: On Silver Mines Run, ⅓ mile north of Pequea Creek, 1¼ miles north of Marticville, and about 9 miles south of Lancaster.
History and production: The mine may have been worked in 1709 by early white settlers and perhaps earlier by Indians. It was worked in 1862-63, with production of a small amount of high grade lead ore, again in 1874-75, and sporadically in 1900-1903. An additional promotional venture was attempted in 1930. Five or six mine openings exist, the largest with about 250 feet of workings.
Host rock: Cambrian Vintage dolomite, and possibly Conestoga limestone.
Structure: The Vintage Dolomite and underlying Antietam Schist are overlain unconformably by phyllitic Conestoga Limestone. The general area exhibits a number of thrust slices, and at the mine the Vintage-Conestoga sequence is repeated by a thrust. This thrust has subsequently been folded, most fold axes striking north to northeast. The ore is concentrated in fold crests just below the Conestoga phyllitic limestone.
Character of mineralized rock: Abundant quartz as irregular veins and lenses up to a few feet thick, mainly along bedding but also in a cross-cutting joint set, accompanied by minor galena in veins up to 6 inches thick. The galena contains 200-300 oz. of silver per ton. Cerussite, hemimorphite, anglesite, chalcopyrite, pyrite, wulfenite, calcite, chloritoid, rutile, siderite, and adularia (?) are reported.
References: Miller, 1924
Foose, 1947
Price, 1947
Wise, 1960
Freedman, 1968b

Friedensville (6, Lehigh Co.)

Location: At Friedensville, about 4 miles south of Bethlehem and 7 miles west of Hellertown. The five mines, the Ueberroth, Old Hartman, New Hartman, Correll and Three-Cornered Lot are within ½ mile north and west of Friedensville.
History: Hemimorphite was first recognized at the Ueberroth mine in 1845, and a small quantity of ore was shipped in 1846. The first real production was in 1853 from the Ueberroth mine. The Correll mine opened in 1859. Mining was more or less continuous until 1893, when increasing amounts of water at depths of 250 feet led to cessation of operations, in spite of a very large pump. Drilling by the New Jersey Zinc Co. in 1914-15, 1923-24, and 1937-42 demonstrated an extension of the Hartman ore body. Shaft sinking to a depth of 1250 ft. and pre-mining development occupied the period 1945-58. Mining of the New Hartman ore body began in 1958.
Production: Up to 1893 the production is estimated at 50,000 tons of zinc spelter and 90,000 tons of zinc oxide worth $20,000,000. Between 1958 and 1964, 2,859,000 tons of ore averaging 6.5% Zn were mined. Current production rate is 2000-2500 tons per day.
Host rock: Ordovician Beekmantown Formation, composed of limy dolomite with local zones of dolomite and limestone.
Structure: The mines occur in complexly folded and faulted limestones of a large graben and downfold into the Precrambrian gneisses. The Hartman ore body occurs near the crest of an overturned anticline which plunges southwest at 18°. The Ueberroth and Old Hartman mines are in the vertical to overturned north limb, but the New Hartman and Correll mines are on the moderately dipping south limb. The New Hartman ore body occurs in a "sedimentary breccia" as a tabular body with a long axis extending parallel to the axis of the anticline. Some sulfide minerals show the effect of deformation, locally to the stage of mylonitization.
Character of mineralized rock: Sphalerite and pyrite replace the matrix of the breccia and fill open spaces. Dolomite, calcite and quartz occur as veins cutting the fragments of the breccia. Chalcopyrite is rare, and galena has not been found. Oxidation products are hemimorphite, smithsonite, greenockite, sauconite and limonite.
References: Callahan, 1968
Miller, 1924
White, 1948
Fraser, 1935
Socolow, 1959

Type G. Zn-Pb Sulfides in Helderberg-Tonoloway Limestones

Scattered mines and prospects for lead and zinc are found in the central part of the state in Upper Silurian and Lower Devonian limestones of the Helderberg and Tonoloway formations. Occurrences are listed in Bedford, Columbia, Huntington, Lycoming, Northumberland and Union Counties, and vague references are made to widespread traces of Pb-Zn in the intervening territory. The Almedia mine in Columbia County and the Doughty mine in Northumberland County produced small amounts of lead and zinc in the 19th century. Deposits are similar to the Appalachian type but are considered separately in view of the stratigraphic control. Relatively little is known of the details of these occurrences. Drill holes at the Almedia mine encountered several encouraging intercepts of zinc-lead mineralization (Earl, 1950a).

Almedia and Webb mines (2, Columbia Co.)

Location: 4 miles east of Bloomsburg on U.S. highway 11, near the boundary between Scott and South Center townships.
History: Apparently the lead was found before 1816 in limestone quarries. A New York group attempted to develop the Webb mine before 1883, without success. In 1901 the Almedia mine was developed a few hundred feet south by an open cut and three shafts, the deepest at least 115 feet in depth. The Bureau of Mines drilled 4 holes in 1949 and intersected ore in several places below the workings.
Production: 1900 tons of concentrates worth $110,000 were shipped to Germany for reduction.

Host Rock: The Silurian Tonoloway Limestone, just below the Keyser Limestone.
Structure: The mineralized zone is in a fracture zone parallel to bedding in the enclosing limestone. The area is on the south flank of an anticlinal structure, and the bedding is nearly vertical with northeast strike.
Character of mineralized rock: Galena and sphalerite occur in carbonate veins and as replacements in the limestone. Minor pyrite occurs with the galena and sphalerite. Assays by the Bureau of Mines show up to 39% Zn and 10% Pb, including one intercept of 14.5% Zn and 3.84% Pb across 7.5 feet.
References: Earl, 1950a
Miller, 1924

Doughty mine (1, Northumberland Co.)

Location: 2.7 miles south of Sunbury, opposite Selinsgrove on the Susquehanna River, 1425 feet southwest of Milepost 136 (not 135) on the Pennsylvania Railroad.

History and production: Discovered about 1840, when a small amount of ore was produced. Further development took place about 1880.
Host rock: The Tonoloway Formation (shaly limestone), in the Upper Silurian.
Structure: The mineralized zone is at and near the crest of a sharp asymmetric anticline. Considerable crumpling and calcite veining are present, as well as some silicified rock.
Character of mineralized rock: Galena and sphalerite occur in "strings" and "pots" in the limestone. An analysis of the ore shows 24% Pb, 32% Zn and 1.4% Cu. Fluorite is a common constituent of the calcite veins in the vicinity.
References: Miller, 1924
White, 1883, p. 129
Gordon, 1922
Smith, 1968

Type H. Other Pb-Zn in Sedimentary Rocks

This group includes about 16 Pb-Zn occurrences about which very little is known. Probably several types are present. Veins in Shawangunk conglomerate and Tuscarora quartzite in Lehigh and Centre Counties probably are similar to the Pb-Zn deposits of the Shawangunk Mountains in New York, where several small mines have operated. Occurrences of Pb in Lancaster County may belong with type F, but no data are available. The remaining occurrences are mainly in the Upper Paleozoic of the Appalachian Plateau but are also poorly known.

Type I. Barite in Limestone

The main occurrences of this type are in Franklin County near Chambersburg. In addition to possible significance for barite, they should be kept in mind as possible associates of Pb-Zn ore.

Type J. Zn-Pb-Cu Sulfides as Fracture-Fillings and Veins in Limestone

The largest group of this type is in York County and is attributable to close observation in limestone quarries by one geologist. Other occurrences are in Lancaster and Montgomery Counties, generally where mineral collectors have closely studied the rocks. The occurrences may be related to type F or Q.

Type K. Wurtzite and Other Sulfides in Concretions, Western Pennsylvania

Wurtzite in clay-ironstone concretions in the Pennsylvanian Conemaugh Group limestones has been reported from more than 15 localities in western Pennsylvania. Calcite, barite, pyrite, and chalcopyrite accompany the wurtzite in some localities. The minerals are of mineralogical interest but give no indication of economic significance.

Type L. Sandstone-Type Copper-Uranium, Uranium, and Copper Deposits

The largest number of occurrences of this type is in the Devonian Catskill Formation of Columbia, Lycoming, Sullivan and Bradford Counties. These prospects contain varying amounts of copper sulfides and uranium in gray and green sandstones intercalated with continental redbeds of the Catskill Formation. The mineralization is closely associated with plant fragments. A small amount of copper was produced from the Carpenter mine in Bradford County. The characteristics demonstrate a similarity to the sandstone-type uranium deposits of Wyoming, Colorado, Utah and New Mexico, and to the red-beds copper deposits.

A second group of occurrences is in Carbon County near Jim Thorpe along the Lehigh River. Copper is absent from most of this group, which occurs in Devonian and Mississippian sandstones. A small production was made from the Mt. Pisgah occurrence, and several others, especially the Penn Haven Junction prospect, seem worthy of further exploration.

An additional cluster of uranium occurrences is in Huntingtdon and Fulton Counties. Other localities are scattered through the Valley and Ridge province and the adjacent Plateau area.

Carpenter mine (1, Bradford Co.)

Location: 1½ miles south of New Albany, on a tributary of Beaver Creek.
History: In 1854 the Towanda Copper Co. was organized to work this deposit, and excavated two tunnels 20 and 30 feet long. About 1905 these workings were full of water. An additional adit was driven about 1955, and the old adit was unwatered, but the original seam of ore had apparently been mined out.
Production: A few tons of ore.
Host rock: Gray clay shale 2½-4 feet thick, underlain by limestone conglomerate and overlain by red shale and sandstone. The shale is within the Devonian Catskill formation.
Structure: The beds dip at a very low angle to the west.
Character of mineralized rock: Tenorite, melaconite, malachite, chalcocite and pyrite are associated with stringers of red clay and abundant coal material and plant remains. The ore is said to assay 3.15% copper. A low but anomalous radioactivity is detected in the coaly material.
References: Weed, 1911
McCauley, 1961

Unnamed mine (6, Bradford Co.)

Location: Three-fourths mile northwest of New Albany, about ⅛ mile downstream from the dam of the New Albany water supply.
History: About 1903 a 30′ adit was driven into the hill.
Production: A small amount of ore containing 2½% Cu and a little silver was shipped to New York in 1903.
Host rock: Indurated dark gray shale bed about 18 inches thick, capped by sandy red shale.
Structure: The beds dip 2-3 degrees into the hill.
Character of mineralized rock: Malachite films coat the black shale, and chalcocite (?) occurs in nodules with carbonaceous material.
References: Weed, 1911

Penn Haven Jct. (3, Carbon Co.)

Location: On the Lehigh River, about 2000 ft. south of Penn Haven Jct., and about 5 miles north of Jim Thorpe.
History: A few shallow drill holes were put down in the 1950's.
Production: None.
Host rock: Gray graywacke sandstone of the Bear Mountain Member of the Catskill Formation.
Structure: The zone of mineralized rock is exposed for a length of 300 ft. in a small anticline and in general is comformable with bedding, but locally cuts across it. Uranium at one location is localized in a "roll" structure similar to those described on the Colorado Plateau and elsewhere. The ore is exposed on both sides of the river about 400 feet apart.
Character of mineralized rock: Uraninite is the main primary uranium mineral and occurs in lenses in the sandstone, in some cases associated with heavy mineral layers. Clausthalite (PbSe) and small amounts of pyrite accompany the uraninite. Secondary minerals are kasolite and uranophane. Samples contain up to 0.56% uranium.
References: Klemic and others, 1963
Lapham and Geyer, 1965

Mt. Pisgah (5, Carbon Co.)

Location: On U.S. Route 309 about ½ mile northwest of Jim Thorpe.
History: Recognized in the early 1900's, and examined more intensively in the 1950's.
Production: Considerable exploration included drilling, driving 3 adits up to 50 ft. long, and mining 300 tons of ore, which was delivered to the AEC.
Host rock: Dark gray sandstone and conglomerate overlain by red beds, in the transition zone between Mississippian Mauch Chunk Formation and Pennsylvanian Pottsville Formation.
Structure: The prospect lies on the nose of a southwest-plunging syncline. Beds dip from 25 to 55° SE, and are cut by numerous shears. Lenses of radioactive siltstone have been squeezed into some of these shears. The conglomerate exhibits cross bedding and channeling. The uranium occurrences are exposed along the strike for 2000 feet.
Character of mineralized rock: The primary uranium occurs in dark graywackes and conglomerates as an unidentified black mineral. Carbonaceous material is usually present with the uranium. Analyses up to 1.8% uranium are recorded. Secondary minerals included carnotite, tyuyamunite, selenium, uranophane, schroeckingerite, liebigite and andersonite. The mineralized rock occurs as lenses and pods in the sandstone and conglomerate sandstone.
References: Klemic and others, 1963
Wherry, 1915
McCauley, 1961

TRIASSIC HOST ROCK GROUP

Type M. Cu, Au and Other Elements in Triassic Diabase

Localities of this type are found in Montgomery County (Cu, Au; 2 localities), Berks Co. (Co, As, Au; 2 localities) and York Co. (Cu; 1 locality). Probably there are many other occurrences of chalcopyrite in the diabase. None of this group appears to be of any economic interest.

Type N. Cornwall-Type Magnetite Deposits

The "Cornwall-type" (Spencer, 1908) iron deposits as a group far exceed the production of any other group considered here, and also constitute the largest number of producing mines. The total recorded production amounts to about 110 million tons of iron ore with a total value at present-day prices near $1 billion. About 85% of this production has been from the Cornwall mine, but the Grace mine near Morgantown is probably of similar size. The next largest producers, at Dillsburg, French Creek and Boyertown, were all much smaller, on the order of 2% of Cornwall.

The Cornwall-type ores are replacements of limestone or limestone conglomerate adjacent to Triassic diabase sheets. Magnetite is the main ore mineral, accompanied locally by hematite. Chalcopyrite and cobalt-bearing pyrite are recovered at Cornwall and Morgantown, and chalcopyrite is present in varying amounts in most of the deposits, along with pyrite. Gangue minerals are mainly actinolite, chlorite, serpentine, and various other calc-silicates and ferromagnesian silicates. A Triassic age is indicated by dates of ore minerals at Cornwall.

The Grace mine at Morgantown was discovered by an aeromagnetic survey in 1948 along with at least one other deposit. Because of complexities in distinguishing magnetic anomalies due to diabase from those due to magnetite ore, there is a possibility of discovering additional magnetite ore bodies of moderate size in the region.

Fegley mine (1, Berks Co.)

Location: 2½ miles NNW of Boyertown, and about ¾ mile SE of Bechtelsville.
History: Mentioned by Spencer in 1908 as an inactive mine.
Production: Some ore is said to have been produced, but apparently only a small amount.
Host rock: Diabase.
Structure: The ore apparently occurred in a fracture in the diabase.
Character of mineralized rock: A vein of magnetite intergrown with feldspar is described from the dump. Stilbite has been described. A 500 gamma magnetic anomaly occurs at the mine.
References: Spencer, 1908
Hawkes, Wedow and Balsley, 1953
Gordon, 1922

Gilbert shaft (2, Berks Co.)

Location: 1 mile SSE of Bechtelsville, just south of the Fegley mine.
History and production: Shown as a working in 1883. Excellent ore is reported to have been taken from this shaft. A strong magnetic anomaly was found in this vicinity.
Host rock: Triassic shale and sandstone at the surface.
Structure: Diabase probably underlies the area at shallow depth. Paleozoic rocks could unconformably underlie the Triassic.
Character of mineralized rock: Unknown.
References: Hawkes, Wedow and Balsley, 1953

Boyertown mines (3, Berks Co.)

Location: At Boyertown in the southeastern part of the business district.
History: The first iron-making furnace in the U.S. was established near Boyertown about 1720 by Thomas Rutter. The ore was presumably derived from Boyertown. At least four mines were significant producers between 1850 and 1900, but all had closed by 1908. The

main mines were the Warwick, Gabel and Phoenix mines. Only minor exploration has been done since 1900.

Production: No figures are available, but the extent of workings suggests a production of roughly a million tons of ore worth several million dollars.

Host rock: Thin units of Cambro-Ordovician limestone or dolomite intercalated in quartzite. Minor amounts of ore may occur in Triassic limestone conglomerate overlying the Paleozoic limestones.

Structure: The Cambro-Ordovician limestones generally dip at moderate angles to the east and southeast but are locally very contorted. The limestones are cross-faulted and only two host beds may be present. Triassic conglomerate and shale unconformably overlie the Cambro-Ordovician. The unconformity and the Triassic beds dip at moderate angles to the east. Some faulting may have taken place along the unconformity.

Character of mineralized rocks: Magnetite is the main ore mineral, along with minor hematite. A few percent pyrite and a few tenths percent copper as chalcopyrite were present in typical ore. Cuprite is also reported. Ore grades range from 30 to 50% Fe.

Very little data exist on the gangue mineralogy, except that it is mainly Ca and Mg silicates, commonly green, and includes serpentine or chlorite, pyroxene, and epidote. In gross form the ore bodies were tabular bodies 5-20 feet thick, but locally, thicker pods several tens or more feet in diameter were encountered.

References: Spencer, 1908
Hawkes, Wedow and Balsley, 1953
Gordon, 1922
d'Invilliers, 1883

Brower mine (4, Berks Co.)

Location: One mile southwest of Boyertown.

History and production: The ore was discovered in a post-hole. The mine was active in 1857 and 1858, when 2000 tons of ore were extracted. When visited by Spencer in 1908 it was abondoned. A tunnel and two shafts opened the property. Workings extended to a depth of 70 feet and along a length of 50 feet.

Host rock: The ore occurred at the upper contact of a diabase sill, and had a hanging wall of flinty baked shale or sandstone, but the character of the replaced material is not recorded.

Structure: The ore layer had a northeast strike and a dip of 35-40° southeast, along the upper contact of the diabase.

Character of mineralized rock: The ore layer was up to 8 feet thick. Magnetite was the main ore mineral.

References: Spencer, 1908

Esterly mine (13, Berks Co.)

Location: Two miles south of Jacksonwald, and 4 miles southwest of Reading, just west of Antietam Creek.

History: The mine was closed by 1908 when Spencer described it. The main opening was an inclined shaft 125 feet deep, with drifts extending 250 feet to the east. The Bishop shaft, 600 feet southeast of the main shaft, was 150 feet deep, with a crosscut driven 200 feet north.

Production: 3000-4000 tons of ore from the Esterly shaft, and 1000 tons from the Bishop shaft.

Host rock: Apparently Triassic limy shale, according to Spencer (1908), but limestone conglomerate is present in the vicinity.

Structure: The Triassic sediments have been intruded by two thick sills of diabase and folded into a syncline. The ore lies below the lower sill, striking east-west and dipping about 50° north under the sill.

Character of mineralized rock: The shale is baked, and in places contains garnet, hornblende, chlorite, and magnetite concentrations. The ore zone apparently has a strike length of only one or two hundred feet. At the Bishop shaft, garnet rock was encountered in the workings and limestone conglomerate at a depth of 450 feet in a drillhole.

References: Spencer, 1908
d'Invilliers, 1883

Fritz Island mine (16, Berks Co.)

Location: On Fritz Island, 1½ miles south of Reading on the Schuylkill River.

History: The ore was discovered about 1850 when flood waters exposed the ore. Workings consisted of an open pit and two inclines, the deeper being 231 feet deep.

Production: The total yield to 1883 was estimated at 250,000 tons, but apparently the mine closed a short time later.

Host rock: Cambrian Leithsville Dolomite, underlain by quartzite and intruded by diabase.

Structure: The ore zone strikes approximately east-west, parallel to and just north of a large diabase body which cuts through the Triassic sediments. Several dikes just north of the main diabase body intrude a short distance into the Paleozoic host rocks. At the surface the ore-bearing rocks were partly overlain by a thin outlier of Triassic limestone conglomerate. The ore zone dipped at moderate to steep angles to the north.

Character of mineralized rock: Magnetite is the main ore mineral. Analyses indicate a pyrite content of several percent, about 0.5% copper as chalcopyrite, 0.04% phosphorus, 15% silica, and 5-10% lime and magnesia. Hematite, malachite, azurite, brucite, bornite, galena, stibnite, aurichalcite, calcite, serpentine, fluorite, scapolite, vesuvianite, garnet, zeolites, apophyllite and chlorite have also been found in the ore and adjacent rocks.

References: Gordon, 1922
Spencer, 1908
d'Invilliers, 1883

Raudenbush mine (17, Berks Co.)

Location: About 2 miles south of Reading and ½ mile west of the Fritz Island mine on the Schuylkill River.

History: Active in the last half of the 19th century. Workings consist of a 280-foot inclined shaft and several shallow shafts, plus drifts extending several hundred feet from the shaft.

Production: Said to furnish 5000 tons per year in 1858, but long idle by 1883. The total production is certainly less than 100,000 tons.

Host rock: Cambrian Leithsville Dolomite, considerably altered.

Structure: The main body of diabase extends to the margin of the Triassic shales and sandstones and is in contact with the Paleozoic rocks to the north. An altered shale forms the hanging wall of the ore. The ore body dips 36° to the south.

Character of mineralized rock: The ore body is apparently tabular and averages 12 feet in thickness, but locally expands to 30 feet. The gangue is described as a "light blue rotten limestone." Magnetite was apparently the ore mineral, but some hematite is present in the vicinity. Pyroxene, chlorite, and stilbite are also reported.

References: Spencer, 1908
d'Invilliers, 1883

Wheatfield mine (18, Berks Co.)

Location: 1½ miles ESE of Fritztown and about 2 miles south of Sinking Spring.

History: The ore was discovered about 1851 in a wheatfield. Major production ceased about 1883, but sporadic minor activity is recorded up to 1906. At least 4 pits were mined.

Production: An estimate of 300,000 tons of ore was given in 1883.

Host rock: Cambro-Ordovician limestone or dolomite overlain by slate.

Structure: The limestone in which the ore occurs is separated from the main body of limestone in the Great Valley to the north by a diabase dike ¼ mile wide. On the south, the limestone is overlain by slate (presumably Paleozoic) and this by Triassic red sandstone and shale dipping gently southward and westward. The limestone is commonly brecciated, and at least locally the ore cuts across the bedding.

Character of mineralized rock: The ore to a depth of 30-40 feet is reported to be soft and earthy, possibly due to decomposition from oxidation of pyrite. Deeper material contains unweathered magnetite. Analyses indicate 37-40% iron, 20% silica, 1.5 to 3% pyrite, 0.1% copper and 0.03-0.05% phosphorus in the ore, with 11-19% magnesia and little or no calcium. Minerals reported include serpentine, fluorite, chlorite, stilbite, quartz, malachite and native copper.

References: Gordon, 1922
Spencer, 1908
d'Invilliers, 1883

Ruth mine (19, Berks Co.)

Location: About ½ mile southeast of Fritztown, and ¾ mile west of the Wheatfield mines.

History: The ore was discovered in 1847 and was mined until 1863. Only minor work was done after this date. An incline to a depth of 190′ furnished access to the ore.

Production: About 10,000 tons of ore were produced to 1863.

Host rock: Cambro-Ordovician limestones and dolomites, the same unit which is the host for ore at the nearby Wheatfield mines.

Structure: The mine is at the west end of the same east-west trending block of Paleozoic limestone and shale in which the Wheatfield mines are located. A thick diabase dike limits the north side of this block, and Triassic sediments overlie it to the south. The diabase dike turns southward just west of the Ruth mine and terminates the block. Bedding is nearly flat at the mine, but the ore dips about 30° southwest. Limestone breccia forms the gangue and the hanging wall of the ore.

Character of mineralized rock: An analysis shows 42% iron, largely as magnetite, 22% silica, 3% alumina and 2% lime. Minerals include magnetite, pyrite, brucite, serpentine, chlorite, hydromagnesite and calcite.

References: Gordon, 1922
Spencer, 1908
d'Invilliers, 1883

Jones and Kinney mines (21, Berks Co.)

Location: 1¼ miles northwest of Elverson and 2½ miles northeast of Morgantown.

History: Mining started about 1780 or before and continued to at least 1883, but had ceased by 1908. The workings consisted of a pit about 400 feet in diameter and 80 feet deep, plus several shafts. A smaller pit was excavated several hundred feet south.

Production: According to Rogers (1858) about 300,000 tons of iron ore were produced by 1853. A total production of 500,000 tons is estimated. During some periods, copper was produced, for instance several thousand tons of 6-7% Cu in 1870-75.

Host rock: Cambrian Vintage Formation (dolomite and shale).

Structure: The dolomite and shale occur as a reentrant in the north edge of a thick diabase dike. Triassic sediments bound the carbonate unit on the north, probably by a fault, although some writers indicate an unconformity. The diabase dips northward under the ore, and a small diabase dike occurs within the ore body. The carbonate bedding is considerably contorted, but has a general dip to the west-northwest.

Character of mineralized rock: The ore consisted largely of magnetite, along with pyrite, chalcopyrite, chalcocite, bornite, cuprite, melaconite, native copper, calcite, aragonite, malachite, chrysocolla, cerrusite, aurichalcite, gypsum, actinolite, serpentine, talc, graphite, and possibly scheelite. Analyses show 44% Fe, 0.6-1.6% Cu, 0.02% P, 8-22% SiO_2 and 11% Al_2O_3 + CaO + MgO.

References: Rogers, 1958
Spencer, 1858
Stose and Bascom, 1938
Gordon, 1922
Hunt, 1876

Grace mine (22, Berks Co.)

Location: 1½ miles north of Morgantown.

History: The ore body was detected by an aeromagnetic survey in 1948. The mine came into production in 1958.

Production: Production through 1964 was 11,243,430 tons of ore. For 1962-64, the annual production rate was about 2,800,000 tons. Products are magnetite concentrate and sulfide concentrate. The latter yields sulfur, copper, and some cobalt and gold.

Host rock: Cambrian limestone, probably the Elbrook dolomitic limestone.

Structure: The ore body replaces limestone lying above a north-dipping diabase sheet. The hanging wall of ore is Triassic sediments. The ore body is tabular, strikes N60W, dips 20-30° NE and plunges about 20° N80E. It lies at depths of 600 to 2200 feet below sea level and did not crop out. Dimensions are 3500 feet long, 700-1500 feet wide, and less than 50 to more than 400 feet thick.

Character of mineralized rock: Average ore contains 44% Fe, 1.9% S, 0.027% P, 0.14% Mn, 0.06% Cu, 0.02% Co, 16% SiO_2, 2.8% Al_2O_3, 12.3% MgO, 3.0% CaO, 0.41% K_2O, 0.20% Na_2O, 0.15% TiO_2, 90 ppm Ni, 80 ppm Zn and 60 ppm Pb. Concentrates contain 68% Fe. Magnetite is the major ore mineral, accompanied by small amounts of pyrite, chalcopyrite and locally pyrrhotite. Traces of sphalerite, marcasite, galena, hematite, digenite and goethite are present. Pyrite contains an average of 0.51% cobalt. Serpentine, talc, and chlorite are the major gangue minerals, but these have apparently replaced earlier diopside, forsterite, tremolite, mica, calcite and dolomite. The ore is typically granular, fine to medium grained with a fine-grained matrix. In places magnetite-rich bands and laminations are separated by gangue minerals.

References: Sims, 1968
Tsusue, 1964

Bylers mine (23, Berks Co.)

Location: 1 mile northwest of Morgantown.

History: Opened about 1860 and worked for about 15 years.

Production: Possibly several hundred thousand tons, judging from the size of the pit.

Host rock: Cambrian limestone with shale.

Structure: At the contact of the limestone with diabase.

Character of mineralized rock: Said to be the same as the Jones mine.

References: Bascom and Stose, 1938

Hopewell mine (1, Chester Co.)

Location: 1¼ miles west and a little north of Warwick.
History: Mined for many years before 1858, and later from 1877-1880 and 1911-1914. Four pits were worked, plus one 200-foot shaft.
Production: About 40,000 tons in 1911-1914, but undoubtedly a much larger amount was mined before 1850.
Host rock: Replacement of a bed, probably marble, in the Precambrian Pickering Gneiss. A thick diabase dike cuts the gneiss a few hundred feet south and probably dips under the ore.
Structure: The ore occurs in two tabular bodies totaling about 25 feet in thickness dipping northwest at about 35°. The gneiss is intruded by a northwest-striking diabase dike, and the ore extends away from this dike.
Character of mineralized rock: Magnetite is accompanied by hematite, garnet, epidote, pyrite, sphalerite, quartz and chalcedony. An analysis shows 37.8% Fe, 0.26% Cu, 1.496% S, 0.55% P and 23.19% SiO_2.

Magnetic, electrical and gravity surveys were conducted over the deposit by Shank (1961), Ross (1963) and Ghaffar-Adly (1961).
References: Bascom and Stose, 1938
Rogers, 1858, p. 707
Gordon, 1922
Shank, 1961
Ghaffer-Adly, 1961
Ross, 1963

Warwick mine (2, Chester Co.)

Location: On the southeast side of the town of Warwick.
History: Mining is reported to have started in 1730, and stopped about 1880. A shallow pit about ¼ mile in diameter was the main working. Several shafts were also sunk.
Production: Estimated at 250,000 tons on the basis of figures given by Rogers (1858).
Host rock: Limestone conglomerate in the Triassic series.
Structure: The mineralized conglomerate bed was nearly flat-lying and exhibited several gentle folds, but the material mined was mostly within 60 feet of the surface. A relatively narrow diabase dike cuts the conglomerate.
Character of mineralized rock: The ore zone ranges from 1 to 9 and locally 17 feet thick. Minerals present besides magnetite include epidote, garnet, actinolite, orthoclase, serpentine, pyrite, chalcopyrite, bornite, hematite and calcite.
References: Bascom and Stose, 1938
Spencer, 1908
Rogers, 1858
Gordon, 1922

Leighton mine (3, Chester Co.)

Location: Just southeast of Warwick.
History: Abandoned before 1858.
Production: Estimated at 20,000 tons.
Host rock: Granitic gneiss. The ore may have replaced marble lenses in the gneiss.
Structure: The ore was in two bands about 4 feet apart striking northeast and dipping northwest at 33°. The bands pinched from about 35 feet thick at the surface to a few feet thick at about 40 feet depth. The workings extend along the strike for 1500 feet, but only 200 feet was mined. Diabase occurs nearby.
Character of mineralized rock: Magnetite is the ore mineral.
References: Rogers, 1858
Bascom and Stose, 1938

Steels mine (4, Chester Co.)

Location: About 0.6 mile north of Warwick.
History: Worked before 1858. Workings consist of a surface pit and an adit.
Production: Probably small.
Host rock: Gneiss, possibly including marble lenses.
Structure: Located on the north edge of a large diabase dike.
Character of mineralized rock: Magnetite with garnet and hematite.
References: Bascom and Stose, 1938
Rogers, 1858
Gordon, 1922

Pine Swamp deposit (5, Chester Co.)

Location: About 1.2 miles north of Warwick and ¼ mile south of the former Pine Swamp School.
History: Discovered by drilling in the 1950's based on an aeromagnetic anomaly. Not yet developed. A small pit existed in this vicinity according to Bascom and Stose (1938).
Production: None to date.
Host rock: Replacement of gneiss, possibly including marble members.
Structure: A large diabase dike dips northward under the ore. Pre-Triassic rocks are complexly folded and faulted. The ore body dips at about 45° to the north.
Character of ore: Magnetite is indicated as the main ore mineral from the magnetic anomaly.
References: Gedde, 1965

Unnamed Mine 1¼ miles NE of Pine Swamp (6, Chester Co.)

Location: 1¼ miles northeast of the former Pine Swamp School.
History: Worked about 1895.
Production: Probably small.
Host rock: Triassic shale and sandstone (?).
Structure: The diabase sill may be present at depth, but projection puts it at many thousands of feet. The Triassic sediments are probably less than 100 feet thick here and the underlying Paleozoic rocks have complex structure.
References: Bascom and Stose, 1938

French Creek mines (7, Chester Co.)

Location: One mile north of Knauertown, just north of St. Peters.
History: The mine was opened before 1850, and minor iron ore was produced in an early period from the French Creek No. 1 mine. An attempt to mine a copper-rich portion of the deposit (Elizabeth Copper mine) was made about 1850. The major periods of exploitation were apparently in the 1880's and 1890's, and from 1914 to 1928 at the No. 2 mine. The workings at this mine extend to a depth of 1350 feet.
Production: 876,140 tons between 1914 and 1928, plus perhaps 100,000 tons before 1900 gives a total near 1 million tons of ore.
Host rock: Marble lenses in Precambrian biotite gneiss, overlying a diabase sheet. Considerable pegmatite is associated with some ore.
Structure: The foliation of the gneiss and the marble lenses dips 45° north and is intersected at a low angle by the diabase sheet which dips north at a slightly lower angle. The ore shoot has a strike length of about 450 feet, and a thickness of about 40-50 feet. It plunges approximately down the dip in the upper 800 feet, and ends where the diabase cuts out the marble. The deeper ore is located to the west where the marble unit still lies above the diabase. Thin pre-ore(?) diabase dikes are found in the ore.
Character of mineralized rock: Magnetite is accompanied by considerable pyrite, minor chalcopyrite and varying amounts of gangue minerals. In approximate order of abundance these are calcite, chlorite, pyrite, actinolite, talc, hydromica, garnet, epidote, graphite, augite, chalcopyrite, pyrrhotite and apatite. The calcite, graphite, augite, apatite and some pyrite are pre-ore constituents of the marble. Other minerals identified include scapolite, byssolite, chalcodite, molybdenite(?), serpentine, apophyllite, ankerite, rhodochrosite, bornite, covellite, sphalerite, hematite, aragonite, gypsum, malachite, azurite, chrysocolla, erythrite, stilbite, heulandite, and anthophyllite.

Analyses of the ore average about 55% Fe, 10% SiO_2, 2% Al_2O_3, 4% CaO, 1.5% MgO, 0.03% P, 0.12% Mn, 3% S, and in one sample 0.6% Cu.
References: Smith, 1931
Lapham and Geyer, 1965
Bascom and Stose, 1938
Gordon, 1922

Hummelstown mine (1, Dauphin Co.)

Location: Two miles southeast of Hummelstown on the east side of Waltonville Brook.
History and production: Active before 1886. Production was several thousand tons.
Host rock: Triassic sandstone. No diabase is known in the vicinity.
Structure: The pits are along an east-west trending zone about 2500 feet in length. Because of an abrupt change in dip of sediments, the zone is probably a fault.
Character of mineralized rock: Magnetite with specular hematite and minor pyrite; also a small amount of garnet. The sandstones are considerably bleached in the area.
References: Spencer, 1908

Rexmont reservoir (1, Lebanon Co.)

Location: Just below one of the dams for the City of Lebanon water supply, about 2 miles east of Cornwall.
History and production: Discovered during reservoir construction. Five hundred tons of magnetite ore was removed at this time. Three holes were drilled about 1900 without encountering additional ore.
Host rock: Paleozoic limestone with associated shale.
Structure: Located at the contact of flat-lying limestone with a wide diabase dike along the contact between the Paleozoic and Triassic rocks.
Character of mineralized rock: Magnetite replacing limestone.
References: Spencer, 1908

Doner mine (2, Lebanon Co.)

Location: One mile east of Cornwall.
History and production: About 5,000 tons of ore is reported to have been mined before 1800 from a pit about 250 by 40 feet in outline.
Host rock: Paleozoic limestone near the north contact of the thick diabase dike of the Cornwall area.
Structure: The ore zone strikes east-west, parallel to the diabase contact, and lies beneath the diabase sheet.
Character of mineralized rock: Apparently a considerably weathered magnetite ore.
References: Spencer, 1908

Cornwall mine (3, Lebanon Co.)

Location: At Cornwall, 5 miles south of Lebanon.
History: The ore body outcropped on three hills and was discovered by Peter Grubb in 1732. Production began a few years later from an open pit and continued until about 1920, when underground mining (No. 3 mine) became necessary to supplement the open pit. A second ore body (No. 4 mine) was discovered by a magnetic survey at about this time and brought into production in 1927. The open pit was finally mined out in 1953 (although a small extension was being stripped in 1967). Chalcopyrite has been recovered since about 1912, and copper ores were mined separately during some early periods.
Production: The total production up to 1964 is estimated at 93,170,679 tons of iron ore. The production rate in 1964 was about 6200 tons of ore per day, containing 38% Fe, 0.36% Cu, 1.3% S and 22% SiO_2. Products are an iron concentrate, a copper concentrate, and a cobalt-bearing pyrite concentrate. The copper concentrate contains small amounts of gold and silver. The pyrite concentrate furnishes both cobalt and sulfur. The iron concentrate is pelletized at Cornwall.
Host rock: Cambrian limestone and impure limestone, probably the Buffalo Springs Formation.
Structure: The deposit lies essentially at the north border of the Triassic province, south of the contact with the Cambrian limestone of the Great Valley. The ore occurs within a slice of limestone that lies on top of a south-dipping diabase sheet 1200 feet thick. The sheet is generally conformable with bedding in the Triassic sediments, and at Cornwall cuts into the limestones. Because of recumbent folding of the Paleozoic rocks, the diabase sheet is also more or less conformable with the limestones. Thin units of "Mill Hill slate" and "Blue conglomerate" occur above and below the ore-bearing limestone and may represent thrust-faulted slices of Ordovician Martinsburg formation which have been considerably brecciated and deformed.

The large western ore body (No. 3 mine and open pit) had a strike length of about 4000 feet, a dip length of about 1600 feet, and a maximum thickness greater than 100 feet. The eastern ore body (No. 4 mine) has a strike length of 3000 feet, a dip length of 2400 feet, and an average thickness of about 100 feet.
Character of mineralized rock: Early diopside and garnet are replaced by actinolite, phlogopite, chlorite, magnetite, pyrite, chalcopyrite and orthoclase. The ore and gangue minerals show a banded appearance inherited from the original limestone in many localities. Other minerals present included hematite, calcite, quartz, bornite, chalcocite, covellite, native copper, galena, marcasite, millerite, pyrrhotite, sphalerite, wurtzite, and zeolites.
References: Lapham, 1968
Spencer, 1908
Gray and Lapham, 1961
Geyer and others, 1958
Spencer, 1908

Carper mine (4, Lebanon Co.)

Location: One mile south of Mt. Pleasant and 6½ miles west of Cornwall.
History: Worked before 1885 by a 25-foot shaft.
Production: 1500 tons of ore.
Host rock: Hornfelsed shale, probably equivalent to the Mill Hill Slate at Cornwall of presumed Ordovician age.
Structure: The deposit is a steeply dipping vein or replacement at the faulted contact between Paleozoic sediments to the north and Triassic rocks to the south. Diabase outcrops a short distance south of the mine.

Character of mineralized rock: Replacement by magnetite in a zone up to 8 feet thick.
References: Spencer, 1908

Minebank schoolhouse (18, York Co.)

Location: Two miles southwest of Wellsville, also includes Sluthower shaft 1¾ miles southwest of Wellsville.
History and production: Ore was discovered about 1805 on property owned by the county schools but was not exploited until 1872. By 1875 a total production of 4000 tons is recorded.
Host rock: Probably a thin limestone bed in the Triassic sandstone and shale.
Structure: The ore zone dips about 30° NW parallel to the enclosing sediments. It is up to 7 feet thick and has been developed for 500 feet along the strike. A thin diabase dike was encountered down dip.
Character of mineralized rock: It is a very micaceous magnetite ore. Assays show 58% Fe, 0.18% Cu, 4.8% Al_2O_3, 0.03% Mn, 0.76% CaO, 0.92% MgO, 0.06% S, trace P, 0.12% CO_2 and 9.5% insoluble. At the Sluthower shaft no ore is recorded, but some malachite staining is reported.
References: Spencer, 1908
Frazer, 1877a, p. 235-237

Lichte mine (19, York Co.)

Location: 5 3/16 miles SW of Wellsville, on the west side of State Route 194, about 1 mile south of Bermudian Creek.
History and production: Opened in 1872. By 1875 at least 1000 tons had been mined.
Host rock: Triassic sandstone.
Structure: The ore is said to occur in a vein 6 ft. thick. A diabase dike forms the hanging wall and dips about 45° N.
Character of mineralized rock: Apparently hard magnetite ore.
References: Frazer, 1877a, p. 229

Wellsville area (20, York Co.)

Location: Just west of Wellsville, includes Marshall, Cadwalader, Comfort, Altland and Harman prospects.
History and production: Pits were dug in about 1870 in this vicinity with the discovery of small amounts of ore. A few tons of ore may have been produced.
Host rock: Triassic sediments or diabase.
Structure: Near the contact of the diabase.
Character of mineralized rock: At the Marshall pit, "micaceous ore" is exposed and is apparently a magnetite ore. At the Harman prospect, unusual amounts of magnetite occur in the diabase. Magnetite is apparently present at the Comfort pit, but at all localities the material is at least partly weathered to limonite. At the Comfort pit, ore contained 33.5% Fe, 0.045% S and 0.105% P.
References: Frazer, 1877a, p. 232-234.

Dillsburg (23, York Co.)

Includes Logan mine, Underwood mine, McCormick mine, Smyser mine, Kings mine, Bells mine, Groves mine, Prices mine, Cox mine, Jauss mine, Longenecker mine.
Location: 1 to 1½ miles east of Dillsburg.
History: Most of these occurrences were prospected about 1850, and mined between 1850 and 1900.
Production: About 1,500,000 tons of ore are reported for this area. The Underwood, Longenecker, McCormick, Jauss and Bell mines were the largest producers.
Host rock: Triassic limestone conglomerate and possibly other sediments.
Structure: The deposits lie in a plate of sediments about 300 feet thick, overlain by a thin diabase sheet and underlain by a thick sheet. The diabase sheets are nearly flat-lying and are discordant to the sediments, which dip 20°-30° north. The ore occurs as tabular bodies concordant with the bedding and rarely more than 15 feet thick.
Character of mineralized rock: Magnetite occurs in a gangue of diopside, chlorite, quartz, feldspar and carbonate. Garnet, epidote and datolite are also present. Analyses show 37-45% Fe, 0.05-0.15% Mn, mostly 1-2% S, 0.02-0.055% P, and up to 0.2% Cu and 0.5% Co.
References: Spencer, 1908
Hotz, 1950
Frazer, 1877a
d'Invilliers, 1877
Neuman, 1947

Bender mine and vicinity (24, York Co.)

Location: 1¼ miles southwest of Dillsburg. Another old pit is located a short distance closer to Dillsburg.
History and production: Opened in 1849. Said to have produced 200 tons of ore in 1849, and 40 tons in 1873, with a total production of 300 tons.
Host rock: Impure limy Triassic sediments.
Structure: The sediments occur as a patch within the diabase.
Character of mineralized rock: Magnetite occurs in hard flinty greenish rock containing garnet and pyroxene. Zeolites, chalcopyrite and sphalerite occur in a road cut nearby.
References: Spencer, 1908
Lapham and Geyer, 1965
Frazer, 1877a

Grantham mines (27, York Co.)

Location: Just southwest of Grantham on the south side of Yellow Beeches Creek. Three mines are present, the Landis or Fuller, the Porter, and the Shelley.
History and production: The Landis mine was opened about 1863, the Fuller about 1855, and the Shelley about 1872. Recorded production is only about 2000 tons, but doubtless more was mined at other dates.
Host rock: Triassic limestone conglomerate, and possibly Cambrian limestone.
Structure: The ore body at the Landis mine lies beneath the diabase which dips 24° to the northwest. At the Porter, a 3-6-foot bed of ore dipping 30° was mined for 25 feet along the strike. At the Shelley about 10 feet of ore in limestone conglomerate underlay diabase. Another ore body is described as chimney-shaped. Several other ore zones are apparently present. The mines are very close to a fault separating diabase from Cambrian limestone.
Character of mineralized rock: Magnetite has replaced the limestone conglomerate, but the accompanying minerals are not known. Analyses show 45-58% Fe, 0.12-.27% Mn, 0-0.24% S, and 0.02% P.
References: Spencer, 1908
Frazer, 1877a
d'Invilliers, 1877

Type O. Copper in Triassic Sediments Adjacent to Diabase, and Related Deposits

Forty-four occurrences, mainly in Adams, Berks, Bucks and Montgomery Counties, are classified in this group. Most consist of minor copper sulfides or copper staining in the hornfelsed Triassic sediments adjacent to the diabase. A subgroup, which perhaps should be considered separately, includes the Solebury and Buchmanville mines where copper occurs with barite in or near fault zones.

The best discussion of these deposits is given by Wherry (1908). Their consistent location in the diabase contact zone indicates that the source of the copper was probably the diabase magma, or at least that the diabase intrusion created conditions favorable for their formation. Similar deposits are present in New Jersey. The Buckmanville mine and similar barite deposits may be genetically related to the diabase, but the immediate control is by fault zones.

None of the deposits in Pennsylvania has produced an appreciable amount of copper, but the existence of similar but somewhat larger mines in New Jersey indicates that these deposits could have some value.

Tetemer's mine (2, Bucks Co.)

Location: 1 mile west of Uhlerstown.
History: Not known.
Production: None recorded.
Host rock: Hornfelsed Triassic shale beneath a diabase sill.
Character of mineralized rock: Traces of chalcocite and malachite in a stratum of Triassic shale have been traced 3 miles along strike; the shale has been bleached locally.
References: Wherry, 1908

Karl's mine (5, Montgomery Co.)

Location: ½ mile NW of Woxall (Mechanicsville), about 1½ miles SE of Green Lane.
History: Several shafts were sunk in about 1875.
Production: None recorded.
Host rock: Hornfelsed Triassic shale adjacent to diabase.
Structure: In shattered rocks along the crest of a fold which becomes a fault farther east. This fault probably controls the Buckmanville barite occurrence.
Character of mineralized rock: Crushed and slickensided shale altered to epidote and garnet with chalcopyrite, hematite and minor bornite in narrow veins, streaks and scattered grains. Oxidation products include azurite, chrysocolla, malachite, melaconite and rare native copper. Magnetite is reported in this vicinity but it is not clear whether it is from this deposit.
References: Wherry, 1908
Gordon, 1922
Newhouse, 1933
Bascom, and others, 1931

Kober's mine (7, Montgomery Co.)

Location: ¾ mile northeast of Woxall (Mechanicsville), about 1½ miles southeast of Greenlane.
Production: None recorded.
Host rock: Hornfelsed Triassic shale adjacent to diabase.
Structure: In faulted rocks near the projection of the fault through the Buckmanville barite mine.
Character of mineralized rock: Crushed and slickensided shale altered to garnet and epidote. Quartz, chalcopyrite, galena, and bornite occur in the mineralized zone along with melaconite, malachite, azurite, chrysocolla, native copper and pyromorphite as oxidation products. Natrolite and stilbite occur in nearby diabase.
References: Wherry, 1908
Gordon, 1922
Newhouse, 1933
Bascom and others, 1931

Old Perkiomen mine (20, Montgomery Co.)

Location: ½ mile NW of Schwenksville.
History: Development began about 1703, and some ore was exported to England. The mine was abandoned at the time of the Revolutionary War and has not been active since.
Production: Small amount (see above).
Host rock: Dark shales of Triassic age, metamorphosed, near contact of large diabase sill.
Character of mineralized rock: Patches and lenses of bornite, chalcopyrite and supergene chalcocite in shale, locally altered to chrysocolla and traces of cuprite and malachite. Fluorite is also present.
References: Wherry, 1908
Newhouse, 1933
Gordon, 1922

Young's mine (3, Montgomery Co.)

Location: ⅜ mile NW of Hendricks, near Kratz.
History: A 150-foot shaft was sunk on the property by a stock company about 1903.
Production: None recorded.
Host rock: Triassic sediments near diabase.
Structure: In shattered rocks in the crest of a fold which becomes a large fault farther east.
Character of mineralized rock: Chalcopyrite, bornite and oxidation products along an altered, crushed, and slickensided zone in sediments. Epidote is reported as an alteration product.
References: Wherry, 1908
Newhouse, 1933
Gordon, 1922
Bascom and others, 1931

Pennsylvania Copper Co. mine (18, Montgomery Co.)

Location: 2 miles northeast of Pottstown.
History: A furnace was erected here in the 1900's.
Production: Small, if any.
Host rock: Hornfelsed Triassic shale adjacent to diabase.
Character of mineralized rock: Films of chrysocolla on shale; grade estimated at 0.5% copper.
References: Wherry, 1908
Stone, 1939

Solebury mine (22, Bucks County)

Location: About 1 mile ENE of Buckmanville at the west end of Bowman Hill.
History: The mine was first worked by the Dutch in about 1650, and was thus one of the earliest mining enterprises in the U.S. No reference to any more recent work is known.
Production: Small amount of copper produced by the Dutch.
Host rock: Metamorphosed shale overlying a small diabase body.
Structure: Near the same fault which runs through the Buckmanville barite-copper mine.
Character of mineralized rock: Bornite, chrysocolla and possibly other copper minerals in shale.
References: Stone, 1939
Wherry, 1908
Willard and others, 1959

Buckmanville mine (23, Bucks Co.)

Location: ¾ mile southwest of Buckmanville on Pa. Route 232.
History: Noted in geologic reports of the early 1900's. Fourteen pits up to 25 ft. deep expose the mineralized rock.

Production: Possible small amount.
Host rock: Brecciated Triassic red sandstone.
Structure: The barite occurs in a breccia zone near a large fault trending ENE and cutting diabase farther east.
Character of mineralized rock: Barite is accompanied in breccia by small amounts of quartz, chalcedony, sericite, orthoclase, plagioclase, hematite, magnetite, pyrite, chalcopyrite, malachite and limonite. These minerals occur mainly between breccia fragments. The pits in combination with float outline an area of about 30 acres of barite occurrences. Some breccia contains 50 to 75% barite.
References: Stone, 1939
Wherry, 1908
Willard and others, 1959

Type P. Copper in Triassic Sediments Distant from Diabase

Twenty-one occurrences are classified in this group, which is characterized by the presence of copper-bearing sulfides and oxidation products in unmetamorphosed Triassic sediments, commonly redbeds. The occurrences are mainly in Montgomery, Bucks, Adams and York Counties.

Malachite is the copper mineral reported at most localities, but chalcopyrite and pyrite are reported at Pennsburg (1, Montgomery Co.), pyrite, chalcopyrite, hematite and chalcocite at the Brendlinger mine (12, Montgomery Co.), pyrite at Keelersville (4, Bucks Co.), and native copper at Glasgow (15, Montgomery Co.). The host rock is generally given as Triassic red shales, but the sulfides occur in small patches of gray shale resulting from reduction of iron in iron oxides. The general features of most of these deposits class them with the "Red beds copper" type of mineralization. Whether they are related in any way to diabase is not clear.

LeCron's Copper Mine (6, York Co.)

Location: 1¼ miles south of Zion View, and about 5½ miles north of York.
History: Prospected before 1883; workings include a pit.
Production: None recorded.
Host rock: Triassic red shale and sandstone.
Structure: No information.
Character of mineralized rock: Malachite and copper stain on fractures and impregnating carbonized wood.
References: Frazer,, 1886
Stose and Jonas, 1939

Leithsville (3, Northampton Co.)

Location: One mile south of Leithsville.
History: Active before 1889.
Production: "A considerable quantity" of ore containing 1.4% Cu was taken out, but the mining was not profitable.
Host rock: Triassic conglomerate.
Structure: Near the border fault of the Triassic province.
Character of mineralized rock: Malachite encrusts the conglomerate.
References: Eyerman, 1889, p. 45

Type Q. Lead, Copper and Zinc in Veins Cutting Triassic and Precambrian rocks (Phoenixville type)

Deposits of this type occur as a cluster near Phoenixville in Chester, Montgomery and Philadelphia Counties, plus the isolated New Galena mine in Bucks County. The Wheatley-Chester Co. mines and the Perkiomen mine were active during the 19th century and produced the largest amount of ore in the group, with a value at present-day prices approaching a million dollars. Lead and silver were the main products at the Wheatley and copper-lead the main products at the Perkiomen mine.

The ore occurs in quartz and quartz-carbonate veins up to several feet wide. Precambrian gneiss and granite rocks are the host at the Wheatley and nearby mines; but uneconomic veins were said to extend into the Triassic. Overlying Triassic sediments are the host in the Perkiomen mine area and at New Galena. Galena, chalcopyrite, sphalerite and pyrite are the most important primary metallic minerals, but a wide variety of oxidation products including carbonates, sulfates, oxides, molybdates, phosphates, vanadates and others have been identified.

An age of Triassic or younger is indicated by the Triassic host rock of the Perkiomen mine area, the New Galena mine, and terminal portions of some veins in the Wheatley mine area. Several small diabase dikes are offset by the Wheatley vein, but it is not certain whether these dikes are Triassic or older, possibly Precambrian. It seems probable that the ores are related, at least indirectly, to the intrusion of the Triassic diabase magma.

New Galena mine (13, Bucks Co.)

Location: 3 miles northwest of Doylestown on the north branch of Neshaminy Creek. Vague references are made to other Pb-Zn deposits in the vicinity.
History: Galena was recognized about 1856, and some mining was done in 1861-62. Further sporadic prospecting and possibly mining was done about 1890, 1904 and 1921. A pit 250 ft. long, 50-75 ft. wide and 20-45 ft. deep was excavated. Additional shafts located nearby.
Production: 106 tons of ore were reported sold in 1862, and small additional amounts may have been recovered.
Host rock: Triassic shale.
Structure: The mineralized zone trends northeast parallel to a diabase dike and dips southeast about 70 degrees. The zone has been traced 450 feet. A diabase sill is exposed 1000 feet south.
Character of mineralized rock: Galena and sphalerite occur with quartz in veins up to 3 feet wide, and disseminated in the shale. Dolomite, ankerite, calcite, cerussite, brochantite, anglesite, tenorite, pyromorphite, pyrite, chalcopyrite and bornite are reported from the mine. Some galena contains 10-15 ounces of silver.
References: Miller, 1924
Earl, 1950c
Smith, 1968, Personal communication on mineralogy
Montgomery, 1967

Wheatley mine and vicinity (16, Chester Co.)
(includes Chester County mine, Brookdale mine, and Phoenix mine)

Location: About 2 miles south of Phoenixville, just south of Pickering Creek and ½ mile east of the Pennsylvania Railroad where it crosses Pickering Creek.
History: The veins of this area were discovered about 1850, and the deposit was mined for lead and zinc between 1851 and 1855. Sporadic work continued until 1870. Additional prospecting and mining was done in 1918-1920. A total of 4000 feet of drifts were driven.
Production: An estimated 1800 tons of ore containing 60% Pb and 26-30 oz. of Ag per ton was produced at the Wheatley mine between 1850-55. At the Chester County mine, 443 tons of ore were produced in 1852, 500 tons valued at $15-79 per ton in 1919, and 100 tons of concentrate averaging 79% Pb and 7½ oz./ton silver in 1920.
Host rock: Precambrian granodiorite or monzonite, and hornblende gneiss. Some veins were said to extend a short distance into the Triassic red shale.
Structure: The ore occurs in quartz veins striking N35E and dipping steeply southeast. The Wheatley vein cuts and displaces three diabase dikes of possible Triassic age. At least some faulting has been later than vein formation. The veins are close to the unconformity with Triassic sediments and according to Rogers (1858) extended into the Triassic as do others in the district. The veins are mostly 1-3 feet thick, but locally attain 5 feet.
Character of mineralized rock: Galena, sphalerite, and pyromorphite were the main economic constituents of the veins, and quartz the main gangue mineral. The galena averaged 10-30 ounces of silver per ton, and minor gold was present. Numerous other minerals occur in smaller amounts, including anglesite, cerussite, hemimorphite, chalcopyrite, chalcocite, cuprite, malachite, azurite, calcite, dolomite, ankerite, barite, pyrite, fluorite, wulfenite, descloizite, mimetite, erythrite, gersdorffite and many others.
References: Miller, 1924
Reed, 1949
Gordon, 1922
Rogers, 1858

Montgomery County mine (15, Chester Co.)

Location: About 2 miles south of Phoenixville, 0.2 mile east of the Pennsylvania Railroad where it crosses Pickering Creek; about 0.3 mile west of the Wheatley mine.
History: All recorded activity at this vein was in the period of 1850-55. The original owners had difficulty smelting the pyromorphite and silver-bearing gossan, and abandoned the mine. In 1853, under a new company, a 118-foot shaft plus 3 shallower shafts and an adit were excavated.
Production: Apparently some ore was smelted, but the mine is not reported to have been profitable.
Host rock: Precambrian granite and possibly some gneiss.
Structure: The vein is approximately parallel to the Wheatley vein, trending N35E. Several smaller veins parallel the main vein and are 3-16 inches wide.
Character of mineralized rock: Galena, cerussite, pyromorphite and sphalerite were the main ore minerals, along with quartz. The galena contained 15-18 oz./ton silver.
References: Miller, 1924

Perkiomen mine (28, Montgomery Co.)

Location: Just north of Mine Run, ½ mile east of its junction with Perkiomen Creek; 4 miles east of Phoenixville.
History: Lead was discovered in the vicinity in 1808, and by 1809 mining was underway from an 80-foot shaft connected to a 356-foot drainage tunnel. This mining may have been at the nearby Ecton property. The work was abandoned in 1810, but was soon resumed by Samuel Wetherill and by 1826 the shaft was 160 feet deep and 3 levels were developed. Mining ceased again in 1826 because of difficulties smelting the pyromorphite ore. In 1851 the Perkiomen Consolidated Mining Co. bought the mines and began mining copper ore. The shaft was deepened to 600 feet. In 1858 the mine was closed. In 1948 the U.S. Bureau of Mines drilled 5 holes on the property and intersected mineralized rock in 2 holes.
Production: The only recorded production before 1826 is about 70 tons of high grade lead ore mined over a period of 18 months. In 1852, 12,200 tons of ore were mined to produce 617 tons of concentrate containing 18% copper with a value of about $38,000. Small tonnages of ore were mined in 1853. In 1858, 151 tons of copper ore and 6½ tons of lead ore were shipped.
Host rock: Triassic shale and sandstone.
Structure: The vein trends about N40E and dips 65-85° SE.
Character of mineralized rock: The vein consists of vuggy white quartz with some carbonate containing fragments of bleached shale. Chalcopyrite and galena are the main ore minerals, accompanied locally by small amounts of sphalerite, pyrite and barite. The vein is 2 to 20 feet wide, the main vein in the ore zone usually averaging 3-5 feet. In the oxidized zone, which extends to about 250 feet in depth, pyromorphite, malachite, cerussite and smithsonite are common to abundant. Other reported minerals are calcite, ankerite, greenockite, arsenopyrite, hematite, bornite, covellite, chalcedony, silver, copper, limonite, melaconite, cuprite, azurite, arsenopyrite, hematite, bornite, covellite, chalcedony, chite, anglesite and wulfenite.
References: Miller, 1924 Earl, 1950b Gordon, 1922

Ecton and Wetherill mines (29, 30, Montgomery Co.)

Location: The Ecton mine is near the junction of Mine Run with Perkiomen Creek; 4 miles east of Phoenixville and 2000 feet SW of the Perkiomen mine. The Wetherill mine is ½ mile south of the Ecton mine, and is probably equivalent to the Audubon mine.
History: Lead was discovered in the vicinity in 1808 and mined in 1809, possibly at this site. In 1852, the Ecton mine was owned in common with the nearby Perkiomen and connected to it by a drift approximately along the vein.
Production: A small amount of lead ore may have been produced in the early work. Stope maps indicate that about 200 tons of ore were extracted. About 300 feet of workings are known, but dumps suggest that they were originally more extensive.
Host rock: Triassic shale and sandstone about 400 feet thick resting on Paleozoic limestone.
Structure: The vein occupies a fault zone about 20 feet wide trending about N40E dipping 75° N. The fault-vein is apparently the same vein worked at the Perkiomen mine.
Character of mineralized rock: Argentiferous galena and chalcopyrite in vein quartz constitute the main primary ore minerals, along with some sphalerite. Dolomite, ankerite, barite, fluorite, pyrite, marcasite, arsenopyrite, chalcopyrite, millerite (?), hematite, chalcocite, bornite, covellite, chalcedony, copper, cuprite, limonite, cerussite, hydrozincite, malachite, azurite, chrysocolla, hemimorphite, pyromorphite, pseudomalachite, anglesite, brochantite, wulfenite, sulfur, linarite and smithsonite are also reported.
References: Boucot, 1949 Miller, 1924
Earl, 1950b Montgomery, 1966d
Gordon, 1922

Type R. Uranium in Triassic Sediments

These 6 uranium occurrences in Triassic sandstone and argillites are part of a larger group in New Jersey. Very little data are available on these occurrences. Most are associated with pyrite or limonite, and are recognized mainly by anomalous radioactivity. Traces of copper are present at one locality in New Jersey.

UNCLASSIFIED GROUP

Types S-W. Unclassified

Except for the placer deposits (type U) and possibly some barite occurrences (type U), none of the deposits in these groups seems of more than mineralogical interest, and the origin of most is obscure. No detailed treatment seems worth while.

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Plate 1, Location of Mineral Occurrences

Scale

0 10 20 30 40 Miles

0 10 20 30 40 50 Kilometers

EXPLANATION

25 M P — Number refers to sequentially numbered deposits in a county.

Letter refers to type of deposit.

P indicates commercial production of the deposit

● *indicates production greater than about $1,000,000*

PRECAMBRIAN AND PIEDMONT HOST ROCK GROUPS

Type A: *Chromite*

Type B: *Gap Nickel*

Type C: *Pegmatites*

Type D: *Copper in gneiss, schist and metagabbro*

Type E: *Copper in metabasalt*

PALEOZOIC HOST ROCK GROUPS

Type F: *Appalachian lead-zinc deposits*

Type G: *Zinc-lead sulfides in Helderberg-Tonoloway limestones*

Type H: *Other zinc-lead sulfides in sedimentary rocks*

Type I: *Barite in limestone*

Type J: *Zinc-copper-lead sulfides in fractures in limestone*

Type K: *Wurtzite and other sulfides in nodules*

Type L: *Sandstone-type copper-uranium deposits*

TRIASSIC HOST ROCK GROUPS

Type M: *Copper and other elements in Triassic diabase*

Type N: *Cornwall-type magnetite-copper deposits*

Type O: *Copper in Triassic sediments adjacent to diabase*

Type P: *Copper in Triassic sediments distant from diabase*

Type Q: *Zinc-lead-copper in quartz veins (Phoenixville type)*

Type R: *Uranium in Triassic sediments*

UNCLASSIFIED HOST ROCK GROUPS

Type S: *Other copper*

Type T: *Other nickel*

Type U: *Other barite*

Type V: *Placer deposits*

Type W: *Miscellaneous*