MINERALS OF GEORGIA

THEIR PROPERTIES AND OCCURRENCES

by

Robert B. Cook

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FRONT COVER PHOTO:
Gold nugget from Dukes Creek, White County, weight 5 oz., 12 dwt., approx. 2x.
BACK COVER PHOTOS:
Upper left - Rutile crystal from Graves Mountain, approx. 1.5x.
Lower left - Goethite from Pulaski County, approx. 1x.
Right - Magnetite crystal face showing interference growth, from Lake Lanier area, approx. 1.5x.

Photography by S. M. Pickering

For convenience in selecting our reports from your bookshelves, they will be color-keyed across the spine by subject as follows:

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Lt. Blue	Coastal Zone studies
Dk. Green	Geochemical and Geophysical studies
Dk. Blue	Hydrology
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Robert B. Cook

STATE OF GEORGIA
DEPARTMENT OF NATURAL RESOURCES
Joe D. Tanner, Commissioner

THE GEOLOGIC AND WATER RESOURCES DIVISION
Sam M. Pickering, State Geologist and Division Director

ATLANTA
1978

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INTRODUCTION

GEORGIA BOASTS A COLORFUL and economically rewarding mineral heritage since the first small shipments of kaolin to England in the mid-18th century. Historically significant periods of mineral exploration, development and production include the well-known gold rush of the 1820's and 1830's, the short-lived copper boom of the 1840's and 1850's, the early exploitation of iron and manganese in the Cartersville Mining District during the 1880's and 1890's, and the development of the marble and granite industries in the late 19th century.

The 20th century has seen almost constant and increasingly important production of industrial minerals such as marble, granite, kaolin, cement materials, sand and gravel, and barite. The gross value of Georgia's annual mineral production now approaches 400 million dollars. Georgia leads the nation in the production of kaolin, crushed granite, and dimension granite.

In addition to the important economic mineral deposits, various localities within the state are well known among professional mineralogists, mineral collectors, and rockhounds as the source of outstanding study, display, and lapidary material. Mineral specimens such as the unsurpassed rutile crystals of Graves Mountain, gold crystals of the Loud Mine, and amethyst crystals of Rabun, Towns, Wilkes, and Morgan Counties are to be found in many important museum and private collections throughout the world. Outstanding Georgia gem materials include saphire of the Hiawassee area, aquamarine from the LaGrange vicinity, and amethyst from Charlies Creek in Towns County.

The great diversity of Georgia's mineral wealth led early mineralogists such as C. U. Shepard, F. A. Genth, G. F. Kunz, and E.S. Dana to study in detail specific mineral occurrences in the state. Since the early work of these scientists, the volume of specific information available on occurrences and properties of Georgia minerals has grown dramatically. An initial attempt to describe Georgia's mineralogy was made in 1871 by M. F. Stephenson. This early work was not improved upon until the publishing of "A Preliminary Report on the Mineral Resources of Georgia," Bulletin No. 23 by the Georgia Geological Survey (McCallie, 1910). Later, an incomplete catalog of Georgia mineral occurrences appeared in serial form in the first volumes of the Georgia Mineral Society Newsletter. The purpose of this particular bulletin, therefore, is to present to the general public, as well as to professional geologists and mineralogists, a comprehensive source of systematically arranged mineralogical and location data for the minerals occurring in Georgia.

The format of this volume is the classical systematic organization of minerals from simple native elements to the most complex silicates. The classification of silicates is based on structural subclasses. Specific information on mineral occurrences is arranged alphabetically by counties with individual locations listed numerically.

General data for specific minerals and groups have been taken from numerous reference sources. Most chemical formulae are those presented in the "1975 Glossary of Mineral Species" by Michael Fleisher (1975). Physical data for most nonsilicate minerals are taken predominantly from Dana's "System of Mineraology," Vol. I and II (Palache, Berman, and Frondel, 1944, 1951). Specific data for rock-forming silicates are primarily from the works of Deer, Howie, and Zussman (1966).

Abbreviations used for general mineralogic data are: Cryst. for crystallographic information including system, class, and Hermann-Mauguin symbol; and Phys. for physical properties such as cleavage, fracture, luster, color, hardness (H.), specific gravity (G.), and melting point (M.P.). The term class denotes the general chemical division (element, sulfide, sulfosalt, etc.) for nonsilicate minerals and the structural type or subclass (inosilicate, tectosilicate, etc.) for silicates. Groups include all minerals related by specific similarities of atomic structure and composition. An example is the Pyroxene Group, all members of which have the general formula $ABSi_2O_6$ where A and B are individual cations or groups of specific cations.

General data are presented for some mineral groups for which detailed descriptions and group subdivisions are lacking in the published literature with respect to Georgia occurrences. In other instances, entire volumes have been dedicated to descriptions of the properties and economic occurrences of certain minerals within the state. Many early publications present detailed descriptions of "minerals" now known to be entire families of closely related species. Other minerals such as silver and mercury have been mistakenly reported and are discussed in order to dispell incorrect though common beliefs about their occurrence. Compounds occurring in Georgia meteorite specimens are included in the discussion of meteoritic iron. In addition, tektites, a natural glass attributed by some to extraterrestrial origins, occur rarely in a broad strewnfield from Washington and Bleckley counties to Irwin county.

Some minerals described herein have never been positively reported within Georgia, although they are assumed to be locally common, essential constituents in certain economic mineral deposits. The best example is the consistent description of psilomelane in the older literature as an abundant mineral in the manganese occurrences of the Cartersville Mining District. Modern research has shown that psilomelane ores are usually composed of cryptomelane, romanechite, and other related manganese oxides. For this reason, most formerly

described psilomelane occurrences are tentatively ascribed to romanechite since it is the barium-bearing, psilomelane-like mineral. Similarly, lepidocrocite is usually considered the most important mineral in brown ochre and is described herein as a predominant mineral in the ochre deposits of the Cartersville Mining District.

Many sources of information have been utilized in compiling the locality descriptions. Important data have been taken from unpublished records of the Georgia Geological Survey and the museum catalog of specimens in the Georgia State Capitol. Other descriptions have been compiled from very old Georgia Geological Survey bulletins which are now essentially unavailable except through major libraries. The oldest descriptive data are those of Silliman (1830) for a Georgia meteorite. The most recent are numerous technical articles published in 1975.

Discussions of specific mineral occurrences and localities are based on mineralogical, economic, or historical significance. Particular attention has been given to nonsilicate ore minerals and localities of special interest to mineral collectors. For many minerals, only one or two locations are as yet known. For others, thousands exist and only a selected few are given which are typical of the mineral's occurrence. Minerals such as calcite, dolomite, and kaolinite are extremely common but are of such economic significance that most of the producing localities are described.

Every attempt has been made to give sufficiently precise locality descriptions for interested parties to locate the occurrences. Many older localities are presented as they originally appeared in the literature, by land lot number, section, and district. More recently described locations generally are related to bearing distances from the center of the nearest major community or from the city limits of these towns. Land lot locations may be found by referring to land lot maps posted in the courthouse of the particular county in which the occurrence is located. In some instances names of original land owners and dates of ownership are given so that specific properties may be located from old tax records.

New data on the mineralogy of Georgia are accumulating constantly. There is no doubt that unpublished or other currently unavailable data exist, thus a work of this type can hardly be complete, particularly in its first edition. Future revised editions of the bulletin are anticipated. With this in mind we ask that anyone with data which they feel should be included in subsequent editions submit them to the Georgia Geological Survey. Such data should be specific with respect to identification techniques, physical description of material, exact geological occurrence, and location.

Critical review of the manuscript by David B. Stewart, Mary E. Mrose, Willard Grant, and Vernon J. Hurst is gratefully acknowledged. Partial financial support for this work was provided by the Geologic and Water Resources Division of the Georgia Department of Natural Resources.

CLASSIFICATION

The following tabulation presents 198 minerals or undivided mineral groups which occur within Georgia. The nonsilicate minerals (excluding elements) are related to general composition type within major divisions (ex. sulfides, oxides). In this classification, general formulae are given to indicate specific types. In these general formulae initial letters of the alphabet refer to larger cations while terminal letters refer to anions. Subscript letters or numbers refer to the relative abundance of anions and cations.

Table 1.
Classification and composition of Georgia minerals

ELEMENTS

CLASSIFICATION	COMPOSITION	PAGE
METALS		
Gold	Au	10
Silver	Ag	13
Copper	Cu	13
Mercury	Hg	14
Platinum	Pt	14
Iron (meteoritic)	Fe	14
Cohenite	$(Fe,Ni,Co)_3C$	17
Schreibersite	$(Fe,Ni)_3P$	17
SEMI-METALS AND NONMETALS		
Bismuth	Bi	18
Sulfur	S	18
Diamond	C	19
Graphite	C	20

SULFIDES

AmXn TYPE WITH m:n > 3:1		
Tellurobismuthite	Bi_2Te_3	22
Tetradymite	Bi_2Te_2S	22
A_2X TYPE		
Chalcocite	Cu_2S	22
A_3X_2 TYPE		
Bornite	Cu_5FeS_4	23
AX TYPE		
Galena	PbS	24
Clausthalite	PbSe	26
Sphalerite	ZnS	26
Chalcopyrite	$CuFeS_2$	28
Pyrrhotite	$Fe_{1-x}S$	32
Troilite	Fe,S	34
Valleriite	$4(Fe,Cu)S \cdot 3)Mg,Al(OH)_2$	34
Pentlandite	$(Fe,Ni)_9S_8$	34
Cubanite	$CuFe_2S_3$	35
Covellite	CuS	35
A_2X_3		
Stibnite	Sb_2S_3	36
AX_2 TYPE		
Pyrite Group		
Pyrite	FeS_2	36
Marcasite Group		
Marcasite	FeS_2	40
Arsenopyrite	FeAsS	40
Molybdenite	MoS_2	41

SULFOSALTS

OXIDES AND HYDROXIDES

PHOSPHATES

$(AB)m(XO_4)pZq \cdot xH_2O$ TYPE WITH m:p = 3:2

Meta-autunite Group

Meta-autunite	$Ca(UO_2)_2(PO_4)_2 \cdot 2\text{-}6H_2O$	101
Metatorbernite	$Cu(UO_2)_2(PO_4)_2 \cdot 8H_2O$	100

$(AB)m(XO_4)pZq \cdot xH_2O$ TYPE WITH m:p < 3:2

Cacoxenite	$Fe_9^{+3}(PO_4)_4(OH)_{15} \cdot 18H_2O$	101

MOLYBDATES AND TUNGSTATES

$A(XO_4)$ TYPE

Scheelite	$CaWO_4$	102
Powellite	$CaMoO_4$	102

$Am(XO_4)p \cdot xH_2O$ TYPE

Ferrimolybdite	$Fe_2(MoO_4)_3 \cdot 8H_2O(?)$	103

SILICATES

NESOSILICATE SUBCLASS

Olivine Group

Forsterite	Mg_2SiO_4	104
Fayalite	Fe_2SiO_4	104

Aluminum Silicate Group

Andalusite	Al_2SiO_5	105
Sillimanite	Al_2SiO_5	106
Kyanite	Al_2SiO_5	107
Staurolite	$(Fe,Mg,Zn)_2Al_9Si_4O_{23}(OH)$	110
Topaz	$Al_2SiO_4(F,OH)_2$	111

Garnet Group $A_3B_2(SiO_4)_3$

$A=Ca,Mg,Fe^{+2},Mn$

$B=Al,Fe^{+3},Cr,V,Ti,Zr$

Almandine	$Fe_3Al_2(SiO_4)_3$	112
Grossular	$Ca_3Al_2(SiO_4)_3$	112
Pyrope	$Mg_3Al_2(SiO_4)_3$	112
Spessartine	$Mn_3Al_2(SiO_4)_3$	112

Humite Group

Chondrodite	$(Mg,Fe)_3SiO_4(OH,F)_2$	114
Zircon	$ZrSiO_4$	114
Soddyite	$(UO_2)_5Si_2O_9 \cdot 6H_2O$	115
Titanite	$CaTiSiO_5$	115

SOROSILICATE SUBCLASS

Vesuvianite	$Ca_{10}Mg_2Al_4(SiO_4)_5(Si_2O_7)_2(OH)_4$	116

Epidote Group

Zoisite	$Ca_2Al_3(Si_3O_{12})(OH)$	116
Clinozoisite	$Ca_2Al_3Si_3O_{12}(OH)$	117
Epidote	$Ca_2(Al,Fe)_3Si_3O_{12}(OH)$	117
Allanite	$(Ce,Ca,Y)_2(Al,Fe)_3(SiO_4)_3(OH)$	118

CYCLOSILICATE SUBCLASS

Axinite Series (undivided)	$Ca_2Fe^{+2}{}_2Al_2BSi_4O_{15}(OH)$ $Ca_2MnAl_2BSi_4O_{15}(OH)$ $(Ca,Mn,Fe)_3Al_2BSi_4O_{15}(OH)$	119
Beryl	$Be_3Al_2Si_6O_{18}$	119
Cordierite	$Mg_2Al_4Si_5O_{18}$	122
Tourmalene Group (undivided)	$(Na,Ca)(Mg,Fe^{+2},Fe^{+3},Al,Li)_3Al_6$ $(BO_3)_3(Si_6O_{18})(OH,F)_4$	123

INOSILICATE SUBCLASS

Amphibole Group

Anthophyllite	$(Mg,Fe)_7Si_8O_{22}(OH)_2$	125
Gedrite	$(Mg,Fe,Al)_7(Al,Si)_8O_{22}(OH)_2$	127
Cummingtonite	$Mg_7Si_8O_{22}(OH)_2$	128
Tremolite	$Ca_2Mg_5Si_8O_{22}(OH)_2$	128
Actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$	129
Hornblende	$(Ca,Na)_{2-3}(Mg,Fe^{+2},Fe^{+3},Al)_5(Al,Si)_8O_{22}(OH)_2$	130
Hastingsite	$NaCa_2(Fe,Mg,Al)_5(Al_2Si_6)O_{22}(OH)_2$	130

Pyroxene Group

Enstatite	$Mg_2Si_2O_6$	131
Hypersthene	$(Mg,Fe)_2Si_2O_6$	132
Diopside	$CaMgSi_2O_6$	133
Augite	$(Ca,Na)(Mg,Ti,Fe,Al)(Si,Al)_2O_6$	132
Pigeonite	$(Mg,Fe,Ca)(Mg,Fe)Si_2O_6$	134
Spodumene	$LiAlSi_2O_6$	134
Rhodonite	$(Mn,Fe,Ca,Mg)SiO_3$	134
Uranophane	$Ca(UO_2)_2Si_2O_7 \cdot 6H_2O$	135
Beta-uranophane	$Ca(UO_2)_2Si_2O_7 \cdot 6H_2O$	135

PHYLLOSILICATE SUBCLASS

Kaolinite Group

Kaolinite	$Al_2Si_2O_5(OH)_4$	136
Halloysite	$Al_2Si_2O_5(OH)_4$	137
Endellite	$Al_2Si_2O_5(OH)_4 \cdot 2H_2O$	138
Illite Group (undivided)	$(K,H_3O)(Al,Mg,Fe)_2(Al,Si)_4O_{10}\{(OH)_2,H_2O\}$	138
Montmorillonite Group (undivided)	$(Na,Ca)_{0.33}(Al,Mg)_2Si_4O_{10}(OH)_2 \cdot nH_2O$	

Palygorskite Group

Palygorskite	$(Mg,Al)_2Si_4O_{10}(OH) \cdot 4H_2O$	139
Sepiolite	$Mg_4Si_6O_{15}(OH)_2 \cdot 6H_2O$	139
Vermiculite Group (undivided)	$(Mg,Fe,Al)_3(Al,Si)_4O_{10}(OH)_2 \cdot 4H_2O$	139
Serpentine Group		141
Chrysotile	$Mg_3Si_2O_5(OH)_4$	141
Antigorite	$(Mg,Fe)_3Si_2O_5(OH)_4$	141
Garnierite Group (undivided)	hydrous nickel silicates	
Pyrophyllite	$Al_2Si_4O_{10}(OH)_2$	142
Talc	$Mg_3Si_4O_{10}(OH)_2$	143

Mica Group

Muscovite	$KAl_2(AlSi_3)O_{10}(OH)_2$	145
Paragonite	$NaAl_2(AlSi_3)O_{10}(OH)_2$	148
Phlogopite	$KMg_3(AlSi_3)O_{10}(F,OH)_2$	148

ELEMENTS

GOLD
Au

Class Native element

Cryst. Isometric: hexoctahedral—4/m $\bar{3}$ 2/m

Habit Crystals octahedral, dodecahedral, cubic. Commonly reticulated, dendritic, arborescent, spongy. Also massive, in rounded fragments, grains, and scales.

Phys. *Cleavage* none. *Fracture* hackly. Very malleable and ductile. **H** 2½–3. **G** 19.3. *Color* and *streak* gold-yellow when pure; silver-white to orange-red in impure varieties. *Luster* metallic. Opaque except thin leaf gold which transmits blue and green light.

Georgia has had a fascinating and lively gold mining history since the first accidental discovery of nuggets and float ore in the 1820's. Though knowledge of an occurrence and possible mining of gold in Georgia prior to the 1820's should be considered legendary, some evidence implies earlier Spanish prospecting in the Nachoochee Valley District, White County. Fluker (1903, p. 119) suggested that gold was first discovered in Georgia in 1823 by Cornish miners near the site of the Columbia Gold Mine in McDuffie County. According to Yeates, McCallie and King (1896, p. 33), the earliest discovery of gold was probably in 1828 by a slave owned by Major Logan of Loudsville, White County. Gold was discovered in 1828 near the site of the Calhoun Gold Mine in Lumpkin County.

Gold was produced continuously in Georgia from about 1828 through 1933. The known figures for production from 1830 to 1879 are only approximations, but since 1880, detailed records of gold production have been published by various governmental agencies. The compilation of data from various sources indicates that Georgia yielded approximately 858,000 ounces (27,000 kg) of gold through 1933. Production since that time has been negligible.

Gold mining was so significant during the 1830's that the United States government established a branch mint at Dahlonega, Lumpkin County, in 1838. This mint operated until the advent of the Civil War and was closed permanently in 1861. A total of 1,381,784 coins were struck having a total face value of $6,190,118.

Gold has been reported from virtually every county in Georgia that is underlain by "crystalline" rocks. In fact, approximately 500 individual gold-bearing properties are known within the state (Park, 1953, p. 107). Jones (1909) divided the gold-bearing regions of Georgia into nine distinct belts: the Dahlonega, Hall County, McDuffie County, Carroll County, Oglethorpe County, Madison County, Gumlog, Coosa Creek, and Hightower Creek belts. Numerous other localities, not falling within these belts, are classified as "isolated areas." While it is beyond the scope of this publication to fully describe the occurrence of gold at the approximately 500 known locations, the following section presents the better-known occurrences in which gold samples worthy of mineralogical study or display were obtained. In addition, from many literary sources, Table 2 lists the 30 largest and most adequately described nuggets discovered in Georgia placer mines.

Cherokee County: 1. Yeates, McCallie and King (1896, p. 214) describe beautiful hand samples of ore containing significant amounts of free gold from the shaft of the Tripp Gold Mine, lot 959, 21st district, directly east of the Georgiana Gold Mine.

Dawson County: 1.The Palmour Brickbat Vein of the Palmour Gold Mine, lot 361, 13th district, 1st section, was well known in the early days for producing samples extremely rich in native gold. Yeates, McCallie and King (1896, p. 160) described several pieces of ore which, when split open, were encrusted with flaky particles of gold.

DeKalb County: 1. Several years ago interesting gold samples were found beside a spring near the east-west forks of Sugar Creek in southeast Atlanta. The gold was in white quartz.

Fannin County: 1. Jones (1909, p. 277) viewed some extremely rich native gold samples belonging to Mr. Willis Garrett of Newport, Georgia, which had been found at the Rantze Hill Gold Mine on lot 285, 7th district.

Hall County: 1. In the early years of gold mining the Potosi Gold Mine on lot 85, 11th district, about 11 miles (17.7 km) northwest of Gainesville, was the source of numerous very fine examples of crystalline gold. One superb example from this location is preserved in the museum of the Georgia State Capitol.

This specimen exhibits relatively sharp octahedral crystals of native gold up to 0.15 inch (0.38 cm) on an edge in a matrix of vuggy, iron-stained quartz.

Lumpkin County: 1. One of the more recent discoveries of specimen-grade native gold was made in 1959 on the American Legion lot (lot 999, 12th district) near Dahlonega. A quartz vein found on this lot contained cellular masses of iron oxide and bright yellow leaf gold. Specimens from this find are on display in the Gold Museum at Dahlonega. 2. Yeates, McCallie and King (1896, p. 364–371) described highly pyritiferous ore from the Bast Gold Mine, lot 1035, 12th district, which showed liberal quantities of free gold, as plates, with pyrite. 3. Perhaps the finest gold samples from Lumpkin County were those found intermittently throughout the productive history of the Battle Branch Gold Mine, lots 457 and 524, 12th district. Several rich pockets were discovered which contained large amounts of crystalline, leaf, and arborescent native gold intergrown with massive galena. Excellent specimens from this occurrence are on display in the museum of the Georgia State Capitol. 4. An exceedingly rich pocket of native gold was discovered in the early days of mining at the Boly Field Gold Mine, lot 1182, 12th district, on the north bank of the Chestatee River about 2.5 miles (4 km) southeast of Dahlonega. The gold occurred in a relatively narrow quartz vein and was accompanied by a mineral dubiously identified as tetradymite. According to Jones (1909, p. 195) the gold reportedly occurred in small chutes on the vein, and, as it was stated to him by reliable parties who had worked in this mine during the 1840's, on one occasion gold was secured in such a large mass that it was cut into convenient-sized pieces on a blacksmith's anvil. 5. Excellent specimens of crystalline native gold in iron-stained quartz are on display in the museum of the Georgia State Capitol from the Briar Patch Gold Mine. This property is immediately opposite the Calhoun Gold Mine and on the west bank of the Chestatee River. 6. The Calhoun Gold Mine, located on lots 164 and 165, 11th district, is traditionally known as the site of the first discovery of lode gold in Lumpkin County. The property is well known for producing small pockets of "high-grade" ore. Jones (1909, p. 180) described a quartz vein exposed in one of the shafts on this property in which free gold was quite abundant in a narrow band or layer that traversed the vein diagonally. Specimens from this mine are maintained in most of the major mineralogical museums in the United States. As recently as 1968 it was possible to secure small, high-grade specimens from muck at the intersection of the main haulage adit and the "cork screw" raise. These specimens contained native gold as plates and small masses in white quartz. 7. Jones (1909, p. 191) described specimens from the Dry Hollow Mine, lot 126, which exhibited large amounts of free gold in quartz. 8. The Findley Gold Mine, situated at the northeast end of Findley Ridge on lots 1047, 1048 and 1087, 12th district, has been the site of the discovery of numerous small but exceedingly rich pockets of native gold. Yeates, McCallie and King (1896, p. 371–383) described one vein in the Findley Mine which contained considerable galena and produced very handsome specimens of native gold in quartz, two of which have been preserved in the museum in the Georgia State Capitol. These specimens contain coarsely crystalline gold in quartz associated with dark-green hornblende. 9. The Norrell Mine, lots 736 and 805, 12th district, produced outstanding specimens of native gold in quartz. A single pocket, at the base of what was known locally as Reservoir Hill (lot 805), produced approximately 700 ounces (22 kg) of gold (Yeates, McCallie and King, 1896, p. 488). 10. An excellent suite of specimens from the Preacher Gold Mine, lot 995, 12th district, is on display in the museum of the Georgia State Capitol. These specimens consist of saccharoidal quartz containing plates of gold about 0.2 inch (0.5 cm) in width. 11. Outstanding examples of coarsely crystalline native gold associated with quartz, pyrite, galena, and pyromorphite were formerly found in the relatively extensive Singleton Gold Mine, lot 1084, 12th district. Very few specimens from this occurrence exist today. 12. The Turkey Hill Gold Mine, lot 163, 11th district, was the site of the discovery of numerous small pockets of high-grade ore. Specimens from this mine contain considerable amounts of hackly gold in porous, saccharoidal quartz. Several specimens from the Turkey Hill Gold Mine are in the collection of the museum in the Georgia State Capitol. 13. The Whim Hill Gold Mine, lot 670, 12th district, was the site of the discovery of several remarkable pockets of ore which were quite rich in native gold. Yeates, McCallie and King (1896, p. 474) described the richness of one of the chutes and the samples obtained.

Union County: 1. Yeates, McCallie and King (1896, p. 474) described samples taken from the Wellborn Gold Mine, lot 18, 9th district, which contained beautifully clean, bright gold in distinct crystals and in leaf-like aggregates. An assay of this ore indicates that it contained 4.47 ounces (139 g) of gold per ton.

White County: 1. The finest crystallized gold in the state was found in the Loud Mine, lots 39 and 40, 1st district, about 4 miles (6.4 km) southwest of Cleveland. Yeates, McCallie and King (1896, p. 76) described this occurrence as follows: "The only vein which has been worked in the Loud mine runs diagonally through lot 39. This is the vein from which the magnificent specimens of crystallized and wire gold exhibited in this country and abroad were taken. It was accidentally discovered by Mr. Courtney of Cleve-

land, Georgia, while scraping the underlying slate of a placer. At the point of discovery a shaft was sunk immediately and for the first 10 feet the richness of the quartz and free gold is said to have been astounding. The vein, a ribbon at the start, and about a little over an inch in width, during its rich descent of 10 feet increased to a maximum width of two feet and varied back and forth in thickness to the depth of the shaft (60 feet). From the depth of 10 feet to the base of the shaft gold was almost totally absent." Excellent specimens from this mine are preserved in numerous museums, and several are on display in the Georgia State Capitol. Some outstandingly large gold nuggets were extracted from the placers on this property.

Wilkes County: 1. An outstanding discovery of pocket gold was made at the Latimer Gold Mine, approximately 3 miles (4.8 km) north of Rayle near the old Danielsville Road. This pocket yielded 180 troy ounces (5.5 kg) of wire and crystalline gold from 2,500 pounds (933 kg) of pocket material (Jones, 1909, p. 108).

TABLE 2.
Largest recorded gold nuggets discovered in Georgia.

Troy weight: Pounds (kg)	*Ounces (g)*	*Penny-weights (g)*	*Grains (g)*	*County*	*Mine*	*Discoverer*
4 (1.5)	6 (187)	...	...	Gilmer	White Path	Unknown
3 (1.1)	6 (187)	...	...	Habersham	LaPrade	Unknown
3 (1.1)	4 (124)	...	...	Gilmer	White Path	Unknown
3 (1.1)	4 (124)	...	...	Gilmer	White Path	Unknown
2 (0.7)	11 (342)	...	...	Gilmer	White Path	Unknown
2 (0.7)	2 (62)	15 (23)	10 (0.6)	White	Black Branch	Thurmond
2 (0.7)	1 (31)	4 (6.2)	4 (0.3)	White	Hamby	Unknown
1 (0.4)	7 (218)	7 (11)	...	White	Nacoochee	Dean
1 (0.4)	6 (187)	10 (16)	...	White	Loud	Unknown
1 (0.4)	3 (93)	...	...	White	Dukes Creek	Hudson
1 (0.4)	3 (93)	...	...	Lumpkin	Josephine	Westbrook
...	11 (342)	5 (7.8)	...	Habersham	Nichols	Unknown
...	6 (187)	7 (11)	...	Lumpkin	Josephine	Howell
...	5 (156)	15 (23)	...	White	Nacoochee	Dean
...	5 (156)	12 (19)	12 (0.8)	White	Dukes Creek	Hudson
...	4 (124)	17 (26)	9 (0.6)	Cherokee	...	Unknown
...	4 (124)	10 (16)	...	Cherokee	Sixes	Unknown
...	4 (124)	9 (14)	2 (0.1)	White	Road Gravel	Chambers
...	4 (124)	7 (11)	14 (0.9)	Lumpkin	Josephine	Summerour
...	4 (124)	3 (4.7)	...	White	Loud	Unknown
...	3 (93)	10 (16)	...	Cherokee	Rudicil	Unknown
...	3 (93)	9 (14)	...	White	Nacoochee	Dean
...	2 (62)	19 (30)	...	White	Nacoochee	Unknown
...	2 (62)	16 (25)	14 (0.9)	White	Hamby	Unknown
...	2 (62)	5 (7.8)	9 (0.6)	White	Hamby	Unknown
...	1 (31)	13 (20)	...	Cherokee	Putnam	Unknown
...	1 (31)	12 (19)	12 (0.8)	Lumpkin	Stegall	Stegall
...	1 (31)	12 (19)	...	Lumpkin	Free Jim	McDonald
...	1 (31)	8 (12)	8 (0.5)	White	Hamby	Unknown
...	1 (31)	7 (11)	...	Lumpkin	Josephine	Bigbee
...	1 (31)	1 (1.6)	17 (1.1)	White	Hamby	Unknown
...	1 (31)	1 (1.6)	...	Wilkes	Latimer	Bankston
...	...	14 (22)	6 (0.4)	Lumpkin	Free Jim	Crisson

SILVER
Ag

Class Native element

Cryst. Isometric; hexoctahedral—4/m $\bar{3}$ 2/m

Habit Cubic, octahedral, dodecahedral. Commonly in variously elongated, reticulated, arborescent, and wiry forms. Also massive, in scales, as a coating.

Phys. *Cleavage* none. Ductile and malleable. *Fracture* hackly. **H** 2½–3. **G** 10.1–11.1; 10.5 (pure). *Luster* metallic. *Color* and *streak* silver-white; often gray to black due to tarnish. Opaque.

Occur.

The total silver production from Georgia through 1944 was approximately 13,300 troy ounces (413 kg), obtained entirely from formerly producing gold mines where it was commonly found alloyed with gold. Documented occurances of native silver are very rare in Georgia. Traditional legendary or lost "silver mines," such as those beneath a river near Cartersville and on Currahee Mountain in Stevens County, should be discounted.

Silver-bearing galena was found in many locations within the state. Galena containing 24.8 ounces (0.8 kg) of silver per ton was discovered in July, 1960, near Gainesville in lot 138, Hall County. Only the Magruder Gold Mine in Lincoln County, approximately 12 miles (19.3 km) northeast of Washington, could have been considered a "silver mine." Shearer and Hull (1918, p. 224) reported analyses of galena-rich ore from this mine yielding up to 14.75 ounces (0.5 kg) of silver per ton.

COPPER
Cu

Class Native element

Cryst. Isometric; hexoctahedral—4/m $\bar{3}$ 2/m

Habit Crystals usually cubic, dodecahedral, or tetrahexahedral; rarely octahedral. Often in distorted hackly masses; arborescent.

Phys. *Cleavage* none. Malleable and ductile. **H** 2½–3. **G** 8.95. Excellent conductor of electricity and heat. *Color* copper-red, tarnishing to brown. *Luster* metallic. *Streak* copper-red, shining. Opaque.

Occur.

With only four reported locations, the occurrence of native copper is rare in Georgia. These occurrences are the result of supergene enrichment processes which deposited small amounts of native copper near the water table. The primary source of copper in these deposits was probably minor amounts of chalcopyrite in the ore.

Fannin County: 1. Specimens of native copper were obtained years ago from the Number Twenty Copper Mine on lot 20, 9th district, second section, 3 miles (4.8 km) southwest of Copper Hill. The copper occurred in small irregular cavities in the upper oxidized part of the sulfide ore body. Specimens from this occurrence are on display in the museum at the Georgia State Capitol.

Lincoln County: 1. Native copper was described by Watson (1904b, 182–186) in samples taken near the water table from the Wardlow and Finley veins of the Magruder Gold Mine, approximately 12 miles (19.3 km) northeast of Washington. It was reported by Jones (1909, p. 252) that masses of native copper weighing as much as 60 pounds (27.2 kg) were recovered in the early days of mining.

Oglethorpe County: 1. Jones (1909, p. 107) described native copper occurring as small masses in seams and cracks in a quartz vein at the Morgan Gold Mine, 6.5 miles (10.5 km) southeast of Lexington.

Wilkes County: 1. Minute inclusions of native copper in bornite were identified in polished sections of samples collected at the Youngs Chapel copper prospect. This prospect lies approximately 3.5 miles (5.1 km) west of Washington along a ridge between Youngs Chapel and Beaver Dam Creek. Associated minerals were azurite, malachite, chalcocite, chalcopyrite, quartz, epidote and garnet (Hurst, Crawford, and Sandy, 1966a, p. 424).

MERCURY
Hg

Class Native element

Phys. Liquid; solidifies at -39°, forming rhombohedral crystals. **G** 13.596; 14.26 pure (cryst., -46°, calc.). *Color* tin-white. *Luster* metallic, very brilliant. Opaque.

Chem. Mercury, Hg, sometimes with a little silver or gold.

Occur.

Mercury is not found in Georgia in its uncombined natural state. However, the element is sometimes encountered by weekend prospectors panning for gold in areas that were formerly subjected to placer mining, and its occurrence is due to accidental loss during cleanup of sluice boxes and other gold-extracting devices. Small amalgam grains and nuggets which resemble silver or platinum are not uncommon in many placers.

PLATINUM
Pt

Class Native element

Cryst. Isometric; hexoctahedral—4/m $\bar{3}$ 2/m

Habit Cubic; often distorted. Usually in grains or scales; occasionally in nuggets or lumps.

Phys. *Cleavage* none. *Fracture* hackly. Malleable and ductile. **H** 4–4½, increasing with iron content. **G** 14–19; 21.46 (calc. Pt, 0°). Nonmagnetic to distinctly magnetic when rich in iron, often with polarity. *Color* whitish steel gray to dark gray. *Luster* metallic. Opaque. In polished section white, isotropic. Percentage reflection in air: green, 70; orange, 73; red, 70.

Occur.

Cherokee County: 1. Stephenson (1878, p. 30) reported that a few small grains of native platinum were found at an undisclosed location in Cherokee County, probably a gold placer.

Habersham County: Small, irregularly shaped gray grains of native platinum are described from 9 locations within Habersham County by Hurst and Crawford (1964, p. 68). The mineral was discovered during a regional survey of the heavy fractions of -115 mesh stream sediment samples.

Lumpkin County: 1. A nugget of platinum weighing one troy ounce (31 g) was found in 1830 on the Etowah River near Auraria (Stephenson, 1878, p. 30).

White County: Small (-115 mesh) platinum grains are reported by Hurst and Otwell (1964, P. 65) in alluvial samples from 8 locations in White County.

IRON (METEORITIC)
Fe

Class. Native element

Cryst. Isometric; hexoctahedral—4/m 3 2/m

Habit Plates and lamellar masses, and in intergrowth with nickel-iron.

Phys. Clevage {001}. Parting on {112}. *Fracture* hackly. Malleable. **H.** 4, **G.** 7.3-7.87. *Luster* metallic. *Color* steel-gray to iron-black. Magnetic. Opaque in polished section white, isotropic.

Occur.

Iron in its uncombined state is not found in Georgia; however, it occurs alloyed with nickel in the 21 authenticated meteorites reported to date (Table 3). Detailed descriptions of all but one of these meteorites have been published by Henderson and Furcron (1957, p. 113–142).

Of these 21 meteorites, an unusually high percentage are composed predominantly of iron and iron-nickel alloys, with only four being in the stony class. Iron within Georgia meteorites is predominantly in the form of kamacite (αNi-Fe), and taenite (λNi-Fe). Associated "minerals" are schreibersite ($(Fe,Ni)_3P$), cohenite ($(Fe,Ni,Co)_3C$), lawrencite ($(Fe,Ni)Cl_2$) and troilite (Fe,S).

Four of the 21 meteorites in Georgia were observed falling to the earth, the Forsyth chondrite being the fifth known witnessed fall in the United States (May, 1829). There is some speculation that the Sardis iron meteorite fell to earth in Miocene time, making it one of the oldest falls thus far discovered.

TABLE 3. Georgia Meteorites

Name	Fall or Discovery	Type	Weight in Pounds (kg)	County	Current Location*
Aragon	1898(D)	Oxidized fragments	0.01 (.005)	Polk	Field Museum
Canton	1894(D)	Coarse oxtahedrite	15.40 (7)	Cherokee	U.S. National Museum
Cedartown	1898(D)	Hexahedrite	24.30 (11)	Polk	U.S. National Museum
Dalton	1877(D)	Medium octahedrite	130.00 (59)	Whitfield	U.S. National Museum
Forsyth	5/8/1889 (F)	Chondrite	35.30 (16)	Monroe	Yale University
Hollands Store	1887(D)	Hexahedrite	26.50 (12)	Chattooga	Naturhistorischen Museum
Locust Grove	7/29/1857(D)	Hexahedrite	24.30 (11)	Henry	Yale University
Losttown	1868(D)	Medium octahedrite	6.60 (3)	Cherokee	Amherst College
Lumpkin	10/6/1869 (F)	Chondrite	0.80 (.36)	Stewart	Harvard Mineralogical Museum
Millen (Bell)	1974(D)	Chondrite (2 frags.)	75.00 (34)	Jenkins	U.S. National Museum
Paulding County	1901(?,D)	Coarse octahedrite	1.60 (.75)	Paulding	Chicago Museum of Natural History
Pickens County	1908(D)	Chondrite	0.88 (.40)	Pickens	Chicago Museum of Natural History
Pitts	4/20/1921 (F)	Mesosiderite	8.16 (3.7)	Wilcox	U.S. National Museum
Pulaski County	1955(D)	Coarse octahedrite	0.25 (.12)	Pulaski	Mr. John Peterson
Putnam County	1839(D)	Fine octahedrite	71.70 (33)	Putnam	U.S. National Museum
Sardis	1940(D)	Coarse octahedrite	1764.00 (800)	Jenkins	U.S. National Museum
Smithonia	1940(D)	Hexahedrite	154.00 (70)	Oglethorpe	Chicago Museum of Natural History
Social Circle	1920(D)	Medium octahedrite	218.00 (99)	Walton	Georgia State Capitol Museum
Thompson	10/15/1888 (F)	Chondrite	0.52 (.23)	McDuffie	U.S. National Museum
Twin City	1955(D)	Ataxite	13.00 (6)	Emanuel	Georgia Geological Survey
Union County	1854(D)	Coarse octahedrite	15.00 (7)	Union	Amherst College

* Institution or individual possessing largest known portion of meteorite.

An additional meteorite, the Elberton, was formerly included in most lists of Georgia meteorites. An examination of this meteorite's history indicates it was a fragment of the Smithonia meteorite that was dispersed in an attempt to sell the major mass.

Chatooga County: 1. Holland's Store hexahedrite was found in March of 1887. This iron fell into the hands of people interested in developing iron mines and was subsequently given to a blacksmith to be broken up and made into horseshoes, nails, etc. Approximately 4.4 pounds (2 kg) of specimens from this meteorite are retained in various museums throughout the world.

Cherokee County: 1. A 15.4 pound (7 kg) coarse octahedrite was discovered partially exposed by a plowman a few hundred yards from the Clarkson Gold Mine, approximately 5 miles (8 km) southwest of Canton, in 1894. This meteorite was badly mutilated shortly after discovery, and today only about half of the original material is known. 2. A medium octahedrite weighing approximately 6.6 pounds (3 kg) was discovered on the Sullivan farm, approximately 2.5 miles (4 km) southwest of Losttown, in April of 1868. The major portion of this meteorite is in the collections of Amherst College.

Emanuel County: 1. An altered nickel-rich ataxite was found by J. L. Drake in 1955 while working for the Emanuel County Highway Department. The meteorite was discovered 8 miles (12.9 km) due east of Twin City at the intersection of U.S. Highway 80 and Georgia Highway 123 in loose soil in front of a road scraper. This unusual meteorite is composed of two large, irregular interlocking masses. A major portion of this ataxite is in the collections of the Georgia Geological Survey.

Henry County: 1. A 24.3 pound (11 kg) hexahedrite was discovered on July 29, 1857, near Locust Grove. This meteorite remained in private collections until 1895. The iron was shaped like a jawbone, the surface of which showed a thin coating of rust and patches of fusion crust. The major portion of this specimen is in the collections of Yale University.

Jenkins County: 1. The largest meteorite thus far discovered in the Southeast, the Sardis Iron, was discovered in 1940 by a farmer plowing a field which had been continuously under cultivation for more than 50 years. The meteorite weighs approximately 1764 pounds (800 kg) and was discovered in soil derived from Miocene sediments. Interestingly, this iron was found in the vicinity of an elliptical Carolina Bay. The dimensions of this specimen are 33 x 28 x 12 inches (84 x 71 x 30 cm). The meteorite is in the U.S. National Museum, Washington, D.C. 2. Two chondrites, presumably representing the same fall, were recovered during cultivation on the Melvin Bell Farm near Millen. The larger mass is rectangular in outline, approximately one foot long (0.3 m) and weighs about 51 pounds (23 kg). Both samples were donated to the U.S. National Museum in 1975.

McDuffie County: 1. A 516 pound (234 g) stony meteorite was found on October 15, 1888, approximately 4 miles (6.4 km) south of Thompson by B. F. Wilson. The stone fell within 30 yards (28 m) of where Mr. Wilson was picking cotton and was buried some 6 or 8 inches (15 or 20 cm) in the earth. The specimen was acquired by the U.S. National Museum in 1909 from George H. Plant of Macon.

Monroe County: 1. The first witnessed meteorite fall in Georgia occurred on May 8, 1829, at 3:30 p.m. E.S.T. The stone is described as a veined chondrite and weighed approximately 36 pounds (16 kg). Silliman (1830, p. 388) reported, "... a small black cloud appeared south of Forsyth from which two distinct explosions were heard, following in immediate succession, succeeded by a tremendous rumbling or whizzing noise passing through the air, which lasted from the first account for two to five minutes. This extraordinary noise was on the same evening accounted for by Mr. Sparks and Capt. Postain, who happened to be near some Negroes working in a field, one mile south of this place, who discovered a large stone descending through the air, weighing, as was afterwards ascertained, 36 pounds. The stone was, in the course of the evening or very early the next morning, recovered from the spot where it fell. It penetrated the earth 2.5 feet." Most of this meteorite has been lost through the years. Only small samples are known today, the largest of which is 4.7 ounces (132 g) in the collection of Yale University.

Oglethorpe County: 1. A large, weathered hexahedrite weighing approximately 154 pounds (70 kg) was discovered about 1940 by Corbett Simmons, approximately 15 miles (24 km) from Athens. The iron was subsequently purchased by the Chicago Museum of Natural History where the major portion remains today.

Paulding County: 1. A small, coarse octahedrite was found in extreme northern Paulding County in about 1912. When found it was a deeply weathered, rough irregular object with considerable limonite on its surface. Although its original weight was given as 26 ounces (725 g), only about 14 ounces (400 g) of it are known. The major mass of the meteorite is in the Chicago Museum of Natural History.

Pickens County: 1. A 14 ounce (400 g) chondrite was found about 1908 on lot 88, 23rd district, 2nd section of Pickens County near Talmadge store, about 6 miles (10 km) east of Fairmont. The stone was described by McCallie (1909, p. 772) who says "... when this was found it was roughly cubical with the appearance of being part of a larger piece. In color and texture it closely resembles basalt, the dark color being blotched here and there by brownish-red spots which seem to be due to oxidation of the contained particles of metallic iron. With the exception of metallic iron, which occurs in irregular masses a fourth of an inch or less in diameter which makes up something like 10% of the entire mass, none of the other minerals could be made out without a lens." The only known specimen of this stone is in the Chicago Museum of Natural History and weighs 13 ounces (380 g).

Polk County: 1. A poorly described meteorite was discovered in 1898 near Aragon. It was classified as a nickel-poor ataxite in the 1916 catalog of the collection of the Field Museum of Natural History. 2. A 24 pound (11 kg) hexahedrite was discovered in a newly plowed field between Cedartown and Cave Springs prior to 1898. This iron came into the possession of S. W. McCallie, former Georgia State Geologist, about 1898 and was subsequently acquired by the U.S. National Museum. The specimen is a relatively thin, 9 x 11 inch (23 x 28 cm) slab resembling a fragment torn from a larger object.

Pulaski County: 1. A 4 ounce (116 g) coarse octahedrite fragment was submitted to the Georgia Geological Survey in the fall of 1955 by Mr. John Peterson of Hapeville. The iron was discovered in Pulaski County at approximately 32°15' North and 83°30' West. After examination by personnel of the U.S. National Museum, the specimen was returned to Mr. Peterson.

Putnam County: 1. A fine octahedrite weighing approximately 72 pounds (32.5 kg) was discovered in 1839. The iron was originally presented to Mercer University but has subsequently been sliced into numerous samples with the major portion residing in the U.S. National Museum. A 0.04 ounce (1 g) sample of this meteorite is in the Vatican collections.

Stewart County: 1. A stony meteorite (hypersthene chondrite) weighing 13 ounces (357 g) fell on October 6, 1869, on land owned by E. Barlow, approximately 12 miles (19 km) southwest of Lumpkin. It was picked up a few moments after it struck. Willet (1870, p. 335) quotes a witness to the fall as saying, "... while standing in the open yard, the sky being bright and clear, he heard first a succession of about three explosions, followed by deep roaring for several seconds, and then by a rushing or whizzing sound of something rushing with great speed through the air nearby. The sound ceased suddenly. The noise continued from first to last about half a minute. Two Negroes were working nearby the well in the same yard, about 60 yards from where Mr. Barlow stood. They heard the noise and supposed it to be the falling in of the plank well curbing, banging from side to side in its descent, and spoke of it to one another before the meteorite fell. While they were speaking thus about the noise, the meteorite fell and struck the ground about 20 steps from them, in full sight knocking up the dirt. They called Capt. Barlow and showed him the spot. It was upon very hard trodden ground in the clean open yard. The earth was freshly loosened up very fine in a circle of about 18 inches in diameter, and upon scraping the loose dirt away with the hands the stone was found about 10 inches below the surface. From the direction in which the ground was crushed in, it must have come from the northwest and at an angle of about 30°. The stone when picked up was covered with black shale ... The stone still had a strong odor. He does not remember that it had any noticeable heat." The major portion of this sample is in the Mineralogical Museum of Harvard University, Cambridge, Massachusetts.

Union County: 1. An approximately 15 pound (7 kg) coarse octahedrite was discovered prior to 1854 in Union County. Details of the find are entirely lacking. The largest mass, weighing 78.5 ounces (2,225 g), is in the collection of Amherst College.

Walton County: 1. The 219 pound (99.3 kg), Social Circle iron meteorite was recognized in 1926 on the W. P. Spearman plantation. It had been in the possession of the family for several years before the state geologist, S. W. McCallie, acquired and described it. The meteorite has been studied in detail several times due to its unusual, uniformly granular texture. This is perhaps the best known Georgia meteorite since it has been on public exhibition in the state capital building for many years.

Whitfield County: 1. Some confusion exists concerning the Dalton meteorite of Whitfield County. The chronology of reporting suggests that two separate meteorites have been described from this county, and both were called the Dalton meteorite. The major sample was apparently discovered on the Francis M. Anderson farm, lot 109, 10th district, 3rd section, in 1879. The sample was an approximately 130 pound (59 kg) medium octahedrite. This iron was found while plowing and was buried about 6 inches below the surface of the ground. The second specimen, described by Smith (1877), may represent a fragment of the 1879 find or a different meteorite entirely. The major mass of the Dalton meteorite is in the U.S. National Museum.

Wilcox County: 1. The witnessed fall of a meteorite at about 9:00 a.m. on April 20, 1921, generated much interest in Wilcox and adjacent counties. Four fragments of the meteorite, which apparently broke up in flight, were recovered. The aggregate weight of these fragments was approximately 8 pounds (3.7 kg). The meteorite was classified a mesosiderite, and the major portions of it are in the U.S. National Museum.

As inclusions in Georgia meteorites, the following two minerals, traditionally classed as native elements, have been identified:

Cohenite
$(Fe,Ni,Co)_3C$

Class Unassigned native element

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Phys. *Cleavages*, {100}, {010}, {001}. Very brittle. **H** 5½–6. **G** 7.20–7.65; 7.68 (calc., Fe_3C). Strongly magnetic. *Color* tin-white, changing to light bronze to gold-yellow on exposure. Opaque.

Occur.

Minute quantities of cohenite have been reported in the Pulaski meteorite (see Iron).

Schreibersite
$(Fe,Ni)_3P$

Class Unassigned

Cryst. Tetragonal; tetragonal-disphenoidal—$\bar{4}$

Habit Crystals rare; often rounded, sometimes with cavities in the terminal faces. In tablets or plates (schreibersite); in rods or needles (rhabdite).

Phys. *Cleavage* {001}, perfect; prismatic, {010} or {110}, imperfect. Very brittle. **H** 6½–7. **G** 7.0–7.3; 7.44 (calc. for 28.68 per cent Ni). *Luster* highly metallic. *Color* silver-white to tin-white, tarnishing to brass-yellow or brown. Opaque. Strongly magnetic.

Occur.

Schreibersite has been identified in Georgia only as minute inclusions in the Losttown, Social Circle, and Twin City meteorites (see Iron).

BISMUTH
Bi

Class Native element

Cryst. Hexagonal-R; hexagonal-scalenohedral—$\bar{3}$ 2/m

Habit Indistinct crystals. Usually in reticulated and arborescent shapes; foliated; granular.

Phys. *Cleavage* perfect basal. Sectile. Brittle. **H** 2–2½. **G** 9.7–9.83. *Luster* metallic. *Color* and *streak* silver white with reddish hue, tarnishing dark brown. Opaque.

Occur.

Jasper County: 1. Very minor native bismuth associated with wittichenite is reported in polished sections of material collected at the Enon Church Feldspar Mine on Georgia Highway 83, approximately 6 miles (10 km) south of Monticello near Gladesville. Bismuth occurs as microscopic inclusions surrounding wittichenite in narrow veinlets of chalcocite and bornite associated with green microcline (personal communication, T. C. Hughes). Identification was confirmed by electron microprobe analysis.

SULFUR
S

Class Native element

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Pyramidal and thick tabular crystals. Also massive, incrusting, and as a powder.

Phys. *Cleavage* imperfect. Brittle. *Fracture* conchoidal. **H** 1½–2½. **G** 2.07. *Color* yellow, brownish, or greenish yellow. *Luster* resinous. *Streak* white. Transparent to translucent.

Occur.

Native sulfur, derived from the weathering and oxidation of the sulfides pyrite and pyrrhotite, occurs in small amounts at numerous localities in the Piedmont.

Carroll County: 1. Native sulfur associated with hematite has been reportedonVine Mountain in Carroll County. 2. Excellent samples of sulfur in weathered pyrite-rich rock have been collected along the Southern Railway at Temple.

Cobb County: 1. Small, well developed crystals of sulfur are reported in the interior portions of large altered pyrite crystals from the Cooper property, 9.9 miles (15.9 km) northwest of Marietta. 2. A similar occurrence is on Cook Road, 0.5 mile (0.8 km) from Statesboro Road.

Hart County: 1. Grant (1958, p. 71) describes sulfur occurring in small cavities in quartz veins at an undisclosed location.

Lumpkin County: Considerable sulfur as minute loose crystals with rounded edges is described in free-milling gold ores of the Lockhart Mine, lots 1,050, 1,085, and 1,086, 12th district (Yeates, McCallie and King, 1896, p. 390).

McDuffie County: 1. Sulfur associated with pyrite and galena is reported in weathered vein quartz from the Old Ned shaft at the Columbia Gold Mine.

Oglethorpe County: 1. Jones (1909, p. 102) described sulfur associated with weathered pyrite but gave no specific locations.

Paulding County: 1. Sulfur occurs with weathered pyrite on the dumps of the Little Bob Pyrite Mine near Hiram. 2. Sulfur is also known in Paulding County on the Sheffield and Heidt properties, lot 656, 3rd district, on Burnt Hickory Ridge. The occurrence is in a quartz vein containing large altered pyrite cubes which occasionally carry native gold associated with the sulfur.

Union County: 1. Native sulfur as small crystals on cellular limonite and as small pea-size masses occurs in weathered pyrite on lot 16, Choestoe District, near Blairsville.

Wilkes County: 1. Small native sulfur crystals line cavities in weathered pyrite at the Latimer Gold Mine, about 3 miles (4.8 km) north of Rayle in the west-central part of the county.

DIAMOND
C

Class Native element

Cryst. Isometric: hexoctahedral—4/m $\bar{3}$ 2/m

Habit Predominantly octahedral; less commonly dodecahedral; rarely cubic; occasionally tetrahedral. Faces commonly much curved by growth and solution facets and often striated, usually {110}. Often flattened {111}; built of successive flattened octahedral plates; variously distorted; in groups; in spherical forms with radiated structure; rarely massive. Variously etched on {111}.

Phys. *Cleavage* {111} perfect. *Fracture* conchoidal. Brittle. **H** 10. **G** 3.50–3.53; purest blue-white, 3.511; 3.511 (calc.). *Luster* adamantine to greasy. *Color* pale yellow to deep yellow; pale brown to deep brown; white to blue-white; occasionally orange, pink, mauve, green, blue, red, black. Transparent to translucent; sometimes nontranslucent owing to inclusions and cavities. Sometimes strongly fluorescent in ultraviolet light and phosphorescent after exposure. Triboelectric. Not sensibly pyroelectric or piezoelectric.

Occur.

The occurrence of diamond has been known in Georgia since the advent of placer gold mining in the early 1800's. Several publications such as those by Stephenson (1871), James (1878) and Henderson (1885) record their occurrence. Banks, Bartow, Camden, Carroll, Cherokee, Clayton, Cobb, Dawson, Forsyth, Gwinnett, Habersham, Hall, Haralson, Lumpkin, Paulding, Twiggs, and White Counties are reported to have furnished one or more stones (McCallie, 1910, p. 118). Many of the reported finds lack satisfactory verification. Deception, fraud, and honest misidentification must be regarded as distinct possibilities with respect to several of the reported finds. The following occurrences are worthy of note due to adequate verification or historical significance.

Burke County: 1. Hurst, Crawford, and Sandy (1966, p. 195) report that Mr. P. L. McNorrill carried to the State Geological Survey in October, 1958, a diamond which had been given to him by his grandmother a number of years before. His grandmother (Eula Hatcher McNorrill) had reportedly found the stone in her backyard at the old Shell Bluff Post Office. The stone weighed 7.11 carats and exhibited a hexoctahedral form. It bore no percussion marks.

Camden County: 1. Two -50 mesh diamonds have been identified from heavy mineral concentrates of of sands collected in this county. One of the stones was a well formed colorless hexoctahedron (S. M. Pickering, personal communication).

Clayton County: 1. In 1887, a diamond was found on the property of Daniel Light, 1.5 miles (2.4 km) northeast of Morrow Station. This stone was discovered during plowing at the crest of a low hill near the Light residence. A shallow exploration shaft was sunk and the soil and saprolite washed without success. The host rock was apparently a biotite granite. The diamond was a 4.25 carat octahedron 0.4 x 0.4 x 0.3 inches (10 x 10 x 7.6 mm) exhibiting a slightly yellow color and a single, small black inclusion. Its surface was curiously marked with long shallow pittings. A rough cast of this crystal is on exhibit in the Field Museum of Natural History in Chicago. 2. A second stone, possibly from Clayton County, was found in 1889 at an undisclosed location "near Atlanta" (Furcron, 1948a). This 2 carat stone was "defective and a very poor color."

Hall County: 1. The earliest reported diamond find in Georgia was made in 1843 by Dr. M. F. Stephenson while panning gold near Winns or Williams Ferry at the mouth of a small branch which enters Muddy Creek at a point about 0.5 mile (0.8 km) from its junction with the Chattahoochee River (Stephenson, 1871, p. 118).

The stone reportedly weighed over 6 carats and was on display in one of the Gainesville banks for several years (Lester, 1959). The locality was visited by Otto Veatch in January, 1908, and the remains of the old placer workings were found. The branch is about 0.75 mile (1.2 km) in length, and a close examination of its drainage basin was conducted. The only rock found was a gray granite which was locally cut by thin pegmatites and quartz veins. 2. An intriguing though possibly unreliable report (Stephenson, 1871, p. 118) of diamonds found in the gravel along Stockeneter Branch at the Glade Gold Mine, 13 miles (20.9 km) northeast of Gainesville, is of historical interest. The property was operated in the 1850's by a Dr. Loyd who reported to Stephenson that during the gold cleanups diamonds were frequently encountered. The stones, however, were not "identified" as diamonds until the late 1860's at which time the mine had been closed, levelled, and planted in corn. "Several pounds" of these stones were saved by Dr. Loyd and his family. The diamonds averaged approximately 4 carats in weight; however, 3 extremely large ones were recovered. One of these was used by his children for years as a "middle man" while playing marbles; another was destroyed by slaves while testing its hardness; and the largest, reportedly weighing over 100 carats, was either lost or stolen on the day of its discovery. Several of these stones were reportedly cut and placed on the European market. Stephenson (1871, p. 118) reports finding several small, well formed diamond crystals in the immediate area of the Glade Gold Mine many years later. It was reported in 1952 that Mr. Rafe Banks of Gainesville, whose grandfather owned the Glade, had in his possession a diamond from this property weighing slightly over one carat.

Lee County: 1. A diamond reportedly found in Lee County, Georgia, in 1901 (Mineral Resources of the United States, 1905, p. 731) was purchased by Tiffany's for $80. The stone, a flattened hexoctahedron weighing 3.5 carats (0.4 x 0.3 x 0.2 inches (10 x 7.6 x 5 mm)), was white with a greenish tint. It is probable that this stone should be attributed to Lee County, Alabama, since the reported discovery was quite near Columbus, Georgia.

Twiggs County: 1. McCallie (1910. p. 119) reports that a number of diamonds have been found on the Nelson property, about 11 miles (17.7 km) southeast of Macon, 1.5 miles (2.4 km) northeast of Pikes Peak Station. The formations here are Cretaceous and Tertiary sands and clays.

White County: 1. Stephenson (1871) reports that 4 small diamonds were found in the gold placers of Nachoochee Valley. 2. In 1866, 2 small (0.15 and 0.5 carat) stones were found at the Horshaw Gold Mine near Loudsville (Stephenson, 1871). 3. Hurst and Otwell (1964, p. 20) report the discovery of a diamond during the early gold mining days of White County on lot 10 on the Lumsden property. All available evidence indicates that the Lumsden property was the site of the Horshaw Gold Mine, suggesting that finds 2 and 3 may represent separate reports of the same stone(s).

GRAPHITE

C

Class Native element

Cryst. Hexagonal; dihexagonal-dipyramidal—6/m 2/m 2/m

Habit Six-sided tabular crystals. Commonly in embedded foliated masses; also scaly, columnar, radiated, granular, earthy, compact.

Phys. *Cleavage* basal perfect. Flexible, but inelastic. Greasy feel. Sectile. **H** 1–2. **G** 2.09–2.23. *Luster* metallic, sometimes dull or earthy. *Color* iron-black to steel-gray. *Streak* black to dark gray, shining. Opaque.

Occur.

Graphite is an exceedingly widespread accessory, and at times, primary rock-forming mineral within the crystalline Piedmont. It normally occurs in one of two distinct forms: crystalline or flake graphite and "amorphous" graphite which is earthy but not truly amorphous. Extensive and persistent graphitic rocks, principally phyllites, graphitic schists and graphitic metaquartzites, have been documented in such rock units as the Ashland, Wedowee, Talledega, Brevard, and Ocoee by various workers. It occurs as fine-grained inclusions in marble in Cherokee and Pickens Counties and within quartz veins and pegmatites associated with kyanite-bearing rocks in Talbot and Upson Counties. It is typically associated with sillimanite in schists and granite gneisses of Hart and Elbert Counties. Graphite has been reported from one or more locations in Bartow, Carroll, Cobb, DeKalb, Douglas, Elbert, Fannin, Fulton, Gilmer, Habersham, Hall, Haralson, Harris, Hart, Heard, Meriweather, Pickens, Talbot, Towns, Troup, Union, Upson, and White Counties. Substantial amounts of graphite have been mined from 2 locations in Bartow County.

Bartow County: 1. A graphitic "talcose slate" containing up to 15 percent graphite was mined approximately 1.3 miles (2 km) southeast of Emerson on the east side of the Western and Atlantic Railroad by the American Chemical Mining Company. 2. A similar deposit was mined by the Cherokee Chemical Company 2 miles (3.2 km) south of Emerson near the Western and Atlantic Railroad. Hayes and Phalen (1908) described these 2 deposits reporting possible malachite staining along fractures and gold associated with abundant pyrite. They also mentioned the presence of alum formed by the weathering of pyrite. These 2 deposits most likely represent a metamorphosed carbonaceous shale.

Habersham County: 1. Scattered boulders of vein quartz containing an estimated 4 to 6 percent flake graphite are reported on the Pitts' property, approximately 250 feet (76 m) southeast of the Southern Railroad northeast of Mount Airy, located about 0.5 mile (0.8 km) southwest of Welcome Home Church (Hurst and Crawford, 1964, p. 45).

Madison County: 1. Graphite has been prospected on the J. J. Brown property on the east side of Broad River, about 1.25 miles (2 km) south of the mouth of Hannah Creek and about one mile (1.6 km) north of the mouth of Winters or Bee-Moon Creek, 6.5 miles (10.5 km) by road southwest of Royston. The graphite occurs as "amorphous" and fine flake material in mica schist which has been injected by pegmatites. 2. Graphite has been mined from a similar deposit on the adjoining Porterfield property. This graphite occurs in segregations within a partially decomposed pegmatite.

Pickens County: 1. Crystalline graphite was prospected many years ago near Sharp Top Mountain, approximately 5 miles (8 km) west of Jasper. Graphite at this location occurs as impregnations in gneiss and, at one point, as a well defined vein traversing the country rock (McCallie, 1910, p. 73).

Troup County. 1. Good quality, massive, amorphous graphite has been prospected on the T. C. Floyd property near Old Salem. 2. Veatch (1911) published a short paper on a possible igneous occurrence of graphite in a small quartz vein. The graphite occurred as minute crystals coating quartz crystals near an exposure of peridotite. The exact location of the vein was not given.

Upson County: 1. Graphite was once mined on Hurricane Creek one mile (1.6 km) south of Crest. The small production apparently mined local segregations of graphite within the lower schist member of the Manchester Formation (Clarke, 1952, p. 87).

TELLUROBISMUTHITE

Bi_2Te_3

Class Telluride

Cryst. Hexagonal—R.

Habit Found only as irregular plates or foliated masses.

Phys. *Cleavage* {0001} perfect. May exhibit a parting inclined about 62° to {001}. Laminae flexible, but not elastic. Somewhat sectile. **H** 1½–2; soils paper. **G** 7.815 ±0.15; 7.86 (calc.). M.P. 573° (artif.). *Luster* metallic, splendent on fresh cleavages. *Color* and *streak* pale lead-gray. Opaque. Thermoelectrically negative. In polished section white in color and weakly anisotropic. May exhibit a triangular set of striations at 60° on cleavage surfaces, due to deformation.

Occur.

Lumpkin County: 1. A detailed review of old literature relating to bismuth minerals in association with the Boly Fields Gold Mine on the Chestatee River, 4 miles (6.4 km) east of Dahlonega, indicates much of the material previously determined to be tetradymite was actually tellurobismuthite (Cook, 1973, p. 185). See Tetradymite.

TETRADYMITE

Bi_2Te_2S

Class Telluride

Cryst. Hexagonal—R; hexagonal-scalenohedral—$\bar{3}$ 2/m

Habit Crystals rarely distinct; commonly foliated to granular massive; in bladed forms.

Phys. *Cleavage* perfect basal. **H** 1½–2. **G** 7.1–7.5. *Luster* metallic. *Color* and *streak* pale steel-gray. Opaque.

Occur.

Tetradymite has been reported from Lumpkin, Cherokee, Polk, Spalding, and Haralson Counties. Examination of the literature indicates that at least one occurrence in Lumpkin County represents misidentification.

Haralson County: 1. Polished section examination of drill core from the Tallapoosa massive sulfide deposit, 20th district, 3rd section, approximately 2.5 miles (4 km) north of Draketown, resulted in the identification of tetradymite in this location. The mineral occurs as 0.004 inch (0.01 cm) long lath-like inclusions in galena, and it is distinguished from galena by its creamy white color, moderate anisotropism, and lamellar twinning. Intimately associated minerals are gold, chalcopyrite, sphalerite, pyrite and dolomite. Electron microprobe analysis yields the composition Bi = 57.2 percent, Te = 35.2 percent, and S = 6.5 percent (Cook, 1973, p. 84).

Lumpkin County: 1. A mineral variously described as bornite, tetradymite, or tellurbismuth has been known since 1859 from the Boly Fields Gold Mine, 4 miles (6.4 km) east of Dahlonega (Jackson, 1859, p. 366; Genth, 1860, p. 350). All published data indicate that the mineral described is actually tellurobismuthite. 2. Park and Wilson (1936) mention the occurrence of tetradymite at the Battle Branch Gold Mine on lots 457 and 524, 12th district.

CHALCOCITE

Cu_2S

Class Sulfide

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Short prismatic and thick tabular crystals. Also compact massive.

Phys. *Cleavage* one indistinct. *Fracture* conchoidal. Brittle. **H** 2½–3. **G** 5.5–5.8. *Luster* metallic. *Color* and *streak* blackish lead-gray. Opaque.

Occur.

Chalcocite occurs in Georgia as a supergene mineral formed by secondary enrichment of primary sulfide ores containing chalcopyrite. Chalcocite is probably the main constituent of the rich "black copper" ores extensively mined from shallow workings before 1900.

Cherokee County: 1. Rich chalcocite-bearing ore was mined prior to 1860 at the Rich or Canton Copper Mine, lot 161, 14th district, 2nd section. Chalcocite pseudomorphs after galena have been reported from this occurrence (Dana, 1892, p. 1081).

Fannin County: 1. Enriched ore containing moderate amounts of chalcocite was produced intermittently from the Number Twenty Copper Mine, lot 20, 9th district, 2nd section. Shearer and Hull (1918, p. 211) report that "black copper" ore averaging nearly 10 percent copper was shipped from the property in 1905.

Haralson County: 1. Very minor amounts of fine-grained chalcocite are reported by Cook (1970, p. 80) in polished sections of drill core from the Tallapoosa copper deposit, 20th district, 3rd section, approximately 2.5 miles (4 km) north of Draketown.

Jasper County: 1. Minor chalcocite after bornite occurs in veins cutting microcline at the Enon Church Feldspar Mine on Georgia Highway 83, approximately 6 miles (9.7 km) south of Monticello, near Gladesville.

Lincoln County: 1. Minor amounts of sooty chalcocite occur in pyritic sericite schist on the dumps of the Magruder Gold Mine in the extreme western part of the county, approximately 2.5 miles (4 km) east of Metasville.

Lumpkin County: 1. Shearer and Hull (1918, p. 195) report that near-surface ore from the Chestatee massive sulfide deposit [6 miles (9.7 km) east of Dahlonega on the south side of the Chestatee River 1.75 miles (2.8 km) below its junction with Tesnatee Creek], contains grains of "black copper," evidently chalcocite. Samples obtained from this deposit contain fractures in massive pyrite which are filled with sooty chalcocite. Associated minerals are covellite, cuprite, linarite, langite and brochanite.

Paulding County: 1. Chalcocite occurs as irregular networks in supergene covellite in near-surface ore of the Little Bob massive sulfide deposit, 2nd district, 3rd section, approximately 2 miles (3.2 km) northwest of Hiram. Diamond drilling has shown no well-defined enrichment zone exists in this deposit. 2. Polished sections of near-surface diamond drill core from the Swift massive sulfide deposit, 19th district, 3rd section, approximately 1.5 miles (2.4 km) east of Draketown contain very minor amounts of sooty chalcocite, intimately associated with covellite, filling fractures in partially oxidized, massive pyrite–pyrrhotite ore (Cook, 1970, p. 44).

Wilkes County: 1. Very minor chalcocite, as irregular veins replacing covellite, occurs in massive white quartz associated with azurite, malachite and chalcopyrite at the Youngs Chapel copper prospect, approximately 3.5 miles (5.6 km) west of Washington along the ridge between Youngs Chapel and Beaver Dam Creek.

BORNITE

Cu_5FeS_4

Class Sulfide

Cryst. Isometric; hexoctahedral—4/m $\bar{3}$ 2/m

Habit Rarely in crystals; massive, granular, or compact.

Phys. *Fracture* uneven. Brittle. **H** 3. **G** 5.06–5.08. *Luster* metallic. *Color* reddish brown, generally tarnished to iridescent colors. *Streak* pale grayish black. Opaque.

Occur.

Bartow County: 1. Anderson (1934, p. 65) reports minor bornite associated with gold, galena, and chalcopyrite in a quartz vein at the Allatoona Gold Mine, lot 929, 21st district.

Fannin County: 1. Minor bornite, associated with pyrrhotite and pyroxene, occurs at the Number Twenty Copper Mine, lot 20, 9th district, 2nd section.

Jasper County: 1. Veinlets of bornite up to one inch (2.54 cm) wide, associated with chalcocite, chalcopyrite, azurite, malachite and fluorite, occur in microcline-rich portions of the Enon Church Feldspar Mine, approximately 6 miles (9.7 km) south of Monticello on Georgia Highway 83, near Gladesville.

Lincoln County: 1. Very minor amounts of bornite are reported from the Magruder Gold Mine, approximately 2.5 miles (4 km) east of Metasville in the extreme western part of the county (Furcron, 1948b, p. 3).

Wilkes County: 1. Bornite, associated with malachite, azurite, chalcopyrite, pyrite, covellite and native copper, occurs as irregular masses up to one inch (2.54 cm) in diameter in massive white quartz at the Youngs Chapel copper prospect, approximately 3.5 miles (5.6 km) west of Washington along the ridge between Youngs Chapel and Beaver Dam Creek.

GALENA
PbS

Class Sulfide

Cryst. Isometric; hexoctahedral—4/m $\bar{3}$ 2/m

Habit Commonly cubic or cubo-octahedral, less often octahedral. Massive, cleavable, coarse, or fine granular.

Phys. *Cleavage* perfect cubic. **H** 2½. **G** 7.57-7.59. *Luster* metallic. *Color* and *streak* lead-gray. Opaque.

Occur.

Bartow County: 1. Small galena and sphalerite crystals in barite are reported by Kesler (1950, p. 45) from the Iron Hill Mine, lots 728 and 729, 21st district, 2.7 miles (4.3 km) northeast of Allatoona. 2. An identical occurrence is mentioned at the Tucker Hollow Iron Mine (Kesler, 1950, p. 45). 3. Anderson (1934, p. 65) mentions the occurrence of galena associated with gold, bornite and chalcopyrite in a quartz vein at the Allatoona Gold Mine, lot 929, 21st district.

Catoosa County: 1. Hurst and Crawford (1970, p. 148) describe small cubes of galena associated with purple fluorite and barite within a 5-foot (1.5 m) brecciated zone in an abandoned dolomite quarry 1.5 miles (2.4 km) southeast of Graysville. In the early 1930's an exploration shaft was put down approximately 20 feet (6 m) without encountering an economic deposit.

Cherokee County: 1. The Rich Copper Mine, perhaps better known as the Canton Copper Mine [located on lots 127, 128, 161 and 162, 14th district, 2nd section, one mile (1.6 km) south of downtown Canton] is an occurrence of minor galena within a massive sulfide deposit (Shearer and Hull, 1918, p. 159).

Fannin County: 1. Galena occurs as an accessory mineral in the Ducktown-type massive sulfide deposit at the Number Twenty Copper Mine on lot 20, 19th district, 2nd section. Galena is intimately associated with pyrrhotite, chalcopyrite, pyrite and sphalerite. Associated gangue minerals are quartz, calcite, actinolite, tremolite, diopside, zoisite and garnet.

Floyd County: 1. Small galena cubes were found in a limestone quarry located where U.S. Highway 27 crosses Big Dry Creek a short distance north of Rome (Hurst and Crawford, 1970, p. 147). 2. Massive pods of coarsely crystalline galena in vuggy quartz were found by Mr. Jack McGuffey of Rome. The exact location of the occurrence was not given (Hurst and Crawford, 1970, p. 147).

Gwinnett County: 1. Jones (1909, p. 117) reports the occurrence of minor galena associated with pyrite and pyromorphite within a milky quartz vein at the Piedmont Gold Mine, lot 304, 7th district, about 2 miles (3.2 km) west of Buford.

Hall County: 1. A series of quartz veins containing rather abundant galena and pyrite were formerly propsected at the Currahee Mine, approximately 6 miles (9.7 km) northeast of Gainesville along the Southern Railroad right-of-way. Stephenson (1878) described a similar occurrence at the Lowman Mine, 5 miles (8 km) northeast of Gainesville. He stated that development ore from this mine contained up to 70 ounces (2000 g) of silver per ton, along with abundant lead and zinc. According to Stephenson, at one time plans were underway to hire up to 1,000 men in various jobs related to the development and operation of this mine. It is probable that the mine described by Stephenson as the Lowman Mine is the same property described by Jones (1909, p. 122) as the Currahee Mine. 2. Yeates, McCallie and King (1896, p. 140) described a quartz vein containing galena and pyrite at the Mammoth prospect, approximately 3 miles (4.8 km) northeast of Gainesville along the Southern Railroad right-of-way. 3. Galena containing 24.8 ounces (708 g) of silver per ton was discovered in July, 1960, near Gainesville on lot 138.

Haralson County: 1. Minor galena, associated with pyrite, chalcopyrite, and sphalerite, occurs in the Tallapoosa massive sulfide deposit in the 20th district, 3rd section, approximately 2.5 miles (4 km) north of Draketown. Local sections of drill core from this deposit contain approximately one percent galena as irregular masses up to 0.1 inch (0.25 cm) in diameter within aggregates of sphalerite and chalcopyrite. Galena also

occurs in pyrite grains as separate or bimineral inclusions accompanied by sphalerite and chalcopyrite (Cook, 1970, p. 84).

Hart County: 1. Galena has been reported from an unspecified location near Hartwell.

Lincoln County: 1. Jones (1909, p. 97) describes galena associated with chalcopyrite, pyrite and native gold in a quartz vein at the Ramsey Gold Mine in the southwest corner of Lincoln County, approximately 2.2 miles (3.5 km) southeast of Amity. 2. The Paschal Gold Mine in the southwest corner of Lincoln County, approximately 0.6 mile (1 km) southeast of Clay Hill, is known for small amounts of rich ore containing moderate quantities of galena and associated chalcopyrite and pyrite. The sulfide minerals occur in quartz stringers and veins. 3. Hurst, Crawford and Sandy (1966, p. 238) describe galena, chalcopyrite and pyrite in a grab sample from the dump of the Phillips gold prospect on the Clark Hill Reservation, approximately 2.6 miles (4 km) southeast of Woodlawn. The sample contained 2.56 ounces (73 g) of gold per ton. 4. Jones (1909, p. 100) describes galena occurring with pyrite and chalcopyrite in a quartz vein at the Julia Gold Mine, approximately 0.5 mile (0.8 km) north of Little River. This property could not be relocated by Hurst, Crawford and Sandy (1966) and is probably covered by the Clark Hill Reservoir. 5. The Magruder Gold Mine in the extreme western part of Lincoln County, approximately 2.5 miles (4 km) east of Metasville, has produced moderate amounts of argentiferous galena associated with chalcopyrite, pyrite and sphalerite from mineralized shear zones. Galena typically occurs as medium- to coarse-grained aggregates in quartz. R. J. Rundle, in a private report on the operation of the Magruder Mine between January and October, 1922, describes a lense of ore encountered in the Wardlow vein between the 90- and 145-foot (27- and 44-meter) levels containing up to 50 percent galena and chalcopyrite. 6. Hurst, Crawford and Sandy (1966, p. 62) describe galena in narrow quartz veins with pyrite and minor iron oxides at their Map Station 190 in the extreme southwest corner of Lincoln County.

Lumpkin County: Galena was a rather common accessory mineral below the water table in the lode gold deposits of Lumpkin County. 1. The Battle Branch Mine, lots 457 and 524, 12th district, is well known for outstanding specimens of coarse-grained galena containing plates of native gold as inclusions along cleavage planes. Specimens from this mine have been disseminated over the years into many major museum collections. 2. Yeates, McCallie and King (1896, p. 372) described a quartz vein in the Findley Gold Mine, lots 1047, 1048 and 1087, 12th district, which varied from 1 to 12 feet (0.3 to 3.7 m) in width and contained considerable galena. 3. The Singleton Gold Mine, lots 1084, 1051 and 1085, is well known for the occurrence of minor quantities of galena and secondary pyromorphite associated with rich pockets of gold ore. Galena commonly occurs at this location as streaks of very fine-grained inclusions in vein quartz and only rarely as small aggregates exhibiting discernible cleavage.

McDuffie County: Galena is an important constituent of numerous gold-bearing veins in an area of formerly intensive gold mining, approximately 11 miles (17.7 km) northwest of Thompson and immediately north of U.S. Highway 78. The area is known collectively as the Columbia Gold Mine area and historically was one of the most productive in Georgia. Galena, associated with pyrite, chalcopyrite, covellite, native gold, pyromorphite, barite, and scheelite, has been reported by various authors from the four major mines in this district. These are the Hamilton, Landers, Parks, and Columbia Mines (Jones, 1909; Hurst, Crawford and Sandy, 1966).

Murray County: The occurrence of galena has been noted at 3 locations by Hurst and Crawford (1970, p. 147–147). 1. Galena and minor disseminated pyrite occur in narrow quartz veins in a 3-foot (9 m) wide mineralized zone within coarse-grained conglomeratic metagraywacke at the Emory Branch prospect, 1.9 miles (3 km) southeast of Hassler Mill. 2. Galena occurs in veins up to one inch (2.54 cm) wide in massive talc at the Old Shop Tunnel Talc Mine. 3. Narrow, quartzose mineralized zones containing sparse galena and sphalerite occur in Ocoee Series metagraywacke at the Earnest galena prospect, 0.6 miles (1 km) west-northwest of the summit of Fort Mountain, 2.4 miles (3.9 km) southwest of Hassler Mill. 4. Galena samples were submitted to the Georgia Geological Survey in 1897 from the C. W. King property, lot 282, 26th district.

Paulding County: 1. Minor galena occurs within sphalerite-rich portions of the Little Bob pyrite deposit, 2nd district, 3rd section, approximately 2 miles (3.2 km) northwest of Hiram. The mineral occurs as small rounded inclusions in pyrite; irregular patches and segregations within sphalerite; and embayments and veins in fractured chalcopyrite (Cook, 1970, p. 30). One sphalerite-rich zone encountered in diamond drilling assayed 0.86 percent lead over a 3-foot (0.9 m) interval. 2. Sphalerite-rich portions of the Swift massive sulfide deposit, 19th district, 3rd section, approximately 1.5 miles (2.4 km) east of Draketown, contain minor quantities of very fine-grained galena. Irregular galena masses separate and slightly embay sphalerite grains, and these masses occur locally as inclusions and embayments within cataclastically deformed pyrite grains (Cook, 1970, p. 49).

Rabun County: Galena occurs with pyrite in a quartz vein prospected for gold on the J. E. Harvey property, about 0.5 mile (0.8 km) south of Flat Creek Church.

White County: 1. Hurst and Otwell (1964, p. 150–154) describe minor galena in a quartz vein (the Reynolds vein) on Hambee Mountain at the Dean property south of Helen. The galena accompanies auriferous pyrite. 2. Quartz veins containing galena and ankerite were exploited at the Thompson Gold Mine, lot 102, 3rd district, about 2 miles (3.2 km) southwest of Nacoochee Post Office (Hurst and Otwell, 1964, p. 103).

Wilkes County: Bands of galena with sphalerite and chalcopyrite occur in chloritic rock on the dumps of the Chambers zinc prospect on the south edge of Butler Branch, about 2,000 feet (609 m) west of the Magruder Gold Mine.

CLAUSTHALITE
PbSe

Class Selenide

Cryst. Isometric; hexoctahedral—4/m $\bar{3}$ 2/m

Habit Massive, commonly fine granular, sometimes foliated.

Phys. *Cleavage* {001} good. *Fracture* granular. **H** 2½–3. **G** 7.8; 8.079 (calc.). *Luster* metallic. *Color* lead-gray, somewhat bluish. *Streak* darker. M.P. 1065° to 1088°. Opaque. In polished section isotropic.

Occur.

Cherokee County: 1. Clausthalite has been reported by Dana (1892, p. 1081) from ores of the Rich or Canton Copper mine on lot 161, 14th district, 2nd section. Associated minerals are pyrite, chalcopyrite, sphalerite, arsenopyrite, galena, quartz, and calcite.

SPHALERITE
ZnS

Class Sulfide

Cryst. Isometric; hextetrahedral—$\bar{4}$ 3m

Habit Tetrahedral and dodecahedral crystals, usually imperfect. Also granular and massive.

Phys. *Cleavage* dodecahedral perfect. *Fracture* conchoidal. Brittle. **H** 3½–4. **G** 3.9–4.1. *Color* brown, black, yellow, red, green, white to nearly colorless when pure. *Luster* resinous to adamantine. *Streak* colorless to yellowish brown. Transparent to translucent. Occasionally fluorescent.

Occur.

Bartow County: 1. Small sphalerite and galena crystals as inclusions in barite are reported by Kesler (1950, p. 45) at the Iron Hill Iron Mine, lots 728 and 729, 21st district, 2.7 miles (4.3 km) northeast of Allatoona. 2. A similar occurrence is described from the Tucker Hollow Iron Mine (Kesler, 1950, p. 45).

Carroll County: 1. Shearer and Hull (1918, p. 58) describe sphalerite in samples from the Jenny Stone massive sulfide deposit, lot 222, 6th district, 5th section, approximately 2 miles (3.2 km) north of Villa Rica. Sphalerite occurs as small, irregular brown grains in granular pyritic rock. Analysis of pyrite ore from this prospect returned 2.77 percent zinc. 2. Minor amounts of fine-grained sphalerite occur at the Lassiter pyrite prospect on lot 188, 5th district, 3rd section. 3. Fine-grained sphalerite occurs at the Askew pyrite prospect, lot 166, 3 miles (4.8 km) west of Villa Rica on the south side of the Southern Railway.

Cherokee County: 1. Zones containing locally abundant sphalerite are reported from the southwest end of the 200-foot (61 m) level of the Bell-Star Pyrite Mine on lots 829, 900 and 901, 21st district, 2nd section. An analysis of pyrite concentrates from this deposit (Shearer and Hull, 1918, p. 152) returned 0.09 percent zinc. 2. Small brown grains of sphalerite intimately associated with pyrite and galena are reported from the Rich or Canton Copper Mine on lots 127, 128, 161 and 162, 14th district, 2nd section, one mile (1.6 km) south of downtown Canton. Two samples of pyrite ore from this deposit contained 1.53 and 2.12 percent zinc (Shearer and Hull, 1918, p. 159).

Dawson County: 1. An analysis of interbedded schist and quartzite containing abundant pyrite on the Church Lot, lots 305 and 257, 13th district, 2.5 miles (4 km) northeast of Dawsonville, contained trace amounts of zinc (Shearer and Hull, 1918, p. 180). It is probable that minor sphalerite occurs disseminated with the pyrite at this location.

Douglas County: 1. Minor amounts of sphalerite occur over erratic intervals in drill core obtained from the Villa Rica massive sulfide deposit in the northwestern corner of Douglas County, 3 miles (4.8 km) north-northwest of Villa Rica, immediately east of Georgia Highway 61. Irregular masses of sphalerite are mutually intergrown with chalcopyrite in carbonate-bearing portions of the massive sulfide ore. Sphalerite embays and veins carbonates, silicates and pyrite. Inclusions of irregular pyrite grains and shattered amphibole, quartz, feldspar and magnetite are common (Cook, 1970, p. 68).

Fannin County: Sphalerite is an accessory mineral in the massive sulfide body at the Number Twenty Copper Mine, lot 20, 9th district, 2nd section. Associated sulfides are pyrrhotite, chalcopyrite, pyrite and galena.

Greene County: Very minor sphalerite occurs with pyrite, fluorite, and molybdenite in narrow veins and segregations in Siloam Granite exposed in an aggregate quarry one mile (1.6 km) east of Siloam, 0.5 mile (0.8 km) south of Interstate Highway 20.

Hall County: 1. Jones (1909, p. 23) mentions the presence of accessory sphalerite in a pyrite- and galena-bearing quartz vein at the Currahee prospect, approximately 6 miles (9.7 km) north of Gainesville along the Southern Railroad right-of-way.

Haralson County: 1. Sphalerite occurs in local abundance at the Tallapoosa copper deposit, 20th district, 3rd section, in the northeast corner of the county. This deposit has a long history of exploration and development for both copper and zinc. Drilling conducted by the United States Bureau of Mines (Ballard and McIntosh, 1948) revealed intersections of 13 feet (4 m) (Hole 1-A) containing 1.65 percent zinc and a maximum of 5.1 percent zinc for a composite sample from 301 to 305 feet (91.7 to 92.9 m) and 316 to 322.1 feet (96.3 to 98 m) in drill hole 2-A. Detailed examination of drill core from this deposit (Cook, 1970, p. 81) indicated that sphalerite is most abundant in dolomite-rich zones. Irregular veins of sphalerite penetrate and embay crystalline aggregates of dolomite along grain boundaries. Cataclastically deformed zones contain twinned dolomite rhombohedra included within massive sphalerite. Dolomite grains exhibit surface corrosion and embayments by sphalerite along twin planes. In pyrite-rich zones, sphalerite locally forms an intergranular matrix for deformed pyrite fragments. Resinous yellow-to-brown grains of sphalerite in granular pyrite matrix are relatively abundant on the dumps of this deposit.

Lincoln County: 1. Sphalerite was a locally important accessory mineral in the Magruder Gold Mine, situated in the extreme western part of the county, approximately 2.5 miles (4 km) east of Metasville. Sphalerite occurs as stringers and lenses associated with pyrite, chalcopyrite and galena in silicified shear zones or veins in rocks of the Little River Series. The deposit has been diamond drilled by private concerns as well as the United States Bureau of Mines. Peyton and Cofer (1950) report intersections up to 6 feet (1.8 m) thick containing a maximum of 3.025 percent zinc. Several analyses reported by Shearer and Hull (1918, p. 224) contained from 1.61 percent zinc to 11.47 percent zinc in high-grade samples of lump galena-rich ore. Watson (1904b) indicates that sphalerite is particularly common in the Magruder vein and has been noted in only trace amounts in the Wardlow and Finley veins. Polished section examination suggests that sphalerite is late in the paragenetic sequence and crystallized toward the close of the period of chalcopyrite crystallization. Apparent eutectic intergrowths of these 2 minerals are common. Continued sphalerite crystallization resulted in the replacement of chalcopyrite by sphalerite (Peyton and Cofer, 1950).

Lumpkin County: Sphalerite is mentioned by Yeates, McCallie and King (1896, p. 307) as a very rare accessory mineral in the gold vein deposits of this county. 1. The Chestatee massive sulfide deposit, located on the Chestatee River, 6 miles (9.7 km) northeast of Dahlonega, has been the site of relatively extensive pyrite mining and exploration for base metal sulfides. Minor sphalerite is associated with pyrite and chalcopyrite in this deposit. An analysis of lump ore (Shearer and Hull, 1918, p. 194) shows 0.72 percent zinc. Diamond drilling by the United States Bureau of Mines reports the occurrence of sphalerite in small amounts and the intersection of a sulfide zone in drill hole number 5 containing 1.10 percent zinc over an interval of 38 feet (11.6 m) (Kline and Beck, 1949).

Murray County: 1. Hurst and Crawford (1970, p. 148) report fine-grained galena and minor sphalerite in veins and vugs at the Earnest galena prospect on the northwest slope of Fort Mountain, 0.6 miles (1 km) west-northwest of its summit, and about 200 feet (61 m) below a tin-roofed shack on the approach to the Earnest Mine. The sphalerite occurs in a 2-foot (0.6 m) zone of irregular quartz veins and locally disseminated within adjacent metagraywacke.

Paulding County: 1. The Little Bob massive sulfide deposit, lots 624, 625, 672, 673, 695, 697, 744 and 745, 2nd district, 3rd section, is well known for massive pyrite–pyrrhotite ore containing locally abundant

sphalerite. As observed in thin section, sphalerite occurs predominantly as an interstitial matrix for deformed pyrite grains, and as individual single crystals and groups within gangue-rich portions of ore and the immediate wall rocks. Sphalerite of the massive sulfide ores exhibits well-defined embayment of pyrite. Sphalerite as dark, purplish-brown, resinous grains is abundant on portions of the old dump, particularly between the main shaft and the creek. The property has been diamond drilled at least 3 times with impressive though spotty results with respect to zinc. One drill hole reportedly returned 2 feet (0.6 m) with an average zinc content of 7.76 percent. Another hole returned 76 feet (23.7 m) averaging 5 percent zinc and including a 4-foot (1.2 m) intersection containing 19.33 percent zinc. 2. Minor amounts of sphalerite occur at the Shirley Pyrite Mine on lot 526, 2nd district, 3rd section, a short distance northeast of the Little Bob Mine. Shearer and Hull (1918, p. 128) report that pyrite concentrated from this property contained 0.50 percent sphalerite. The occurrence of sphalerite at this property is identical to that at the nearby Little Bob deposit. 3. Trace amounts of zinc, probably as sphalerite, are reported by Shearer and Hull (1918, p. 135) at the Coggins and Smith pyrite prospect on lot 116, 2nd district, 3rd section, 4.5 miles (7.2 km) north of Hiram. 4. The Swift massive sulfide deposit on lots 1184, 1197, 1198 and 1199, 19th district, 3rd section, is known for intermittent exploration for base metal sulfides. Sphalerite occurs here associated with massive pyrite and pyrrhotite in an essentially massive lens of sulfide minerals enclosed in a mafic metavolcanic rock. The property has been diamond drilled several times. Intersections containing up to 8.36 percent zinc over a 2-foot (0.6 m) interval and 3.65 percent zinc over a 30-foot (9 m) interval have been obtained (Hurst and Crawford, 1970, p. 45–47). In polished sections sphalerite is seen to occur predominantly as an interstitial matrix for cataclastically deformed pyrite grains and as large, irregular masses intergrown with chalcopyrite and pyrrhotite. Textural evidence indicates that sphalerite crystallized after pyrite and replaced both pyrite and associated silicates (Cook, 1970, p. 46–48).

Polk County: Sphalerite has not been reported from any specific occurrence in this county, however, small amounts of zinc and lead, probably derived from sphalerite and galena, have been noted in the brown iron ores from several mines in this area (Hurst and Crawford, 1970, p. 147).

Towns County: 1. Sphalerite with massive garnet occurs on lots 28 and 35, 18th district. 2. The Geology Museum at Emory University contains a specimen of coarsely crystalline, black sphalerite accompanied by pyrite in quartz reportedly from Towns County.

Troup County: 1. Vugs containing sphalerite, fluorite, pyrite, and zeolites are reported in the Yellow Jacket Quarry immediately west of U.S. Highway 29, north of Hogansville (Furcron, 1949, p. 2–4). Sphalerite occurs in irregular, translucent, red masses included within and coating small fluorite crystals.

Wilkes County: 1. The Chambers zinc prospect on Butlers Creek, approximately 2,000 feet (610 m) west of the Magruder Gold Mine in extreme east-central Wilkes County, has been explored for sphalerite. The deposit has been examined by a 60-foot (18 m) shaft and 12-foot (3.7 m) cross cut in which "nice stringers of sphalerite" were encountered (Peyton and Cofer, 1950). Diamond drilling by the United States Bureau of Mines intersected a mineralized zone approximately 61 feet (18.6 m) thick containing erratic mineralization including one interval of 4.6 feet (1.4 m) containing 9.13 percent zinc and an adjacent interval of 1.5 feet (0.5 m) containing 12.00 percent zinc. Excellent examples of coarse-grained, massive brown sphalerite in chloritic schist can be found on the dump of this prospect.

CHALCOPYRITE

$CuFeS_2$

Class Sulfide

Cryst. Tetragonal; tetragonal-scalenohedral—$\bar{4}$ 2 m

Habit Characteristically in sphenoidal crystals resembling tetrahedrons. Usually massive.

Phys. *Fracture* uneven. Brittle. **H** 3½–4. **G** 4.1–4.3. *Luster* metallic. *Color* golden, often tarnished and iridescent. *Streak* greenish black. Opaque.

Occur.

Chalcopyrite is one of the more widely distributed sulfide minerals encountered in the crystalline rocks of Georgia. It is most frequently reported in the numerous lode gold occurrences, and in massive pyrite–pyrrhotite deposits and associated host rocks. Chalcopyrite has been prospected as an ore mineral of copper since the development of the famous Ducktown, Tennessee, deposits in the mid 1800's. Numerous

occurrences have been explored by modern methods in recent years, particularly by diamond drilling. Records of this work and examination of retained drill core have provided valuable information concerning the occurrence of this mineral.

Bartow County: 1. Very minor chalcopyrite is reported as inclusions in barite by Hull (1920, p. 56) from the Section House Barite Mine on lots 751 and 752, 4th district, in the Cartersville Mining District. 2. A similar occurrence is reported by Kesler (1950, p. 46) from the Tucker Hollow Barite Mine, lots 460 and 477, 4th district. 3. Chalcopyrite and associated tennantite are reported from an outcrop of dark-blue, fractured and silicified dolomitic rock in the east bank of U.S. Highway 411 on the north side of Pine Log Creek Bridge in the northern part of the Cartersville Mining District (Kesler, 1950, p. 46). 4. A narrow quartz vein containing chalcopyrite with enargite inclusions has been prospected along the south bank of Sugarhill Creek, 0.4 mile (0.6 km) northeast of Fairview Church, approximately 2 miles (3.2 km) due south of the above described occurrence (Kesler, 1950, p. 46).

Carroll County: 1. A minor amount of chalcopyrite is reported from the more massive portions of a sulfide deposit exploited for pyrite at the Jenny Stone prospect in the northeastern portion of the county on lot 222, 6th district, 5th section (Shearer and Hull, 1918, p. 58). 2. Minor chalcopyrite associated with coarse euhedral garnets and abundant pyrite in an altered amphibolite occurs at the Lassiter pyrite prospect, lot 188, 5th district, 3rd section. 3. A similar occurrence has been diamond drilled at the Askew pyrite prospect on lot 166, 5th district, 3rd section, about 3 miles (4.8 km) west of Villa Rica.

Cherokee County: 1. The unusual occurrence of accessory chalcopyrite in a muscovite-bearing pegmatite at the Amphlett Mica Mine, lot 46, Conn Creek district, 0.4 mile (0.6 km) S30°E of Conn Church, is reported by Heinrich and Jahns (1953, p. 378). 2. A small quantity of chalcopyrite was encountered below the water table in the extensive underground workings of the Franklin-Creighton Gold Mine, centering on lots 466 and 467 in extreme east-central Cherokee County. Associated minerals are ankerite, pyrite, and pyrrhotite. 3. Chalcopyrite, constituting up to several percent of the prospected material, has been described from the Dickerson property on lots 856, 857, 872, 873 and 874, approximately 7 miles (11 km) east of Canton (Shearer and Hull, 1918, p. 162). 4. Very minor chalcopyrite associated with pyrite and various carbonate minerals occurs in quartz pods contained in chlorite schist exposed at the Little River arm of Allatoona Lake. 5. Chalcopyrite was an important accessory mineral at the Rich or Canton Copper Mine on lots 127, 128, 161 and 162, 14th district, 2nd section, approximately one mile (1.6 km) south of the center of Canton. Important associated minerals are pyrite, pyrrhotite, galena and arsenopyrite. 6. Chalcopyrite was a minor accessory mineral in the massive pyrite ore formerly exploited at the Standard Mine on lots 462, 3rd district, 2nd section, about 7 miles (11 km) southeast of Ball Ground and adjacent to the Franklin-Creighton Gold Mine. Diamond drilling records indicate that chalcopyrite occurred in narrow zones within the pyrite ore body. The highest copper content reported is 3.04 percent over an interval of 1.5 feet (2.4 km). This same interval contained 4.63 percent zinc. 7. A quartz vein exploited at the Stansill Gold Mine, lot 848, 20th district, contains irregular zones rich in pyrite and chalcopyrite (Yeates, McCallie and King, 1896, p. 260).

Columbia County: 1. Hurst, Crawford and Sandy (1966, p. 189) report that drill core containing relatively abundant chalcopyrite has been obtained in the vicinity of Pollards Corner. A preliminary soil geochemical survey in the immediate area revealed no strong copper anomaly.

Dawson County: . Minor chalcopyrite occurs in the mineralized zone exposed in the old workings of the Kin Mori Gold Mine, about 4 miles (6 km) south of Dawsonville.

Douglas County: 1. Examination of diamond drill core from the Villa Rica or Sulfur Mining and Railroad Company Pyrite Mine, 3 miles (4.8 km) north-northwest of Villa Rica and immediately east of Georgia Highway 61, indicates that minor chalcopyrite was present in portions of the massive sulfide ore body. Chalcopyrite occurs predominantly as inclusions within pyrite and sphalerite in portions of the ore zones containing relatively abundant sphalerite (Cook, 1970, p. 69).

Fannin County: 1. Chalcopyrite was the primary ore mineral exploited below water table at the Number Twenty Copper Mine, lot 20, 9th district, 2nd section. The occurrence is classified as a Ducktown-type massive sulfide deposit consisting essentially of massive pyrite and pyrrhotite with accessory chalcopyrite, sphalerite and galena. A zone of supergene ore consisting predominantly of chalcocite was mined prior to the exploitation of the chalcopyrite ores. Accessory and gangue minerals within the deposit are quartz, calcite, actinolite, tremolite, diopside, ziosite and garnet. 2. A similar occurrence is at the old Mobile Copper Mine located on lot 59, 9th district, 2nd section, approximately one mile (1.6 km) south of the Number Twenty Copper Mine. Chalcopyrite occurs here associated primarily with pyrrhotite in a gangue of calcium-silicate minerals similar to those previously described (1 above). 3. Chalcopyrite and accessory malachite have been prospected on the Phillips property, lot 21, 9th district, 2nd section, immediately adjacent to the Number Twenty Mine property on the west. 4. Chalcopyrite has been prospected at the Sally

Jane copper prospect mid-way between the Mobile Copper Mine and Copperhill, Tennessee. 5. Chalcopyrite has been prospected at the Jeptha Patterson prospect on a ridge 0.5 mile (0.8 km) southwest of Pierceville. 6. Chalcopyrite with minor pyrrhotite occurs in numerous prospect pits and adits on Mount Pisgah, approximately 9 miles (14 km) southwest of Copperhill, 1.2 miles (1.9 km) southwest of Higdons store. 7. Chalcopyrite-bearing samples are reported from lot 56, 9th district, and from the Deering property. Additional information on these occurrences is not available. 8. Small crystals of chalcopyrite are reported in Murphy Marble exposed along Hame String Creek at the base of High Top Mountain (McCallie, 1894, p. 23). 9. A similar occurrence of chalcopyrite is on Weaver Creek, lots 239 and 240, 8th district, 2nd section, approximately one mile (1.6 km) east of Blue Ridge (McCallie, 1894, p. 26).

Fulton County: 1. Minor amounts of chalcopyrite were found associated with pyrite at the Cash prospect on lot 34, 14th district, about one mile (1.6 km) south-southwest of Ben Hill (Shearer and Hull, 1918, p. 143–145). 2. Coarse-grained chalcopyrite in a milky quartz vein has been prospected on the Jett property. The exact location of this occurrence is not known.

Gilmer County: 1. Chalcopyrite is a local accessory mineral in Murphy Marble exposed on the Gartrell property, generally known as Marble Bluff, along the east side of Tolona Valley below the mouth of Price's Creek (McCallie, 1894, p. 34).

Greene County: 1. Chalcopyrite was the predominant copper mineral below water table at the old Tuggle Copper Mine, about 4 miles (6.4 km) northeast of Union Point. The deposit is on the north side of the south fork of Little River near Durhamtown Community on land owned by Mercer Reynolds. Malachite is the predominant secondary mineral above water table and is relatively abundant on the old dumps. 2. Chalcopyrite crystals exceeding one inch (2.54 cm) in diameter were exposed in an altered portion of the Siloam Granite during construction of Interstate Highway 20, approximately one mile (1.6 km) northeast of Siloam. Chalcopyrite has also been reported from the aggregate quarry immediately south of this occurrence. Associated minerals are very minor fluorite, pyrite and molybdenite.

Gwinnett County: 1. Chalcopyrite-bearing rock was submitted to the Georgia Geological Survey in 1899 from the Owens Gold Mine, lot 343, 7th district, approximately 3 miles (5 km) west of Buford. Associated minerals are malachite and azurite. 2. Coarse-grained chalcopyrite and pyrrhotite in a pyroxene-bearing rock was exposed during the foundation construction for Buford Dam.

Habersham County: 1. An interesting occurrence of chalcopyrite, malachite, corundum, and garnet within an altered ultramafic rock is described by Hurst and Crawford (1964, p. 32) from the forks of Amos Creek at its headwaters on the west side of Alec Mountain. 2. A three-foot (0.9 m) thick vein of pyrrhotite and pyrite containing scattered chalcopyrite has been prospected on the north side of Bog Shoals Branch, locally known as Horse Creek, approximately 2,000 feet (610 m) upstream from its intersection with Panther Creek (Hurst and Crawford, 1964, p. 125). The location is approximately 2 miles (3.2 km) southwest of Yonah Lake and may be reached via Georgia Highway 184.

Haralson County: 1. Minor chalcopyrite in hypogene sulfide ore is indicated by analyses presented by Espenshade (1963, p. 19) for pyritic ore from the Reeds Mountain Pyrite Mine, lot 246, 7th district, 5th section, approximately 1.5 miles (2.4 km) southeast of Bremen. Analysis of gossan shows a content of 0.22 percent copper. 2. Minor chalcopyrite occurs in massive pyrite ore formerly exploited at the Smith-McCandless pyrite prospect on lot 851, 20th district, 3rd section, in the northeastern corner of the county. Analysis of gossan overlying hypogene ore indicates 0.53 percent copper (Espenshade, 1963, p. 19). 3. One of the most productive copper mines in the state was the Tallapoosa or Waldrop Copper Mine on lot 932, 20th district, about 3.1 miles (5 km) N44°W from Draketown. Chalcopyrite occurs here in a conformable lens of pyrite-rich ore which strikes N35°E and varies in dip from 25° to 60° southeast. The property has been explored by diamond drilling by various groups including the United States Bureau of Mines. Drilling has shown that the occurrence is persistent with depth and that chalcopyrite-bearing intervals contain up to 6 percent copper over widths of 4 feet (1.2 m) (Ballard and McIntosh, 1948, p. 6).

Jasper County: 1. Minor chalcopyrite has been reported from various portions of the extensive Gladesville Norite body centering approximately 5 miles (8 km) south of Monticello. A single diamond drill hole put down by the Georgia Geological Survey intersected several zones containing scattered chalcopyrite and associated pyrrhotite in a bronzite-rich portion of the norite. 2. Chalcopyrite, chalcocite and bornite are the dominant sulfides in narrow veins exposed in the Enon Church Feldspar Mine east of Georgia Highway 83, approximately 6 miles (9.7 km) south of Monticello near Gladesville.

Lincoln County: 1. Chalcopyrite and associated galena, sphalerite, pyrite and barite occur in the silicified shear zones and veins formerly exploited for gold and later for copper at the Magruder Mine in the extreme western part of the county, approximately 2.5 miles (4 km) east of Metasville. Selected samples of ore from this property contain up to 9.95 percent copper (Shearer and Hull, 1918, p. 224). 2. Jones (1902, p. 97) describes a two-foot (0.6 m) wide quartz vein containing galena, pyrite, chalcopyrite and native gold at

the Ramsey Gold Mine, approximately 2.2 miles (3.5 km) S39°E from Amity in the southeast corner of the county. The shafts and prospect pits described by Jones are now largely obscured; some are covered by the Clark Hill Reservoir. The site of former prospecting is located on the east side of a small inlet and south of the old Kelly homestead (Hurst, Crawford and Sandy, 1966, p. 233). 3. A similar chalcopyrite-bearing quartz vein was exploited at the Paschal Gold Mine, approximately 0.6 mile (1 km) S7°E from Clayhill in the southwest corner of the county. The mine was located on Hickorynut Hill, about one mile (1.6 km) southwest of the Dill residence, 0.25 mile (0.4 km) south of Clayhill Post Office. Coarsely crystalline chalcopyrite occurs with pyrite, galena and native gold in a quartz vein up to 4 feet (1.2 m) wide. 4. Dump material from the Phillips Gold Mine, approximately 2.6 miles (4 km) S50°E from Woodlawn in the south-central part of the county, contains pyrite, galena and chalcopyrite (Hurst, Crawford and Sandy, 1966, p. 238). 5. Jones (1909, p. 100) describes chalcopyrite and associated galena and pyrite in a quartz vein at the Julia Gold Mine, approximately 0.5 mile (0.8 km) north of Little River. This property could not be relocated by Hurst, Crawford and Sandy in 1966 and is probably covered by Clark Hill Reservoir.

Lumpkin County: 1. Chalcopyrite was apparently a widely distributed, though rather rare, accessory mineral below water table in the lode gold deposits formerly exploited in the Dahlonega gold district. Yeates, McCallie and King (1896) mention its presence in ores of the Lockhard, Singleton, Yahoola, and Battle Branch Gold Mines but give no details of the mineral's occurrence. 2. Chalcopyrite was the primary copper mineral exploited below water table at the Chestatee massive sulfide deposit on the south side of the Chestatee River, about 1.75 miles (2.7 km) below its junction with Tesnatee Creek, approximately 6 miles (10 km) northeast of Dahlonega. Diamond drilling by the United States Bureau of Mines (Kline and Beck, 1949) report intersections up to 38.7 feet (11.8 m) containing 0.9 percent copper, presumably as chalcopyrite. Accessory minerals are predominantly pyrite with minor chalcocite reported above water level. 3. A narrow quartz vein containing chalcopyrite was formerly exploited for gold at the Wells Gold Mine, approximately 0.5 mile (0.8 km) southwest of Auraria on lot 1213, 12th district (Yeates, McCallie and King, 1896, p. 483). 4. An interesting copper prospect, presumably containing rather abundant chalcopyrite, is situated on lots 241 and 242, 6th district, 1st section, adjacent to the Union County line. The prospect is at the head of a valley on the south side of the Blue Ridge, one mile (1.6 km) east of Winding Stair Gap and about 12 miles (19.3 km) northwest of Dahlonega. The deposit is apparently a vein of almost massive sulfides reportedly 10 or 12 feet (3 or 3.6 m) thick and locally containing up to 15 percent copper (Shearer and Hull, 1918, p. 198).

McDuffie County: 1. Chalcopyrite was an important accessory constituent of numerous gold-bearing veins in an area of formerly intensive gold mining, approximately 11 miles (17.7 km) northwest of Thompson and immediately north of U.S. Highway 78. The area is known locally as the Columbia Gold Mine area and historically was one of the most productive in Georgia. Chalcopyrite associated with galena, pyrite, covellite, native gold, pyromorphite, barite and scheelite has been reported by various authors from the Hamilton, Porter, Landers, Parks, and Columbia Mines (Jones, 1909; Hurst, Crawford and Sandy, 1966).

Murray County: 1. The presence of copper sulfide, presumably chalcopyrite, is indicated by malachite stains on mineralized dump material and outcrops at the Mill Creek copper prospect along Mill Creek Road, 3 miles (4.8 km) east-northeast of the railroad crossing at Crandall. The mineralized zone is apparently a shear zone containing relatively abundant pyrite and other sulfides (Hurst and Crawford, 1970, p. 145). 2. Scattered coarse patches of pyrite and chalcopyrite occur in fractured and vuggy vein quartz at the Leadmine Branch copper prospect in the bed of Leadmine Branch, 0.6 miles (1 km) south of Holly Creek. The largest veins exposed by prospecting are 2 feet (0.6 m) thick (Hurst and Crawford, 1970, p. 145).

Oglethorpe County: 1. Chalcopyrite and pyrite were the chief sulfides in a quartz vein exploited for gold at the Morgan Mine, approximately 2 miles (3.2 km) north of U.S. Highway 78, 6.5 miles (10.4 km) southeast of Lexington. 2. Very minor chalcopyrite occurs with pyrite and secondary malachite in a small quartz vein at the Guarantee Gold Mine immediately south of U.S. Highway 78, approximately 5.5 miles (8.9 km) southeast of Lexington and 2 miles (3.2 km) southwest of the Morgan Gold Mine.

Paulding County: 1. Chalcopyrite is a common accessory mineral in the Swift massive sulfide deposit, 19th district, 3rd section, in extreme southwest Paulding County, approximately 1.5 miles (2.4 km) east of Draketown. Dominant sulfide minerals are pyrite, pyrrhotite, sphalerite and very minor galena. Chalcopyrite occurs in sphalerite-rich zones and is locally intergrown with pyrrhotite. Cubanite and valleriite occur locally as inclusions within chalcopyrite (Cook, 1970, p. 48). Diamond drilling by the New Jersey Zinc Company returned intersections containing 1.2 percent copper as chalcopyrite over a width of 22 feet (6.7 m) and a high-grade intersection of 3.38 percent copper over one foot (0.3 m). 2. Chalcopyrite is an important ore mineral in the Little Bob massive sulfide deposit within the 2nd district, 3rd section of Paulding County, approximately 2 miles (3.2 km) northwest of Hiram. Chalcopyrite is localized within sphalerite-rich portions

of the deposit and within altered wall rock. Predominant sulfides in the deposit are pyrite and pyrrhotite. Inclusions of valeriite and cubanite are present in coarse-grained chalcopyrite. Diamond drilling by the New Jersey Zinc Company returned intersections of up to 76.5 feet (23.3 m) containing 0.4 percent copper as chalcopyrite with high-grade intersections containing up to 2 percent copper over 3.5 feet (1 m). 3. Chalcopyrite is an important constituent of a small massive sulfide body at the Rush-Banks property, lot 189, 19th district, 3rd section, in the western part of the county. The property is 3 miles (4.8 km) southwest of Hanlin and 3.5 miles (5.6 km) southwest of McPheron. Analyses of sulfide-rich material reported by Shearer and Hull (1918, p. 109) indicate a maximum copper content of 12.35 percent for selected samples. 4. Minor disseminated chalcopyrite occurs in altered hornblende gneiss in a prospect adit at the McGruder copper prospect, 2.05 miles (4 km) due west of Huntsville on the east bank of Raccoon Creek (Hurst and Crawford, 1970, p. 50).

Pickens County: 1. Sparse euhedral, though quite small, chalcopyrite crystals occur on calcite crystals in cavities encountered at the New York and other quarries at Marble Hill. 2. Chalcopyrite is relatively abundant in Murphy Marble exposed on the Disheroom property, approximately one mile (1.6 km) east of Marble Hill on the east branch of Longswamp Creek (McCallie, 1894, p. 39).

Putnam County: 1. Euhedral chalcopyrite crystals up to 0.25 inch (0.6 cm) in diameter occur with pyrite and molybdenite in quartz veins along Georgia Highway 16 immediately west of Crooked Creek. The veins cut biotite gneiss and migmatite.

Rabun County: 1. Chalcopyrite and pyrrhotite occur in a mineralized zone on the east-west line between lot 48 and 49, 6th district, 11 miles (17.7 km) west-northwest of Clayton and 0.5 mile (0.8 km) east of Tom Coward Gap (Shearer and Hull, 1918, p. 205). 2. Considerable pyrite and chalcopyrite are reported in an approximately 30-foot (9 m) wide mineralized zone at the Moore Girls Gold Mine on lot 58 and 59, 1st district, near Persimmon Creek (Yeates, McCallie and King, 1896, p. 97).

Towns County: 1. Analytical work by Espenshade (1963, p. 19) reflects the presence of copper, presumably as chalcopyrite, below water table in the Berrong or Johnson copper prospect on lot 196, 18th district, 1st section, approximately 0.5 mile (0.8 km) north of Buck Knob and 4 miles (6.4 km) south-southeast of Hiawassee.

White County: 1. Chalcopyrite and associated pyrite, calcite and scheelite occur in amphibolite along U.S. Highway 129, 2.75 miles (4.4 km) northwest of Cleveland (Hurst and Otwell, 1964, p. 82). 2. Minor chalcopyrite and pyrite occur in a small quartz vein on lot 41, 3rd district.

Wilkes County: 1. Chalcopyrite and associated malachite occur in a series of quartz lenses exposed in a cut along a secondary road approximately 4.5 miles (7.2 km) S30°E of Metasville (Hurst, Crawford and Sandy, 1966). 2. Pyrite and minor chalcopyrite were exposed in quartz lenses at the Latimer Gold Mine approximately 3.8 miles (6 km) N34°W of Rayle in the west-central part of the county. 3. Minor chalcopyrite is associated with malachite, azurite, bornite, chalcocite, and epidote in a silicified zone at the Youngs Chapel copper prospect, approximately 3.5 miles (5.6 km) west of Washington along the ridge between Youngs Chapel and Beaver Dam Creek. 4. A minor amount of chalcopyrite was encountered in altered hornblende gneiss during United States Bureau of Mines diamond drilling at the Chambers prospect on Butlers Creek, approximately 2,000 feet (610 m) west of the McGruder Gold Mine in the extreme east-central portion of the county. Associated sulfides are sphalerite, pyrite and minor galena. Smithsonite and rhodonite are also reported (Peyton and Cofer, 1950, p. 22–23). A 5-foot (1.5 m) interval intersected during drilling returned 0.54 percent copper, presumably as chalcopyrite.

PYRRHOTITE

$Fe_{1-x}S$

Class Sulfide

Cryst. Hexagonal; dihexagonal-dipyramidal—6/m 2/m 2/m

Habit Tabular to platy crystals. Usually massive, granular.

Phys. *Cleavage* none. *Fracture* uneven to subconchoidal. Brittle. **H** 3½–4½. **G** 4.6–4.8. *Luster* metallic. *Color* bronze-yellow to bronze-brown, tarnishing quickly on exposure. *Streak* grayish black.

Occur.

Phyrrhotite is physically similar to pyrite and as such has been historically grouped with pyrite in the discussion of Georgia sulfide occurrences. It occurs as an accessory mineral in numerous high-grade metamorphic rocks, with pyrite in quartz veins exploited for gold, and with pyrite and other sulfide minerals in massive sulfide deposits explored for copper and exploited in the early 20th century for sulfur.

Carroll County: 1. Lenticular masses of pyrrhotite are quite common in drill core from the Lasseter prospect, lot 188, 5th district, 3rd section. 2. Similar pyrrhotite occurs with pyrite in hornblende gneiss at the Askew pyrite prospect, lot 166, approximately 3 miles (4.8 km) west of Villa Rica.

Cherokee County: 1. An unusual pegmatite containing relatively abundant pyrrhotite and chalcopyrite in addition to tourmaline, garnet, apatite, beryl, columbite, and uranium minerals was exploited at the Amphlett Mica Mine near Conn Church, about 4.3 miles (7 km) S86°E of Ball Ground (Heinrich and Jahns, 1953, p. 378). 2. Stringers of coarsely crystalline pyrrhotite occur in shear zones formerly exploited for gold at the Franklin-Creighton Gold Mine centering on lots 466 and 467 in extreme east-central Cherokee County. Associated minerals are gold, chalcopyrite, pyrite and ankerite.

Douglas County: 1. Pyrrhotite and associated pyrite were extensively exploited for sulfur at the Villa Rica or Sulfur Mining and Railroad Company Mine, approximately 3 miles (4.8 km) north-northeast of Villa Rica adjacent to Georgia Highway 61.

Fannin County: 1. Coarse-grained pyrrhotite associated with pyrite, chalcopyrite, and sphalerite is abundant in the massive sulfide deposit formerly exploited at the Number Twenty Copper Mine, lot 20, 9th district, 2nd section. 2. Pyrrhotite is abundant in a similar occurrence at the Mobile Copper Mine, lot 59, 9th district, 2nd section, approximately one mile (1.6 km) south of the Number Twenty Mine. Pyrite and chalcopyrite associated with a complex suite of calcium silicate minerals accompany the pyrrhotite. 3. Pyrrhotite, chalcopyrite, and pyrite are locally abundant in numerous prospect pits and adits on Mount Pisgah, approximately 9 miles (14.4 km) southwest of Copper Hill and 1.2 miles (1.9 km) southwest of Higdons store (Shearer and Hull, 1918, p. 218–220).

Gilmer County: 1. Pyrrhotite and minor chalcopyrite occur in several narrow quartz veins in the vicinity of Cherrylog.

Gwinnett County: 1. Coarse-grained pyrrhotite with accessory chalcopyrite and augite was exposed during the construction of Buford Dam.

Habersham County: 1. Pyrrhotite is the dominant sulfide mineral in a brecciated quartz vein approximately 800 feet (244 m) N80°E from the mouth of a creek known locally as Horse Creek, labeled "Big Shoal Branch" on the topographic maps, and known locally as the Panther Creek propsect. The occurrence is on lot 208, 12th district, approximately 2.5 miles (4 km) from Turnerville. The vein has been prospected for both chalcopyrite and pyrrhotite. 2. Massive pyrrhotite occurs on the George Robinson property near Tallulah Falls. Samples of this material are in the geology museum at Emory University.

Hart County: 1. Pyrrhotite is an accessory mnineral in the pegmatite exploited at the Taylor Mica Mine, 5.3 miles (8.5 km) northwest of Hartwell (Lesure, 1962, p. 1).

Lumpkin County: 1. Pyrrhotite was apparently the second most abundant sulfide encountered below water level in the numerous lode gold occurrences of the Dahlonega district. Mines containing relatively abundant pyrrhotite are the Field, Lockhart, Benning, Jumbo, Etowah, and Battle Branch (Park, 1953, p. 110). 2. Pyrrhotite was an important constituent of the sulfide ores formerly exploited as a source of sulfur at the Chestatee mine on the south side of the Chestatee River, about 1.75 miles (2.8 km) below its junction with Tesnatee Creek, approximately 6 miles (10 km) northeast of Dahlonega.

Paulding County: Pyrrhotite is an important sulfide mineral in the numerous massive and disseminated sulfide occurrences in this county. It is typically associated with pyrite and minor sphalerite and chalcopyrite in sulfide lenses within altered metavolcanic rocks. 1. Pyrrhotite is abundant at the Little Bob Pyrite Mine, 2nd district, 3rd section, approximately 2 miles (3.4 km) northwest of Hiram. The typical occurrence is as foliated masses near the sulfide-zone margins. Most pyrrhotite exhibits the effects of cataclasis, reflected by such features as deformation twinning, preferred grain orientation and twins, and sub-grain formation (Cook, 1970, p. 26). Pyrrhotite is also abundant in massive sulfide zones as a matrix for other sulfide minerals. 2. Pyrrhotite is abundant in the Swift massive sulfide deposit, 19th district, 3rd section, 1.5 miles (2.4 km) east of Draketown. It is most abundant in massive ore, occurring as large aggregates of interlocking grains. Larger pyrrhotite masses are characterized by randomly distributed inclusions of corroded, subhedral pyrite crystals up to 0.5 inch (1.3 cm) in diameter. Pyrrhotite of this occurrence exhibits the same deformational effects as that of the Little Bob deposit (Cook, 1970, p. 46). 3. Similar pyrrhotite occurs within the relatively small massive sulfide body at the Rush-Banks prospect, lot 189, 19th district, 3rd section, in the western part of the county. Associated minerals are pyrite, chalcopyrite and sphalerite.

Pickens County: 1. Pyrrhotite is locally abundant in a quartz vein near Whitestone (Shearer and Hull, 1918, p. 24).

Rabun County: 1. Pyrrhotite and chalcopyrite are the dominant sulfides in a mineralized zone at Tom Coward Gap. The occurrence is on the east-west line between lots 48 and 49, 6th district, 11 miles (17.7 km) west-northwest of Clayton and 0.5 mile (0.8 km) east of the gap.

TROILITE

FeS

Class Sulfide

Cryst. Hexagonal; dihexagonal-dipyramidal—6/m 2/m 2/m

Phys. Commonly massive, compact granular; *Cleavage* none. **H** 3½–4½. **G** 4.67–4.82 (Meas.), 4.85 (calc.). *Luster* metallic, opaque. *Color* light grayish brown; rapidly tarnishes to bronze-brown. *Streak* black.

Occur.

There are no known occurrences of terrestrial troilite in Georgia; however, it has been reported as inclusions within the Pitts, Social circle, and Thompson meteorites (see Iron).

VALLERIITE

$4(Fe,Cu)S \cdot 3(Mg,Al)(OH)_2$

Class Sulfide

Cryst. Hexagonal-R; hexagonal-scalenohedral—$\bar{3}$ 2/m; ditrigonal scalenohedral—3 2/m

Habit Massive resembling pyrrhotite in color and graphite in physical properties.

Phys. *Cleavage* {0001} perfect. **H** very soft, sooty. **G** 3.09–3.14 (meas.), 4.26 (x-ray). *Luster* metallic, opaque. *Color* bronze-yellow; cream-white, highly anisotropic in reflected light.

Occur.

Paulding County: 1. Valleriite occurs as oriented, lamellar intergrowths within chalcopyrite of the Little Bob massive sulfide deposit, 2nd district, 3rd section, approximately 2 miles (3.4 km) northwest of Hiram. The mineral is light brown and exhibits extreme anisotropism from white to gray in polished section. Lamellae are generally less than 0.001 inch (0.003 cm) wide and lie en echelon within the enclosing chalcopyrite. Textural relations suggest that the valleriite is the product of exsolution (Cook, 1970, p. 30). 2. An identical occurrence of valleriite is at the Swift massive sulfide deposit, 19th district, 3rd section, approximately 1.5 miles (2.4 km) east of Draketown. The mineral occurs as narrow lamellae and threads in chalcopyrite masses containing cubanite (Cook, 1970, p. 48).

PENTLANDITE

$(Fe,Ni)_9S_8$

Class Sulfide

Cryst. Isometric; hexoctahedral—4/m $\bar{3}$ 2/m

Habit Massive, usually in granular aggregates, sometimes in large pieces showing continuous parting plane (?).

Phys. *Cleavage* none. Parting {111}. *Fracture* conchoidal. Brittle. **H** 3½–4. **G** 4.6–5.0; 4.956 (calc. for $(Fe,Ni)_9S_8$ with F=Ni=1:1 and a_0 9.91); 5.185 (calc. for $(Fe,Ni)_9S_8$ with F : Ni = 2 : 1 and a_0 10.09). M.P. 878°. *Luster* metallic. *Color* light bronze-yellow. *Streak* light bronze-brown. Nonmagnetic. Opaque.

Occur.

Jasper County: 1. Pentlandite has been observed microscopically in polished sections of pyrrhotite-rich sections of a Georgia Geological Survey drill core from the Gladesville Norite, approximately 5 miles (8 km) south of Monticello and approximately 0.5 mile (0.8 km) south of the Feldspar Corporation Plant. Pentlandite forms exsolution "flames" within pyrrhotite and is associated with chalcopyrite.

Towns County: 1. Trace amounts of pentlandite exhibiting characteristic flame texture occur within pyrrhotite in troctolites exposed in the vicinity of Lake Chatuge (Hartley, 1973, p. 26).

CUBANITE
$CuFe_2S_3$

Class Sulfide

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Elongated {001}; thick tabular {001}; thick tabular {110}. Common forms: c b l m y o r p; {001} striated {010}. Also massive.

Phys. *Cleavage* none. Parting on {110} and {1$\bar{3}$0}. *Fracture* conchoidal. **H** 3½ (crystals). **G** 4.03–4.18 (massive), 4.101 (Sudbury crystals); (4.076) calc. Strongly magnetic with {010} as the magnetic axis. *Color* brass to bronze-yellow. Opaque. In polished section anisotropic.

Occur.

Douglas County: 1. Very minor cubanite has been reported in polished sections of drill core from the Villa Rica massive sulfide deposit in the northwestern corner of the county, approximately 3 miles (4.8 km) north-northwest of Villa Rica and immediately east of Georgia Highway 61. Cubanite occurs here as tapered lamellar inclusions within and near the margins of chalcopyrite grains (Cook, 1970, p. 69).

Paulding County: 1. Chalcopyrite-rich portions of the Little Bob massive sulfide deposit, 2nd district, 3rd section, approximately 2 miles (3.2 km) northwest of Hiram, contain minor cubanite intimately associated with chalcopyrite. Cubanite occurs as tapered lamellae and threads in chalcopyrite and as irregular, anhedral grains around the margin of cubanite-free chalcopyrite and pyrrhotite aggregates (Cook, 1970, p. 29). 2. An identical cubanite occurrence is reported by Cook (1970, p. 48) at the Swift massive sulfide deposit, 19th district, 3rd section, approximately 1.5 miles (2.4 km) east of Draketown. Similar cubanite occurrences have been described in Ducktown ores by Carpenter (1965, p. 19) and are believed to be the product of solid solution unmixing (Ramdohr, 1960, p. 581).

COVELLITE
CuS

Class Sulfide

Cryst. Hexagonal; dihexagonal-dipyramidal—6/m 2/m 2/m

Habit Rarely in hexagonal plates. Commonly massive or spheroidal.

Phys. *Cleavage* basal perfect. Flexible in thin leaves. **H** 1½–2. **G** 4.6–4.76. *Luster* submetallic to resinous; dull when massive. *Color* indigo-blue. *Streak* grayish black, shining.

Occur.

Covellite has been reported from relatively few specific locations within the state, though it is an unquestionable constituent of enriched near-surface copper ores exploited at numerous locations such as the Number Twenty Mine in Fannin County and properties in the west-central Georgia massive sulfide district. Normally in these occurrences, it is finely intergrown with dominant sooty chalcocite and can only be recognized microscopically.

Cherokee County: 1. Covellite aggregates, retaining the cubic cleavage of galena and originally considered to be a new mineral, are described by Dana (1892, p. 69) from the Rich or Canton Copper Mine, lots, 127, 128, 161 and 162, 14th district, 2nd section, one mile (1.6 km) south of Canton. The covellite is apparently pseudomorphous after chalcocite which has replaced galena in the enriched zone of the massive sulfide ore body.

Douglas County: 1. Supergene covellite has been identified by polished section examination of drill core from the Villa Rica or Sulphur Mining and Railroad Company Mine, approximately 3 miles (4.8 km) north-northeast of Villa Rica adjacent to Georgia Highway 61. Covellite replaces cataclastically deformed chalcopyrite along fractures and grain boundaries in the near-surface ores. Narrow chalcopyrite veins in

silicates and pyrite are replaced by covellite at the chalcopyrite–silicate and chalcopyrite–pyrite interfaces (Cook, 1970, p. 69).

Haralson County: 1. Replacement of chalcopyrite by covellite is conspicuous in massive pyrite ore from the Tallapoosa or Waldrop Copper Mine on lot 932, 20th district, about 3.1 miles (5 km) N44°W of Drake-town. Covellite is seen in polished section to replace chalcopyrite in shattered pyrite grains, particularly along the chalcopyrite–pyrite grain boundaries. The central portions of larger covellite masses are locally replaced by later chalcocite (Cook, 1970, p. 84).

Jasper County: 1. Minor covellite occurs with bornite, chalcocite, chalcopyrite, azurite, malachite, and flourite in green microcline-rich portions of the Enon Church Feldspar Mine, approximately 6 miles (10 km) south of Monticello on Georgia Highway 83 near Gladesville.

Lincoln County: 1. Minor covellite replaces chalcopyrite in enriched ore near water level in the Magruder Gold Mine, approximately 2.5 miles (4 km) east of Metasville in the extreme western part of the county.

McDuffie County: 1. Aggregates of covellite and chalcocite up to 0.5 inch (1.3 cm) in diameter replace chalcopyrite in a quartz vein exposed at the Parks Gold Mine near the Columbia Gold Mine, approximately 11 miles (17.7 km) northwest of Thompson, immediately north of U.S. Highway 78. Megascopic native gold commonly occurs in the central portion of the covellite–chalcocite aggregates.

Paulding County: 1. Covellite and associated chalcocite are reported in polished sections of drill core from enriched portions of the Little Bob pyrite deposit, 2nd district, 3rd section, approximately 2 miles (4.8 km) northwest of Hiram (Cook, 1970, p. 30). Covellite typically replaces chalcopyrite veins in fractured pyrite. Sphalerite and pyrite grains are locally coated and embayed by thin films of covellite. In polished surfaces the covellite exhibits an extreme pleochroism and a tendency to tarnish rapidly when exposed to air. Chalcocite occurs as irregular networks in covellite. 2. Isolated masses of chalcopyrite show apparent rim replacement along grain boundaries by covellite in polished sections of massive sulfide ore from the Swift deposit, 19th district, 3rd section, approximately 1.5 miles (2.4 km) east of Draketown (Cook, 1970, p. 48).

Wilkes County: 1. Minor covellite replacing other sulfides occurs with bornite, chalcopyrite, pyrite, native copper, malachite, and azurite in a massive white quartz lens at the Youngs Chapel copper prospect, approximately 3.5 miles (5.6 km) west of Washington along the ridge between Youngs Chapel and Beaver Dam Creek.

STIBNITE

Sb_2S_3

Class Sulfide

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Stout to slender prismatic crystals. Commonly, in radiated groups, columnar masses, and granular.

Phys. *Cleavage* perfect {010}. Highly flexible; not elastic. **H** 2. **G** 4.61–4.66. *Luster* metallic. *Color* and *streak* lead-gray. Opaque.

Occur.

DeKalb County: 1. Gray stibnite crystals associated with black tourmaline are reported from a pegmatite exposed at the operations of Consolidated Quarries (Hurst, 1958c, p. 48). One curved prism is described as being 1.5 inches (3.8 cm) long by 0.5 inch (1.3 cm) across. In addition to crystals, the stibnite forms thin steel gray coatings on fractures and cleavages in feldspar crystals.

PYRITE

FeS_2

Class Sulfide

Cryst. Isometric; diploidal—2/m $\bar{3}$

Habit Crystals common; most frequently cubic, less commonly pyritohedral or octahedral. Often massive, fine granular, radiated, reniform, globular, or stalactitic.

Phys. *Cleavage* indistinct. *Fracture* conchoidal. Brittle. **H** 6–6½. **G** 5. *Luster* metallic. *Color* brass-yellow; iridescent when tarnished. *Streak* greenish black.

Occur.

Pyrite is the most common, widely distributed sulfide mineral in Georgia. It occurs in at least accessory amounts in rocks of virtually every type and age. Pyrite occurs in innumerable locations as concretionary masses associated with lignite in Cretaceous and younger sediments of the Coastal Plain region. It occurs below water table in almost every quartz vein that has been exploited for gold. Pyrite is a major constituent of Ducktown-type massive sulfide deposits which have been prospected in north- and west-central Georgia.

Pyrite was exploited in the early 20th century from numerous occurrences as a source of sulfur. The localities described below are those which have been either previously exploited for commercial pyrite, and have produced pyrite of specimen quality, or contain economic iron deposits that owe their origin at least in part to the oxidation of pyrite in the subsurface.

Bartow County: It was shown by Kesler (1950) that the brown iron oxide ores exploited in Bartow and Polk Counties are in part residual after weathered sulfides, predominantly pyrite. Recent examination of these gossans (Hurst and Crawford, 1970) indicates that pyrite occurs in thin, tabular veinlike deposits characterized by pinching and swelling, and in larger, more irregularly shaped massive bodies. Even larger zones of disseminated sulfides or pyritic country rocks account for some of the brown ores. Much of the pyrite appears to be localized in fault zones averaging 5 to 15 feet (1.5 to 4.6 m) wide. A few typical occurrences in which pyrite has been exposed by deep mining are presented below.

1. Massive pyrite is exposed in the northeastern-most cut of the Conner Iron Mine, lot 181, 22nd district, 1.1 miles (1.8 km) east of White. 2. Lenses of massive, fine- to coarse-granular pyrite are exposed at the northern end of the large open cut of the Big Mountain Iron Mine, lot 179 and 182, 22nd district, 1.5 miles (2.4 km) east of White. Pyrite is within fractured and brecciated quartzite. The property has been explored by the Tennessee Copper Company. 3. Massive pyrite is exposed in the bottom of the main open cut of the Black Bank Iron Mine, lot 186, 22nd district, 3.3 miles (5.3 km) east of White (Hurst and Crawford, 1970, p. 132). 4. A pyritized fault zone is well exposed in the Peachtree Iron Mine, lot 148, 22nd district, 2.6 miles (4.2 km) southeast of White (Hurst and Crawford, 1970, p. 128). 5. A similar mineralized fault zone is exposed in an unnamed mine of the Vineyard Mountain group on lots 578 and 579, 21st district, one mile (1.6 km) south of Allatoona Dam (Hurst and Crawford, 1970, p. 118).

Carroll County: Pyrite has been prospected in at least 16 locations within a sequence of altered, amphibole-rich schists and gneisses which cross the county in a northeast direction extending into Paulding, Haralson, Douglas and Bartow Counties. Pyrite has been actively mined at Reeds Mountain south of Bremen and exploited to a small degree at the Jenny Stone prospect.

1. Approximately 4,000 tons (3630 metric tons) of pyrite concentrate were shipped from the Reeds Mountain Pyrite Mine between 1910 and 1914 (Shearer and Hull, 1918, p. 39). Former mining was on lot 259, 7th district, 5th section, about 1.5 miles (2.4 km) south of Bremen. The pyrite occurs as veins or lenses associated with coarsely crystalline quartz and chlorite enclosed in quartz-sericite, chlorite and biotite schists. 2. Pyrite occurs in a massive sulfide zone exposed at the Jenny Stone pyrite prospect, lot 222, 6th district, 5th section, approximately 2 miles (3.2 km) north of Villa Rica. The occurence is in an altered mafic rock and is reportedly 12 feet (3.7 m) thick where exposed in the shaft (Shearer and Hull, 1918, p. 57). Associated minerals are pyrrhotite, sphalerite, and chalcopyrite. 3. Pyrite and other sulfide minerals have been prospected on the Lassiter property, lot 188, 5th district, 3rd section. 4. Pyrite, pyrrhotite, and chalcopyrite occur in a prospect on the Askew property, lot 166, 5th district, 3rd section. 5. Pyrite has been prospected from additional minor occurrences within the county. These are adequately described by Shearer and Hull (1918, p. 31–62).

Cherokee County: 1. Approximately 8,000 tons (7260 metric tons) of pyrite concentrate were shipped between 1900 and 1908 from the Bell-Star mine, lots 829, 900 and 901, 21st district, 2nd section, 3.8 miles (6 km) west of Woodstock (Shearer and Hull, 1918, p. 147). The deposit is in a hornblende gneiss which has been locally altered to a chloritic rock. 2. Pyrite was apparently the most common sulfide mineral in the Rich or Canton Copper Mine, lots 127, 128, 161 and 162, 14th district, 2nd section, one mile (1.6 km) south of Canton. Pyrite concentrates have not been produced from the property; however, the 350-foot (107 m) shaft was dewatered in 1902 and an examination made for commercial pyrite. The property is noted historically for the occurrence of unusual accessory minerals. These include gahnite, clausthalite, plumbogummite, lanthanite, pyromorphite, and others (Dana, 1892, p. 1081). 3. Several small shipments of pyrite concentrate were made prior to 1917 from prospects on the Dickerson property, lots 856, 857, 872 and 873, approximately 7 miles (11 km) east of Canton (Shearer and Hull, 1918, p. 160). 4. Approximately 22,000 tons (19,960 metric tons) of pyrite concentrate were produced by October, 1917, from relatively extensive massive pyrite deposits at the Standard Pyrite Mine, lot 62, 3rd district, 2nd section, 7.3 miles (11.7 km) by road south of Ball Ground (Shearer and Hull, 1918, p. 174). 5. Approximately 4,000 tons (3630 metric tons) of massive pyrite ore were shipped between 1906 and 1911 from the Swift Pyrite Mine on lots 475 and 476, 3rd

district, 2nd section, a short distance from the previously described Standard Mine (Shearer and Hull, p. 175). The massive pyrite deposits on this and the previously described property occur as conformable lenses within an interbedded sequence of mafic and felsic schists and gneisses. Most of the material mined was granular pyrite with few accessory minerals. Pyrite crystals in ore and adjacent wall rock average approximately 0.1 inch (0.25 cm) in diameter. 6. Pyrite has been prospected on the Smith property, lots 802, 803, 855 and 854, 3rd district, 2nd section, and the S. E. McRea property, lot 233, 14th district, 2nd section.

Cobb County: 1. Small shipments of pyrite concentrate were made in 1917 from the Marietta Pyrite Mine, approximately 2.5 miles (4 km) southwest of Marietta. The deposit, apparently a mineralized shear zone, was exploited by a 360-foot (110 m) inclined shaft and lateral workings (Shearer and Hull, p. 141). The mineralized zone consists of granular pyrite in a massive quartz matrix. The immediate wall rock is a coarsely crystalline biotite schist containing locally abundant kyanite. 2. Pyrite has been prospected on lot 372, 17th district, 2nd section; lot 140, 20th district; and the C. G. Wright property near Lost Mountain (Shearer and Hull, 1918, p. 141–143). Pyrite crystals and masses up to 2 inches (5 cm) in diameter are reported from the Wright prospect.

Dawson County: Prospecting has been conducted for pyrite on lots 850 and 854, 4th district; lots 305 and 257, 13th district; and lots 241 and 258, 13th district (Shearer and Hull, 1918, p. 179–181). Prospecting at these locations has generally been in conjunction with gold exploration, and most pyrite occurrences represent small disseminated cubes in chloritic- or hornblende-rich rock.

Douglas County: 1. The most extensively developed pyrite deposit in Georgia is that commonly known as the Villa Rica or Sulphur Mining Company and Railroad Company Mine, approximately 3 miles (4.8 km) north-northeast of Villa Rica adjacent to Georgia Highway 61. The property is credited with a total production of approximately 400,000 tons (362,900 metric tons) of pyrite–pyrrhotite ore mined between 1899 and 1917. The deposit was exploited through a 500-foot (152 m) deep shaft and lies near the contact of a sequence of altered hornblende gneisses and amphibolites with granitic gneiss. The ore body is a series of tabular sulfide lenses pitching northeast. Accessory minerals are minor chalcopyrite, sphalerite and magnetite. 2. A narrow pyrite lens was prospected on the Keaten property, lot 78, 2nd district, 5th section, about 4 miles (6.4 km) south-southeast of Villa Rica (Shearer and Hull, 1918, p. 89).

Fannin County: 1. Pyrite was the predominant sulfide mineral encountered below water table at the Number Twenty Copper Mine, lot 20, 9th district, 2nd section. The occurrence is classified as a Ducktown-type massive sulfide deposit consisting essentially of massive pyrite and pyrrhotite with accessory chalcopyrite, sphalerite and galena. Accessory and gangue minerals are quartz, calcite, actinolite, tremolite, diopside, zoisite and garnet. Total production from the deposit is unknown; however, Shearer and Hull (1918, p. 211) report that during the summer of 1917 production was about 300 tons (272 metric tons) of ore a day. 2. A similar occurrence is the Mobile Copper Mine, lot 59, 9th district, 2nd section, approximately one mile (1.6 km) south of the Number Twenty Copper Mine. Pyrite, pyrrhotite, and chalcopyrite occur here associated with a complex suite of calcium–silicate minerals. 3. Pyrite and chalcopyrite have been prospected on the Phillips property, lot 21, 9th district, 2nd section, immediately adjacent to the Number Twenty Mine on the west. 4. Pyrite is the predominant sulfide mineral at the Sally Jane copper prospect, midway between the Mobile Copper Mine and Copper Hill. 5. Chalcopyrite and pyrite have been prospected at the Jeptha Patterson prospect on a ridge 0.5 mile (0.8 km) southwest of Pierceville (Shearer and Hull, 1918, p. 217). 6. Pyrite occurs with minor chalcopyrite and pyrrhotite in numerous prospect pits and adits on Mt. Pisgah, approximately 9 miles (14.4 km) southwest of Copper Hill and 1.2 miles (1.9 km) southwest of Higdons Store (Shearer and Hull, 1918, p. 218–220).

Fulton County: 1. Pyrite with minor chalcopyrite has been prospected at the Cash property, lot 34, 14th district, about one mile (1.6 km) south-southwest of Ben Hill (Shearer and Hull, 1918, p. 143–145).

Hall County: Pyrite has been prospected at intervals along a belt of hornblende–epidote–chlorite schists and gneisses extending in a northeasterly direction from approximately 3.5 miles (5.6 km) south of Lula into Banks County (Shearer and Hull, 1918, p. 202–204).

Haralson County: 1. Pyrite accompanied by minor chalcopyrite and sphalerite has been exploited at the Tallapoosa or Waldrop Copper Mine on lot 932, 20th district, about 3.1 miles (5 km) N44°W of Draketown. Approximately 7,500 tons (6800 metric tons) of massive sulfide ore were shipped from the property (Shearer and Hull, 1918, p. 70). Pyrite occurs in a generally massive lens striking N35°E and dipping irregularly from 27° to 60° southeast. Dominant gangue minerals are dolomite and quartz. 2. Pyrite, chalcopyrite, and pyrrhotite occur in a massive sulfide zone formerly exploited at the Smith-McCandless prospect on lot 851, 20th district, 3rd section, in the northeastern corner of the county. Production is estimated at approximately 100 tons (91 metric tons) (Shearer and Hull, 1918, p. 83). 3. Pyrite has been prospected at 9 additional properties. Chief among these are lots 146 and 113, 6th district, 5th section; lot 220, 7th district, 5th section; and lots 17 and 18, 8th district, 3rd section (Shearer and Hull, 1918, p. 63–68).

Lincoln County: 1. Pyrite was the predominant sulfide mineral in silicified shear zones and veins at the Magruder Gold Mine in the extreme western part of the county, approximately 2.5 miles (4 km) east of Metasville. Associated sulfide minerals are chalcopyrite, galena and sphalerite. Gangue minerals are quartz, sericite and barite.

Lumpkin County: 1. A considerable quantity of pyrite-rich massive sulfide ore was produced from the Chestatee deposit, 6 miles (9.7 km) east of Dahlonega on the south side of the Chestatee River, 1.75 miles (2.8 km) below its junction with Tesnatee Creek. The ore body was a conformable lens of essentially massive pyrite and pyrrhotite within hornblende gneisses and chlorite schists. Accessory sulfides are very minor chalcocite, sphalerite and chalcopyrite. 2. Pyrite has been prospected on lots 241, and 242, 6th district, 1st section; lot 830, 12th district, 1st section; the vicinity of the Turkey Hill Gold Mine, 4 miles (6.4 km) south of Dahlonega; and on the Summerour property, 2 miles (3.2 km) southwest of Auraria (Shearer and Hull, 1918, p. 198–200). 3. Pyrite is a ubiquitous mineral below the water table in virtually all of the lode gold deposits in the Dahlonega district.

Murray County: 1. Excellent samples of specimen-grade pyrite occur in slate and talc at numerous mines in the Chatsworth district. Well-formed modified cubes of pyrite up to 4 inches (10 cm) wide are known from several mines in the district.

Paulding County: 1. A small amount of pyrite was produced from the Swift Mine, lots 1184, 1197, 1198 and 1199, 19th district, 3rd section, about 1.25 miles (2 km) east of Draketown. Ore from this occurrence is typical Ducktown-type massive sulfide consisting of euhedral and shattered pyrite grains in a matrix of pyrrhotite. Accessory sulfides are sphalerite, chalcopyrite, galena, cubanite, and valleriite. The property has been explored by diamond drilling several times. 2. A similar occurrence of massive pyrite–pyrrhotite ore has been prospected at the Rush-Banks property, lot 189, 19th district, 3rd section, approximately 3.5 miles (5.6 km) southwest of McPherson. Accessory sulfides are predominantly chalcopyrite with lesser chalcocite. 3. A large quantity of pyrite-rich ore has been produced from the Little Bob massive sulfide deposit, 2nd district, 3rd section, approximately 2 miles (3.2 km) northwest of Hiram. Production records are quite inconsistent, with estimates varying from several tens of thousands of tons to several hundred thousand tons. The deposit is an irregular lens conformable with the enclosing hornblende- and chlorite-rich rocks. Accessory minerals are pyrrhotite, chalcopyrite, sphalerite, and magnetite. Predominant gangue minerals are quartz and minor calcite. The property has been explored both geophysically and by diamond drilling. 4. Several hundred tons of pyrite concentrate were produced from the Shirley Pyrite Mine on lot 526, 2nd district, 3rd section, approximately 3 miles (4.8 km) northwest of Hiram (Shearer and Hull, 1918, p. 124–129). The deposit is within a zone of altered hornblende gneiss containing up to 50 percent disseminated pyrite cubes. 5. A similar pyrite occurrence has been prospected on the Berg property, lots 482, 483, and 527, 2nd district, 3rd section, immediately adjacent to the Shirley Pyrite Mine. 6. Pyrite scattered throughout contorted chlorite schist and garnet-bearing quartzite has been prospected at the Mammoth property, lots 600, 601, 602 and 624, 2nd district, 3rd section, adjacent to the Little Bob Mine (Shearer and Hull, 1918, p. 122–123). 7. Small pyrite crystals disseminated throughout chloritic and sericitic schist have been prospected at the McGarrity property, lots 361, 362, and 410, 19th district, 3rd section, approximately 1.5 miles (2.4 km) south of Yorkville (Shearer and Hull, 1918, p. 104). 8. A minor quantity of pyrite-rich ore was produced from the Helms prospect on lot 861, 19th district, 3rd section, about 8 miles (12.9 km) southwest of Dallas (Shearer and Hull, 1918, p. 103). Both disseminated and massive pyrite are reported from the property. 9. Pyrite has been prospected at numerous other localities throughout the county. Chief among these are lot 151, 19th district, 2nd section; lot 116, 2nd district, 3rd section; lot 196, 19th district; lot 851, 19th district; and lots 460 and 461, 2nd district (Shearer and Hull, 1918, p. 133–136).

Polk County: 1. Pyrite is a common constituent of the central portion of boulder ores mined from the Cedartown and adjacent brown ore districts. Properties from which pyrite-rich boulder ore has been produced are numerous and only the best known examples are presented below. Locations are from a synopsis of brown iron ore mining in Polk, Bartow, Floyd, Gordon, and Murray Counties by Hurst and Crawford (1970, p. 93–109).

1. Iron oxide boulders containing cores of pyrite were produced from lot 971, 2nd district, on the west side of Cedar Creek, approximately 4 miles (6.4 km) northwest of Cedartown. 2. Similar material has been produced from lot 573, 2nd district, again 4 miles (6.4 km) northwest of Cedartown. 3. Pyritiferous boulder iron ore has been produced from lots 1235, 1236 and 1237, 3rd district and lot 433, 2nd district on the west side of Cedar Creek in the vicinity of Mt. Hope Church. 4. Boulder iron ore containing cores of pyrite has been mined from lot 105, 2nd district. 5. Boulder ore containing cores of pyrite has been produced from lot 113, 2nd district, 0.5 mile (0.8 km) northeast of Shiloh Church. 6. Iron oxide boulders containing pyrite were

produced from lot 42, 2nd district, 1.5 miles (2.4 km) east of Esom Hill. 7. Large irregular masses of iron oxide containing cores of pyrite have been mined from lots 43 and 106, 2nd district.

Rabun County: 1. Pyrite with associated pyrrhotite and chalcopyrite occurs in a mineralized zone in hornblende gneiss at a prospect on the east-west line between lots 48 and 49, 6th district, 11 miles (17.7 km) west-northwest of Clayton and 0.5 mile (0.8 km) east of Tom Coward Gap.

Towns County: 1. Relatively pure pyrite ore has been prospected on lot 196, 0.5 mile (0.8 km) north of Bucks Knob and 4 miles (6.4 km) south-southwest of Hiawassee at a locality formerly known as the Berrong or Johnson copper prospect (Shearer and Hull, 1918, p. 207). 2. A similar pyrite occurrence is on lot 157, 18th district, 1st section, approximately 2 miles (3.2 km) southeast of Hiawassee (Shearer and Hull, 1918, p. 208).

White County: Pyrite is the major sulfide mineral of numerous gold-bearing quartz veins in the many old gold mining properties of the county. Pyrite has been prospected at only one location.

1. Quartzitic schist containing up to 8.5 percent pyrite has been prospected on the property of W. A. Danforth, approximately 3 miles (4.8 km) north-northwest of Cleveland and 0.5 mile (0.8 km) northeast of the old Longstreet Gold Mine. The pyrite-rich rock is exposed along Little Tesnatee Creek (Shearer and Hull, 1918, p. 201).

Wilkes County: 1. Pyrite is relatively abundant at the Chambers zinc prospect on Butlers Creek, approximately 2,000 feet (610 km) west of the Magruder Gold Mine in extreme east-central Wilkes County. Associated minerals are sphalerite and very minor chalcopyrite and galena.

MARCASITE

FeS_2

Class Sulfide

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Commonly in tabular or pyramidal crystals; less often prismatic. Also in concretionary masses with radiating structure and as reniform or botryoidal crusts.

Phys. *Cleavage* poor {101}. *Fracture* uneven. Brittle. **H** 6–6½. **G** 4.85–4.90. *Luster* metallic. *Color* pale brass-yellow, deepening on exposure; tin-white on fresh fracture. *Streak* grayish or brownish black. Opaque.

Occur.

Massive marcasite is physically quite similar to pyrite. For this reason there are very few accurate records of its occurrence in Georgia. Marcasite is, in most instances, a supergene mineral and is most frequently found in sedimentary materials such as limestone, clays, and lignite deposits, and as concretions.

Lumpkin County: 1. Park and Wilson (1936, p. 86) report marcasite from the upper levels of the Battle Branch Gold Mine, lots 457 and 524, 12th district, one mile (1.6 km) south of Auraria.

ARSENOPYRITE

FeAsS

Class Sulfide

Cryst. Monoclinic; prismatic—2/m

Habit Elongated prismatic crystals; also short prismatic. Commonly granular or compact.

Phys. *Cleavage* distinct {110}. *Fracture* uneven. Brittle. **H** 5½–6. **G** 5.9–6.2. *Luster* metallic. *Color* silver white to steel gray. *Streak* grayish black. Opaque.

Occur.

Arsenopyrite is an uncommon accessory mineral in primary sulfide-bearing ore formerly exploited in several gold mines within Georgia. Its occurrence is probably more widespread than has been reported in the literature.

Cherokee County: 1. Dana (1892, p. 1081) mentions the occurrence of arsenopyrite in massive sulfide ore from the Canton or Rich Copper Mine, approximately one mile (1.6 km) south of downtown Canton on lot 161, 14th district, 2nd section. 2. Small quantities of arsenopyrite occur at the Sixes Gold Mine, lots 150, 212, 221 and 284, 15th district.

Dawson County: Coarse euhedral arsenopyrite occurs erratically below the water table at the Kin Mori Gold Mine on Harris Branch, approximately 4 miles (6.4 km) south of Dawsonville.

Forsyth County: 1. Arsenopyrite occurs with pyrite in a quartz vein at the Charles Gold Mine, lot 77, 3rd district, 1st section (Jones, 1909, p. 167).

Lumpkin County: 1. Small amounts of coarse-grained arsenopyrite occur with native gold in white quartz at the Calhoun Gold Mine, lots 164 and 165, 11th district. 2. Arsenopyrite is an accessory mineral at the Findley Gold Mine, lots 1047, 1048 and 1087, 12th district. 3. Arsenopyrite crystals up to 1.5 inches (3.8 cm) in length occur in vein quartz on the dumps of the Etowah Gold Mine centering on lot 118, 15th district, on the Lumpkin–Dawson County line (Pardee and Park, 1948, p. 137).

Pickens County: Arsenopyrite-bearing samples have been submitted to the Georgia Geological Survey from an unspecified location in this county.

MOLYBDENITE

MoS_2

Class Sulfide

Cryst. Hexagonal; dihexagonal-dipyramidal—6/m 2/m 2/m

Habit Hexagonal tabular crystals; commonly foliated massive or in scales.

Phys. *Cleavage* perfect basal. Laminae very flexible, but not elastic. Sectile. **H** 1–1½. **G** 4.62–4.73. *Luster* metallic. *Color* pure lead-gray. *Streak* on porcelain, greenish; on paper, bluish gray. Opaque. Greasy feel.

Occur.

Carroll County: 1. Molybdenite was reported by Mr. Paul E. Jones along U.S. Highway 78 near Villa Rica. The report has not been verified.

DeKalb County: 1. Irregular masses of molybdenite a few inches in diameter occur in granite gneiss approximately 0.75 mile (1.2 km) north of Lithonia at the quarry of the Southern Granite Company. 2. Molybdenite in small grains occurs at Arabia Mountain. 3. Herrman (1954, p. 33) reports molybdenite occurring in small, lead-gray foliated masses in several pegmatites on Little Stone Mountain.

Douglas County: 1. Coarsely crystalline molybdenite associated with pyrite occurs on the old Henslee Farm south of Winston. A sample from this location was submitted years ago and is on display in the museum at the State Capitol.

Fulton County: 1. Molybdenite, pink calcite, epidote and garnet occur in quartz veins and pods in biotite gneiss exposed at the Monroe Drive interchange on Interstate Highway 85.

Greene County: 1. Small crystals of molybdenite occur in the Siloam Granite at an aggregate quarry, approximately one mile (1.6 km) east of Siloam and 0.5 mile (0.8 km) south of Interstate Highway 20 (Guinn, 1973, p. 81). Associated minerals are chalcopyrite, fluorite, scheelite, and amethyst.

Gwinnett County: 1. Molybdenite-bearing rock was exposed during the construction of Buford Dam.

Haralson County: 1. Small flakes of molybdenite and pyrite occur disseminated in a granite gneiss, approximately 6 miles (9.7 km) northeast of Bremen on lot 94, 7th district.

Heard County: 1. Molybdenite is reported by Dana (1892, p. 1081) as occurring at an undisclosed location in this county.

Putnam County: 1. Coarsely crystalline euhedral molybdenite associated with chalcopyrite and pyrite occurs in a series of quartz veins along Georgia Highway 16, immediately west of Crooked Creek. The veins cut biotite gneiss and migmatite. Canary yellow ferrimolybdite is conspicuous in residual quartz boulders at this location.

Wilkes County: 1. Euhedral molybdenite grains up to 0.5 inch (1.3 cm) in diameter occur with minor pyrite and chalcopyrite near the southern margin of the Delhi Syenite, approximately 0.75 mile (1.2 km) north of Dehli in northeast Wilkes County.

SULFOSALTS

WITTICHENITE

Cu_3BiS_3

Class Sulfosalt

Cryst. Orthorhombic

Habit Tabular {001}; also columnar or acicular. Massive.

Phys. *Cleavage* none. *Fracture* conchoidal. **H** 2–3. **G** 4.3–4.5. *Color* steel-gray to tin-white, tarnishing pale lead-gray. *Streak* black. In polished section, weakly anisotropic.

Occur.

Jasper County: 1. Microscopic inclusions of wittichenite in native bismuth are reported from the Enon Church Feldspar Mine on Georgia Highway 83, approximately 6 miles (9.7 km) south of Monticello near Gladesville (personal communication, T. C. Hughes). The minerals occur in narrow chalcocite and bornite veinlets within granitic pegmatite.

TENNANTITE

$(Cu,Fe)_{12}As_4S_{13}$

Class Sulfosalt

Cryst. Isometric; hextetrahedral—$\bar{4}$ 3m

Habit Tetrahedral; sometimes as groups of parallel crystals. Also massive, coarse or fine granular to compact.

Phys. *Cleavage* none. *Fracture* subconchoidal to uneven. Rather brittle. **H** 3–4½ (with tennantite harder than tetrahedrite). **G** 4.6–5.1, increasing with content of Sb. *Luster* metallic, often splendent. *Color* flint-gray to iron-black. *Streak* from black to brown to cherry-red (high As, and low Fe). Opaque except in very thin splinters, which are cherry-red by transmitted light, with $n_{Li} > 2.72$. In polished section, gray inclining to olive-brown, isotropic. Slight variations in reflectivity with compositional changes.

Occur.

Bartow County: 1. Minute inclusions of tennantite in barite have been noted from the Tucker Hollow Iron Mine, lot 477, 4th district, 3rd section, by Kesler (1950, p. 46). 2. Tennantite containing small inclusions of pink enargite (marginally altered to chalcocite) has been observed in residual jasperoid and vein quartz at the Aubry Manganese Mine, lots 299, 300 and 314, 5th district (Kesler, 1950, p. 46). 3. Minor tennanite and associated chalcopyrite, azurite and malachite occur in fractured silicified dolomite exposed in the east bank of U.S. Highway 411 on the north side of the Pine Log Creek Bridge in the extreme northern part of the Cartersville Mining District.

ENARGITE

Cu_3AsS_4

Class Sulfosalt

Cryst. Orthorhombic; rhombic-pyramidal—m m 2

Habit Tabular {001}; also prismatic {001}. Prism zone striated {001}; {001} striated $\parallel$ {010}. Also massive, granular, or prismatic.

Phys. *Cleavage* {110} perfect; {100} and {010} distinct; {001} indistinct. *Fracture* uneven. Brittle. **H** 3. **G** 4.45 ± 0.05; 4.40 (calc.). *Luster* metallic, tarnishing dull. *Color* grayish black to iron-black. *Streak* grayish black. In polished section gray to light rose-brown in color, with strong anisotropism and weak pleochroism.

Occur.

Bartow County: 1. Accessory enargite occurs with chalcopyrite in a quartz vein on the south bank of Sugar Creek, 0.4 mile (0.6 km) northeast of Fairview Church (Kesler, 1950, p. 46). 2. Enargite inclusions in tennantite are described in residual jasperoid and vein quartz at the Aubry Manganese Mine, lots 299, 300, and 314, 5th district by Kesler (1950, p. 46). The pink color of this mineral in reflected light suggests that it may be luzonite, the tetragonal dimorph of enargite.

ZINKENITE

$Pb_6Sb_{14}S_{27}$

Class Sulfosalt

Cryst. Orthorhombic

Habit. Crystals seldom distinct. Usually massive and in columnar- to radial-fibrous aggregates.

Phys. *Cleavage* indistinct. *Fracture* uneven. **H** 3–3½. **G** 5.25–5.35. *Luster* metallic. *Color* and *streak* steel-gray. Sometimes tarnished iridescent. Opaque.

Occur.

Lincoln County: 1. An opaque mineral tentatively identified by its optical properties as zinkenite occurs as minute euhedral inclusions in galena collected at the Magruder Gold Mine in the extreme western part of the county, approximately 2.5 miles (4 km) east of Metasville. Analysis of a concentrate shipment from this property to American Smelting and Refining Company returned payment for 13 percent antimony.

OXIDES

CUPRITE
Cu_2O

Class Simple oxide

Cryst. Isometric; hexoctahedral—4/m $\bar{3}$ 2/m

Habit Usually octahedral crystals; less often cubic or dodecahedral. Also massive, granular, or earthy.

Phys. *Cleavage* poor octahedral. *Fracture* conchoidal. Brittle. **H** 3½–4. **G** 5.8–8.16. *Luster* adamantine, submetallic, or earthy. *Color* red to very dark red. *Streak* brownish red.

Occur.

Bartow County: 1. Red granular cuprite associated with malachite in a quartz vein has been reported from an unspecified location in this county.

Lumpkin County: 1. Thin films of brick-red cuprite fill cracks in oxidized ore from the upper postions of the Chestatee massive sulfide deposit on the Chestatee River 6 miles (9.7 km) northeast of Dahlonega.

Oglethorpe County: Samples of cuprite coating native copper were found at water level in the Morgan Gold Mine, 6.5 miles (10 km) southeast of Lexington.

TENORITE
CuO

Class Simple oxide

Cryst. Monoclinic; prismatic—2/m

Habit In minute scales; as an earthy powder; massive.

Phys. *Cleavage* none. Brittle. Scales are flexible and elastic. **H** 3½. **G** 5.8–6-4. *Luster* metallic to dull. *Color* and *streak* black.

Occur.

Although tenorite has been reported from only two specific occurrences, its presence as a minor constituent of supergene enriched copper ores formerly exploited at numerous locations must be suspected.

Fannin County: 1. Black earthy tenorite occurs near water level in the Number Twenty Mine, lot 20, 9th district, 2nd section, 3 miles (4.8 km) southwest of Copper Hill. Samples of this material are in the museum at the Georgia State Capitol.

Lincoln County: 1. Tenorite associated with native copper occurred near water level in the Magruder Gold Mine in the extreme western part of the county, approximately 2.5 miles (4 km) east of Metasville.

CORUNDUM
Al_2O_3

Class Oxide

Cryst. Hexagonal-R; hexagonal-scalenohedral—$\bar{3}$ 2/m

Habit Often steep pyramidal. Also rough and rounded, barrel-shaped crystals, sometimes of considerable size, varying from short prismatic {0001} with a large base to steep pyramidal. More rarely flat tabular {0001} or rhombohedral. Striae on {0001} ‖ {$0\bar{1}10$}; sometimes lines in direction {$11\bar{2}0$} divide the base into six sectors. Pyramidal and prism faces frequently show horizontal striae due to oscillations. Large blocks showing rhombohedral and basal parting are frequently observed (Georgia). Massive granular (emery); in rounded grains.

Phys. *Cleavage* none. *Fracture* uneven to conchoidal. Parting {0001} sometimes perfect, but interrupted, and frequently having a pearly luster; also on {$10\bar{1}1$} due

to twin lamination, often prominent (Georgia). Brittle; very tough when compact. **H** 9. **G** 4.022. 4.0–4.1; 3.98 (calc.). *Luster* adamantine to vitreous; on {0001} sometimes pearly. *Color* various: shades of blue (sapphire) to colorless, yellow to golden, rarely purple to violet, green; pink to deep pigeon-blood red (ruby); sometimes blue in daylight and reddish in artificial light (alexandrite–sapphire). The same crystal sometimes shows difference in depth of color, or has color zoning with blue and red (Georgia) or other banding; some natural and artificial crystals have color zones parallel to a pyramid, or are more intensely pigmented toward the apices. Some sapphires and rubies are phosphorescent and fluorescent in ultra-violet light. *Streak* uncolored. Transparent in gem varities, others transparent in thin pieces.

Occur.

Occurrences of corundum are uncommon though widespread throughout the crystalline Piedmont and Blue Ridge. It is typically an accessory mineral near the margins of altered olivine peridotites intrusive into aluminous metamorphic rocks. Many corundum occurrences have been discovered during examination of the host peridotites for asbestos, talc, vermiculite, or chromite. Georgia led the nation in abrasive corundum production for a brief period in the late 19th century. A comprehensive review of the occurrence of corundum in Georgia was published by Furcron (1960a, p. 167–177).

Baldwin County: 1. Small grains of bright blue corundum occur near the cores of andalusite nodules found between the State Sanitarium and the Oconee River (Hurst, 1956, p. 125).

Carroll County: 1. Float corundum has been found associated with olivine, actinolite and talc on lot 165, 2nd district (King, 1894, p. 104). 2. Corundum encased in margarite and associated with olivine in a narrow vein of asbestos is reported by King (1894, p. 105) on lot 118, 5th district, within what is now the northeastern part of the city of Carrollton near Georgia Highway 166. 3. Corundum and margarite are described from lot 110, 5th district, 1.5 miles (2.4 km) east of Carrollton by Hopkins (1914, p. 86). 4. Small fragments of blue and pink corundum associated with kyanite are reported by Hopkins (1914, p. 284) one mile (1.6 km) east of Villa Rica at New Hope Spring. 5. Corundum and margarite are reported on the W. W. Smith property, 0.5 mile (0.8 km) south of Burwell Station.

Cherokee County: 1. Segregations of magnetite and corundum in pieces up to 4 inches (10 cm) in diameter are reported by Hopkins (1914, p. 172) from a large pyroxenite intrusive on lot 71, Hickory Flat Military District (1010), approximately 7 miles (11 km) east of Canton. 2. Corundum has been reported from an unspecified location near Woodstock.

Cobb County: 1. Excellent corundum varying in color from grayish-white to blue and red has been prospected on lot 1271, 19th district in the southern part of the county. King (1894, p. 102) indicates that the corundum occurred as lenses within a 5- to 6-foot (1.5 to 1.8 m) wide zone in chlorite schist. Corundum from this property is commonly associated with crystalline kyanite, the pink and blue combination of colors making exceptionally attractive specimens. 2. Surface corundum was reported from the V. H. Stansill property, lot 1321, 19th district (Furcron, 1960, p. 169). A single mass weighing 150 pounds (68 kg) was broken up in attempts to extract a red portion. 3. Float corundum is reported by King (1894, p. 102) along a general trend extending from lot 684 southwestward to the vicinity of Brownsville in Paulding County. 4. A small amount of float corundum has been found on lot 1236, 19th district, near Clarkdale (King, 1894, p. 101).

Columbia County: 1. Residual corundum is reported by Hurst, Crawford and Sandy (1966, p. 398) for a distance of about 3 miles (4.8 km) along the contact between ultramafic rock and granitic gneiss on the southeast side of Burt and Dixie Mountains. The crystals are mostly less than 0.25 inch (0.6 km) across and are typically brown or gray, although pink, orange-red, white and deep blue specimens are reported. A brown variety showing a bronze play of light across basal partings is described. The largest pieces are translucent and deep blue in color, and they measure more than 0.75 x 0.25 x 0.25 inch (1.9 x 0.6 x 0.6 cm).

Douglas County: 1. Float corundum is reported by King (1894, p. 104) on lot 178, 6th district, within what is now the northern part of Villa Rica.

Fulton County: 1. Corundum associated with kyanite in muscovite schist has been reported 3.5 miles (5.6 km) east of Roswell.

Habersham County: 1. Corundum has been prospected at numerous localities on, and in the vicinity of, Alec Mountain, approximately 6 miles (9.7 km) northwest of Clarksville. Specific occurrences are on lots 125, 126, 127, 131, 132, 133, and 134 of the 11th district (King, 1894, p. 97). Exceptional bright red corundum encased by margarite is found on lot 133 near Piedmont Orchards. Corundum associated with black hornblende and plagioclase occurs as float on lot 134. 2. Hopkins (1914, p. 159) reports that considerable prospecting for both asbestos and corundum was carried out on the John Martin property in the northern part of the county near the White–Habersham County line, 11 miles (17.7 km) northwest of Clarksville and 1.5 miles

(2.4 km) west of Soque. The area includes lots 64, 65 and 66, 6th district, largely on Mac and Wolf Pit Mountains. Extensive prospecting for corundum was carried out on the south slope of Mac Mountain where small hexagonal crystals of corundum may be found on the dump of an exploration adit. 3. Corundum has been prospected on the Ruel White property, approximately 5 miles (8 km) north of Sautee, possibly on lot 65, 11th district. 4. Float corundum is reported by King (1894, p. 98) from lots 16 and 17, 3rd district, and lot 129, 11th district. 5. Corundum has been prospected on lot 30, 11th district, 2.5 miles (4 km) northeast of Soque (Hopkins, 1914, p. 165).

Hall County: 1. Excellent specimens of margarite-encased red corundum in masses up to 6 inches (15 cm) in diameter were prospected on what is commonly known as Soapstone Hill, approximately one mile (1.6 km) west of downtown Gainesville. The area is now residential, and the outlook for the discovery of new specimen material is not good.

Hart County: 1. Blue-gray crystals of corundum occur in coarse, massive muscovite schist within the sillimanite belt of Hart County at a road intersection 2 miles (3.2 km) S26°E of Bowman (Furcron and Teague, 1945, p. 17–18). Specimens were found in a cultivated field near the road.

Heard County: 1. Boulders of corundum weighing from 50 to 100 pounds (23–45 kg) are reported from a prospect on lot 44, 13th district, 3.5 miles (5.6 km) northwest of Centralhatchee (King, 1894, p. 105). The corundum is associated with black tourmaline and pink scales of margarite.

Lumpkin County: 1. King (1894, p. 96) reports that several pounds of blocky corundum fragments ranging in color from white to pink and blue were found about one mile (1.6 km) southeast of Porter Springs on the eastern side of lot 249.

Morgan County: 1. Fragments of corundum in pieces from 3 to 6 inches (8 to 15 cm) in diameter and bounded by ill-defined crystal faces are reported by Hopkins (1914, p. 177) from the G. W. Murell property, 4 miles (6.4 km) east of Newborn near the church at Marks. 2. A small amount of float corundum has been found on the property of Bill Oxford, approximately 3 miles (4.8 km) S25°E of Rutledge. At least one attractive, wine-colored cabachon has been cut from this material. 3. Small gray and pink corundum crystals have been panned from the branch on the Bertram Richardson property, a short distance east of Rutledge. Also encountered at this location are small, blue octahedral crystals of spinel and wire gold (Furcron, 1960a, p. 170).

Oconee County: 1. Excellent silver-gray corundum crystals up to 1 x 3 inches (2.5 x 7.6 cm) occur in soil over an area of less than one acre in a peach orchard immediately west of U.S. Highway 441, approximately 2 miles (3.2 km) south of Watkinsville. At least one stone exhibiting an excellent star has been cut from material found at this location.

Paulding County: 1. Beautiful specimens of dark-blue and deep-pink corundum have been found on lots 533 and 534, 3rd district, 3rd section (King, 1894, p. 103). The property was prospected before King's time by the Sapphire Valley Company of North Carolina. Furcron (1960a, p. 170) indicates that this property is probably west of Georgia Highway 82 and west of Possum Creek, about one mile (1.6 km) N45°E of Mount Zion Church, G. M. D. 1596. 2. Float corundum was reportedly encountered on lot 456, 1st district, 3rd section, 1.5 miles (2.4 km) south of Brownsville (King, 1894, p. 104). 3. Excellent specimens of blue corundum have been found on the W. L. Prather property 7 miles (11 km) southwest of Acworth.

Rabun County: 1. Small, prismatic corundum crystals with included vermiculite were encountered during prospecting at what is known as Bevetts Mine on lot 177, 2nd district (King, 1894, p. 84). Slightly north of this occurrence on lot 188, 2nd district, several pounds of corundum were found in a weathered vein of kaolinized feldspar, quartz, and phlogopite in chlorite schist. 2. Corundum was reported from the Hicks Asbestos Mine, lot 81, 3rd district by King (1894, p. 83); however, it is fairly certain that the material was salted with corundum obtained at the nearby Laurel Creek Mine. 3. Corundum crystals measuring 16 inches (41 cm) in length and 8.5 inches (22 cm) in width were obtained from the well-known Laurel Creek Corundum Mine in the southern part of lot 72, 3rd district, about one mile (1.6 km) southwest of Pine Mountain on Laurel Creek. A single corundum mass weighing approximately 5,000 pounds (2267 kg) was mined (King, 1894, p. 83). Large amounts of corundum were obtained from this deposit from approximately 1873 until 1894. Old maps and descriptions indicate that most corundum was obtained near or at the contact of the host peridotite and the surrounding country rock. Gray and blue corundum associated with vermiculite and asbestos can be obtained from the old dumps and by panning gravel in Laurel Creek. 4. Corundum associated with talc and asbestos is reported by King (1894, p. 84) on lots 27 and 28, 3rd district.

Towns County: 1. Excellent samples of bright pink corundum and chlorite in kaolinized feldspar were once common on the dumps of the Bell Creek Corundum Mine, approximately 4 miles (6.4 km) north of Hiawassee, lot 6, 18th district, just west of Bell Scene Church. 2. According to Furcron (1960, p. 174), corundum was known at an early date from numerous lots along Brasstown Creek extending northward toward

Brasstown Bald. Corundum has been prospected on lot 60, 17th district where it occured in a matrix of margarite. 3. Corundum has been prospected at several places on lot 42, 18th district, where interesting examples of gray-white and blue corundum occur with large, euhedral hornblende crystals and plagioclase (Furcron, 1960a, p. 174). 4. Pink corundum, locally referred to as ruby, as well as blue, gray, and white corundum was mined at the Hogg Creek Corundum Mine, lot 92, 17th district (King, 1894, p. 88). The occurrence was prospected without success by the U.S. Bureau of Mines during World War II. Furcron (1960a, p. 174) reports that an exposure south of the mine contains pink corundum in a matrix of "smaragdite." 5. Corundum can be found at numerous places around the margins of Lake Chatuge between Hiawassee and the North Carolina state line. In many cases the shore of the lake lies directly against ultramafic rocks which carry corundum, and at other localities corundum can be found in the beach sands from sources which have not been discovered. One such occurrence is 1.3 miles (2.1 km) north of the Enota Motel along the Bell Creek Road where an altered peridotite occurs on the west side of the road at the shore of Lake Chatuge (Furcron, 1960a, p. 174). 6. Corundum has been picked up on the surface at numerous locations near Hiawassee. For the most part, these occurrences are unprospected and are essentially unknown geologically. Reported occurrences include lots 4, 5, 25, 34, 35, 36, 41, 43, 73, 91, 92 and 163, of the 17th district and lots 41, 89, 90 and 91 of the 18th district.

Troup County: 1. Corundum was observed in 1941 during the course of W.P.A. prospecting at the east end of the Louise Chromite Belt, approximately 0.75 mile (1.2 km) south of the intersection of the Mountville–Hogansville Road and Beech Creek. Corundum was found on the west side of the road over an area not much more than one acre. Also occurring at this locality are octahedra of spinel up to several inches in diameter. The corundum at this occurrence is typically massive and of mottled gray and blue color. 2. Small pieces of corundum are reported from several asbestos prospects on lots 275, 285, 286 and 315, 5th district. northeast of West Point. A minor amount of prospecting was conducted with W.P.A. labor about 1941, and some pieces of corundum were reported at that time (Furcron, 1960a, p. 175).

Union County: 1. Corundum was mined in the late 1800's at Track Rock Gap. The occurrence is in lot 259, 17th district, on the south side of the gap and is readily accessible by a secondary road leading south from U.S. Highway 76, about 2.5 miles (4 km) west of Young Harris. The property was explored by the U.S. Bureau of Mines during World War II with negative results (Furcron, 1960a, p. 175). 2. A small amount of corundum has been found immediately north of the Track Rock Corundum Mine on lot 246, 17th district, at what is known as the Stone Corundum Mine (Furcron, 1960a, p. 176). 3. King (1894, p. 95) describes several other occurrences which he states have been indifferently prospected for corundum. The lots mentioned in this category are 51, 208, 244, 282, 295, and 318, 17th district. 4. Aggregates of kyanite crystals radiating from small corundum masses occur in prospects on Gumlog Mountain, approximately 10 miles (16 km) north of Blairsville (Prindle *et al.*, 1935, p. 22).

Upson County: 1. Well-formed, blue and bronze corundum crystals up to 1 x 2 inches (2.5 x 5.0 cm) have been found on the Kelly Farm, approximately 7 miles (11 km) southeast of Thomaston. An analysis of this material by Dr. Edgar Everhart (February 27, 1930) indicated that the sample contained 2.16 percent beryllium oxide (Furcron, 1960a, p. 176). 2. Corundum crystals have been found in soil on lot 89, 16th district.

Walton County: 1. Over 500 pounds (227 kg) of corundum were shipped from the Breedlove property, lot 160, 3rd district, approximately 4.5 miles (7.2 km) north of Monroe (King, 1894, p. 106). Small well-formed crystals of blue, gray, and burgundy corundum may be found in the soil at this occurrence. The location description given by Furcron (1960a, p. 176) for this occurrence is in error. 2. Soapstone and corundum are reported from the property of Judge A. C. Stone, approximately 1.25 miles (2 km) northeast of Monroe (Hopkins, 1914, p. 176). 3. Excellent specimen-grade corundum has been collected on the Little and Goodlove property near Monroe.

HEMATITE

α-Fe_2O_3

Class Simple oxide

Cryst. Hexagonal-R; hexagonal-scalenohedral—$\bar{3}$ 2/m

Habit Crystals thin to thick tabular. Also compact massive, lamellar, granular, micaceous, and earthy.

Phys. *Cleavage* none. *Fracture* subconchoidal to uneven. Crystals brittle; elastic in thin laminae. **H** 5–6. **G** 4.9–5.3. *Luster* metallic to submetallic to dull. *Color* black, red, brown. *Streak* bright to dark red. Translucent in thin scales.

Occur.

Hematite is one of the most common iron oxide minerals in the state. It was exploited for more than a century from Silurian formations in Dade, Walker, Catoosa and Chatooga Counties as a source of iron for the manufacture of steel. It is a locally important constituent of the residual brown iron ores of Bartow, Polk, and Floyd Counties.

Hematite is one of a group of iron oxides produced by the weathering of other iron-bearing minerals, and as such may be expected in small quantities in virtually any county of the state. Locality descriptions presented below represent those at which hematite has been exploited as an ore of iron or is mineralogically or geologically unusual.

Bartow County: Specular hematite is a locally common constituent of the iron ores of the Cartersville Mining District. Most iron ores of this district contain red iron oxide which is locally termed hematite. The predominant ore mineral in this district, however, is goethite.

1. Specular hematite is reported from the old iron mine on the Larey property, lots 671 and 750, 4th district, about one mile (1.6 km) northwest of Emerson (McCallie, 1900, p. 120). 2. Excellent examples of specular hematite occur near the summit of a small hill on which Ore-Bank No. 1 was mined by the Bartow Furnace Company, lot 903, 4th district, one mile (1.6 km) east of Emerson (McCallie, 1900, p. 121). This is the probable location of the Bartow Mountain Mine mentioned by Kesler (1950, p. 60) as having produced small amounts of hematite ore in 1941. 3. Specular hematite has been produced from pits of the Roan Iron Company, lots 616, 679, 680, and 681, 4th district, approximately 2.5 miles (4 km) northwest of Emerson. Kesler (1950, p. 89) reports that hematite beds form a more or less continuous outcrop within the Shady Formation and that hematite occurs in platy or tabular grains oriented parallel to bedding. 4. Specular hematite occurs in bands as much as one inch (2.5 cm) thick intercalated with layers of clay beneath massive ferruginous quartzite at the Burford Ore-Bank No. 1 Mine on lot 301, 5th district, along Pettet Creek (McCallie, 1900, p. 153). 5. Limonite with specular hematite and intercalated slate has been prospected at the Wildcat Bank on lot 312, 5th district (McCallie, 1900, p. 153). 6. Brown iron ore and specular hematite were mined together from an open cut at the Red No. 1 Hematite Mine on lot 300, 5th district, about 0.5 mile (0.8 km) east of the old Iron Belt Railway near Pettet Creek. 7. A similar occurrence of specular hematite and limonite has been mined at the Red No. 2 Mine in lots 299, 313 and 314, 5th district, southeast of the Little Aubrey Manganese Mine. The hematite-bearing beds are part of the Shady Formation. 8. Specular hematite float is abundant in the colluvium on a low ridge due south of the No. 1 shaft of the Will Lee Manganese Mine in the eastern part of lot 276, 6.5 miles (10.4 km) northeast of Cartersville (Kesler, 1950, p. 80).

Catoosa County: Relatively thin beds of Clinton-type Silurian hematite of the Red Mountain Formation have been mined in Catoosa County in the vicinity of Taylors Ridge. Individual hematite beds rarely exceed a few feet in thickness and consist predominantly of aggregates of rounded, oölitic, flaxseed-like particles which generally have their long axes parallel to bedding. Hematite casts of fossils are common. Hematite-rich Red Mountain Formation is known only on Dicks and Taylors Ridges and in the northern extension of the latter ridge north of Chickamauga Creek, known as White Oak Mountain.

1. Hematite is particularly abundant on lot 25, 27th district, a few hundred yards from a gap locally known as the Narrows (McCallie, 1908, p. 140). Float ore in rectangular blocks from 6 to 8 inches (15 to 20 cm) in thickness is quite abundant at this location. 2. Numerous occurrences of the Red Mountain Formation are known on the east side of Taylors Ridge. Abundant float is reported from lot 10, 27th district, and lots 157, 168, 169, 194, 200, 227, 228, 262, 263, 279, 299, 300 and 315, of the 28th district (McCallie, 1908, p. 142). Mining of this ore has been conducted on lot 192.

Chattooga County: Clinton-type hematite of the Red Mountain Formation occurs along a line of knobby hills at the base of Lookout Mountain north and south of Menlo, on Dirtseller Mountain near the Georgia–Alabama line, and on Gaylors and Taylors Ridges farther to the south and west.

1. Minor production is reported by McCallie (1908, p. 123) from lots 171 and 188, 13th district, near Chelsea. Production of hematite is reported from lots 210, 222 and 223, 13th district, a short distance north of Menlo. Approximately 15 inches (38 cm) of Clinton-type ore is exposed in these workings. 2. Approximately 250,000 tons (227,273 metric tons) of high-grade hematite have been produced from mines on Dirtseller Mountain, roughly 4 miles (6.4 km) southwest of Lyerly. The main seam of ore is approximately 20 inches (50 cm) thick where mined. 3. Considerable hematite has been shipped from the Maddox property, lot 161, 6th district, on the west side of Taylors Ridge, about 3.5 miles (5.6 km) east of Summerville. 4. A large

quantity of hematite has been mined from open cuts on the Kyle property, lot 144, 5th district, on the east side of Taylors Ridge (McCallie, 1908, p. 136).

Dade County: Exposures of Clinton-type hematite ore are confined to Lookout Valley and Johnsons Crook near Rising Fawn at the head of the valley in the vicinity of the old Rising Fawn furnace. Hematite mines in Lookout Valley were mostly in the vicinity of New England City, approximately 4 miles (6.4 km) northeast of Trenton.

1. Production of hematite near the head of Johnsons Crook has been predominantly from lots 51, 83, 184, 213, 214, 218 and 219, 18th district. The ore-bearing horizon exploited on lot 251 had a total thickness of 62 inches (157 cm). Shale partings represented 16 inches (41 cm) of this interval. 2. Large amounts of hematite were produced from surface workings on lots 22, 35 and 37, 18th district, about 3 miles (4.8 km) south of Trenton. 3. Large quantities of hematite were recovered from numerous small openings east of New England City. The more important mines were on lots 173, 174, 186 and 212, 10th district.

Haralson County: 1. Aggregates of extremely lustrous, prismatic hematite crystals up to 0.4 inch (1 cm) in diameter have been found on the C. J. McDonald property near Temple.

Polk County: Hematite is a constituent of the residual brown iron ores mined near Cedartown, Etna, and Aragon. 1. A red, porous iron ore containing fragments of chert has been described from lot 1235, 2nd district, near Mount Hope Church (McCallie, 1900, p. 53). McCallie states that this ore seems to be "true hematite which has apparently formed from the alteration of limonite by local metamorphism." 2. A similar occurrence of earthy red hematite, apparently forming from limonitic ore, is reported from lots 966 and 967, 21st district, approximately 6 miles (7 km) east of Cedartown near Grady Station (McCallie, 1900, p. 62).

Walker County: Hematite-rich beds of the Red Mountain Formation occur along the eastern foothills of Lookout Mountain, along the eastern and western foothills of Pigeon Mountain, and along the eastern slope of Taylors and Dicks Ridges. According to McCallie (1908, p. 86), the total outcrop length of Clinton-type iron ores in Walker County exceeds 70 miles (113 km).

1. Hematite has been exploited to a considerable degree along an outcrop trend from Eagle Cliff through Highpoint to the vicinity of Cedar Grove, a distance of approximately 20 miles (32 km). Most production has been from lots 162, 199, 234, 235 and 271, 10th district; and lot 21, 11th district. Ore was developed by both surface and underground methods from seams that locally exceed 36 inches (71 cm) in thickness (McCallie, 1908, p. 87–96). 2. The most extensively developed Clinton-type hematite district in the state is centered near Estelle on the northwest slope of Pigeon Mountain. The largest workings in the district are on lots 220, 249, 254, 255, 287, 288 and 289, 8th district, and lots 289, 307 and 341, 11th district. The main ore bed varies in thickness from 30 to 40 inches (76 to 102 cm). This bed was extensively developed in shallow strip mines and locally underground (McCallie, 1908, p. 96–97). 3. Minor hematite production has been from a small district centered near the community of Bronco, approximately 6 miles (10 km) southwest of LaFayette.

ILMENITE
$FeTiO_3$

Class Simple oxide

Cryst. Hexagonal-R; rhombohedral—$\bar{3}$

Habit Commonly thick tabular crystals. Sometimes in thin laminae. Compact massive; as embedded grains; loose in sand.

Phys. *Cleavage* none. *Fracture* conchoidal to subconchoidal. **H** 5–6. **G** 4.68–4.76. *Color* iron-black. *Luster* metallic to submetallic. *Streak* black. Opaque, except in thin splinters, which transmit only red light.

Occur.

Ilmenite is a common accessory mineral of igneous and metamorphic rocks of the crystalline Piedmont and is locally abundant as tabular crystals in quartz veins and pods within these rocks. It is a major constituent of heavy mineral sands in streams, rivers and within Coastal Plain sediments. Ilmenite commonly occurs as inclusions of minute crystals in magnetite and as small, lath-like crystals in amphibolites and hornblende gneisses of Bartow, Paulding, Douglas, Haralson, Dawson and Lumpkin Counties. Properties described below are noted for euhedral ilmenite crystals or magnetite containing abundant ilmenite inclusions.

Bartow County: 1. Euhedral ilmenite crystals are reported from an undisclosed location near Allatoona Station.

Cherokee County: 1. Residual titaniferous magnetite containing up to 23.2 percent TiO_2 is reported by Haseltine (1924, p. 217) from lot 56, 2nd district. 2. Euhedral ilmenite crystals up to 1 inch (2.5 cm) in diameter occur with float quartz behind the American Legion Post at Holly Springs.

Cobb County: 1. Residual fragments of magnetite up to 6 inches (15.2 cm) in diameter containing up to 26.5 percent TiO_2 have been reported by Haseltine (1924, p. 189) on the Kemp property, 2.5 miles (4 km) northeast of Marietta.

Fulton County: 1. Euhedral ilmenite crystals are reported from the William Coleman Farm near Fairburn.

Jasper County: 1. Euhedral, tabular ilmenite crystals up to 2.5 inches (6.3 cm) in diameter occur locally as float in soil over the Gladesville Norite, approximately 6 miles (10 km) south of Monticello.

Lincoln County: 1. Tabular ilmenite crystals up to 3 inches (7.6 cm) in diameter have been found in vein quartz float around the base of Graves Mountain, immediately southeast of U.S. Highway 378 a few miles west of Lincolnton. 2. Fractured vein quartz, containing up to 16 percent coarsely crystalline ilmenite, litters the surface over an area approximately 250 feet by 150 feet (76 m by 46 m) on the Leslie Holloway property, approximately 7 miles (11 km) southeast of Lincolnton (Hurst, Crawford and Sandy, 1966, p. 282). 3. Exceptionally sharp crystals of ilmenite are occasionally encountered in vein quartz at the Colley Manganese Mine adjacent to Georgia Highway 47, approximately 3.5 miles (5.6 km) east of Lincolnton.

Lumpkin County: 1. Excellent ilmenite crystals in vein quartz occur in the Findley Gold Mine, lots 1047, 1048 and 1087, 12th district, about one mile (1.6 km) southeast of Dahlonega.

Taliaferro County: 1. A medium- to coarse-grained muscovitic rock containing up to several percent disseminated ilmenite is reported by Hurst, Crawford and Sandy (1966, p. 285) along the contact of granite with biotite and hornblende gneiss, approximately 3 miles (5 km) northwest of Hillman in northern Taliaferro County. The ilmenite-bearing zone is 300 feet (91 m) in maximum width and can be traced for 1600 feet (488 m) along strike.

Upson County: 1. Norite exposed along Fourth Branch, approximately 0.6 mile (1 km) N65°W of Mulberry Level, contains up to 12 percent ilmenite (Clarke, 1952, p. 45).

PYROPHANITE

$MnTiO_3$

Class Simple oxide

Cryst. Hexagonal—R; rhombohedral—$\bar{3}$

Habit Fine scaly; sometimes in thin laminae; compact massive.

Phys. *Cleavage* {02$\bar{2}$1} perfect, {10$\bar{1}$2} less so. *Fracture* conchoidal to subconchoidal. **H** 5–5. **G** 4.54. *Color* deep blood-red. *Luster* metallic to submetallic. *Streak* red to ochre-yellow with greenish tinge. Opaque, except in thin splinters which transmit only red light.

Occur.

Jackson County: 1. Pyrophanite, as small inclusions in magnetite and irregular grains at magnetite–silicate grain boundaries, has been reported (Hughes, 1970, p. 521) from a location 7 miles (11 km) southwest of Jefferson, 0.8 mile (1.2 km) west of Georgia Highway 11, and 0.7 mile (1.1 km) north of the Barrow County line. The occurrence is a magnetite-rich quartzite.

BRAUNITE

$3Mn_2O_3 \cdot MnSiO_3$

Class Simple oxide

Cryst. Tetragonal; ditetragonal-dipyramidal—4/m 2/m 2/m

Habit Pyramidal {011} and {131}. Striated on {001} and {201} ‖ {010}. Also granular massive. Commonest forms: x e c g n y.

Phys. *Cleavage* {112} perfect. *Fracture* uneven to subconchoidal. Brittle. **H** 6–6½. **G** 4.72–4.83; 4.67 (calc. for Mn : Si = 7 : 1). *Luster* submetallic. *Color* dark, brownish black to steel-gray. *Streak* same. Weakly magnetic. Opaque. In polished section anisotropic.

Occur.

Bartow County: Braunite is mentioned by Watson (1908, p. 49) as a minor constituent of manganese oxide ores of the Cartersville Mining District. Braunite has not been positively identified in ores of this district by modern techniques, and its identification is suspect.

RUTILE

TiO_2

Class Simple oxide

Cryst. Tetragonal; ditetragonal-dipyramidal—4/m 2/m 2/m

Habit Commonly prismatic; often slender to acicular. Rarely pyramidal. Also granular, massive, coarse to fine.

Phys. *Cleavage* distinct {110}, less distinct basal. *Structure* conchoidal to uneven. Brittle. **H** 6–6½. **G** 4.2–4.4 (for ferrian material; 4.2–5.6 (for niobium and tantalian material). *Color* red, reddish brown, black. *Streak* pale brown to yellowish; grayish or greenish black in black Nb–Ta varieties. Translucent to transparent in small pieces.

Occur.

Rutile is a rather common accessory mineral in metamorphic rocks of the crystalline Piedmont. It is a rare but economically significant constituent of heavy mineral beach sands in Pleistocene shoreline sediments of southern coastal counties. The specific occurrences listed below are those which have been reported in the literature as unusual or mineralogically interesting.

Carroll County: Multiple twinned rutile crystals up to several inches in diameter are locally abundant in soil over a wide area in southern Carroll and northwestern Heard Counties. The rutile occurs in a sequence of schist and quartzite with associated vein quartz that crops out along a major overturned anticline northwest of and parallel to the Brevard Zone (Long, 1971, p. 139).

Cherokee County: 1. Prismatic rutile crystals in clear quartz have been found in a location approximately 2.5 miles (4 km) northeast of Ball Ground and one mile (1.6 km) northwest of Cherry Grove School. 2. Simple and twinned rutile crystals, as much as 1.5 inches (3.8 cm) in length and one inch (2.5 cm) thick, are reported by Bayley (1928, p. 135) from soil along the old road running northwest from Sharp Mountain Church, about one mile (1.6 km) north of Gober on Georgia Highway 5.

Fulton County: 1. A deep red, twinned rutile crystal 2 inches (5 cm) in diameter is reported by Furcron (1951, p. 5) from an occurrence 7 miles (11 km) south of College Park on the Old Roosevelt Highway.

Gwinnett County: 1. Small, red rutile crystals in geniculate twins have been reported from the vicinity of Buford. Samples of this material were reported in 1955 by Montie Bagley of Route 3, Buford.

Habersham County: 1. Reddish rutile crystals up to an inch (2.5 cm) long and 0.06 inch (0.2 cm) in diameter occur in quartz float associated with asbestos, beryl, kyanite, talc and tourmaline near the Arrendale residence, 1.4 miles (2.3 km) south of Batesville on Georgia Highway 197 (Hurst and Crawford, 1964, p. 93). 2. Good specimens of black rutile in crystals up to one inch (2.5 cm) in diameter occur with garnet, kyanite and quartz crystals in soil along a country road approximately 3 miles (5km) due east of Hollywood and 0.5 mile (0.8 km) south of Liberty Creek (Hurst and Crawford, 1964, p. 119).

Lincoln County: 1. Perhaps the finest known rutile specimens have come from Graves Mountain, immediately southwest of U.S. Highway 378 between Lincolnton and Washington. According to the noted American gemologist and mineral collector George F. Kunz, approximately $20,000 worth of crystals had been sold from this locality prior to 1900. The Graves Mountain deposit has been mined for several years as an economic source of kyanite for the production of mullite. During the coarse of mining, numerous spectacular rutile specimens have been discovered. Sharp brilliant twins up to 10 pounds (4.5 kg) and 6 to 8 inches (15 to 20 cm) in diameter have been placed on the collector and museum market recently. Prior to mining, the finest crystals were found in the saddle and on the slopes north of the saddle. Hurst (1958d, p. 19)

mapped the geology of Graves Mountain prior to mining and reports that most coarse rutile occurred as scattered crystals or groups of crystals in the kyanite-quartz rock both in unaltered and in pyrophyllitized zones. In addition, brilliant crystals occur in highly altered kyanite masses that are impregnated with secondary iron minerals. Collecting at this site is by permission only. 2. Red, acicular rutile crystals with associated black tourmaline occur in small quartz pods at map location 228 in the Central Savannah River area (Hurst, Crawford and Sandy, 1966). The occurrence is along a secondary road immediately north of Dry Fork Creek, approximately 2 miles (3.2 km) southeast of Lincolnton.

Pickens County: 1. Rutile crystals exceeding one inch (2.5 cm) in diameter have been found with kyanite and quartz crystals in soil adjacent to the pegmatite at the F. M. Cagle Mica Mine, approximately 4.8 miles (7.7 km) S65°W of Tate. The mine is on lot 195, 13th district, 2nd section (Furcron and Teague, 1943, p. 107). 2. Brilliant red, prismatic rutile crystals up to 0.3 inch (0.8 cm) in length occur with chalcopyrite, pyrite and clay minerals on large calcite crystals found in vugs in Murphy Marble at the New York Quarry at Marble Hill.

Stephens County: 1. Well-formed, red rutile crystals occur in stream sands behind Buz Bailey's store in Mize and behind New Hope Church. Fragments of glassy quartz that contain rutile needles are found at these locations.

Towns County: Crude, multiple twinned rutile crystals are locally abundant in soil overlying an ill-defined belt of rutile-bearing garnet mica schist extending from near Shooting Creek, North Carolina, to near Young Harris. A portion of the rutile-bearing zone has been mapped by Hartley (1973, p. 48).

Troup County: 1. Small, twinned rutile crystals were found in soil associated with pegmatite mining at the Hogg or Minerals Processing Company Mine 8 miles (12.8 km) south of LaGrange on lot 184, 4th district.

Wilkes County: 1. Hurst, Crawford and Sandy (1966, p. 295) report that rutile, in euhedral to subhedral crystals less than 1/16 inch (0.15 cm) across, is a common but minor accessory in the kyanite deposit on the Cristine Freeman property. The occurrence is on Georgia Highway 80, approximately 6.2 miles (10 km) S33°E from Washington.

PYROLUSITE

MnO_2

Class Simple oxide

Cryst. Tetragonal; ditetragonal-dipyramidal—4/m 2/m 2/m

Habit Rarely in well-developed crystals. Usually massive, fibrous, concretionary, incrusting, granular to powdery, and as dendritic growths.

Phys. *Cleavage* {110} perfect. *Fracture* uneven. Brittle. **H** 6–6½ (crystals); 2–6 (massive). Often soils the fingers. *Luster* metallic. *Color* light steel-gray or iron-gray in crystals; dark steel-gray or iron-black in massive material. *Streak* black. Opaque.

Occur.

Although manganese oxides have been produced commercially from six districts along with numerous outlying occurrences since approximately 1895, the mineralogy of these deposits has not been studied in detail with the exception of those in the Cartersville Mining District. Detailed examination of manganese oxide minerals from this district (Kesler, 1950, p. 53) has shown that the dominant mineral is pyrolusite. Since Cartersville manganese ores are similar to those of the other major districts, the major manganese oxide occurrences in the state will be described as pyrolusite-rich. Less commonly associated manganese oxides such as cryptomelane and romanechite (psilomelane) are described separately. Pyrolusite occurrences described herein are those in which crystalline material suitable for detailed study is known to occur or those which are representative of specific districts or outlying deposits. Details concerning the production of manganese oxide minerals in Georgia have been presented by Watson (1908), Hull, LaForge, and Crane (1919), and Kesler (1950).

Bartow County: The largest and most historically significant production of manganese in the state has been from the Cartersville Mining District. Black manganese oxide minerals occur commonly intermixed with brown iron oxides and in finely disseminated and concretionary forms in residual clays and saprolite. Most manganese deposits have highly irregular outlines although some are sharply defined lenticular zones (Kesler, 1950, p. 53). Previously exploited deposits occur in a general belt from Emerson northward to the vicinity of Stamp Creek. Production has been reported from approximately 70 locations although the majority of the district's output may be accounted for by approximately 10 larger deposits.

1. Large concretionary masses of pyrolusite have been mined on lot 312, 4th district, 3rd section, approximately 1.25 miles (2 km) north-northeast of Cartersville (Hull, LaForge and Crane, 1919, p. 99). Pyrolusite occurs locally within concretions as radial aggregates of needle-like crystals. Prisms locally exceed one inch (2.5 cm) in length. Pyrolusite also occurs at this location in very small, tabular, highly lustrous crystals in irregular cavities within larger concretions. These stout tabular crystals exhibit forms typical of manganite and may be pseudomorphous after this mineral. 2. Similar crystalline pyrolusite is reported from the old Wyvern Mine on the east side of lot 200, 5th district, 3rd section, approximately 0.25 mile (0.4 km) northeast of Wyvern Station, 4 miles (6.4 km) north of Cartersville. 3. Crystalline pyrolusite is reported by Hull, LaForge and Crane (1919, p. 93) from the Appalachian Manganese Mine on lots 305 and 306, 5th district, 3rd section, 4.25 miles (6.8 km) northeast of Cartersville on Rowland Springs Road. 4. Similar crystalline pyrolusite occurs at the Blue Ridge Manganese Mine, lots 303 and 274, 5th district, 3rd section, 6 miles (9.7 km) north-northeast of Cartersville. 5. Crystalline pyrolusite occurs in the Abramson Manganese Mine, lot 826, 4th district, 3rd section, near Emerson. 6. Crystalline pyrolusite is relatively abundant at the old workings on lots 471 and 472, 4th district, 3rd section, approximately 2.5 miles (4 km) east of Cartersville (Watson, 1908, p. 76). 7. Large, dense concretionary masses of manganese oxides containing pockets and seams of crystalline pyrolusite are reported from lot 226, 4th district, on the Rowland Springs Road (Watson, 1908, p. 83. 8. Concretionary masses of manganese oxide containing needle-like crystals of pyrolusite occur in the workings of the Bishop-Smith Mine on lot 235, 5th district, approximately one mile (1.6 km) from Cartersville. 9. Pyrolusite-rich ore was first produced in Georgia in 1859 from the old Blue Ridge Ocher Company's property or the old Silva Mine, lot 390, 4th district. 10. Crystalline pyrolusite can occasionally be found in large massive boulders of manganese oxides at the extensive workings of the Aubrey-Stephenson and Bufford Mines, the largest in the district, on lots 299, 300 and 314, 5th district (Kesler, 1950, p. 68). 11. Crystalline pyrolusite occurs locally in the Chumley Hill–Red Mountain manganese deposit in lots 143, 144, 145, 146 and 147, 22nd district, east of the Aubrey-Stephenson Mines (Kesler, 1950, p. 73). The deposit at this location is unusual due to its continuous mined length of 0.75 mile (1.2 km). 12. Concretionary masses of manganese oxides containing concentric layers of locally crystalline pyrolusite occur in the Will Lee Manganese Mine in the eastern part of lot 276, 6.5 miles (10.4 km) northeast of Cartersville on the J. M. Neel property (Kesler, 1950, p. 80). It has been reported by local miners that manganese oxide stalactites as much as one foot (0.3 m) in length were found at depth in open crevices in jasperoid.

Catoosa County: High-grade manganese oxides containing some pyrolusite and romanechite occur in that portion of the Tunnel Hill Mining District occupying the eastern part of Catoosa County (Hull, LaForge and Crane, 1919, p. 185). Former production has been from the Fox and Dowler properties which includes portions of lots 215, 218, 251, 254, 286, 287, 289 and 290, 11th district, 3rd section. Manganese oxide nodules grading outward to an iron oxide rim are common on these properties.

Fannin County: 1. A small amount of pyrolusite-bearing manganese oxide has been shipped from the old iron mine adjacent to the Louisville and Nashville Railroad in the northern part of the town of Blue RIdge. Manganese oxides at this location are generally concretionary and locally stalactitic, occurring as pockets and veins in clay and partially decomposed schist and slate.

Floyd County: A moderate production of manganese is reported from the old Cave Spring Mining District in the southern part of Floyd and adjacent Polk Counties.

1. Crystalline and botryoidal pyrolusite occurs in a matrix of chert breccia and locally as concretionary masses in the old workings on lots 822, 823, 824, 832, 833, 834 and 835, 3rd district, 4th section, approximately 6 miles (10 km) east of Cave Springs (Hull, LaForge and Crane, 1919, p. 169). 2. Small prismatic crystals of pyrolusite occur locally with iron oxide in the State Ore-Banks workings on lot 997, 3rd district, approximately 1.25 miles (2 km) southeast of Cave Springs (McCallie, 1900, p. 179).

Gilmer County: 1. A small amount of pyrolusite-bearing manganese oxide ore has been produced from the Davis prospects on lot 251, 7th district, less than one mile (1.6 km) north-northeast of Whitepath.

Habersham County: 1. A small quantity of very high-grade pyrolusite-bearing manganese oxide ore has been shipped from the Fort property, lot 177, 10th district, 2 miles (3.2 km) northeast of Mount Airy in the southern part of the county (Hall, LaForge, and Crane, 1919, p. 209). The deposit is apparently associated with a large quartz vein which has been shattered and cemented by manganese minerals. Former production was from residual material mined from shallow surface workings.

Haralson County: 1. Small shipments of relatively high-grade, pyrolusite-bearing manganese oxide have been made from what are known as the old Douglass prospects centering on lot 981, 19th district, 3rd section, 2 miles (3.2 km) north of Draketown in the eastern part of the county. The manganese oxides occur within and adjacent to a persistent quartzite lens and are associated with magnetite-rich rock. Manganese oxides at this location occur in finely granular, massive, compact, botryoidal, and globular forms with very little crystalline material.

Hart County: 1. Manganese oxide ore, presumably containing at least some pyrolusite, has been shipped from the J. R. Brown property, approximately 1.5 miles (2.4 km) east of Bowersville in the western part of the county (Hull, LaForge and Crane, 1919, p. 210). The ore occurs in a lense-like massive deposit within partially weathered mica schist and red residual clays.

Lincoln County: 1. A moderate amount of pyrolusite-bearing manganese oxide ore was produced from the Colley Mine, approximately 3.25 miles (5.2 km) east of Lincolnton. Manganese oxides occur in residuum over vein-like bodies of rock containing abundant manganese silicates and carbonates. The property is near the northeast end of the Piedmont Manganese Belt and has been recently examined and described by Hurst, Crawford and Sandy (1966, p. 338).

Lumpkin County: 1. Botryoidal masses of pyrolusite up to 3 inches (7.6 cm) thick and several feet in length have been found in a gold-bearing quartz vein exposed in the Bast Mine near Dahlonega.

Murray County: 1. Manganiferous iron ore and high-grade manganese oxide nodules occur in yellow clay on the Green property, lots 163, 165 and 196, 27th district, 2nd section, in the northern part of the county. Most production has been from lot 196, approximately 0.5 mile (0.8 km) north of Doogan. 2. Brecciated quartzite containing partially crystalline pyrolusite in fractures up to one foot (0.3 m) thick has been exploited for manganese on the Powell property, lots 236 and 237, 27th district, 2nd section, approximately one mile (1.6 km) northeast of Doogan Mountain (Hull, LaForge and Crane, 1919, p. 199).

Paulding County: 1. Pyrolusite-bearing manganese ore has been produced from the Douglass prospects, lot 915, 19th district, 3rd section, in the western part of the county, about 2 miles (3.2 km) north of Draketown. Concretionary oxide masses contain an exterior shell-like layer up to 3 inches (7.6 cm) thick composed of hard, siliceous iron oxides surrounding an inner mass of bluish-black manganese oxides. The occurrence is adjacent to resistant magnetite-bearing quartzite and is a continuation of the similar occurrences described in adjacent Haralson County.

Polk County: Manganese oxide has been produced in moderate quantities from the southern half of the Cave Springs district and from a small isolated area near the Alabama border immediately southeast of the community of Haynie, approximately one mile (1.6 km) north of Oredell.

1. Crystalline pyrolusite is particularly abundant in old workings on lots 1160, 1161, 1216 and 1217, 3rd district, 4th section, in the northwestern part of the county, approximately 2 miles (3.2 km) south of Cave Springs. 2. Small, well-formed crystals of pyrolusite are locally abundant on the dump of an iron mine on the old Hampton property, lots 146 and 212, 2nd district (McCallie, 1900, p. 55).

Taliaferro County: Manganese oxide minerals have been prospected sporadically along a portion of what has been known as the Piedmont Manganese Belt from the Greene–Taliaferro County line northeastward to the Taliaferro–Wilkes County line. All former production has been from the properties controlled by the now defunct Georgia Manganese Company. Former production was from the old Judge John C. Hart Manganese–iron Mine, about 8 miles (13 km) northeast of Union Point and 4 miles (6.4 km) north of Robinson. This property, as well as other prospects in the belt, has been reexamined indetil by Hurst, Crawford and Sandy (1966, p. 328). Manganese oxides within this trend are apparently residual after weathered spessartine and other manganese-rich silicates.

Towns County: 1. A very small quantity of high-grade manganese oxide was produced from the McConnell property, approximately 2 miles (3.2 km) west-northwest of Hiawassee. Rhodochrosite-filled cavities in porous masses of impure manganese oxide have been reported from this general vicinity (Watson, 1908, p. 160–165).

Whitfield County: 1. Manganese oxides have been produced from several occurrences in what has been known as the Varnell-Cohutta Mining District, extending for approximately 9 miles (14 km) from a point between Waring and Varnell northward, east of Cohutta, to the Georgia–Tennessee state line east of Red Clay. Pyrolusite appears to be the dominant manganese oxide in this district. Production has been chiefly from small openings on lots 169, 170, 172, 189, 190 and 191, 11th district, 3rd section, approximately 1.5 miles (2.4 km) northeast of Varnell and old workings of the Chicago-Tennessee Coal and Oil Company, approximately 3 miles (5 km) south of the Georgia–Tennessee state line on lot 60, 11th district, 3rd section, approximately 0.5 mile (0.8 km) east of Cohutta (Hull, LaForge and Crane, 1919, p. 191–195).

CASSITERITE

SnO_2

Class Simple oxide

Cryst. Tetragonal; ditetragonal-dipyramidal—4/m 2/m 2/m

Habit Commonly in well-formed crystals, often bipyramidal, but sometimes prismatic. Also massive in banded fibrous crusts, concretionary masses, and in granular masses.

Phys. *Cleavage* poor {100}. *Fracture* subchoncoidal to uneven. Brittle. **H** 6–7. **G** 6.8–7.1. *Luster* adamantine to greasy. *Color* usually black, brownish black, yellowish brown, or reddish brown; occasionally red, yellow, gray, or white; very rarely colorless. *Streak* brownish, gray, white. Transparent to translucent; some varieties nearly opaque.

Occur.

Although a small amount of cassiterite has been produced in Alabama, South Carolina, and North Carolina, there are currently no authenticated occurrences of this mineral in Georgia. It has, however, been reported from at least 4 counties. Its occurrence within the southeastern Piedmont is generally restricted to pegmatites.

Cherokee County: 1. Galpin (1915, p. 149) reports that tin, probably cassiterite, was found on the E. J. White property near Lathantown. Galpin was unable to obtain any of the tin-bearing material.

Fannin County: 1. There is a long-standing legend of the discovery of tin in old Gilmer County near the Tennessee line. This discovery is reported to have been made by Dr. John R. Cotting who was appointed the first State Geologist in 1836. This legend has been researched in detail by Furcron (1960b, p. 124–125). Most evidence suggests that Cotting's discovery was in the northeastern corner of what is now Fannin County. This occurrence has been prospected by numerous individuals without success.

Lumpkin County: 1. It was reported in the 16th Annual Report of the United States Geological Survey (1895, vol. 3, p. 527) that samples collected from lots 95, 96, 97 and 120, 1st section, 9 miles (14.4 km) northeast of Dahlonega near Grendle, contain up to 1.5 percent tin (presumably as cassiterite). Rocks in the immediate area are interbedded granitic gneiss and chlorite schist. 2. Very small amounts of alluvial cassiterite have been reported in the Dahlonega district from the cleanup of placer gold mining operations (Hess and Graton, 1904, p. 164).

White County: 1. Minute grains of cassiterite (var. wood tin) are reported from the gold placers of Nacoochee Valley by Blake (1874).

ANATASE

Class Simple oxide

Cryst. Tetragonal; ditetragonal-dipyramidal—4/m 2/m 2/m

Habit Commonly acute pyramidal {011}. Less commonly obtuse pyramidal, usually with {017} or {013}. Also tabular {001}. Rarely prismatic {001} with {110} or, very rarely, {010}. The crystals are often highly modified.

Phys. *Cleavage* {001} and {011}, perfect. *Fracture* subconchoidal. Brittle. **H** 5½–6. **G** 3.90; 4.04 (calc.). *Luster* adamantine or metallic adamantine, sometimes splendent. *Color* various shades of brown, including yellowish and reddish brown, passing into indigo-blue and black; also greenish, blue-green, pale lilac, slate-gray, and rarely, nearly colorless. *Streak* colorless to pale yellow. Transparent; the very deeply colored varities are transparent only in small fragments. Pyramidal crystals often appear opaque owing to total reflection.

Occur.

Fine-grained anatase has been shown to be the dominate titanium mineral in many of the economic kaolinite deposits of the Coastal Plain. The possible detrital nature of this impurity suggests that its presence in the crystalline rocks may be much more widespread than the single known occurrence indicates.

Fannin County: 1. Light gray monoclinic crystals, up to 0.75 inch (1.9 cm) across and exhibiting the wedge-shaped habit of titanite, occur in a thin clay seam within weathered metagraywacke along a county road halfway between Chestnut Gap and Lebanon School (Hurst, 1956c, p. 73). The crystals were identified by X-ray diffraction as anatase, suggesting that they are pseudomorphs after titanite.

BROOKITE

TiO_2

Class Simple oxide

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Found only as crystals. Usually tabular {010} and elongated {001}, with {010} and the prism faces striated {001}; also prismatic {001} with {120} prominent (and sometimes simulating rutile); rarely tabular {001}, or pseudohexagonal with {120} and {111} equally developed; also pyramidal {111}. Common forms: M b e c t y. A dark brown to black, rarely blue, hourglass coloration is often seen through {010} as sectors extending from the terminal faces.

Phys. *Cleavage* {120} indistinct, {001} still more so. *Fracture* subconchoidal to uneven. Brittle. **H** 5½–6. **G** 4.14 ± 0.06 (highest in dark-colored material); 4.12 (calc.). *Luster* metallic adamantine to submetallic. *Color* hair-brown, yellowish brown, reddish brown; also dark brown to iron black. *Streak* uncolored to grayish to yellowish. Transparent in small fragments; in dark brown to black varieties transparent only in thin splinters.

Occur.

Coweta County: 1. Good crystals of a mineral originally identified as brookite were submitted to the Georgia Geological Survey in the early 1900's from the J. A. Powers Farm. Recent examination of the original samples suggests that the crystals are actually twinned rutile.

CRYPTOMELANE

$K(Mn^{+4},Mn^{+2})_8O_{16}$

Class Oxide

Cryst. Monoclinic-pseudotetragonal

Habit Usually massive, fine-grained, often loosely aggregated or porous; less commonly compact and cleavable. Also botryoidal or radial-fibrous to distinct fibers.

Phys. *Cleavage* none. Variable hardness **H** to 6.5. **G** 4.39 (calc.). *Color* steel-gray to bluish gray; often tarnishes dull grayish black. Opaque. *Luster* metallic, submetallic, or dull. *Streak* brownish black.

Occur.

Bartow County: Qualitative chemical determinations and X-ray examination of manganese oxide samples from the Cartersville Mining District by Fleischer and Axelrod of the U.S. Geological Survey (Kesler, 1950, p. 53) suggest that the predominant psilomelane-type mineral in the district is cryptomelane. Specific occurrences are not given.

Habersham County: 1. Cryptomelane has been tentatively identified by Hurst and Crawford (1964, p. 130) from old manganese prospects approximately 2 miles (3.2 km) north of Mount Airy.

URANINITE

UO_2

Class Simple oxide

Cryst. Isometric; hexoctahedral—4/m $\bar{3}$ 2/m

Habit Commonly in cubic crystals or cubes modified by octahedral or dodecahedral faces. Also massive, dense to granular; occasionally pulverulent or almost graphitic; as reniform or botryoidal crusts.

Phys. *Cleavage* none. *Fracture* uneven to rough conchoidal. Brittle. **H** 5–6. **G** 7.5–10 (for natural crystals); 6.5–9 (for pitchblende). *Luster* submetallic to pitch-like or greasy. *Color* dark steel-gray to velvety black in crystals; brownish black, dark

brown, greenish gray in oxidized and altered material. *Streak* brownish black, grayish, or dull olive-green.

Occur.

The known occurrences of uraninite are all related to pegmatites in areas of granitic instrusive activity. Positive identification of radioactive species is somewhat difficult due to the self-destructive or metamict character of the material.

Fulton County: 1. Black, irregularly shaped masses of uraninite up to 0.4 inch (1 cm) across have been reported from an undisclosed pegmatite occurrence (Hurst, 1957, p. 55). The uraninite was completely metamict but recrystallized readily at 1,000°C.

Greene County: 1. A brownish-black, primary-type "uranium ore" is reported from a pegmatite previously exploited for mica and feldspar on the property of W. M. Poss, about 4 miles (6.4 km) northeast of Union Point. Spectrographic analysis indicates niobium to be a major component with uranium and other metals as minor elements suggesting that uraninite, if present, is a very minor constituent (Furcron, 1955, p. 42).

Hart County: 1. Black uraninite cubes up to 0.1 inch (0.2 cm) on edge occur disseminated in pink pegmatite at the aggregate quarry near Hartwell Dam. Four X-ray precession photographs indicate that uraninite is completely metamict in some portions and still crystalline in others, with most of the metamict portions near the center of the cubes (Hurst, 1957b, p. 55).

Jasper County: 1. Black, heavy primary-type "uranium ore" (presumably containing at least some uraninite) is reported from the property of J. R. Parker, Route 2, Hillsboro, 9 miles (14.4 km) south of Monticello on Georgia Highway 11 near the Baron Fullerton home (Furcron, 1955, p. 42).

Lamar County: 1. Uraninite cubes up to 0.3 inch (0.5 cm) in diameter associated with metatorbernite, meta-autunite, beta-uranophane, and soddyite occur in a pegmatite exploited for mica on Red Bone Farm owned by A. N. Moye, about 5 miles (8 km) southeast of Barnesville.

Putnam County: 1. Iron-stained quartz containing radioactive minerals has been found on the W. B. Larman property neary Eatonton. Unidentified, fluorescent uranium minerals in some samples may be secondary after primary uraninite.

SPINEL

$MgAl_2O_4$

Class Multiple oxide

Cryst. Isometric; hexoctahedral—4/m $\bar{3}$ 2/m

Habit Usually octahedral; less often modified by a{010} or d{011}; rarely dodecahedral or cubic. Also massive, coarse granular to compact and as irregular or rounded embedded grains.

Twin. Common on {111}, the spinel law, with twinned aggregates often flattened parallel {111}, the composition plane. Sometimes as sixlings by repeated twinning.

Phys. Separation plane {111} indistinct, and probably parting rather than *cleavage*. *Fracture* conchoidal; sometimes uneven to splintery. Brittle. **H** 7½–8. **G** 3.55. *Luster* vitreous, splendent to nearly dull. *Color* variable: red (ruby-spinel gem) to blue, green, brown to nearly colorless. *Streak* white.

Occur.

Spinel is a rather widely distributed accessory mineral in mafic and ultra-mafic intrusive igneous rocks. It is normally reported only during microscopic examination of thin sections.

Columbia County: 1. Spinel (pleonaste) is described by Hopkins (1914, p. 23) as an accessory mineral in an amphibole-pyroxene gneiss near Hatcher Mountain, 5 miles (8 km) east of Phinizy. Spinel is intimately associated with sphene and occurs in considerable quantities in zoisite–epidote zones derived by the alteration of plagioclase.

Jasper County: 1. Irregular rims of green spinel surrounding altered olivine grains occur in the Gladesville Norite, approximately 5 miles (8 km) south of Monticello.

Morgan County: 1. Well-formed crystals of blue-to-purple spinel may be panned from the branch on the Bertram Richardson property a short distance east of Rutledge. The crystals are typically simple octahedra and are found with corundum and wire gold.

Rabun County: 1. Green spinel is described as an accessory constituent of an olivine websterite pluton near Rabun Gap by Hopkins (1914, p. 66). Associated minerals are pyrite, hornblende, biotite, chlorite, serpentine and magnetite.

Towns County: 1. Spinel (picotite and pleonaste) is described in thin sections of troctolite collected at Brasstown Creek, 1.75 miles (2.8 km) north of Youngtown (Hopkins, 1914, p. 41). 2. Spinel has been reported as a very minor constituent of numerous ultramafic and mafic rocks exposed in the Young Harris and Hiawassee vicinity. One such occurrence of vermicular green spinel intergrown with amphibole in coronite troctolite is given by Hartley (1973, p. 28). At no place is spinel reported in megascopic amounts.

Troup County: 1. Octahedra of black spinel up to several inches across were reported during W.P.A. prospecting at the east end of the Louise Chromite Belt. The spinel was found over an area of approximately one acre, 0.75 mile (1.2 km) south of the intersection of the Mountville–Hogansville Road and Beech Creek. Residual corundum is also found at this location.

GAHNITE
$ZnAl_2O_4$

Class Multiple oxide

Cryst. Isometric; hexoctahedral—4/m $\bar{3}$ 2/m

Habit Usually octahedral; less often modified by a{010} or d{011}; rarely dodecahedral or cubic. Also massive, coarse granular to compact and as irregular or rounded embedded grains.

Twin. Common on {111}, the spinel law, with twinned aggregates often flattened parallel {111}, the composition plane. Sometimes as sixlings by repeated twinning.

Phys. Separation plane {111} indistinct, and probably parting rather than *cleavage*. *Fracture* conchoidal; sometimes uneven to splintery. Brittle. **H** 7½–8. **G** 4.62. *Luster* vitreous, splendent to nearly dull. *Color* dark blue-green. *Streak* gray.

Occur.

Gahnite occurs as an accessory mineral in wall rocks of several precious and base metal deposits within the crystalline Piedmont. It has recently been reported as an accessory mineral in an inadequately described iron–manganese prospect.

Cherokee County: 1. Small green octahedral crystals of gahnite are reported by Dana (1912, p. 339) from the Rich or Canton Copper Mine on lots 127, 128, 161 and 162, 14th district, 2nd section, approximately one mile (1.6 km) south of Canton.

Douglas County: 1. Subhedral masses of gahnite up to 0.1 inch (0.25 cm) in diameter associated with pyrrhotite are described in thin sections of altered wall rock from the Villa Rica massive sulfide deposit, approximately 3 miles (4.8 km) northeast of Villa Rica, immediately east of Georgia Highway 61 (Cook, 1970, p. 63). Associated minerals are muscovite, pyrite, and dravite.

Lincoln County: 1. Small subhedral-to-euhedral gahnite crystals are disseminated in chlorite–sericite schist at the Magruder Gold Mine in the extreme western part of the county, approximately 2.5 miles (4 km) east of Metasville (Cofer, 1953, p. 309). Crystals are normally octahedral and leaf-green to olive green. Gahnite and associated spessartine are considered to be products of wall rock alteration produced early in the stages of mineralization by hydrothermal solutions rising from depth.

Lumpkin County: 1. Gahnite is mentioned in ores of the Standard Gold Mine by Lindgren (1906, p. 123). This mine, formerly the Singleton and Dahlonega Mines, is on lots 1083 and 1084, 12th district, on Yahoola Creek. Analyses of gahnite from the Dahlonega Gold Mine are presented by Wells (1937, p. 134).

Paulding County: 1. Euhedral, dark-green gahnite crystals up to 0.25 inch (0.6 cm) across are locally abundant in muscovite–quartz schist on dumps of the Little Bob Pyrite Mine, 2nd district, 3rd section, approximately 2 miles (3.2 km) northwest of Hiram. The mineral is typically associated with altered wall rocks adjacent to sphalerite-rich massive sulfide lenses.

Taliaferro County: 1. Gahnite is reported as a minor accessory mineral in the iron–manganese oxide prospects on the old Judge John C. Hart property, approximately 6.5 miles (10 km) northwest of Crawfordville and 1.2 miles (1.9 km) west of the crossroads at Springfield Church (R. H. Carpenter, personal communication).

MAGNETITE

$Fe^{+2}Fe^{+3}_2O_4$

Class Multiple oxide

Cryst. Isometric; hexoctahedral—4/m $\bar{3}$ 2/m

Habit Usually octahedral crystals; also massive and granular.

Phys. *Cleavage* none. **H** 5½–6½. **G** 5.2. *Luster* metallic to semimetallic, splendent to nearly dull. *Color* iron-black. *Streak* black.

Occur.

Magnetite is an exceedingly common and very widely distributed mineral within Georgia. It is an accessory mineral of most of the metamorphic and igneous rocks in the crystalline Piedmont and has been reported in thick segregations and disseminations within mafic and ultramafic plutons. Its relatively high density and resistance to weathering make it a major constituent of black sand accumulations including the currently exploited heavy mineral deposits of the Coastal Plain. The occurrences described below are those which are unusual with respect to mineralogy or occurrence and have been reported either in the published literature or in private reports in the files of the Georgia Department of Natural Resources.

Cherokee County: 1. Schist containing bands and segregations of magnetite occurs interbedded with quartzite, hornblende schist, and garnetiferous mica schist on lot 202, 14th district, 2nd section, one mile (1.6 km) east of Canton (Haseltine, 1924, p. 195). 2. Fragments of massive, intergrown magnetite and corundum up to 4 inches (10 cm) across occur in soil over an ultramafic intrusion on lot 71, 4th district, 2nd section, 7 miles (11 km) east of Canton (Hopkins, 1914, p. 172). 3. Coarsely crystalline magnetite float is reported from additional properties including lot 1282, 15th district, 2 miles (3.2 km) southeast of Woodstock.

Cobb County: 1. Prospecting for economic magnetite deposits has been conducted within an irregular belt about 8 miles (13 km) long and approximately one mile (1.6 km) wide extending roughly from Marietta northward to Woodstock. Masses of magnetite up to 3 inches (7.6 cm) in diameter occur as fragments in soil within this belt on numerous land lots such as lot 15, 16th district; the J. B. Knight property, 2.5 miles (4 km) north of Blackwells and 0.5 mile (0.8 km) east of the Louisville and Nashville Railroad; the J. W. Gunnin, Jr. property, 1.5 miles (2.4 km) north of Blackwells; and the A. D. Kemp property, 2.5 miles (4 km) northeast of Marietta (Haseltine, 1924, p. 187–189).

Dawson County: 1. High-grade magnetite float is reported on lot 97, 4th district by Haseltine (1924, p. 193).

Elbert County: 1. Excellent striated octahedra of magnetite occur on the north edge of Elberton on the property of H. H. Wilcox.

Fulton County: 1. Large lumps of magnetite (var. lodestone) may be found on lots 199 and 200, 10th district, 6 miles (9.6 km) northeast of Greenville on the Greenville–Rocky Mount Road.

Gilmer County: 1. Magnetite-bearing rock has been prospected on lot 215, 7th district, 2nd section, about 0.25 mile (0.4 km) south of Cherrylog on the Louisville and Nashville Railroad.

Habersham County: 1. Excellent magnetite octahedra up to 0.5 inch (1.3 cm) across occur with mass-fiber asbestos on a bouldery knoll underlain by serpentine and chlorite schist, approximately 6 miles (9.6 km) west of Clarksville immediately north of the forks of Amos Creek on the west side of Alec Mountain. 2. Residual fragments of magnetite showing crystal faces litter the ground over a small area approximately 2 miles (3.2 km) southeast of Demorest (Hurst and Crawford, 1964, p. 130).

Jasper County: 1. Poorly formed, striated magnetite crystals up to 2 inches (5 cm) in diameter occur in residuum overlying parts of the southeast margin of the Gladesville Norite, approximately 6 miles (9.6 km) south of Monticello.

Lumpkin County: 1. Magnetite has been prospected as a source of iron from at least three parallel trends striking northeast and crossing the county immediately northwest of Dahlonega. The prospect area has been investigated geophysically (Brown, Yates, Rowlands and Straley, 1953, p. 136). Good crystals are reported from one of these units which crosses lots 682, 683, and 649 near the old Siebold home on U.S. Highway 19.

Paulding County: 1. Excellent, though small, perfectly formed octahedral crystals of magnetite occur in residuum and in quartz-rich units in the vicinity of massive sulfide prospects in both Paulding and Haralson Counties. A typical occurrence is in the vicinity and on the dumps of the Little Bob Pyrite Mine, lots 624, 625, 672, 673, 695, 697, 744 and 745, 2nd district, 3rd section. 2. Considerable magnetite occurs with pyrite, pyrrhotite, chalcopyrite, and sphalerite at the Swift massive sulfide prospect on lots 1184, 1197, 1198, and 1199, 19th district, 3rd section.

Taliaferro County: 1. Magnetite and associated manganese oxides have been prospected from two shallow shafts on property formerly belonging to Judge John C. Hart, approximately 6.5 miles (10 km) north-

west of Crawfordville, 3.2 miles (5 km) northeast of Robinson, and 1.2 miles (1.9 km) west of the crossroads at Springfield Church (Haseltine, 1924, p. 190). The deposit consists of a series of veins having an overall length of approximately 3,800 feet (1158 m) and an average combined width of about 2 feet (0.6 m). Associated minerals are hematite, manganese oxides, garnet and quartz. Magnetite with manganese oxide float occurs in a northeast trend from this and the nearby Murden property for at least as far as central Lincoln County. Sporadic prospecting has occurred throughout the belt. A detailed description of this mineralized trend is given by Hurst, Crawford and Sandy (1966). 2. One carload of magnetite was shipped to smelters at Birmingham from a small prospect on the Murden property, approximately one mile (1.6 km) north of Robinson.

White County: 1. Fragments of magnetite litter the surface of a small field approximately 800 feet (244 m) south of Georgia Highway 115 and 4.2 miles (6.8 km) southwest of Cleveland (Hurst and Otwell, 1964, p. 87). 2. Fragments of magnetite up to 2 inches (5 cm) in diameter litter a hillside northwest of an unpaved county road approximately one mile (1.6 km) southeast of Leaf Community, 6 miles (9.6 km) east of Cleveland (Hurst and Otwell, 1964, p. 92.)

JACOBSITE

$(Mn^{+2},Fe^{+2},Mg)(Fe^{+3},Mn^{+3})_2O_4$

Class Multiple oxide

Cryst. Isometric; hexoctahedral—4/m $\bar{3}$ 2/m

Habit Rarely found as distorted, octahedral crystals; massive, granular, coarse or fine.

Twinning Common on {111}, with same face as composition face. Twins flattened ‖ {111} (the typical spinel twin) or as lamellar twins, producing striae on {111}.

Phys. Reported parting at (3•50•60). **H** 5.5–6.5. **G** 4.76 (meas.), 5.03 (calc.). *Color* black, opaque. *Luster* metallic to dull. *Streak* brown. Weakly magnetic.

Occur.

Cherokee County: 1. Shearer and Hull (1918, p. 146–153) report the probable occurrence of jacobsite as an accessory mineral in rocks associated with the massive pyrite deposit at the Bell-Star Pyrite Mine, 3.8 miles (6 km) west of Woodstock and 6.7 miles (10.7 km) north of Kennesaw, lots 900 and 901, 21st district, 2nd section.

CHROMITE

$FeCr_2O_4$

Class Multiple oxide

Cryst. Isometric; hexoctahedral—4/m $\bar{3}$ 2/m

Habit Crystals not common. Commonly massive; fine granular to compact.

Phys. *Cleavage* none. *Fracture* uneven. Brittle. **H** 5½. **G** 4.5–4.8. *Luster* metallic. *Color* black. *Streak* brown. Opaque, except in thin splinters.

Occur.

Chromite is a very common, though minor, accessory mineral in the ultramafic intrusive rocks of Georgia and neighboring states. Only those occurrences that have been reported in the literature or in unpublished state records are described below. Careful search would undoubtedly disclose the presence of residual chromite in soil overlying most of the known peridotite occurrences.

Cherokee County: 1. Chromite samples were submitted to the Georgia Geological Survey for identification in 1896 from a locality near Holly Springs, possibly from the vicinity of the Verde Antique Quarry in lot 444, 15th district, 2 miles (3.2 km) southwest of Holly Springs.

Clarke County: 1. Masses of granular chromite weighing up to 4 pounds (1.8 kg) have been found as float in soil overlying a very small mafic body immediately west of U.S. Highway 441, approximately 2 miles (3.2 km) south of Watkinsville.

Columbia County: 1. Chromite is described by Hurst, Crawford and Sandy (1966, p. 89) from an area between Pollards Corner and the Savannah River. The area is underlain by at least three large serpentinite masses. Chromite occurs as disseminated particles, concentrations of small grains, veins, and pods. Veins up

to 2 inches (5 cm) thick and pods as thick as 3 inches (7.6 cm) are described from the large serpentinite mass south of Dixie Mountain. Coarse chromite is most abundant in residuum along the south side of Dixie Mountain and along the large serpentinite mass southeast of this mountain. Geochemical analyses of soil indicate that the highest concentration of chromium is on the northeast side of Burte Mountain.

Habersham County: 1. Chromite fragments litter the soil over a small area south of Beaver Dam Creek, 2 miles (3.2 km) west of Clarksville and 2,000 feet (610 m) north of the junction of Georgia Highways 17 and 115. Small pods and irregularly shaped grains of chromite are scattered throughout fuchsite schist in several small prospect trenches (Hurst and Crawford, 1964, p. 28).

Harris County: 1. Chromite has been found one mile (1.6 km) south of the Kingsboro–Waverly Hall Road, approximately 5 miles (8 km) west of Waverly Hall.

Meriwether County: 1. Samples of chromite were submitted to the Georgia Geological Survey for identification in 1896 from the J. D. O'Kelly property near Caleb.

Rabun County: 1. Chromite occurs as an accessory mineral in numerous small ultramafic bodies within this county. It is described by Hunter (1941, p. 116) as an accessory mineral at the well-known Laurel Creek Corundum Mine as disseminated grains within the dunite.

Towns County: 1. Chromite associated with corundum, zoisite, and nickel silicates has been prospected in the vicinity of the Hogg Creek Corundum Mine, lot 92, 17th district. 2. Chromite is reported from the west side of the gap on the road running northwest from the Hiawassee–Clayton Highway to Scattaway Creek. 3. Samples of chromite were submitted to the Georgia Geological Survey in 1896 from lots 45 and 125, 17th district.

Troup County: 1. The most well known and extensively studied chromite deposits in Georgia occur near Louise, approximately 8 miles (13 km) north of LaGrange. Three separate properties, the Turner, Polhill and Owens, have been prospected by various groups including the United States Bureau of Mines (Ballard, 1948). The specific prospects are located within lots 32 and 239, approximately 2 miles (3.2 km) east of Louise. Chromite occurs as lenses and disseminations within peridotite and dunite which have been variously altered to other mafic rocks. Individual grains reaching one inch (2.5 cm) in diameter are reported from the Polhill property. The chromite is of inferior quality, being relatively high in iron. Corundum, well crystallized spinel, garnierite, asbestos and talc are associated with the chromite. Beryl-bearing pegmatite cuts the ultramafic mass exposed in underground workings on the Turner property. Numerous open pits and shafts exist in the immediate prospect area and care should be taken in examining these properties. 2. Chromite was reportedly encountered during the construction of the LaGrange Airport. Chromite, possibly from this location, was submitted to the Georgia Geological Survey for identification in 1896 from an unspecified location 2 miles (3.2 km) south of LaGrange.

Upson County: 1. Residual chromite grains and masses occur in soil over a small ultramafic body exposed on the Kelly property, 7 miles (11 km) southeast of Thomaston. Corundum crystals from this locality are commonly encrusted with chromite grains.

COLUMBITE–TANTALITE

$(Fe^{+2},Mn)(Nb,Ta)_2O_6 - (Fe^{+2},Mn)(Ta,Nb)_2O_6$

Class Multiple oxide

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Crystals short prisms; often rectangular prisms with the pinacoids prominent; sometimes thin to thick tabular; less often pyramidal. In large groups of parallel or subparallel crystals; also massive.

Phys. *Cleavage* distinct {100} and {010}. *Fracture* subconchoidal to uneven. Brittle. **H** 6 (columbite), 6–6½ (tantalite). **G** 5.2 (columbite) to 8.0 (tantalite). *Color* iron-black to brownish black. Frequently tarnished iridescent. *Streak* dark red to black. Opaque to transparent in thin splinters.

Occur.

Columbite and tantalite are uncommon minerals in Georgia and are known only as accessories within the intermediate and core portions of zoned pegmatites.

Banks County: 1. Crude columbite crystals up to 2 inches (5 cm) in diameter are reported from the J. A. Hills property.

Cherokee County: 1. A few small grains of columbite intimately associated with pale yellow-green beryl are described from the Amphlett Mica Mine, lot 46, Conn Creek district, 0.4 mile (0.6 km) S32°E of Conn Church (Heinrich and Jahns, 1953, p. 378).

Fayette County: 1. Coarsely crystalline columbite and associated black tourmaline occur in a pegmatite previously prospected for mica on the D. D. Porter property, lot 190, 6th district, about 8 miles (13 km) southwest of Fayetteville and 2 miles (3.2 km) northeast of Starrs Mill.

Paulding County: 1. Coarse crystals of columbite weighing up to 10 pounds (4.5 kg) were encountered in the C. W. Dean Mica Mine, located in the bed of Copper Mine Creek at the old Dean Mill, approximately 0.4 mile (0.6 km) southwest of Hiram. A large partial crystal from this occurrence is on display in the Capitol museum.

Putnam County: 1. Excellent terminated columbite crystals were found loose in soil overlying a large zoned pegmatite recently exploited for crushed quartz, approximately 3 miles (4.8 km) northeast of Camp Rock Eagle. Well-formed crystals up to 6 inches (15 cm) long were recovered during mining. Associated minerals are euxenite and coarsely crystalline apatite.

Troup County: 1. Columbite crystals have been found on the Will Stevens property, approximately 3 miles (4.8 km) south of LaGrange. 2.Small columbite crystals associated with yellow beryl occur in a pegmatite exposed on the L. M. Mulky property, immediately west of Georgia Highway 219, 5 miles (8 km) south of LaGrange, 0.75 mile (1.2 km) south of Bryants Corner, and adjoining the Hogg Mine Property.

EUXENITE–POLYCRASE

$(Y,Ca,Ce,U,Th)(Nb,Ta,Ti)_2O_6 - (Y,Ca,Ce,U,Th)(Ti,Nb,Ta)_2O_6$

Class Multiple oxide

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Stout prismatic {001}, sometimes flattened {010} (polycrase). The faces on polycrase and, to a less extent, euxenite are striated parallel to their intersection with {010}. Often in parallel or subparallel and slightly radial aggregates of crystals. Also massive. Commonest forms: b d m p a.

Phys. *Fracture* subconchoidal to conchoidal.**H** 5½–6½. **G** 5.00 ± 0.10 (for Nb:Ta < 2:1, and apparently not varying markedly with varying ratio of (Nb + Ta): Ti); 5-3–5.9 (for Nb : Ta < 1:1); the **G** decreases with alteration and increases after ignition. *Luster* often brilliant, submetallic, or somewhat greasy or vitreous. *Color* black, sometimes with a greenish or brownish tint. *Streak* yellowish, grayish, or reddish brown. Transparent in thin splinters. Metamict.

Occur.

Putnam County: Small nodule-like masses of brilliant black euxenite have been found in saprolite immediately adjacent to a columbite-bearing pegmatite recently exploited for quartz, approximately 3 miles (4.8 km) northeast of Camp Rock Eagle.

SAMARSKITE

$(Y,Ce,U,Ca,Pb)(Nb,Ta,Ti,Sn)_2O_6$

Class Multiple oxide

Cryst. Monoclinic

Habit Prismatic {001} (with rectangular cross section); less often tabular {100} or {010}; sometimes elongated {010}, with prominent {101}. Crystals rough. Often massive (and then not easily identified as samarskite).

Phys. *Cleavage* {010} indistinct (?) *Fracture* conchoidal to small conchoidal. Brittle. **H** 5–6. **G** 5.69 (probably best value), the low values (as low as 4.1) are due, no doubt, to alteration; high titanian varieties may reach 6.2. The specific gravity is said to decrease on ignition. *Luster* on the fracture vitreous to resinous, sometimes submetallic, and splendent; the crystals often are externally dull. *Color* velvet black, sometimes with a brownish tint; externally often brown or yellowish brown due to alteration. *Streak* dark reddish brown to black; also gray, yellow-brown, etc., on altered material. Transparent in thin splinters.

Occur.

DeKalb County: 1. Samarskite has been reported in minor amounts as an accessory mineral in pegmatites cutting the Lithonia Gneiss (Walter, 1956, p. 40).

Greene County: 1. A black, niobium-rich mineral which may be samarskite occurs in a pegmatite previously exploited for muscovite, feldspar, and clay on the W. M. Poss property, about 4 miles (6.4 km) northwest of Union Point.

HOLLANDITE

$Ba(Mn^{+4},Mn^{+2})_8O_{16}$

Class Multiple oxide

Cryst. Monoclinic; pseudotetragonal

Habit Short prismatic, terminated by a flat pyramid. Also massive; fibrous.

Phys. *Cleavage* prismatic, distinct. The crystals readily break parallel {001} into striated chips or fibers. Brittle. **H** 6 on crystal faces, less on fracture surfaces. **G** 4.95. *Luster* metallic shining. *Color* silvery gray to grayish black and black. *Streak* black. In polished section white in color with strong anisotropism and weak pleochroism.

Occur.

Bartow County: 1. A massive variety of cryptomelane encountered at the surface of the Gemes manganese deposit, lot 313, 4th district, was found to be a mixture of hollandite and lithiophorite. This material is distinguished from other manganese oxide ores by a bluish tint and a cobalt content ranging up to 1.3 percent (Pierce, 1944, p. 271–275). 2. A similar occurrence of admixed hollandite and lithiophorite containing cobalt is described by Pierce (1944, p. 271–275) from the Ward or North Vaughn manganese deposit, lots 266 and 267, 5th district.

LEPIDOCROCITE (Ocher)

γ-FeO(OH)

Class Hydroxide

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m?

Habit As scales flattened {010} and slightly elongated {100}. {010} sometimes striated {100}. Usually as isolated crystals attached by an edge to the matrix, or aggregated into palmate or plumose groups; most crystals have a rounded indistinct {010} zone; also as loose rosettes; massive, bladed to fibrous or micaceous. The fibrous varieties are elongated {100}.

Phys. *Cleavage* {010} perfect, {100} less perfect, {001} good. Brittle. **H** 5. **G** 4.09 ± 0.04; 3.96 (calc.). *Luster* submetallic. *Color* ruby-red to reddish brown. *Streak* dull orange. Transparent.

Occur.

Although lepidocrocite has not been specifically reported from Georgia, it is generally of common occurrence under weathering conditions as an oxidation product of numerous iron-bearing minerals. It is typically the pigment in brown ocher and, as such, probably occurs in the Cartersville Mining District, Bartow County. The occurrences described below are those representative of possible lepidocrocite-bearing ocher deposits.

Bartow County: 1. Ocher was produced for many years from an approximately 8 mile (13 km) long, north-south belt entending from near Emerson to Rowland Springs. The belt lies entirely within district 4 and encompasses portions of land lots 113, 114, 115, 171, 172, 187, 188, 245, 260, 331, 332, 390, 402, 403, 404, 405, 406, 461, 462, 473, 474, 475, 476, 477, 835, 836, 894 and 907.

1. A large quantity of ocher was mined on the property of the Georgia Peruvian Ocher Company, approximately 2 miles (3.2 km) southeast of Cartersville on the Etowah River. Ocher occurred here as pocket zones and vein-like bodies within deformed and altered Weisner Quartzite (Watson, 1906, p. 36). 2. Abundant ocher has been mined on lots 406 and 459, 4th district, 3rd section, one mile (1.6 km) east of Cartersville. The deposits are adjacent to bold outcrops of Weisner Quartzite (Watson, 1906, p. 40). Detailed work by Kesler

(1950, p. 86) indicates that ocher on this property was formed by the weathering of hematite in the Shady Formation which is in apparent fault contact with the underlying Weisner rocks. 3. Ocher has been found produced in recent years by the New Riverside Ocher Company. Recent mining has been conducted within the city limits of Cartersville just east of U.S. Highway 41 on River Road. The material is used primarily for pigmentation in paint, concrete and brick.

BOEHMITE
AlO(OH)

Class Hydroxide

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m?

Habit In microscopic lenticular crystals; tabular {001}. Usually disseminated or in pisolitic aggregates.

Phys. *Cleavage* {010}. **G** 3.01–3.06 (artif.), 3.11 (calc.). Optical properties uncertain but probably biaxial negative (–), Y=c, Z=b, mean refractive index about 1.64.

Occur.

Boehmite, along with its dimorph diaspore, and gibbsite are the principal constituents of most bauxite deposits. As such, boehmite may be considered to occur in some of the localities listed for gibbsite. See GIBBSITE, p. 71).

LITHIOPHORITE
$(AL,Li)Mn^{+4}O_2(OH)_2$

Class Hydroxide

Cryst. Monoclinic; prismatic—2/m

Habit Massive, compact, botryoidal, also as fine scales and dendritic.

Phys. *Cleavage* {001} perfect. **H** 3. **G** 3.14–3.4 *Color* bluish black to black. *Luster* dull to metallic; opaque. *Streak* blackish gray to black.

Occur.

Bartow County: 1. Cobalt-bearing, massive manganese oxides from several occurrences in the Cartersville Mining District have been found to be a mixture of lithiophorite and hollandite. Chief occurrences are the Gemes Mine, lot 313, 4th district and the Ward or North Vaughn deposit a short distance east of Pinegrove Church, approximately 6 miles (10 km) northeast of Cartersville (Kesler, 1950, p. 53).

Hall County: 1. Black lithiophorite crystals up to one inch (2.5 cm) long on larger, clear quartz crystals that line small cavities in gneiss are reported from an unspecified location in Hall County by Hurst and Porter (1963, p. 12). These are apparently the finest crystals of lithiophorite yet reported.

ROMANECHITE (Psilomelane)
$BaMn^{+2}Mn_8^{+4}O_{16}(OH)_4$

Class Hydroxide

Cryst. Monoclinic; prismatic—2/m

Habit Found only massive, as botryoidal, reniform, or mammillary crusts, and stalactitic; also earthy and pulverulent.

Phys. **H** 5–6, decreasing in the earthy varieties. **G** 4.71 ± 0.01, 4.42 (calc.). *Luster* submetallic; dull. *Color* iron-black, passing into dark steel-gray. *Streak* brownish black to black, shining. Opaque.

Occur.

Psilomelane is described in the older literature as an important component of Georgia's economic manganese deposits, particularly those of the Cartersville Mining District. Former identification of this mineral was based on chemical analyses of massive, earthy, and concretionary material. Samples containing significant barium were identified as psilomelane. Modern research has shown that material formerly called psilomelane is actually composed of a group of manganese minerals, the barium-rich member being romanechite. Work by the United States Geological Survey on manganese ores of the Cartersville district indicates that at least some previously identified psilomelane is actually the potassium-bearing manganese oxide cryptomelane and that the barium content reported in the older literature may be due in part to physically admixed barite (Kesler, 1950, p. 53). Since a detailed mineralogic examination of manganese oxides has not been conducted for most of the numerous, formerly productive properties within Georgia, psilomelane occurrences described below are those for which published analytical data suggest the presence of romanechite as at least a minor constitutent of the ores.

Bartow County: Psilomelane has been historically described as a major component of nodular, concretionary, massive, and earthy manganese oxides formerly exploited at numerous locations in a belt extending from near the town of Emerson northward to the vicinity of Stamp Creek.

1. Samples of ferruginous manganese oxides from the Hebble Mine on the south side of lot 391, 4th district, 3rd section, approximately 2 miles (3.2 km) due east of Cartersville, contain significant amounts of barium and are considered to be at least in part romanechite. 2. Similar barium-bearing manganese oxides are found at the Dobbins Manganese Mine on lots 270 and 271, 5th district, and lots 30, 31, 42 and 43, 4th district, 3rd section, adjacent to Rowland Spring Road, about 4 miles (6.4 km) northeast of Cartersville. 3. Selected fragments of hard,dense manganese oxide containing up to 14 percent barium, and considered to be romanechite, have been collected at the Wyvern Manganese Mine on the east side of lot 200, 5th district, 3rd section, 0.25 mile (0.4 km) northeast of the old Wyvern Station on the Louisville and Nashville Railroad, approximately 4 miles (6.4 km) north of Cartersville (Hull, LaForge, and Crane, 1919, p. 113–115). 4. Similar, barium-rich, concretionary manganese oxide ore has been shipped from the old mines of the Georgia Iron and Coal Company in the 4th and 5th Districts, 3rd section and the 22nd district of the 2nd section. The mines are centered around Aubrey, approximately 5 miles (8 km) north-northeast of Cartersville. 5. Romanechite, as small hard nodules made up of thin concentric layers, is described from the manganese oxide occurrence exploited on lot 315, 5th district, 3rd section (Hull, LaForge and Crane, 1919, p. 135). 6. Other occurrences where romanechite may be suspected as a constituent of manganese oxide ores are discussed under pyrolusite and have been described in detail by Hull, LaForge and Crane (1919) and Kesler (1950).

Catoosa County: 1. Finely stalactitic romanechite lining the walls of small cavities in brecciated chert is described from manganese oxide prospects extending over a distance of approximately 2 miles (3.2 km) on lots 215, 218, 251, 254, 286, 287, 289 and 290, 11th district, 3rd section, approximately 2.5 miles (4 km) north-northeast of Tunnel Hill (Hull, LaForge and Crane, 1919, p.188). Analyses of a sample representative of a 6-foot (1.83-m) working face returned a combined barium oxide-sulfate content of 1.39 percent.

Floyd County: 1. Romanechite is indicated as a constituent of nodular manganese oxide ore formerly exploited on the Pattillo property in the eastern part of the county, approximately 4 miles (6.4 km) east of Rome, lots 331 and 349, 23rd district, 3rd section (Hull, LaForge and Crane, 1919, p. 173).

Gilmer County: 1. Fragments of hard manganese oxide ore collected 18 feet (5.6 m) below ground level at the David manganese prospects on lot 251, 7th district, less than one mile (1.6 km) north-northeast of Whitepath, contain up to 0.26 percent barium oxide, suggesting the presence of romanechite (Hull, LaForge and Crane, 1919, p. 205).

Haralson County: 1. A considerable barium content, indicating the presence of romanechite, is reported for dense manganese oxide ores developed in the Douglass prospects on lot 981, 19th district, 3rd section, in the eastern part of the county, approximately 2 miles (3.2 km) north of Draketown (Hull, LaForge and Crane, 1919, p. 179).

Lincoln County: 1. A combined barium sulfate-barium oxide content of 6.99 percent is reported for manganese oxide formerly exploited at the Colley Mine, approximately 3.25 miles (5.2 km) east of Lincolnton. Manganese oxides at this location are residual nodular masses apparently over vein-like bodies of spessartine-, rhodonite- and rhodochrosite-bearing rock.

Murray County: 1. The occurrence of romanechite is suggested by analyses of manganese oxide ores from the Green property, lots 163, 165 and 196, 27th district, 2nd section, in northern Murray County, about 0.5 mile (0.8 km) north of Doogan (Hull, LaForge and Crane, 1919, p. 198).

Paulding County: 1. Significant barium, suggesting the presence of romanechite, is reported for dense manganese oxides prospected on the Cochran property, lot 300, 3rd district, about 2 miles (3.2 km) north of Huntsville on Burnt Hickory Ridge. The locality is approximately 10 miles (16 km) south of the Cartersville

mining district and about 12 miles (19.3 km) north of Dallas. Magnetite is locally abundant at this location. High-grade pockets of manganese oxides occur in a dominant quartzite unit near its contact with quartz veins (Hull, LaForge, and Crane, 1919, p. 184).

Taliaferro County: 1. Up to 6.9 percent barium oxide is reported for high-grade manganese oxide ore shipped from the former workings of the Georgia Manganese Company on the old Judge John C. Hart place along the Greene–Taliaferro County line, about 8 miles (13 km) northeast of Union Point and 4 miles (6.4 km) north of Robinson (Hull, LaForge and Crane, 1919, p. 213). This occurrence marks the approximate southwestern limit of the Piedmont Manganese Belt as recently redescribed by Hurst, Crawford and Sandy (1966).

Whitfield County: 1. Manganese oxide ore described as hard lump psilomelane containing 5.19 percent barium oxide is reported from the Lanski property centering on lot 191, 11th district, 3rd section, in northwestern Whitfield County, approximately 1.5 miles (2.4 km) northeast of Varnell (Hull, LaForge and Crane, 199, p. 192). Hematite has also been exploited at this location.

MANGANITE
$MnO(OH)$

Class Hydroxide

Cryst. Monoclinic; prismatic—2/m (pseudo-orthorhombic)

Habit Crystals striated and short to long prismatic {001}. Often terminated by {001} alone, by {001} with macrodomes, or by a series of macropyramids; sometimes highly modified. Prismatic faces deeply striated {001}, and terminal {h01} or {hk1} faces striated ‖ to their mutual intersections. Crystals often grouped in bundles, or markedly composite subparallel {001}. Also columnar to coarse fibrous; seldom granular; stalactitic.

Phys. *Cleavage* {010} very perfect, {110} abd {001} less perfect. *Fracture* uneven. Brittle. **H** 4. **G** 4.33 ± 0.01; 4.38 (calc.). *Luster* submetallic. *Color* dark steel-gray to iron-black. *Streak* reddish brown, sometimes nearly black. Transparent only in thin splinters.

Occur.

Bartow County: Manganite has been described by early workers such as Watson (1908, p. 49) as a constituent of manganese oxide ores exploited in the Cartersville Mining District. Numerous samples of small crystals exhibiting forms typical of manganite have invariably been shown to be pyrolusite. While this mineral is in all likelihood a minor constituent of ores in this district, inadequate comprehensive mineralogical study has been conducted to conclusively prove its presence.

DIASPORE
$AlO(OH)$

Class Hydroxide

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Crystals commonly thin platy {010} and elongated {001}; sometimes acicular {001}; rarely tabular {100}. Faces in zone {010} striated {010}; in zone {001} striated {001}; and in zone $\{0\bar{1}2\}$ striated $\{0\bar{1}2\}$. Also foliated massive and in thin scales; sometimes stalactitic. Disseminated.

Phys. *Cleavage* {010} perfect, {110} less so, {100} in traces. *Fracture* conchoidal. Very brittle. **H** 6½–7. **G** 3.3–3.5; 3.44 ± 0.02 (crystals); 3.37 (calc.). *Luster* brilliant; pearly on cleavage faces, elsewhere vitreous. *Color* white, grayish white, colorless; also greenish gray, hair-brown, yellowish, lilac, pick; sometimes violet-blue in one direction, reddish plum in another and pale asparagus-green in the third, rose-red to dark red in the manganoan variety. Transparent.

Occur.

Diaspore is a common constituent of bauxite and fire clays, and, as such, is present in numerous locations throughout the state. In addition, diaspore is frequently found as a hydrothermal alteration product of aluminous minerals such as sillimanite, kyanite, andalusite, pyrophyllite, and corundum. Although the mineral is

undoubtedly widespread, its indistinctive physical characteristics make it very difficult to identify except under precise laboratory conditions. For this reason only one specific occurrence where megascopic diaspore may be observed is reported.

Rabun County: 1. Small, tabular white crystals of diaspore are described by King (1894, p. 38) at the abandoned Laurel Creek Corundum Mine in the southern part of lot 72, 3rd district, about one mile (1.6 km) southwest of Pine Mountain on Laurel Creek.

GOETHITE

α-FeO(OH)

Class Hydroxide

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Usually massive, as reniform, botryoidal, or stalactitic masses with an internal concentric or radial-fibrous structure.

Phys. *Cleavage* perfect {010}. *Fracture* uneven. Brittle. **H** 5–5½. **G** 3.3–4.3. *Luster* adamantine to submetallic; fibrous varieties often silky. *Color* of crystals blackish brown; massive varieties yellowish or reddish brown, and when earthy, brownish yellow, ocher-yellow. *Streak* yellowish brown.

Occur.

Brown iron ores, commonly referred to as limonite, have been mined for more than 100 years from numerous districts in all geologic provinces of Georgia. Although no substantial research has been conducted on the detailed mineralogy of most Georgia occurrences, the major constituent of brown iron ores is considered to be goethite. In addition to the more obvious occurrences, goethite is an exceedingly common constituent of films and incrustations of iron-bearing minerals formed by processes of weathering and secondary enrichment. It is a common secondary product after pyrite and occurs abundantly in gossan over the many massive sulfide deposits in Paulding, Haralson, Carroll, Douglas, and Lumpkin Counties. Residual goethite has been mined in Polk, Floyd, Bartow and Pulaski Counties, and is currently being produced in Steward and Quitman Counties.

Bartow County: Iron oxide composed predominantly of goethite has been produced from 51 significant mines occupying portions of 82 individual land lots, mostly in the 4th, 5th, 15th, 16th, 17th, 21st and 22nd districts. The productive area constitutes the Cartersville Mining District, encompassing a mineralized area approximately 5 miles (8 km) wide and 15 miles (24 km) long from south of Emerson to approximately 5 miles (8 km) north of White. Minor production of brown iron ores is recorded for outlying deposits west of the Cartersville district in a general area between Euharlee and Kingston. Estimated production of geothite-rich iron ores for Bartow and adjacent counties is approximately 18,000,000 tons (16,300,000 metric tons) (Hurst and Crawford, 1970, p. 92–111).

Occurrences given below are either representative of the district or contain goethite in unusual or mineralogically significant forms. Most goethite-rich ore consists of earthy, massive limonitic material which commonly contains sinuous veins and crusts of crystalline goethite arranged in closely packed, parallel acicular crystals, or in radial clusters. The surfaces of these clusters and open spaces are commonly botryoidal, black, and have a stong metallic luster.

1. Mammillary and stalactitic goethite is abundant in residual masses of iron oxide exposed in the Sloan Iron Mine, lot 1039, 4th district, 1.2 miles (1.9 km) south of Emerson. 2. Over 1,000,000 tons (900,000 metric tons) of goethite-rich, brown iron ore has been produced from the Bartow group of mines on lots 903, 904, 969 and 970, 4th district, 0.75 mile (1.2 km) southeast of Emerson. Much of the goethite produced from these mines has been derived from primary pyrite and is associated with fracturing and brecciation. 3.Earthy, botryoidal, concretionary and stalactitic goethite has been produced from the Iron Hill Mine on lots 728 and 729, 21st district, 2.7 miles (4.3 km) northeast of Allatoona. 4. Botryoidal, concretionary and stalactitic goethite, derived from iron sulfides apparently introduced along a fault, has been exploited on lot 575, 21st district, 0.7 mile (1.1 km) south of Allatoona Dam on Vineyard Mountain. 5. Cavernous botryoidal goethite formed by secondary deposition of iron oxide, and dense massive gossan formed by in-place oxidation of pyrite, have been mined at the Hurrican Hollow Mine on lots 329, 330, 392, 393 and 400, 4th district, 2.4 miles (3.9 km) east-northeast of Cartersville. 6. Goethite is the major iron oxide cementing material in extensively developed breccia exposed in the Black Bank Iron Mine on lot 186, 22nd district, 3.3 miles (5.3 km) east of White.

Burke County: 1. Small amounts of brown iron ore were mined during the Civil War from the McElmurray property, about 8 miles (13 km) southeast of Waynesboro along Sandy Run Creek. The iron oxide occurrence

is reportedly exposed in thicknesses of 25 feet (7.6 m) and is apparently a secondary product within the Claiborne Formation (Haseltine, 1924, p. 165). 2. Similar occurrences are along McIntosh Creek, one mile (1.6 km) south of Waynesboro, and in railroad cuts one mile (1.6 km) north of Waynesboro.

Carroll County: 1. Goethite is particularly abundant in gossan exposed at the Reeds Mountain Pyrite Mine on lot 259, 7th district, 5th section, approximately 1.5 miles (2.6 km) southeast of Bremen. Approximately 1,000 tons (900 metric tons) of high-grade gossan were shipped from this property about 1900.

Chattooga County: 1. Limonitic iron oxide has been prospected on the Shropshire property, lots 186 and 189, 5th district, 4th section, about 6 miles (10 km) southeast of Summerville. A large number of brachiopods which have been completely replaced by brown iron oxide occur in this material. 2. Goethite in thickly aggregated needles and iridescent masses has been produced from the Bellah property on lot 87, 6th district, about one mile (1.6 km) east of Summerville (Haseltine, 1924, p. 58).

Cherokee County: 1. Iron oxide has been prospected extensively along what is known as the Chattahoochee Iron Lead, approximately 2 miles (3.2 km) northwest of Canton and one mile (1.6 km) north of the Etowah River. Most work was conducted on lot 98, 14th district. Goethite and other iron oxides occur in narrow vein-like bodies which are apparently secondary after magnetite. 2. A small amount of brown iron ore was mined during the Civil War from lot 337, 4th district, about 0.5 mile (0.8 km) northwest of Ball Ground (Haseltine, 1924, p. 127. 3. Masses of residual iron oxide were taken from lot 259, 4th district, about 2.5 miles (4 km) northeast of Ball Ground for the old forge on Sharpe Mountain Creek. 4. Secondary goethite after magnetite has been prospected on lot 281, 14th district, 0.5 mile (0.8 km) northeast of Keithsburg (Haseltine, 1924, p. 126). 5. Numerous other small surface showings of goethite-rich iron oxides have been prospected in Cherokee County. Chief among these are lots 24, 58, 61, 64, 139, 149, 150, 154, 170, 221, 222, 249, 261 and 290 of the 14th district.

Douglas County: 1. Porous, dark reddish-brown gossan, composed in part of goethite, covers a rather large area of the Villa Rica Pyrite Mine, approximately 3 miles (4.8 km) northeast of Villa Rica. The material is secondary after massive pyrite and pyrrhotite.

Fannin County: 1. A limited amount of goethite-rich brown iron ore has been shipped from the Robinson property, approximately 2.5 miles (4 km) southeast of Blue Ridge along the Louisville and Nashville Railroad (Haseltine, 1924, p. 87). The ore occurred in irregular pockets in high-grade metamorphic schist and as an apparent laminated vein up to 3 feet (0.9 m) thick. 2. A moderate amount of brown iron ore has been shipped from the McKinney Mine on lot 298, 8th district, approximately 0.5 mile (0.8 km) south of Blue Ridge and adjacent to the Louisville and Nashville Railroad. Production was from both surface and underground workings (Haseltine, 1924, p. 88–89). 3. Considerable brown iron ore was mined prior to the Civil War for feed at the Hemptown Forge near Morganton. The property is lot 265, 8th district, about 1.5 miles (2.4 km) northeast of Blue Ridge. 4. Similar occurrences of goethite have been prospected along a northeasterly trend extending from the Gilmer County line near Long Mountain northeast through Blue Ridge and Mineral Bluff to Sweetgum near the Tennessee line. Principal among these are lots 277, 278, 299, 300 and 314, 8th district, and lots 10 and 11 of the 7th district. 5. Numerous small exposures of goethite-bearing gossan are known in Fannin County south of the Copperhill Mining District. Principal among these are Mine No. 20 on lot 20, 9th district, 2nd section and the Mobile Copper Mine about one mile (1.6 km) south of Mine No. 20 on lot 59, 9th district.

Floyd County: Moderate amounts of goethite-rich brown iron ores have been produced from shallow workings in 14 individual mines encompassing portions of 20 land lots in the 3rd, 4th, 22nd and 23rd districts. Most former production has been from the Cave Springs district in the southwestern part of the county and from the Silver Creek district near Reesburg in the south-central part of the county.

1. The largest production from Floyd County is credited to the old Asbury Mine, approximately 2 miles (3.2 km) east of Cave Springs on lots 950 and 951, 3rd district (McCallie, 1900, p. 179). 2. Large goethite geodes and concretionary masses occur on the Wiggins property, lot 948, 3rd district, approximately 1.5 miles (2.4 km) southeast of Cave Springs.

Gilmer County: 1. A moderate amount of goethite-rich ore was produced from the old Ellijay Mining Company's workings on lot 84, 11th district, 2nd section, on the north bank of Cartecay River, 0.5 mile (0.8 km) south of Ellijay. Ore was exploited in large open cuts and prospected over a considerable distance by drilling and underground openings. Considerable wavellite is associated with the near-surface ores. Goethite is apparently secondary and occurs in well-defined veins in a quartzose schist. 2. Small amounts of goethite-rich brown ore was shipped to the furnace at Ellijay from the Haley property, lot 304, 10th district, 2nd section, 3.5 miles (5.6 km) northeast of Ellijay (Haseltine, 1924, p. 103). Mamillary and geodal masses are abundant on this property. 3. An apparent replacement deposit of goethite in siliceous schist has been mined on the Searcy property, lots 215 and 219, 7th district, approximately 0.5 mile (0.8 km) southwest of Cherrylog.

4. Moderate quantities of brown iron ore were produced from the Georgia-Tioga Mine, lot 260, 11th district, 6 miles (9.7 km) southwest of Ellijay at Tioga. The ore is apparently residual and occurs immediately adjacent to bold outcrops of Murphy Marble.

Gordon County: 1. Approximately 55,000 tons (50,000 metric tons) of goethite-rich brown iron ore were mined from lot 20, 25th district, 2 miles (3.2 km) west of Sugar Valley (Haseltine, 1924, p. 67). Similar quantities of iron ore were mined from adjacent lots, particularly lot 91, 25th district. 2. Moderate amounts of goethite-rich ore were produced from shallow workings on lot 182, 14th district, 2.5 miles (4 km) northwest of Oostanaula. 3. Moderate amounts of brown iron ore are reported at numerous other occurrences in the county, particularly lots 183, 253, 255, 287 and 288, 14th district (Haseltine, 1924, p. 72–74).

Habersham County: 1. Residual accumulations of brown iron iron ore have been prospected on the Piedmont Farms property, lot 73, 10th district, 0.5 mile (0.8 km) east of Demorest (Haseltine, 1924, p. 113).

Haralson County: 1. Porous gossan occurs abundantly near the Tallapoosa Pyrite Mine on lot 932, 20th district, 3rd section, about 3 miles (4.8 km) northwest of Draketown. 2. Goethite as a secondary weathering product of magnetite has been produced in small quantities from the King property, lot 852, 19th district, about 3 miles (4.8 km) north of Draketown (Haseltine, 1924, p. 147).

Lincoln County: 1. Botryoidal goethite-rich masses of iron oxide up to several feet across were abundant on the east side of the highest summet and in the saddle of Graves Mountain in west-central Lincoln County, immediately southeast of U.S. Highway 378. This iron-rich material, the product of secondary concentration of iron during the weathering of pyrite, forms the matrix for exceptional rutile crystals.

Lumpkin County: Goethite-rich gossan crops out intermittently for a distance of approximately 3,500 feet (1067 m) over the massive sulfide occurrence exploited at the Chestatee Pyrite Mine, 6 miles (9.7 km) east of Dahlonega on the south side of the Chestatee River, 1.75 miles (2.8 km) below its junction with Tesnatee Creek. Most material is vesicular, spongy, of uniform iron content and typically exhibits iridescent coatings.

Meriwether County: 1. Dense, iridescent, mammillary and stalactitic goethite has been mined from a small occurrence on the Grant property, lot 46, 0.75 mile (1.2 km) south of Chalybeate Springs (Haseltine, 1924, p. 141).

Murray County: 1. Goethite-rich iron oxide has been prospected extensively on lots 236 and 237, 27th district, about 2.5 miles (4 km) east of Cisco. The occurrence is on the summit or slopes of a narrow quartzite ridge and apparently represents residual iron oxides resulting from the weathering of ferruginous schist and quartzite. 2. A small amount of brown iron ore has been shipped from the Poteet property, lot 306, 10th district, about one mile (1.6 km) east-northeast of Crandall. 3. A moderate amount of goethite has been shipped from the Hickey property, lot 203, 26th district, 2.5 miles (4 km) southeast of Crandall (Haseltine, 1924, p. 80–81). The goethite is apparently secondary after pyrite-rich slate. 4. A small amount of goethite-rich iron ore was shipped from the O'Neal property, lot 19, 26th district, 2 miles (3.2 km) southeast of Crandall (Haseltine, p. 81). The material was apparently residual after weathered pyrite-rich slate. 5. Similar material has been shipped from the Keith property, lot 57, 9th district, 0.75 mile (1.2 km) northeast of Eton.

Paulding County: 1. Goethite is locally abundant in Paulding County as gossan over massive pyrite–pyrrhotite deposits. Gossan is particularly abundant in the vicinity of the Swift Pyrite Mine, lot 1198, 19th district, about one mile (1.6 km) east of Draketown; the Rush-Banks pyrite prospect on lot 189, 19th district, 3rd section, 9 miles (14.4 km) west of Dallas; and in the vicinity of the Little Bob Pyrite Mine on lot 625, 2nd district, 3rd section, about 3 miles (4.8 km) northwest of Hiram.

Pickens County: 1. Small quantities of relatively low-grade, brown iron ores have been produced from several properties in this county. Chief among these are lots 132, 133 and 172, 13th district (Haseltine, 1924, p. 114–115).

Pike County: 1. Rather poor-quality, goethite-rich iron ore has been prospected at several points near Zebulon. Most former prospecting has been conducted on lots 198 and 219, 8th district, approximately 2 miles (3.2 km) south of Zebulon. Goethite is apparently secondary after magnetite and occurs in shallow residual deposits.

Polk County: Goethite-rich brown iron ore deposits have been exploited on at least 78 properties including portions of 135 individual land lots in districts 1, 2, 3, 16, 17, 18 and 21 (Hurst and Crawford, 1970, p. 93–100). Specific production records for the county are not known. Properties described below represent those which have apparently contributed the largest production.

1. More than 400,000 tons (360,000 metric tons) of goethite-rich brown iron ore were produced from the Ledbetter Mine, lots 661, 662 and 665, 2nd district, 1.25 miles (2 km) west of Cedartown near Cedar Creek. The residual oxide ores were produced from depths up to 60 feet (18 m) and consisted of nodular porous masses embedded in varicolored clays. 2. More than 300,000 tons (270,000 metric tons) of similar brown iron ore were produced from the Reed Mine, lots 639 and 640, 2nd district, 2.5 miles (2 km) northwest of

Cedartown. 3. Over 1,000,000 tons (900,000 metric tons) of boulder and nodular brown iron ore were produced from the Grady Mine on lots 730, 731, 804, 805 and 824, 21st district, 6 miles (9.7 km) east of Cedartown. The ore consisted of pebbles, boulders and irregular masses of iron oxides in varicolored clays. 4. Similar production is reported from the adjacent Central Mining Company property, lots 878, 879, 880, 897, 953, 954, 955 and 971, 21st district. 5. Several hundred thousand tons of residual, goethite-rich brown iron ore were produced from irregular pockets in the State-Line Bank Mine, approximately 0.5 mile (0.8 km) southwest of Etna Station. 6. Approximately 200,000 tons (180,000 metric tons) of residual gravel iron ores were produced at the Etna Furnace Mine immediately east of the State-Line ore-bank. 7. Approximately 150,000 tons (136,000 metric tons) of brown iron ore were produced from pocket-like concentrations in red clay on the Oredell property along both sides of the Southern Railway in the vicinity of Oredell Station.

Pulaski County: 1. Goethite-rich brown iron ores, resulting from near-surface enrichment of iron oxide in residuum derived from an Oligocene limestone, have been described in Pulaski County by Pickering (1961, p. 81–90). Similar material is reported in adjacent Dooly and Houston Counties. Brown iron ore of this type is found in red, yellow, or ocherous clay as dornicks up to 6 feet (1.8 m) in diameter, geodes to 3 feet (0.9 m) in diameter, solid beds, and small isolated fragments. A goethite geode from the Chandler Mine weighs 140 pounds (63.5 kg) and holds 2 gallons (7.5 l) of water. Its interior is smooth and bright, and the entire sample is composed of fibrous needle ore.

1. A small production is reported from the Chandler Iron Mine, about 8 miles (13 km) west-southwest of Hawkinsville on Georgia Highway 230. 2. Residual iron oxide is particularly abundant south of the Chandler Mine at Mock Springs near the Dooly County line.

Quitman County: Goethite-rich brown iron ores occur in masses and disconnected lenses near the base of the Clayton Formation over wide areas of both Quitman and Stewart Counties (Furcron, 1956, p. 116). Much of the residual material occurs as hollow geodes ranging up to one foot (0.3 m) in diameter, the interiors of which contain clay or sand. Iridescent goethite is not uncommon. Residual iron ores are particularly abundant north and west of Hatcher in the south-central part of the county and approximately 6 miles (9.7 km) northeast of Georgetown in the northeast corner of the county. Ore was being produced in 1972 at the McKenzie Mine, approximately 6 miles (9.7 km) east-northeast of Georgetown on Georgia Highway 27, 1.2 miles (1.9 km) northwest of Hodchodkee Creek.

Richmond County: 1. Residual boulders and masses of goethite-rich iron oxide associated with the Claiborne Formation have been prospected in the southern part of the county. Most prospecting has been conducted on the Merton property, 13 miles (21 km) south of Augusta on the west side of the Augusta–Savannah Highway (Haseltine, 1924, p. 165).

Spalding County: 1. Dark-colored masses of goethite-rich iron ore occur on the Walker property within the southern Griffin city limits. Residual iron oxides occur sporadically south of this property in the direction of Zebulon, Pike County. 2. Float goethite occurs in abundance on the B. Slade property, 5.5 miles (8.9 km) northeast of Zebulon.

Stewart County: Goethite-rich brown iron ore occurs in tabular bodies near the base of the Clayton Formation in the vicinity of Lumpkin. Geodes and iridescent masses are relatively abundant although nodules and concretions of iron oxide make up the bulk of formerly exploited ore.

1. Brown iron ore is produced by the Dunbar and Layton Mining Company from a location just northeast of Brooklyne, approximately 6 miles (9.7 km) north of Richland city limits on U.S. Highway 280. 2. Similar material is mined approximately 7 miles (11 km) west of Lumpkin, immediately south of Georgia Highway 27. 3. A relatively large production of goethite-rich iron ore has come from the Georgia Craft Pits of the Pigeon Creek Mining Company in an area 4.5 to 7.5 miles (7.2 to 12 km) northwest of Lumpkin and one mile (1.6 km) north of the Providence Canyon Road.

Walker County: 1. A small amount of siliceous, brown iron ore was produced many years ago from the Richardson property, lot 59, 7th district, 2 miles (3.2 km) east of Lafayette. The ore occurs as residual masses on a steep chert ridge. Similar material has been prospected on lots 238 and 15, 8th district, approximately 4 miles (6.4 km) northeast of Lafayette.

Whitfield County: 1. Irregular masses of residual brown iron ore in saprolite have been mined from lots 37, 72 and 73, 13th district, about 6 miles (9.6 km) northwest of Carbondale in Redwine Cove. The most extensive workings are on lot 73 on the west slope of what is locally called Middle Mountain. 2. Similar masses of goethite-rich brown iron ore are found on lots 104, 178 and 211, 13th district, near Carbondale. 3. Brown iron ore accompanied by abundant chert was produced many years ago from the Hamilton property, lot 65, 11th district, about 2 miles (3.2 km) west of Cohutta. Nodules of chert show replacement by iron oxide along concentric layers. A considerable amount of slickensided, dense hematite also occurs locally (Haseltine, 1924, p. 66).

GIBBSITE
$Al(OH)_3$

Class Hydroxide

Cryst. Monoclinic; prismatic—2/m

Habit Crystals tabular {001}, with {100} and {110} usually well developed and giving a hexagonal aspect. Occasionally in lamellar-radiate spheroidal concretions. Also stalactitic, or small mammillary and incrusting, with a smooth surface and often a faint fibrous structure within; compact earthy; as enamel- or hyalite like coatings.

Phys. *Cleavage* {001} perfect. Tough. **H** 2½–3½. **G** 2.40±0.02 (crystals), 2.3–2.4 (massive); 2.44 (calc.). *Luster* on cleavage surfaces pearly, on other surfaces vitreous. *Color* white, grayish, greenish, or reddish white; also reddish yellow when impure. Transparent. A strong argillacrous odor when breathed on.

Occur.

Gibbsite, diaspore, and boehmite are the principal aluminous minerals in bauxite. As such, gibbsite is an important constituent of bauxite deposits in the Hermitage, Andersonville, and other areas. Gibbsite is also an erratic but common constituent in the more deeply weathered soils derived from granitic rocks. Identification of gibbsite, similar aluminous silicates, and related clay minerals is normally possible only by x-ray and differential thermal analysis techniques.

Bartow County: 1. Gibbsite in stalactitic, mammillary, and encrusting forms is described with bauxite at the Barnsley occurrences, principally on lot 115, 16th district (Spencer, 1893, p. 213).

Chattooga County: 1. Bauxite, presumably containing substantial gibbsite, has been produced from numerous occurrences near Summerville (Watson, 1904a, p. 114). Principal among these are the Taylor Bank; the Scruggs Bank on lot 15, 4th district; and the Armington Bank, approximately 8 miles (13 km) due north of Summerville near McConnells Station.

Floyd County: 1. Bauxite, containing substantial gibbsite, has been mined from numerous deposits in what is historically known as the Hermitage district. This district includes an area of more than 50 square miles lying between Rome, Kingston, and Adairsville, east of the Oostanaula River and north of the Etowah River. The area has been extensively prospected, and mining has been conducted at interrupted intervals since April, 1888.

The first bauxite mine in the United States was on the Holland property, lot 61, 23rd district of Floyd County. In 1889, the 728 tons (660 metric tons) of bauxite mined in Georgia represented the total United States production (Watson, 1904a, p. 25). By the turn of the century, 18 individual deposits, all lying within the 3rd section, 23rd district, had been either extensively prospected or mined for bauxite. Typical occurrences that have been extensively exploited are at the Maddox Bank, lot 38, 23rd district, 3rd section, and the Watters Bank, lot 147, 23rd district, 3rd section, approximately 5 miles (8 km) north of Rome. 2. Similar bauxite, presumably containing substantial gibbsite, has been produced from the Bobo Bauxite District in the southern half of the county and the northern half of adjacent Polk County. Most production has been from the 3rd district, 4th section, and the 22nd district, 3rd section. Extensive production is reported from the Bobo Bank on lot 534, 3rd district, 4th section, 3 miles (4.8 km) south of Six Mile Station in Vans Valley. Forty-two individual occurrences have been briefly described by Furcron (1958, p. 1–15.)

Gordon County: 1. Bauxite has been prospected at the Bailey Bank, approximately one mile (1.6 km) northeast of Calhoun and about 0.5 mile (0.8 km) east of the Oostanaula River (Watson, 1904a, p. 118).

Macon County: 1. Moderate quantities of bauxite, presumably containing substantial gibbsite, have been produced from isolated occurrences in the southern part of the county several miles north of Andersonville (Sumter County). Formerly producing occurrences include the McMichael Mine, 2.5 miles (4 km) northwest of Andersonville, lot 120, 29th district; the English Mine on the north side of Boggy Branch, lot 119, 29th district, 2.5 miles (4 km) north of Andersonville; the Felton place, lots 335, 336, 337 and 385, 28th district; the Park property on lot 83, 29th district, 7 miles (11 km) east of Ellaville; and the Kleckley estate, 8.5 miles (13.6 km) west of Oglethorpe and 9.5 miles (15.2 km) east of Ellaville in the western part of the county (Smith, 1929, p. 443–451).

Meriwether County: 1. Bauxite, presumably containing appreciable gibbsite, and associated kaolin have been produced from unusual small occurrences near the base of Pine Mountain, approximately 2.5 miles (4 km) west of Warm Springs. Former production has been predominantly from the Wynne, Large and Turner properties centering on lot 55, 2nd district (Smith, 1929, p. 452–456).

Polk County: 1. The extreme southern portion of the Bobo Bauxite District extends into the northernmost portion of central Polk County. Bauxite, presumably containing gibbsite, has been produced or prospected at the Broadaway Bank, lot 53, 22nd district, 3rd section; lot 179, 16th district; lot 182, 16th district; and the Bigelow Bank or Williams property, approximately 0.2 mile (0.3 km) south of the Floyd County line (Watson, 1904a, p. 110–112).

Randolph County: 1. Bauxite, presumably containing gibbsite, has been mined from numerous locations in the vicinity of Springvale, approximately 8 miles (13 km) northwest of Cuthbert. Former production has been from the Royal place on the Springvale–Coleman road, 9 miles (14.4 km) west of Cuthbert and 4 miles (6.4 km) south of Springvale; the Massee property, lot 59, 9th district; the J. S. Garner property, lot 58, 9th district; the L. L. Cobb property, lot 70, 9th district; lot 90, 19th district; the Fussell property, lot 72, 9th district, 1.5 miles (2.4 km) east of Springvale; and the Yarboro property, lots 106 and 119, 9th district, 5 miles (8 km) northeast of Springvale (Smith, 1929, p. 417–428).

Sumter County: Bauxite, presumably containing gibbsite, is currently mined from numerous, large open pits in the immediate vicinity of Andersonville. Production is from clays of the Nanafalia Formation of Eocene age. Substantial production is from the Webb and Cavender-Thigpen Mines, approximately 2.25 miles (3.6 km) east of Andersonville city limits and approximately the same distance east of Georgia Highway 49. The mines are owned and operated by American Cyanamid Company. Bauxite is produced by the Mullite Corporation of America from mines 3.5 miles (5.6 km) east of Andersonville city limits and 3.5 miles (5.6 km) east of Georgia Highway 49 near the county line, immediately adjacent to Georgia Highway 195.

Walker County: 1. A small bauxite occurrence has been prospected a short distance from McConnells Station in the southern part of Walker County (Watson, 1904a, p. 114). The property is known as the Armington or Thurman Bank and lies approximately 8 miles (13 km) due north of the Summerville district.

HALIDES

FLUORITE
CaF_2

Class Halide

Cryst. Isometric; hexoctahedral—4/m $\bar{3}$ 2/m

Habit Crystals usually cubic; less frequently octahedral. Also massive; coarse to fine granular; compact, earthy; rarely columnar, fibrous or in globular aggregates.

Phys. *Cleavage* perfect octahedral. Brittle. *Fracture* flat-conchoidal to splintery or uneven. **H** 4. **G** 3.18. *Luster* vitreous. *Colorless* and water-clear when pure; commonly wine-yellow, green, greenish blue, violet-blue; also white, gray, yellow, sky blue, deep purple, bluish black, and brown; rarely rose-red, crimson-red, or pink. Some varieties show phosphorescence when heated gently. Often strongly fluorescent blue or yellowish under long-wave ultraviolet light and less intense under short-wave ultraviolet light.

Occur

Fluorite is an uncommon mineral in Georgia, occurring only in Paleozoic carbonate rocks and as an accessory mineral associated with granitic intrusive rocks of the crystalline Piedmont.

Catoosa County: 1. Deep purple fluorite in cubes approximately 0.25 inch (0.6 cm) in diameter associated with barite and galena occurs in brecciated Knox Dolomite at the Hale Quarry near Graysville. This quarry is located 1.5 miles (2.4 km) southeast of Graysville, immediately north of and adjoining the Louisville and Nashville Railroad.

Chattooga County: 1. Fluorite has been reported from an undisclosed location in Chattooga County.

DeKalb County: 1. Irregular masses of fluorite are relatively abundant in several pegmatites exposed in quarries on Arabia Mountain. The fluorite varies in color from pale green through pale rose to colorless and is fluorescent (Cofer and Renshaw, 1953, p. 312). 2. Lavender fluorite coats joint planes at numerous quarries in the Lithonia Gneiss in the eastern portion of the county.

Elbert County: 1. Purple fluorite associated with epidote commonly coats joint planes in granite of the Elberton district (Furcron, 1960, p. 128).

Floyd County: 1. Small crystals of purple fluorite occur with calcite in cavities in Mississippian limestone exposed in an old quarry near Berry Schools, about 2.5 miles (4 km) north of the Southern Railway overpass on the Rome–Summerville Road.

Gordon County: 1. Excellent crystals and cleavages of green fluorite are found loose in soil immediately east of the Hamrick Black Marble Quarry at Ranger (Furcron, 1951, p. 87). Fluorite from this location is thermoluminescent.

Greene County: 1. Minor amounts of purple fluorite associated with molybdenite and sphalerite occur near the margins of several pegmatites exposed at an aggregate quarry in the Siloam Granite, approximately one mile (1.6 km) east of Siloam and 0.5 mile (0.8 km) south of Interstate Highway 20 (Guinn, 1973, p. 81).

Hancock County: 1. Small masses of burgundy fluorite occur in several pegmatites exposed in an abandoned granite quarry along a secondary road, 2.4 miles (3.8 km) due east of Sparta.

Jasper County: 1. Excellent etched crystals of vibrant green fluorite up to one inch (2.5 cm) in diameter have been recovered from the Enon Church Feldspar Mine, approximately 6 miles (9.7 km) south of Monticello on Georgia Highway 83 near Gladesville. Several very attractive stones have been faceted from this material.

Troup County: 1. Colorless- to yellowish-white crystals of fluorite averaging about 0.06 inch (0.15 cm) in diameter are reported from the Yellow Jacket Quarry, immediately west of U.S. Highway 29 on the northern outskirts of Hogansville (Furcron, 1949, p. 3). Associated minerals are pyrite, sphalerite, and natrolite.

LAWRENCITE
$(Fe,Ni)Cl_2$

Class Halide

Cryst. Hexagonal—R; hexagonal-scalenohedral—$\bar{3}$ 2/m(?)

Habit Thin hexagonal plates {0001} (artif.). The natural mineral is found only massive.

Phys. *Cleavage* {0001} perfect (?). **H** soft. **G** 3.16 (artif.); 3.32 (calc.). *Color* green to brown; fresh artificial material is white. Deliquescent.

Occur.

Minutes quantities of lawrencite occur in the Sardis Meteorite (see Iron [meteoritic] p. 14).

CARBONATES

CALCITE
$CaCO_3$

Class Anhydrous carbonate

Cryst. Hexagonal—R; hexagonal-scalenohedral—$\bar{3}$ 2/m

Habit Crystals extremely varied in appearance; scalenohedrons and rhombohedrons most common. Also massive, fibrous, granular, stalactitic, chalky.

Phys. *Cleavage* perfect rhombohedral. *Fracture* conchoidal. Brittle. **H** 3. **G** 2.7. *Luster* vitreous to pearly. *Colorless* and transparent, or white, when pure. Often various shades of gray, yellow, brown, red, green, blue and black from impurities. *Streak* white to grayish. Often fluorescent and phosphorescent under ultraviolet light in shades of green, yellow, blue, and red.

Occur.

Calcite is the most abundant, widely distributed and economically important non-silicate rock-forming mineral in Georgia. It is found in abundance in all geologic provinces and is produced as a source of aggregate, cement, agricultural lime and dimension stone.

Carbonate-rich formations of Paleozoic age underlie much of the northwestern portion of the state, including Bartow, Catoosa, Chattooga, Dade, Floyd, Gordon, Murray, Polk, Walker and Whitfield Counties. Important calcite-rich units belong mainly to the Cambrian Conasauga Group, the Cambro-Ordovician Knox Group, the Ordovician Newala Limestone and Chickamauga Limestone, and the Mississippian System. The carbonate rocks in the Coosa Valley area of northwestern Georgia have been reviewed in detail by McLemore and Hurst (1970).

Limestones are particularly abundant in Mesozoic and Cenozoic Coastal Plain rocks. Important limestone-bearing units include the Chattahoochee Group, and the Vicksburg, Ocala, Claiborne, Midway and Ripley Formations. Details of Coastal Plain limestone are presented by Brantley (1916). Marbles of considerable economic importance are found in the Murphy Marble Belt of Fannin, Gilmer, Pickens and Cherokee Counties, and discontinuously along the Brevard zone in Hall and Habersham Counties.

Although exceptional crystallized specimens of calcite are reported from relatively few locations, crystal-filled cavities may be found in numerous operating and abandoned limestone quarries, particularly in the northwest portion of the state. Localities presented are examples of these which are currently producing calcite-rich rock as an economic commodity or contain calcite in a mineralogically interesting occurrence.

Bartow County: 1. Gray, fine-grained Conasauga Limestone is produced by the Marquette Cement Company from a quarry 3.5 miles (5.6 km) east of Kingston on the south side of Georgia Highway 20.

Calhoun County: 1. Ocala Limestone is produced from the Arlington Quarry, approximately 3 miles (4.8 km) west of Arlington city limits near the county line on Wampee Road.

Chattooga County: 1. Chickamauga Limestone is currently quarried for terrazo chips by the Marble Products Corporation on the west slope of Taylor Ridge, 3.5 miles (5.6 km) southeast of Summerville. The site was chosen because of the red color of the limestone.

Douglas County: 1. Calcite crystals more than one inch (2.5 cm) long reportedly lined cavities in massive sulfide ore of the Villa Rica Mine, approximately 3 miles (4.8 km) northeast of Villa Rica immediately east of Georgia Highway 61 (Shearer and Hull, 1918, p. 94).

Early County: 1. Ocala Limestone is produced from the Spring Creek Quarry west of Arlington city limits near the county line on Wampee Road. The material is utilized for road and concrete aggregate and agricultural lime.

Fannin County: 1. Coarse-grained white calcite occurs locally in massive sulfide ore and associated calcium silicate minerals at the Number Twenty Copper Mine, lot 20, 9th district, 2nd section. Much of this material is fluorescent red under short-wave ultraviolet radiation. 2. Similar calcite occurs at the Mobile Copper Mine, lot 59, 9th district, 2nd section, approximately one mile (1.6 km) south of the Number Twenty Mine.

Floyd County: 1. Ste. Genevieve-Gasper Limestone is extensively quarried from an opening 3 miles (4.8 km) northwest of Rome on a spur of the Central of Georgia Railroad. This is the largest limestone quarry in northwest Georgia. The limestone is typically bluish-gray, medium- to coarse-grained and locally contains oölites.

Gilmer County: 1. Marble is produced from 4 underground openings from 0.25 to 1 mile (0.4 to 1.6 km) north of Whitestone, east of the Louisville and Nashville Railroad. The marble is within the Murphy Marble Belt and is utilized for crushed stone, agricultural lime, terrazzo and aggregate.

Hall County: 1. Locally dolomitic marble of the Brevard Belt is produced from the Gainesville Quarry, 1.75 miles (2.8 km) northeast of Gainesville city limits and 1.75 miles (2.8 km) north of U.S. Highway 23 off White Sulfur Road.

Houston County: 1. Ocala Limestone is produced from the Perry Quarry, 1.4 miles (2.2 km) south of Perry city limits, south of the confluence of Big Indian Creek and Flat Creek on Plant Road.

McDuffie County: 1. Coarse-grained aggregates of light pink calcite are abundant in wall rock of the Hamilton Gold Mine, north of the Columbia Gold Mine, approximately 11 miles (17.7 km) northwest of Thompson and immediately north of U.S. Highway 78. The material fluoresces rose-red under shortwave ultraviolet radiation.

Mitchell County: 1. Suwannee Limestone is produced for road aggregate, agricultural lime, and concrete block from the Bridgeboro Quarry, 5.25 miles (8.4 km) east-southeast of Baconton.

Oglethorpe County: 1. Calcite was locally abundant in the quartz vein exploited at the Morgan Gold Mine, 6.5 miles (10.4 km) southeast of Lexington.

Pickens County: 1. Exceptional, complex rhombohedral calcite crystals, occasionally exceeding 10 inches (25 cm) in diameter, occur in large cavities in the Murphy Marble exploited at the New York Quarry, 0.25 mile (0.4 km) southeast of Marble Hill, south of Georgia Highway 53. This locality has consistently produced the finest calcite specimens known from Georgia. Accessory minerals are palygorskite, chalcopyrite, pyrite, and rutile. Collecting sites are underground and not normally open to collectors. 2. Marble is produced from quarries 1 and 5 of the Marble Products Corporation of Georgia, one mile (1.6 km) south of Whitestone, east of the Louisville and Nashville Railroad.

Upson County: 1. Unusual secondary calcite is reported from the Mitchell Creek Mica Mine by Grant (1955, p. 150). Secondary calcite crystals exhibiting simple rhombohedra up to 0.25 inch (0.6 cm) in diameter coat fracture surfaces on pyrite-bearing biotite–quartz schist.

Walker County: 1. Limestone of Mississippian age is produced from the Patton Rock Products Quarry, approximately 3 miles (4.8 km) west of LaFayette city limits, 2 miles (3.2 km) south of Dug Gap on the west side of Georgia Highway 193. 2. Chickamauga Limestone is quarried at Rossville at the junction of McFarland Road and Salem Road, just south of Rossville city limits.

White County: 1. Pink fluorescent calcite associated with octahedral pyrite crystals occurs in an abandoned prospect adit approximately 3,500 feet (1067 m) northwest of the Chattahoochee Grill at Helen (Hurst and Otwell, 1964, p. 71). 2. Calcite pods and veins contain disseminated grains of scheelite, pyrite and chalcopyrite, approximately 1.5 miles (2.4 km) northwest of Walters Place tavern along U.S. Highway 129 (Hurst and Otwell, 1964, p. 87). The calcite fluoresces pink to red when exposed to shortwave ultraviolet radiation.

Whitfield County: 1. Limestone of the Conasauga Formation is quarried by Dalton Rock Products Corporation 4.5 miles (7.2 km) northeast of the Dalton city limits, 2.25 miles (3.6 km) east of Georgia Highway 71.

MAGNESITE

$MgCO_3$

Class Anhydrous carbonate

Cryst. Hexagonal—R; hexagonal-scalenohedral—$\bar{3}$ 2/m

Habit Distinct crystals are rare, usually rhombohedral {$10\bar{1}1$}, also {$01\bar{1}2$}; rarely prismatic {0001} with {$11\bar{2}0$} and {0001} or tabular {0001}; rarely scalenohedral. Magnesite is commonly massive, coarse- to fine-granular or very compact and porcelaneous; earthy to somewhat chalky; lamellar or coarsely fibrous.

Phys. *Cleavage* {$10\bar{1}1$} perfect. *Fracture* conchoidal. Brittle. **H** 3¾–4½. **G** 3.00 ± 0.02 (pure $MgCO_3$); the **G** varies essentially linearly toward the end-members with the substitution of Fe, etc., for Mg; **G.**~ 3.48 for Mg:Fe = 1:; compact types with low Fe have **G.** ~ 2.9. *Luster* vitreous. *Colorless* and transparent in pure crystals; white, grayish white, yellowish to brown. *Streak* nearly white. Transparent to subtranslucent.

Occur.

Magnesite is a common alteration product of various magnesium-rich minerals in mafic and ultramafic igneous rocks. It is commonly produced when serpentinites undergo low or medium grade metamorphism under conditions in which CO_2 is readily available. Although magnesite has been reported from very few occurrences in Georgia, its physical properties are so similar to dolomite that it would not be identified under ordinary conditions. Magnesite may be expected as an accessory constituent of any of the major

serpentinite masses found in the crystalline Piedmont and may be one of the minor accessory carbonates in the Chatsworth Talc District.

Cherokee County: 1. Narrow veins of white, coarsely crystalline magnesite containing a minor amount of iron occur in altered serpentinite formerly quarried 2 miles (3.2 km) southwest of Holly Springs, lot 444, 15th district. Associated minerals are chromite, talc, and hydroxyl-apatite. The iron-rich variety of magnesite is typically referred to as bruennerite.

Habersham County: 1. A small amount of magnesite is reported from altered mafic rock exposed in old asbestos pits near Hollywood (Hopkins, 1914, p. 155).

Murray County: In a general discussion of carbonate minerals associated with talc deposits of this county, Hopkins (1914, p. 210) indicates that qualitative analyses of various samples from scattered occurrences show that compositions vary from dolomite to magnesite, rather than the typical variation of dolomite toward calcite.

Paulding County: 1. An altered peridotite containing secondary magnesite is exposed on the south side of a road at Waltons Store, about 3 miles (4.8 km) northwest of Douglasville (Hopkins, 1914, p. 282).

Rabun County: 1. Very small masses of magnesite are intimately associated with enstatite in an altered mafic rock exposed on Pig Pen Mountain, one mile (1.6 km) southeast of Pine Mountain (Hopkins, 1914, p. 53). 2. Very minor magnesite is reported by Hopkins (1914, p. 148) in altered dunite exposed on lot 156, 2nd district, 5 miles (8 km) west of Dillard.

SIDERITE
$FeCO_3$

Class Anhydrous carbonate

Cryst. Hexagonal—R; hexagonal-scalenohedral—$\bar{3}$ 2/m

Habit Crystals commonly rhombohedral, often saddle-shaped like dolomite. Less frequently, thin to thick tabular, prismatic, scalenohedral. Often massive, granular; earthy or stony and impure from admixture with clay or silica.

Phys. *Cleavage* rhombohedral perfect. *Fracture* conchoidal. Brittle. **H** 3¾–4¼. **G** 3.5–3.9. *Luster* vitreous to pearly. *Color* ash-gray to dark brown. *Streak* white. Translucent to subtranslucent.

Occur.

Although siderite has been positively identified at relatively few locations in Georgia, its distribution is thought to be widespread. It occurs locally within lower Paleozoic carbonate rocks and is an accessory constituent of gold-bearing quartz veins of the crystalline Piedmont. It is particularly abundant in small lenses and within pod-shaped quartz aggregates in metamorphic rocks adjacent to the Cartersville Fault in Bartow County. Siderite nodules are described in Cretaceous cuttings from wells in the Coastal Plain by Applin and Applin (1964).

Bartow County: 1. A siderite bed up to 30 feet (9 m) thick reportedly was exposed at the Cripple Creek ore bank at the base of Sugar Hill in the northeastern part of the county near Pine Log Mountain. Iron oxide ores at this location are apparently secondary after this material. The siderite is reportedly dark-grey in color and contains considerable pyrite. The dump of this mine contains abundant siderite (McCallie, 1900, p. 162).

Gwinnett County: 1. Siderite is particularly abundant in quartz veins formerly exploited for gold on the Harris property, lot 275, 7th district, about one mile (1.6 km) northeast of Suwannee.

Talbot County: 1. Excellent clusters of siderite crystals up to 1.5 inches (3.8 cm) in diameter have been found on the J. C. Rye property. Most crystals are altered externally to goethite.

RHODOCHROSITE
$MnCO_3$

Class Anhydrous carbonate

Cryst. Hexagonal—R; hexagonal-scalenohedral—$\bar{3}$ 2/m

Habit Distinct crystals not common; usually rhombohedral. Massive coarsely granular to compact; columnar; incrusting. Also globular and botryoidal.

Phys. *Cleavage* perfect rhombohedral. *Fracture* uneven to conchoidal. Brittle. **H** 3½–4. **G** 3.7. *Luster* vitreous to pearly. *Color* pink to red; also gray, brown. *Streak* white. Transparent to translucent.

Occur.

Lincoln County: 1. Rhodochrosite has been reported as a constituent of primary mineralization beneath the oxide zone at the Colley Manganese Mine adjacent to Georgia Highway 47, approximately 3.5 miles (5.6 km) east of Lincolnton. Associated minerals are rhodonite, pyrite, quartz, pyrolusite and other manganese oxides.

Polk County: 1. The occurrence of rhodochrosite is mentioned by Watson (1908, p. 161) at the Ledbetter Iron Mine near Cedartown.

Towns County: 1. Rhodochrosite is described in association with iron and manganese oxides in hornblende-bearing rocks of the "corundum belt," 2.5 miles (4 km) west of Hiawassee by Watson (1908, p. 160). This occurrence is probably that referred to by Haseltine (1924, p. 131) as the W. H. McConnell prospect on lot 89, 17th district, 1st section.

SMITHSONITE
$ZnCO_3$

Class Anhydrous carbonate

Cryst. Hexagonal—R; hexagonal-scalenohedral—$\bar{3}$ 2/m

Habit Rarely well-crystallized. Commonly botryoidal, reniform, or stalactitic; as crystalline incrustations; coarsely granular to compact massive; earthy and friable.

Phys. *Cleavage* rhombohedral. *Fracture* imperfectly conchoidal. Brittle. **H** 4–4½. **G** 4.3–4.4. *Luster* vitreous to pearly. *Color* white, gray, greenish, bluish, pinkish. Translucent.

Occur.

Wilkes County: 1. Smithsonite with calcite in veins cutting biotite-chlorite schist is mentioned in diamond drill hole logs of the United States Bureau of Mines drilling at the Chambers zinc prospect on Butlers Creek adjacent to the Lincoln County line, approximately 0.5 mile (0.8 km) west of the Magruder Gold Mine (Peyton and Cofer, 1950, p. 22). Identification of smithsonite in this core is questionable since it is reported in the 328- to 375-foot (100–115 m) interval.

ARAGONITE
$CaCO_3$

Class Anhydrous carbonate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Usually slender, prismatic crystals; also in tabular plates. Columnar, fibrous coralloidal, stalactitic, as laminated crusts, massive.

Phys. *Cleavage* distinct {010}. *Fracture* subconchoidal. Brittle. **H** 3½–4. **G** 2.93–2.95. *Luster* vitreous to resinous. *Color*less, white, gray, brown, yellow, green, blue; less often violet, rose-red. Transparent to translucent. Often fluorescent and phosphorescent.

Occur.

Aragonite, being metastable at normal temperatures and pressures, is much less common than calcite. It may be a component of certain fossil shells as old as the latter half of the Mesozoic Era. Aragonite is the normal material of pearls. Since primary precipitation of $CaCO_3$ from sea water occurs as aragonite, it is a component of recent calcareous muds and some oöliths. It is most common in Georgia as aggregates of delicate crystals and stalactites in limestone caves of both Paleozoic rocks of the northwestern corner of the state and limestones of the Coastal Plain.

Bartow County: 1. Exceptional though locally iron-stained aggregates of acicular aragonite crystals occur in solution cavities in the Knox Dolomite at the Ladd Lime and Cement Company Quarry, 2.6 miles (4 km) southwest of Cartersville on the east slope of Quarry Mountain. Individual crystals reach 2 inches

(5 cm) in length and clusters may be 6 inches (15 cm) in diameter. The locality is normally closed to collecting.

Decatur County: 1. Excellent clusters of white prismatic aragonite crystals occur locally within Climax Cave near Bainbridge.

Effingham County: 1. Unusual nodules of radial aragonite occur at Porters Landing on the Savannah River.

CERUSSITE
$PbCO_3$

Class Anhydrous carbonate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Crystals extremely varied; simple crystals often tabular and elongated. Crystals commonly grouped in clusters of reticular aggregates. Also massive, granular to dense and compact; sometimes stalactitic, or pulverulent to earthy.

Phys. *Cleavage* distinct {110}, {021}. *Fracture* conchoidal. Very brittle. **H** 3–3½. **G** 6.53–6.57. *Luster* adamantine, inclining to vitreous, resinous, or pearly. *Color*less to white and gray or smoky. *Streak* colorless to white. Transparent to subtranslucent.

Occur.

Cerussite is of quite uncommon occurrence in Georgia. It may be suspected in very minor amounts near the water table in quartz veins containing galena.

Bartow County: Cerussite occurs as minute selvages along the margins of microscopic galena grains included in barite at the Iron Hill and Tucker Hollow Mines (Kesler, 1950, p. 46). These mines are on lots 728 and 729, 21st district, 2.7 miles (4.3 km) northeast of Allatoona, and lots 460 and 477, 4th district, respectively.

Lumpkin County: 1. Cerussite occurs in minor amounts near the water table in galena-rich gold ores of the Battle Branch Mine, lots 457 and 524, 12th district (Pardee and Park, 1948, p. 38).

McDuffie County: Colorless, twinned cerussite crystals to 0.1 inch (0.25 cm) in diameter occur with pyromorphite and barite in vuggy quartz on the dump of the Landers Gold Mine, approximately 11 miles (17.7 km) northwest of Thompson and immediately north of U.S. Highway 78.

DOLOMITE
$CaMg(CO_3)_2$

Class Anhydrous carbonate

Cryst. Hexagonal—R; rhombohedral—$\bar{3}$

Habit Crystals usually rhombohedrons, often curved. Also massive, coarse to fine granular.

Phys. *Cleavage* rhombohedral perfect. *Fracture* subconchoidal. Brittle. **H** 3½–4. **G** 2.8–2.9. *Luster* vitreous to pearly. *Color*less, white pink, green-brown, gray, gray, black. Transparent to subtranslucent.

Occur.

Dolomite is one of the more important rock-forming industrial minerals found in Georgia. In northwest Georgia, dolomite is a constituent of numerous formations of Paleozoic age including the Shady, Knox, and Chickamauga Formations. Dolomite occurs in carbonate rocks of the Murphy Marble Belt from Fannin County southward to a point several miles north of Canton, Cherokee County. Apparently discontinuous carbonate rocks containing some dolomite occur in Hall and Habersham Counties along what is known locally as the Gainesville Marble Belt within the Brevard Zone. Dolomite-rich carbonate units are scarce in the Coastal Plain, however, magnesium limestones occur in the Chattahoochee Formation of lower Miocene age in Decatur, Grady, Thomas, Brooks, and Echols Counties.

In addition to its importance as a rock-forming mineral, dolomite is a relatively abundant accessory mineral within various altered ultramafic rocks and is typically associated with commercial talc deposits as at Chatsworth, Murray County. Dolomite is occasionally mentioned as a minor accessory mineral in sulfide-bearing quartz veins in the crystalline Piedmont. Localities described below have been chosen to represent specific geologic occurrences and geographic distribution of dolomite-rich rocks. Most occurrences have been chosen for easy access and availability of study material.

Bartow County: Paleozoic carbonate rocks underlie portions of the western half of the county. Dolomite predominates in the Knox Group and Shady Formation, and is locally abundant in the Newala Limestone. Most Conasauga Group rocks contain gray bedded dolomite.

1. Fine- to medium-grained dolomite is exposed vertically over a distance of more than 300 feet (91 m) in the Ladd Lime and Cement Company Quarry on the Seaboard Airline Railroad, 2.6 miles (4 km) southwest of Cartersville, on the east slope of Quarry Mountain. Workings are in formations of the Knox Group. Solution cavities lined with interesting groups of aragonite crystals are common at this location. 2. Dolomite of the lower Conasauga Group is produced from the Shinall Quarry, one mile (1.6 km) north of White, adjacent to the Louisville and Nashville Railroad. This material is typically gray, fine-grained, and locally contains narrow veins of white calcite.

Catoosa County: Dolomite interbedded with low-magnesia, low-silica limestone is particularly abundant in the Knox Group exposed extensively throughout the county. Exposures are abundant in the Graysville area where relief is high and overburden is limited.

1. Dolomite of the Newala Limestone is well exposed in the Acuff or Reesville Quarry, 4.2 miles (5.8 km) north of Ringgold and 0.3 mile (0.5 km) west of Georgia Highway 17. 2. Gray, heavy-bedded fine-grained dolomite interbedded with cherty dolomite of the Knox Group is exposed at the Hale Quarry, about 1.5 miles (2.4 km) southeast of Graysville adjacent to, and on the north side of, the Louisville and Nashville Railroad. Fluorite, galena, and barite are locally present in the quarry. 3. Additional exposures of dolomite-rich rocks of the Knox Group are exposed in quarries 0.5 mile (0.8 km) northwest, 0.5 mile (0.8 km) east, and 0.5 mile (0.8 km) northwest of Graysville.

Chattooga County: Dolomite and limestone of the Knox Group underlie a large portion of the county, particularly west of Taylor Ridge.

1. Rose-colored dolomite of the Knox Group has been produced from an underground quarry 1.5 miles (2.4 km) north of the Trion City Hall on the Central of Georgia Railroad. This site has been operated by the Marble Products Corporation for terrazzo chips since 1962. 2. Fine-grained Knox Dolomite is exposed in a large outcrop along the Central of Georgia Railroad, approximately 2 miles (3.2 km) southeast of Lyerly.

Cherokee County: The locally dolomitic Murphy Marble Belt extends into Cherokee County to a point just north of Canton.

1. Dolomitic marble is exposed over a thickness of 15 feet (4.6 m) along the east side of Lost Town Creek at a point about 7 miles (11 km) northwest of Canton and about 0.5 mile (0.8 m) north of the junction of Lost Town and Shoal Creeks (Maynard, 1912).

Dade County: Dolomitic rocks of the Knox Group are found only in the southern part of the county. They extend northward from the Alabama-Georgia line along the axis of the northeast plunging Wills Creek Anticline (McLemore and Hurst, 1970, p. 87).

Fannin County: Dolomite is locally abundant in the Murphy Marble Belt which extends southward through the county from a point just east of Sweetgum. The marble occurs east of Mineral Bluff and Blue Ridge, forming an almost continuous outcrop between these locations.

1. The Murphy Marble is confined to two northeast-trending belts extending along Youngstown and Dry Creek, and along Cutcane Creek, Creaseman Branch and Weaver Creek in the northern part of the county within the Mineral Bluff Quadrangle (Hurst, 1955a, p. 51). Accessory minerals are pale brown mica, pyrite, chalcopyrite, garnet, tremolite, and talc. Specific occurrences where dolomitic marble may be observed are along Cutcane Creek 0.4 mile (0.64 km) northeast of its confluence with Hemptown Creek and at the mouth of Youngstown Creek.

Floyd County: Dolomitic limestone of the Knox Group underlies nearly all of the southeast one-third of the county (McLemore and Hurst, 1970, p. 95). 1. Dolomitic carbonate rocks are exposed 1.2 miles (1.9 km) north of Vans Valley, on the north side of Cedar Creek. The occurrence is apparently the contact between the Conasauga and Knox Groups.

Gilmer County: The Murphy Marble Belt enters Gilmer County from the north along the valley of Brock Creek west of Cherry Log Post Office. It is reported in the valley of Whitepath Creek and also in the valleys of Big and Little Turnip Creeks near the Louisville and Nashville Railroad. The marble is again exposed along the west side of Talona Creek at Tioga and extends down this valley into Pickens County on the south (Maynard, 1912, p. 117). Dolomitic marble was quarried in the early 20th century by the North Georgia Marble Company on the west side of Talona Creek at Tioga Station.

Gordon County: The principle dolomite-bearing rocks underlying Gordon County are those of the Knox Group. Three areas in the central part of the county are underlain at least in part by dolomite. The western area extends northward from Bartow County to about one mile (1.6 km) north of Lilly Pond. An intermediate area extends northeastward from Calhoun almost to the Oostanaula River. A third area extends from the

Bartow County line through Farmville to the Murray County line, approximately one mile (1.6 km) east of Nickelville (McLemore and Hurst, 1970, p. 107).

Habersham County: Dolomitic marble of the Brevard Zone crops out discontinuously across the county from approximately 2 miles (3.2 km) west of Also, northeast through Piedmont College Farm to the Stephens County line in the northernmost part of the county near the South Carolina line (Hurst and Crawford, 1964, p. 56.

1. Dolomitic marble was prospected on the Wilbank's property, approximately 2 miles (3.2 km) west of Alto. Good outcrops may be found along Mud and Little Mud Creeks, particularly where the Lula-Raoul road crosses Little Mud Creek. 2. Relatively extensive outcrops of siliceous dolomitic marble occur about one mile (1.6 km) northeast of Walker Branch and adjacent to Davidson Creek in the northern part of the county. 3. A small amount of dolomitic marble has been quarried near Walker Branch and Georgia Highway 17, approximately 6 miles (9.7 km) west of Clarksville. 4. Analyses of dolomitic marble from several occurrences near Panther Creek and the Turnerville public road are given by Furcron (1942, p. 17). 5. The remains of an old quarry and kiln are on the Ellard property on Panther Creek near the junction of Panther and Devils Den Creeks.

Hall County: Dolomitic marble of the Brevard Zone crops out intermittently along a northeast trend from Flowery Branch to the Habersham County line.

1. Dolomitic marble was quarried immediately south of Gainesville near Chicopee on the east side of the Southern Railroad. 2. Similar material is currently quarried by the Gainesville Limestone Products Company, 1.75 miles (2.8 km) northeast of Gainesville city limits, 0.75 mile (1.2 km) north of U.S. Highway 23. 3. Dolomitic marble crops out at numerous locations in the vicinity of White Sulphur Springs (Furcron, 1942, p. 7). One such occurrence is on the W. O. Ramsey property, approximately 2 miles (3.2 km) southeast of White Sulfur Springs.

Haralson County: 1. Dolomitic marble was apparently once exposed in the bed of Little River on the Sanders property, approximately 3 miles (4.8 km) northeast of Buchanan. 2. A small outcrop of dolomitic marble is reported from the Bowling property, approximately 1.5 miles (2.4 km) north of Buchanan. Both this and the preceding occurrence have been core-drilled. Records indicate that marble was encountered. 3. Euhedral dolomite crystals in chloritic schist occur in wall rock of the Tallapoosa or Waldrop Copper Mine on lot 932, 20th district, about 3.1 miles (5 km) N44°W from Draketown. Examinations of massive sulfide ore indicate that relatively extensive replacement of dolomite by chalcopyrite and pyrite occurred at this location (Cook, 1970, p. 83).

Murray County: Dolomitic limestones of the Knox Group underlie the northwest portion of the county. Dolomitic marble is reported east of the Cartersville Fault approximately 1.3 miles (2 km) northeast of Cisco. Dolomite is an abundant and widespread accessory mineral in the talc deposits of the Chatsworth district.

1. Light gray, medium-grained sugary dolomite occurs interbedded with gray, medium-grained limestone of the Newala Formation on the D. O. Baxter property, 9.5 miles (15.2 km) north of Chatsworth. 2. Dolomitic marble, heavily veined with coarse-grained calcite, is exposed approximately 1.3 miles (2 km) northeast of Cisco. 3. Three stages of dolomite development have been recognized in the talc deposits of the Chatsworth district (Furcron, Teague and Calver, 1947, p.39). The most obvious dolomite is that of secondary origin which occurs in coarse-grained white aggregates associated with secondary quartz and apple-green talc. Significant occurrences are the Georgia mine, 3.5 miles (5.6 km) southeast of Chatsworth on lot 271, and the Earnest and Fort Mountain Mines on lot 297, 3.5 miles (5.6 km) northeast of Chatsworth on the northwest slope of Fort Mountain (Needham and Hurst, 1970, p. 11).

Pickens County: Locally dolomitic marble of the Murphy Marble Belt is exposed more or less continuously from a point east of Jasper southward to the Cherokee County line. Exposures are abundant on high bluffs at the Gilmer-Pickens County line and in the valley of Palona Creek. Similar exposures are in the Fishers Creek vicinity. Outcrops may be found 2 miles (3.2 km) northeast of Jasper in the valley of Longswamp Creek. These exposures may be traced to approximately 2 miles (3.2 km) south of Jasper. Locally dolomitic marble of the Murphy belt occupies the eastern portion of the valley of the east branch of Longswamp Creek in the vicinity of Tate and is locally exposed along this valley to the Cherokee County line.

1. Fine-grained dolomitic marble interbedded with coarsely crystalline, high-calcium marble has been quarried from the property of King Marble Company, 0.75 mile (1.2 km) north of Whitestone Station on the Louisville and Nashville Railroad (Maynard, 1912, p. 120). 2. Approximately 10 feet (3 m) of finely crystalline white and grayish-white dolomitic marble is exposed in the quarry of the Detroit Marble Company between Whitestone Station and the Pickens-Gilmer County line, adjacent to the Louisville and Nashville Railroad (Maynard, 1912, p. 120). 3. Dolomitic Murphy Marble, locally altered to magnesium silicates, has been quarried from the property of the Whitestone Marble Company at Whitestone. 4. Dolomitic marble is exposed over a stratigraphic distance of about 20 feet (6 m) in an old quarry approximately 2 miles (3.2 km) northeast of Jasper along the east side of east fork of Longswamp Creek (Maynard, 1912, p. 124). 5. Similar

material has been quarried at the Perseverance Quarry, about 1.75 miles (2.8 km) east of Jasper on the east side of Longswamp Creek. 6. Dolomite is a local constituent of marble quarried at numerous sites near Tate and Marble Hill by the Georgia Marble Company. Most quarries are located along the valley of Longswamp Creek and along the south bluff paralleling the east branch of this creek about 0.5 mile (0.8 km) west of Marble Hill. Local accessory minerals are graphite, hematite, fuchsite and tremolite. 7. Other currently active quarries in locally dolomitic Murphy Marble are located one mile (1.6 km) south of Whitestone east of the Louisville and Nashville Railroad and at Cove Mountain, approximately one mile (1.6 km) east of the Jasper city limits on Longswamp Creek.

Polk County: Locally dolomitic carbonate rocks underlie most of the county north of the Cartersville Fault. Low-magnesia limestone has been selectively quarried for many years in the vicinity of Rockmart. Associated magnesium-rich or dolomitic limestones have normally been left in place and are quite abundant at the Marble Hill lime quarries, the quarries of Southern States Portland Cement Company, and quarries of the Marquette Cement Company.

1. Large tonnages of dolomitic limestone reportedly exist at the old quarry of the Southern States Portland Cement Company east of Georgia Highway 101, 1.5 miles (2.4 km) north of Rockmart (McLemore and Hurst, 1970, p. 123). 2. Locally dolomitic limestone is exposed in the Southern Lime Manufacturing Company quarry, 3.4 miles (5.5 km) north of Rockmart and about 0.5 mile (0.8 km) east of Aragon Station. The dolomite is part of the Newala Limestone Formation. 3. The dolomitic Beaver Limestone is exposed locally on the northeast end of Indian Mountain where it extends from the Georgia–Alabama line northeast to Oredell.

Walker County: Most of Walker County is underlain by dolomitic carbonate-bearing formations of Paleozoic age. Outcrops of dolomitic Knox Group rocks are abundant on Missionary Ridge and Peavine Ridge. These same units are exposed on the ridge that passes through LaFayette and in the ridge complex in the eastern part of the county between Dicks Ridge and Mill Creek Mountain.

1. Pale gray, fine-grained dolomitic limestone is exposed in a quarry 1.8 miles (2.9 km) northeast of Kensington. 2. Dolomitic beds are exposed in the W. M. Matthews Quarry at Dug Gap on the northern end of Pigeon Mountain, approximately 1200 feet (366 m) north of Georgia Highway 193 (McLemore and Hurst, 1970, p. 141).

Whitfield County: More than one-half of Whitfield County is underlain by carbonate-bearing formations, some of which are locally dolomitic. Chief among these are dolomitic units within the Conasauga and Knox Groups.

1. Dolomitic Conasauga limestone is exposed east of Duckets Mill along the south side of the Dalton–Springplace road (Maynard, 1912, p. 259). The rock is grayish-blue and dark-blue in color and is thin-bedded. 2. Although Knox Group rocks are abundant in the subsurface, exposures are relatively uncommon. The best exposure is on Oder Ridge, 0.5 mile (0.8 km) south of U.S. Highway 76 in an old road materials quarry (McLemore and Hurst, 1970, p. 159).

ANKERITE

$Ca(Fe,Mg,Mn)(CO_3)_2$

Class Anhydrous carbonate

Cryst. Hexagonal—R; rhombohedral—$\bar{3}$

Habit Commonly rhombohedral crystals. Also prismatic and terminated by rhombohedrons, tabular, or octahedral. Commonly in curved, saddle-shaped forms. Massive, coarse to fine granular; columnar.

Phys. *Cleavage* rhombohedral. *Fracture* subconchoidal. Brittle. **H** 3½–4. **G** 2.85–3.2. *Luster* vitreous to pearly. *Color* white to brown. Translucent to subtranslucent. On weathering, turns darker brown or reddish in color.

Occur.

Ankerite in Georgia is known primarily as an accessory mineral of gold vein deposits. Park (1953, p. 3) reports that quartz and ankerite are the predominant gangue minerals in many vein deposits within the crystalline Piedmont.

Cherokee County: 1. Ankerite is locally abundant within the extensively exploited ore zones of the Franklin-Creighton Gold Mine centering on lots 466 and 467 in the extreme east-central part of the county. Associated minerals are quartz, pyrrhotite, and chalcopyrite.

DeKalb County: 1. Ankerite occurs in pegmatite zones exposed in quarrying operations at Arabia Mountain.

Lumpkin County: Milky-white ankerite is a common constituent of veins exploited for gold in the Battle Branch, Capps, Ivy, and Lockhart Mines of the Dahlonega District (Pardee and Park, 1948, p. 38). Textural relationships suggest that ankerite may have been formed by a reaction between silica-bearing fluids and adjacent schists.

LANTHANITE

$(La,Ce)_2(CO_3)_3 \cdot 8H_2O$

Class Hydrated carbonate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Platy to thick tabular {010}, sometimes lath-like by extension {001}. Also fine granular to earthy; as scales.

Phys. *Cleavage* {010}, micaceous. Not brittle. **H** 2½-3. **G** 2.69-2.74. *Luster* pearly. *Color-less* to white, pink, yellowish. Transparent.

Occur.

Cherokee County: 1. A mineral described as lanthanite is reported by Dana (1892, p. 1081) from the Canton or Rich Copper Mine on lots 127, 128, 161 and 162, 14th district, 2nd section, one mile (1.6 km) south of downtown Canton. The identification of lanthanite at this location is very questionable.

ZARATITE

$Ni_3(CO_3)(OH)_4 \cdot 4H_2O$

Class Hydrated basic carbonate

Cryst. Isometric

Phys. *Cleavage* none. *Fracture* (of aggregates) conchoidal. Brittle. **H** 3½. **G** 2.57–2.69, 2.649 (Lilaz); 2.67 (calc.). *Luster* vitreous to greasy. *Color* emerald-green. *Streak* paler. Transparent to translucent.

Occur.

Small amounts of green zaratite occur in the Sardis Meteorite (Henderson and Furcron, 1957, p. 133).

MALACHITE

$Cu_2(CO_3)(OH)_2$

Class Basic carbonate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals rare; usually needle-like and grouped in tufts and rosettes. Commonly massive with mammillary or botryoidal surface, earthy, and as thin stains on rock.

Phys. *Cleavage* {$\bar{2}$01} perfect in crystals. *Fracture* uneven. **H** 3½–4. **G** 3.6–4. *Luster* of crystals vitreous; fibrous varieties silky or velvety; often dull and earthy. *Color* light to dark green. *Streak* pale green. Translucent to opaque.

Occur.

Malachite has been reported from numerous occurrences within the Piedmont and Blue Ridge Provinces, most typically from the upper oxidized portions of deposits containing minor amounts of chalcopyrite. While all chalcopyrite occurrences are not known to contain associated malachite, the presence of malachite must be suspected in far more occurrences than are presented below. Malachite is rarely encountered in anything more than thin green films and occasional crusts of radiating, fibrous crystals.

Bartow County: 1. Malachite with associated azurite, chalcopyrite, and tennantite in vein quartz is described by Kesler (1950, p. 92) in the east bank of U. S. Highway 411 on the north side of Pine Log Creek

Bridge in the northern part of the Cartersville Mining District. 2. A similar malachite occurrence is described by Kesler (1950, p. 92) along the south bank of Sugar Hill Creek, 0.4 mile (0.64 km) northeast of Fairview Church, approximately 2 miles (3.2 km) due south of the above described occurrence.

Cherokee County: 1. Samples of limonite stained with malachite were submitted to the Georgia Geological Survey for identification from an unspecified location near Holly Springs in 1895. 2. Thin films of bright green malachite coat fractures in a pegmatite previously exploited for muscovite at the Amphlett Mica Mine, lot 46, Conn Creek district, 0.4 mile (0.64 km) S32°E of Conn Church (Heinrich and Jahns, 1953, p. 378).

Columbia County: 1. Small amounts of malachite and other secondary copper minerals occur in altered rock near the site of the diamond drill hole in the vicinity of Pollards Corner (Hurst, Crawford and Sandy, 1966, p. 189).

Fannin County: 1. Malachite associated with chalcocite was encountered in the near-surface workings of the Number Twenty Copper Mine, lot 20, 9th district, 2nd section, about 3 miles (4.8 km) southwest of Copperhill, Tennessee. 2. Malachite is reported from a similar occurrence at the Mobile Copper Mine on lot 59, 9th district, 2nd section, approximately one mile (1.6 km) south of the Number Twenty Mine. 3. Thin films of malachite stain rocks on the dump of the Phillips copper prospect, lot 21, 9th district, 2nd section. 4. Similar malachite stained material occurs on the dumps of the Sally Jane prospect, approximately half-way between the Mobile Copper Mine and Copperhill, Tennessee. 5. Malachite-stained dump material may be collected at the Jeptha Patterson copper prospect on a ridge about 0.5 mile (0.8 km) southwest of Pierceville. 6. Malachite is relatively abundant as thin films and coatings along fracture and joint planes in rock exposed at the Mount Pisgah or Higdon copper prospect on Mount Pisgah, 9 miles (14.4 km) southwest of Copperhill, Tennessee, and 1.2 miles (1.9 km) southwest of Higdons Store (Shearer and Hull, 1918, p. 218–220).

Greene County: 1. Nodules of malachite and rock impregnated with malachite occur in dump material at the old Tuggle Copper Mine, about 4 miles (6.4 km) northeast of Union Point on the north side of the south fork of Little River. The location is near Durham Town settlement on land owned by Mercer Reynolds.

Gwinnett County: 1. Rock containing malachite and associated azurite and chalcopyrite was submitted to the Georgia Geological Survey in 1899 from the Owens Gold Mine, lot 349, 7th district, approximately 3 miles (4.8 km) west of Buford.

Habersham County: 1. An interesting occurrence of malachite and chalcopyrite associated with corundum, andradite garnet, and hornblende in an altered ultramafic rock is described by Hurst and Crawford (1964, p. 32) near the forks of Amos Creek at its headwaters on the west side of Alec Mountain.

Haralson County: 1. Thin films of malachite encrusting dump material and filling fractures in ore are notable at the Tallapoosa or Waldrop Copper Mine, lot 932, 20th district, 3rd section. Shearer and Hull (1918, p. 78) describe light green bands of malachite occurring at the contact of pyrite and carbonate host rock.

Jasper County: 1. Malachite occurs with azurite and various copper sulfides in light green microcline at a pegmatite exploited for feldspar near Enon Church on Georgia Highway 83, approximately 6 miles (9.7 km) south of Monticello near Gladesville.

Lincoln County: 1. Thin films of malachite coat fractures and stain country rock in workings of the Magruder Gold Mine in the extreme western part of the county, approximately 2.5 miles (4 km) east of Metasville. 2. Relatively abundant malachite after chalcopyrite occurred in the upper workings of the Paschal Gold Mine, approximately 0.6 mile (1 km) S7°E of Clay Hill in the southwest corner of the county. Associated sulfide minerals are galena, chalcopyrite and pyrite, all occurring in quartz stringers and veins cutting rocks of the Little River Series.

Lumpkin County: 1. Thin films of malachite associated with linarite, brochantite, and langite coat supergene chalcocite in the upper stopes of the Chestatee Pyrite Mine, approximately 6 miles (10 km) east of Dahlonega on the southeast side of the Chestatee River, 1.75 miles (2.8 km) below its junction with Tesnatee Creek.

McDuffie County: 1. Green stains consisting predominantly of malachite coat fractures in dump material at the Landers and Parks Gold Mines, approximately 11 miles (17.7 km) northwest of Thompson and immediately north of U.S. Highway 78. Associated minerals are galena, pyrite, chalcopyrite, gold, pyromorphite, barite and scheelite.

Murray County: 1. Malachite-stained country rock is reported from the Mill Creek copper prospect in the north road bank of Mill Creek Road, 3 miles (4.8 km) east-northeast of the railroad crossing at Crandall (Hurst and Crawford, 1970, p. 145). Malachite at this location is presumably secondary after chalcopyrite and is confined to a 60–80 foot (18–24 m) thick shear zone containing pyrite as the predominant sulfide mineral.

Oglethorpe County: 1. Minor malachite associated with chalcopyrite and native copper was encountered near the water level in the Morgan Gold Mine, approximately 6.5 miles (10.4 km) southeast of Lexington. 2. Vein quartz containing malachite in fractures and on weathered surfaces occurs at the Guarantee Gold

Mine (7.5 miles (12 km) southeast of Lexington and immediately adjacent to U.S. Highway 78. 3. A similar occurrence of malachite is at the Buffalo Gold Mine, approximately 6.5 miles (10.4 km) east of Stevens.

Paulding County: Very minor malachite may be encountered in dump material at any of the numerous massive sulfide prospects within this and adjacent counties. For a detailed description of occurrences refer to sections on chalcopyrite, pyrite, and pyrrhotite.

1. Thin crusts of malachite stain the rocks exposed near the entrance of a prospect adit at the McGruder copper prospect, 2.05 miles (3.3 km) due west of Huntsville, on the east bank of Raccoon Creek (Hurst and Crawford, 1970, p. 50).

Wilkes County: 1. Minor malachite occurs with epidote in an 18-inch (46-cm) wide quartz vein in a roadside exposure on the Metasville–Tignall road, approximately 2 miles (3.2 km) north of Metasville and 2 miles (3.2 km) south of Fishing Creek. 2. Malachite with chalcopyrite and ilmenite occurs in a series of quartz lenses exposed in a cut along a secondary road, approximately 4.5 miles (7.2 km) S30°E of Metasville (Hurst, Crawford and Sandy, 1966). 3. Malachite associated with azurite, bornite, chalcocite and epidote occurs in a silicified zone and quartz veins at the Youngs Chapel copper prospect, approximately 3.5 miles (5.6 km) west of Washington along a ridge between Youngs Chapel and Beaver Dam Creek.

AZURITE

$Cu_3(CO_3)_2(OH)_2$

Class Basic carbonate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals usually tabular. Also in crusts, massive and earthy.

Phys. *Cleavage* perfect {011} and fair {100}. *Fracture* conchoidal. Brittle. **H** 3½–4. **G** 3.77; 3.83 (calc.). *Luster* vitreous to adamantine. *Color* light blue to very dark blue. *Streak* light blue. Transparent to subtranslucent.

Occur.

Azurite is found very sparingly as a secondary mineral coating fractures in the upper weathered portions of deposits containing primary copper minerals. Although it has been reported from surprisingly few locations, in all probability it was a minor constituent of the supergene enrichment zones in numerous formerly prospected chalcopyrite occurrences, particular those of Fannin County south of the Ducktown district and those of the west-Georgia massive sulfide district.

Bartow County: 1. Azurite coats fractures in blue-gray dolomite in the east bank of U.S. Highway 411 on the north side of the Pine Log Creek Bridge in the northern part of the Cartersville Mining District. The azurite and associated malachite are formed during the weathering of chalcopyrite and tennantite (Kesler, 1950, p. 92).

Gwinnett County: 1. Azurite and malachite occur in the upper portion of a quartz vein exploited for gold at the Owens Mine, lot 349, 7th district, approximately 3 miles (4.8 km) west of Buford.

Jasper County: 1. Crusts of deep blue azurite up to 0.1 inch (0.25 cm) thick coat fractures in pegmatite containing chalcopyrite, chalcocite, bornite, bismuth, wittichenite, and fluorite at the Enon Church Feldspar Mine on Georgia Highway 83, approximately 6 miles (9.7 km) south of Monticello near Gladesville.

Lincoln County: 1. Very thin films of azurite occur above the water table at the Magruder Gold Mine in the extreme western part of the county, approximately 2.5 miles (4 km) east of Metasville. 2. Minor azurite and malachite stain dump material at the Paschal Gold Mine in the southwest corner of the county, approximately 0.6 mile (1 km) S7°E of Clay Hill.

McDuffie County: 1. Minor azurite occurs with pyrite, galena, chalcopyrite and malachite at the Landers Gold Mine, approximately 11 miles (17.7 km) northwest of Thompson and about one mile (1.6 km) north of U.S. Highway 78.

Wilkes County: Bright blue films of crystalline azurite fill fractures in white quartz at the Youngs Chapel copper prospect, approximately 3.5 miles (4.8 km) west of Washington on the ridge between Youngs Chapel and Beaver Dam Creek. The azurite is secondary after chalcopyrite and bornite and is associated with malachite, covellite, bornite and native copper.

NITER
KNO_3

Class Nitrate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Generally in thin crusts, silky tufts, and delicate acicular crystallizations; also massive, granular, or columnar; earthy; mealy. Artificial crystals are prismatic {001}, with {110}, {010} and usually {001}.

Phys. *Cleavage* {011} nearly perfect, {010} fairly good; {110} imperfect. *Fracture* subconchoidal to uneven. Brittle. **H** 2. **g** 2.109 ± 0.002; 2.08 (calc.). *Luster* vitreous. Transparent. *Color* and *streak* colorless to white; sometimes gray, or tinted by mechanically admixed impurities.

Occur.

Niter, commonly known as saltpeter, occurs in numerous caves within Paleozoic rocks and has been produced from several sites for the manufacture of gunpowder. Two well known examples are given below:

Bartow County: 1. Saltpeter was produced in evaporating ponds in the first half of the 19th Century from lots 256 and 257, 16th district about 2 miles (3.2 km) southeast of Kingston (Goff, 1959a, p. 124). 2. Niter was produced sporadically from Saltpeter Cave a short distance south of the above mentioned ponds (Goff, 1959a, p. 124).

SULFATES

BARITE
$BaSO_4$

Class Anhydrous sulfate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Crystals usually thin to thick tabular, less often short to long prismatic. Also found as globular or nodular concretions, fibrous to columnar within; as concretionary single crystals, groups, and rosette-like aggregates of crystals (desert roses) enclosing sand; massive, granular to compact; columnar to fibrous, either parallel or radiated; stalactitic; earthy.

Phys. *Cleavage* perfect basal and {210}; often shows good {010} cleavage. *Fracture* uneven. Brittle. **H** 3–3½. *Luster* vitreous to resinous. *Color*less to white, yellow, brown, dark brown, gray, reddish, less common greenish or blue. Often shows zonal coloration. *Streak* white. Transparent to subtranslucent. Some varieties fluorescent in ultraviolet light.

Occur.

Barite is one of the economically important industrial minerals currently produced in Georgia. It has been mined here, chiefly from the Cartersville district, since about 1887. Georgia currently ranks third in the United States in barite production, accounting for approximately 25 percent of the annual domestic supply. In addition to the numerous mines and prospects in the Cartersville area, many barite occurrences are known in similar and other geologic environments beyond the limits of this district.

Bartow County: The barite deposits of the Cartersville district have been described in detail by both Hull (1920) and Kesler (1950). Kesler reports that as of 1944 there were approximately 35 major barite mines that had an appreciably productive record. Most barite has been recovered from deposits along a belt extending from approximately 0.1 mile (0.16 km) south of Emerson northward to Cartersville, entirely within district 4.

Barite in the Cartersville district is mined from residual concentrations overlying Paleozoic rocks containing hydrothermally deposited barite. These host units are principally the Rome and Shady Formations of Cambrian age. Most barite within the district is white and massive, affording little opportunity for the collection of material worthy of mineralogical study or display; however, several locations have recently produced crystal specimens of unusual quality.

1. Outstanding museum quality specimens consisting of tabular, gray-blue barite crystals up to 6 inches (15 cm) long in generally parallel or radial aggregates occur on the south bank of the old road to the Georgia Peruvian Ochre Company Mine, lots 676, 677, 693, and 764, 4th district, 3rd section. The occurrence is in brecciated Wiesner Formation exposed in the nose of a northwest-plunging anticline. Exceptional, colorless, terminated barite crystals up to 2 inches (5 cm) long also occur in pockets at this locality. It should be stressed that this occurrence is on private property and has been exploited by rock hounds to such a degree that the locality is now quite unsafe for collecting. Several serious injuries have resulted from carelessness and rock falls. Hull (1920, p. 56) reports that beautiful barite crystals are commonly associated with ocher and ocherous quartzite on lots 676, 677 and 693, and abundantly in the big open cut just south of the "Dixie Highway" and the Old Log Washer on lot 677. 2. Clear, tabular barite crystals as much as 2 inches (5 cm) in length are reported by Hull (1920, p. 117) from the Jones property, lots 1039 and 1050, located just north of Pumpkinvine Creek about 1.5 miles (2.4 km) south-southwest of Emerson. The crystals occur loose in soil, in residual, and in in-place boulders of jasperoid. Similar material occurs on the adjacent Puckett property (lots 1037, 1038 and 1051). 3. An interesting occurrence of radial, columnar and mammillary barite is reported by Hull (1920, p. 79) from the Krebs Pigment and Chemical Company Mine on lots 533, 548 and 605, 4th district, 3rd section. 4. Unusual fossils replaced by barite are reported from the Hurricane Hollow, Barium Reduction, New Riverside, Nulsen, and Bertha Mines by various authors.

Barite is known from several outlying areas in Bartow County. Among these are several prospects near Stilesboro and one near Kingston. 5. Fragments of massive barite occur as residual concentrations over a small area on lot 1200, 17th district, 3rd section, approximately 2 miles (3.2 km) southwest of Stilesboro and 0.5 mile (0.8 km) southeast of McGinnis (Hull, 1920, p. 126). 6. A similar residual occurrence over Chickamauga Limestone is on lot 1177, 17th district, 3rd section, about 0.4 mile (0.64 km) southeast of McGinnis. 7. Massive

and crystalline aggregates of barite in residuum overlying Knox Dolomite have been prospected on lot 158, 16th district, 3rd section, in the western part of Bartow County (Hull, 1920, p. 127). Crystalline aggregates at this location consist of groups of thin, curved plates arranged in bud-shaped masses (barite roses).

Catoosa County: 1. Barite occurs with small cubes of galena and purple fluorite in a 5-foot (1.5 m) thick brecciated zone at the Hale Dolomite Quarry, 1.5 miles (2.4 km) southeast of Graysville.

Cherokee County: 1. Barite is present at an old copper prospect on lot 164, 22nd district, 2nd section, in the western part of Cherokee County about one mile (1.6 km) north of Moores Mill and 4 miles (6.4 km) southwest of Waleska. Barite occurs as narrow lenses interbedded with sheared quartzite and schist and is associated with pyrite.

Floyd County: 1. Residual masses of barite occur over Conasauga Formation rocks on lot 222, 24th district, 3rd section, in the northeastern part of the county. 2. Barite was mined about 1897 from lot 224, 24th district, 3rd section, about 2 miles (3.2 km) south-southwest of Plainville. The barite occurs as an approximately 3-foot (0.9 m) wide vein in Conasauga Limestone. 3. Barite fragments occur in residuum over Knox Dolomite on lots 337 and 338, 23rd district, 3rd section, in eastern Floyd County approximately 0.5 mile (0.8 km) south of Bass Ferry (Hull, 1920, p. 139).

Gordon County: 1. Barite has been prospected from residuum overlying Conasauga Limestone on lot 26, 15th district, 3rd section, approximately 1.5 miles (2.4 km) north of Plainville (Hull, 1920, p. 136).

Lincoln County: 1. Stubby, euhedral barite crystals up to 0.5 inch (1.3 cm) long occur in the kyanite-quartz rock currently mined at Graves Mountain. Most crystals formerly exposed in outcrop were at least partially altered to secondary crusts of yellow alunite (Hurst, 1958d, p. 15). 2. Massive barite was a common gangue mineral in the Magruder Gold Mine, approximately 2.5 miles (4 km) east of Metasville in the extreme western part of the county. Masses of coarsely crystalline barite are relatively abundant on the dumps of this mine and can be found as float over a considerable area. 3. Barite occurs in the alluvium in west-central Lincoln County, mainly along Soap Creek which drains the Magruder Mine area, Florence and Dry Branch Creeks southeast of Lincolnton, and in the headwaters of Grays Creek (Hurst, Crawford and Sandy, 1966, p. 82).

McDuffie County: 1. Euhedral, colorless barite crystals line cavities in ore at the Landers Gold Mine, approximately 11 miles (17.7 km) northwest of Thompson and immediately north of U.S. Highway 78 near the Columbia Gold Mine. Associated minerals are galena, pyrite, chalcopyrite, covellite, pyromorphite and scheelite. 2. Barite has been identified in alluvium from a tributary of Big Creek about 7 miles (11 km) north of Thomson (Hurst, Crawford and Sandy, 1966, p. 82).

Murray County: Barite was mined in Murray County in the early 1900's from what has been described as the Eton district by Hull (1920, p. 129–133). 1. Barite has been mined from residuum over the Knox Dolomite on lot 157, 9th district, 3rd section, approximately 2.7 miles (4.3 km) south-southwest of Eton. 2. Residual barite occurs in the south part of lot 157 adjoining the previously described property. 3. A similar unprospected occurrence is on lot 132, 9th district, 3rd section, approximately 2.5 miles (4 km) south-southwest of Eton. 4. A small amount of barite has been produced from lot 88, 9th district, 3rd section, within the corporate limits of Eton. 5. Tabular barite crystals up to 0.3 inch (0.8 cm) in length and coated with iridescent limonite occur in the iron prospect on lot 57, 9th district, 3rd section, approximately 0.75 mile (1.2 km) northeast of Eton.

Polk County: Barite has been reported from a location several miles south of Esom Hill. Hull (1920, p. 142) reports than an investigation of the Esom Hill vicinity in 1917 failed to disclose the presence of barite.

Whitfield County: 1. Barite has been produced from residuum over Knox Dolomite on lot 271, 11th district, and lot 288, 10th district, approximately 9.5 miles (15 km) northeast of Dalton. Interesting specimens occur here containing groups of transparent and translucent tabular crystals arranged in crested form and enclosed in an "ocherous cherty" matrix (Hull, 1920, p. 135). 2. A similar occurrence is on lots 253 and 217, 10th district, 3rd section, north of Rural Vale Crossroads (Hull, 1920, p. 136). 3. A barite prospect occurs on lot 181, 10th district, 3rd section, approximately 3 miles (4.8 km) west-southwest of Beaverdale (Hull, 1920, p. 136).

Wilkes County: 1. Barite is reported in alluvium from Rocky Creek, approximately 4 miles (6.4 km) southeast of Washington (Hurst, Crawford and Sandy, 1966, p. 82).

ANGLESITE
$PbSO_4$

Class Anhydrous sulfate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Found as thin to thick tabular crystals. Commonly massive, granular to compact; nodular, stalactitic; often massive with concentric banding and enclosing an an unaltered core of galena.

Phys. *Cleavage* good basal. *Fracture* conchoidal. Brittle. **H** 2½–3. **G** 6.36–6.39. *Luster* adamantine. *Color* white, yellow, gray, green and rarely, blue. *Streak* uncolored.

Occur.

Lincoln County: 1. Thin concentric layers of anglesite surround galena in partially oxidized ore samples at the Magruder Gold Mine in the extreme western part of the county, approximately 2.5 miles (4 km) east of Metasville. Associated minerals are barite, pyrite, chalcopyrite and sphalerite.

MENDOZITE
$NaAL(SO_4)_2 \cdot 11H_2O$

Class Hydrous sulfate

Cryst. Monoclinic; prismatic—2/m

Habit Artificial crystals are prismatic {001} with large {100}; also pseudo-rhombohedral with {100} and {$\bar{2}$11}. As fibrous masses.

Phys. *Cleavage* {100} good, {001} and {010} indistinct. **H** 3. **G** 1.730, 1.765. *Color*less and transparent; white. On exposure becomes white and turbid (tamarugite).

Occur.

Rabun County: 1. A recrystallization product of natural alum, tentatively identified as mendozite, is described by Grant (1949a, p. 9) from near Rabun Gap. The material as submitted is a yellowish-to-white, crusty aggregate of particles which individually have waxy luster and often appear fibrous.

KALINITE
$KAl(SO_4)_2 \cdot 11H_2O$

Class Hydrous sulfate

Cryst. Monoclinic (?)

Habit As an efflorescence; fibrous.

Phys. *Color*less, white. Transparent. Soluble in water. Tastes sweetish and astringent. **H** 2–2½. **G** not determined.

Occur.

Rabun County: 1. Grant (1949a, p. 8) reports mineralogical work conducted on natural alums from near Rabun Gap. A recrystallization product identified tentatively as kalinite is described.

GYPSUM
$CaSO_4 \cdot 2H_2O$

Class Hydrous sulfate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals common; flattened diamond-shaped, or prismatic to acicular. Massive, granular, fibrous, lamellar. Crystals often form swallow-tail twins.

Phys. *Cleavage* perfect {010}. Easily flexible but not elastic. **H** 2. **G** 2.3. *Luster* vitreous to pearly. *Color*less, white, gray, yellowish, brownish, reddish; often tinted other shades of color by impurities. *Streak* white. Transparent to translucent. Often fluorescent and phosphorescent in various shades of yellow and green.

Occur.

Bartow County: 1. Highly lustrous, transparent gypsum crystals up to one inch (2.5 cm) in diameter occur in cavities in goethite-rich brown iron ore at numerous locations in the Cartersville Mining District. Gypsum is most abundant in goethite boulders containing remnant cores of pyrite.

Camden County: 1. Gypsum crystals occur in the Pleistocene Satilla Formation exposed at Colerain Bluff on St. Marys River (Veatch and Stephenson, 1911, p. 435).

Chatham County: 1. Gypsum crystals occur locally in the Pleistocene Satilla Formation exposed in and around Savannah (Veatch and Stephenson, 1911, p. 435).

Chattahoochee County: 1. Gyspum is locally abundant near the top of the Upper Cretaceous Blufftown Formation. It may be collected in road cuts along U.S. Highway 280, approximately 2 miles (3.2 km) northwest of Cusseta. Crystals at this location are twinned and etched, with maximum dimensions up to 3 inches (7.6 cm).

Clinch County: 1. A small amount of gymsum is reported in dolomite chips recovered between 1,325 and 1,370 feet in an oil test on Timber Products Company land, lot 306, 7th district (Applin and Applin, 1964, p. 76). The material is of Eocene age.

Lumpkin County: 1. A highly unusual occurrence of gypsum in the Chestatee Pyrite Mine has been described by Cook and Hughes (1973, p. 84). Aggregates of white gypsum crystals up to 0.3 inch (0.76 cm) in length coat rock, mine rail, electric wire and other debris in open portions of the old stopes. The gypsum has apparently formed in a very restricted environment from water charged with the sulfate radical produced by decomposition of sulfide minerals. The mine is located on the south side of the Chestatee River about 1.75 miles (2.8 km) below its junction with Tesnatee Creek, approximately 6 miles (10 km) northeast of Dahlonega.

MELANTERITE

$FeSO_4 \cdot 7H_2O$

Class Hydrous sulfate

Cryst. Monoclinic; prismatic—2/m

Habit Usually in stalactitic or concretionary forms; as fibrous to capillary aggregates and crusts; massive, pulverulent.

Phys. *Cleavage* perfect basal. Brittle. **H** 2. **G** 1.8–1.9. *Luster* vitreous. *Color* green to white. *Streak* colorless. On exposure to dry air becomes yellowish white and opaque.

Occur.

Although melanterite has been reported from only two specific locations, its occurrence is to be expected wherever iron sulfides are oxidizing in humid restricted environments such as stopes in old mines and cavities in near-surface rocks. Material vaguely referred to as copperas in old literature is melanterite.

Chattooga County: 1. Samples containing melanterite with clay and lignite have been submitted to the Georgia Geological Survey from Taylors Mine. Additional data are lacking.

Lumpkin County: 1. Melanterite formed by the alteration of pyrite is described by Yeates, McCallie and King (1896, p. 505) from the rear of a tunnel on the Chestatee Mine property on the south side of the Chestatee River about 1.75 miles (2.8 km) below its junction with Tesnatee Creek, approximately 6 miles (10 km) northeast of Dahlonega. The mineral occurred as small prismatic crystals forming crusts on oxidized pyrite contained in a relatively narrow quartz vein. Examination of accessible portions of this mine in 1960 disclosed the presence of very abundant melanterite and gypsum coating most stope walls and broken ore.

EPSOMITE

$MgSO_4 \cdot 7H_2O$

Class Hydrous sulfate

Cryst. Orthorhombic; rhombic-disphenoidal—222

Habit Usually as fibrous to hair-like or acicular crusts; also as woolly efflorescences; as botryoidal or reniform masses; stalactitic.

Phys. *Cleavage* perfect {010}. *Fracture* conchoidal. **H** 2–2½. **G** 1.687 (artif.), 1.65 (calc.). *Luster* vitreous to earthy. *Color* and *streak* white.

Occur.

Epsomite has been tentatively identified from only one location; however, its occurrence in minor quantities may be suspected where magnesium-rich rocks containing accessory pyrite are decomposing under restricted conditions.

Haralson County: 1. Minute prismatic crystals identified as epsomite have been found in cavities in oxidized ore at the Tallapoosa or Waldrop Copper Mine on lot 932, 20th district, approximately 3.1 miles (5 km) N44°W of Draketown. The mineral has apparently formed from the breakdown of dolomite-rich wall rock by sulfuric acid produced during the oxidation of pyrite. Associated minerals are goethite and jarosite.

HALOTRICHITE

$$Fe^{+2}Al_2(SO_4)_4 \cdot 22H_2O$$

Class Hydrous sulfate

Cryst. Monoclinic; sphenoidal—2

Habit As radial or matted aggregates of acicular or hair-like crystals; tufted, spheroidal, as an incrustation or efflorescence.

Phys. *Cleavage* one poor. *Fracture* conchoidal. Brittle. **H** 1½. **G** 1.89. *Luster* vitreous. *Color*less to white; also yellowish or greenish.

Occur.

Rabun County: 1. An anisotropic, bladed, radiating recrystallization product of impure natural alum from an unspecified location near Rabun Gap is tentatively identified as halotrichite by Grant (1949a, p. 8).

BROCHANTITE

$$Cu_4(SO_4)(OH)_6$$

Class Basic sulfate

Cryst. Monoclinic; prismatic—2/m

Habit Stout prismatic to acicular {001}, but sometimes elongated {010} or more rarely, {100}; also tabular {001}. As loosely coherent aggregates of acicular crystals; in groups and drusy crusts; massive, granular.

Phys. *Cleavage* {100} perfect. *Fracture* uneven to conchoidal. **H** 3½–4. **G** 3.97; 4.09 (calc.). Luster vitreous, on the cleavage somewhat pearly. *Color* emerald-green to blackish green, also light green. *Streak* pale green. Transparent to translucent.

Occur.

Lumpkin County: 1. Brochantite is the most abundant secondary copper sulfate in the Chestatee massive sulfide deposit, 6 miles (9.7 km) east of Dahlonega on the southeastern side of the Chestatee River, 1.75 miles (2.8 km) below its junction with Tesnatee Creek. Brochantite occurs as emerald-green crusts, crystal aggregates, and individual crystals on fracture surfaces of partially oxidized sulfide ore containing unusual amounts of chalcocite and covellite. Crystals are elongate on {010}, average 0.05 inch (0.1 cm) in length, and exhibit dominant {001} and {110} forms (Cook and Hughes, 1973, p. 84).

LINARITE

$$PbCu(SO_4)(OH)_2$$

Class Basic sulfate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals elongated {010}, and often tabular {101} or {001} rarely {100}. Crystals either singly or in groups; as crusts or confused aggregates of prismatic crystals.

Phys. *Cleavage* {100} perfect, {001} imperfect. *Fracture* conchoidal. Brittle. **H** 2½. **G** 5.35; 5.33 (calc.). *Luster* vitreous to subadamantine. *Color* deep azure-blue. *Streak* pale blue. Translucent.

Occur.

Lumpkin County: 1. Azure-blue radial aggregates and individual crystals of linarite occur on bronchantite crusts and within chalcocite-lined cavities in the oxidized portion of the Chestatee massive sulfide deposit. The occurrence is 6 miles (9.7 km) east of Dahlonega on the southeast side of the Chestatee River, 1.75 miles (2.8 km) below its junction with Tesnatee Creek (Cook and Hughes, 1973, p. 84). Most crystals are simple prisms to 0.07 inch (0.2 cm) in length exhibiting dominant {001}, {101}, {110}, and {210} forms, and twinning on {100}. Isolated crystals occasionally display a tabular habit with well developed {110} faces.

ALUNITE

$KAl_3(SO_4)_2(OH)_6$

Class Basic sulfate

Cryst. Hexagonal—R; ditrigonal-pyramidal—3m

Habit Small crystals and massive.

Phys. *Cleavage* distinct basal. Brittle. **H** 3½–4. **G** 2.58–2.75. *Color white, sometimes* reddish. *Streak* white. Transparent to subtranslucent.

Occur.

Lincoln County: 1. Alunite is reported by Hurst (1958d, p. 15) as a secondary mineral at Graves Mountain, located on U.S. Highway 378 between Lincolnton and Washington. Small cavities in weathered kyanite-quartz rock are lined and partially filled with pale masses of alunite in which there are minute, colorless quartz crystals and porous masses of gray barite. The best exposures were reported to be 150 feet (46 m) south of the saddle within the area that has now been mined out.

JAROSITE

$KFe_3(SO_4)_2(OH)_6$

Class Basic sulfate

Cryst. Hexagonal—R; ditrigonal-pyramidal—3m

Habit Small plate-like crystals; as crusts or coatings of microscopic crystals; granular massive; fibrous; also as earthy coatings.

Phys. *Cleavage* distinct basal. Brittle. **H** 2½–3½. **G** 2.91–3.26. *Luster* vitreous. *Color* ocherous, amber-yellow to dark brown. *Streak* yellow. Translucent.

Occur.

Jarosite is a relatively common secondary mineral in the oxidized portions of iron-rich sulfide deposits. It is often unrecognized due to its typically earthy nature and mechanical combination with geothite and other iron oxides.

Haralson County: 1. Crusts of yellow-brown jarosite fill cracks and voids in partially oxidized ore and mineralized wall rock of the Tallapoosa or Waldrop Copper Mine on lot 932, 20th district, about 3.1 miles (5 km) N44°W of Draketon. Epsomite is locally associated with the jarosite.

Polk County: 1. Minute, lustrous brown crystals of jarosite fill fractures and cavities in goethite at several mines at Esom Hill in the western portion of the county. The identification has been confirmed by X-ray powder diffraction analysis.

LANGITE

$Cu_4(SO_4)(OH)_6 \cdot 2H_2O$

Class Hydrous basic sulfate

Cryst. Orthorhombic

Habit Crystals small, equant or elongated {100}. As laths or scales, forming fibro-lamellar crusts; also earthy.

Phys. *Cleavage* {001} and {010}. **H** 2½-3. **G** 3.48-3.50. *Luster* of crystals vitreous, of crusts somewhat silky. *Color* fine blue to greenish blue. Translucent.

Occur.

Lumpkin County: 1. Langite associated with brochantite and linarite is reported by Cook and Hughes (1973, p. 84) as a secondary mineral in the upper levels of the Chestatee Pyrite Mine, 6 miles (9.7 km) east of Dahlonega on the south side of the Chestatee River, 1.75 miles (2.8 km) below its junction with Tesnatee Creek. Langite occurs as 0.05-inch (0.13 cm) equant blue crystals displaying {001}, {110}, {010}, and {021} forms, and as prismatic crystals up to 0.1 inch (0.25 cm) in length elongate on {100}. Pseudohexagonal and star-shaped twins on {110} are common. The mineral is typically associated with abundant gypsum in apparent desiccation cracks in partially oxidized pyrite-pyrrhotite ore.

PHOSPHATES

XENOTIME

YPO_4

Class Anhydrous phosphate

Cryst. Tetragonal; ditetragonal-dipyramidal—4/m 2/m 2/m

Habit Short to long prismatic, equant, and pyramidal crystals. Also in radial aggregates of coarse crystals; in rosettes.

Phys. *Cleavage* {100} perfect. *Fracture* uneven to splintery. Brittle. **H** 4–5. **G** 4.4–5.1. *Luster* vitreous to resinous. *Color* commonly yellowish brown to reddish brown; also flesh-red, pale yellow, grayish white, greenish. *Streak* pale brown, yellowish, or reddish. Translucent to opaque.

Occur.

Xenotime is a widely distributed though very minor accessory mineral of many granitic igneous and metamorphic rocks. While its presence may be suspected throughout the Piedmont Province, very few specific occurrences have been reported. It is a constituent of heavy mineral beach sands of the Coastal Plain.

Clarke County: 1. Hurst (1953, p. 247) describes zenotime from heavy mineral concentrates of saprolite overlying granitic gneiss in the immediate Athens area. A small percentage of the xenotime occurs as bright green crystals with prism facies surpressed so that the crystals appear to be stubby tetragonal dipyramids.

DeKalb County: 1. Xenotime is reported in saprolite derived from Stone Mountain quartz monzonite by Hurst (1953, p. 259).

Habersham County: 1. Xenotime crystals in heavy sand concentrates from gold placers in Nacoochee Valley are described by Smith (1854, p. 377–378).

MONAZITE

$(Ce,La,Nd,Th)PO_4$

Class Anhydrous phosphate

Cryst. Monoclinic; prismatic—2/m

Habit Commonly in small flattened crystals; the faces are often rough, striated, or uneven. Also massive granular. Monazite is a common detrital mineral.

Phys. *Cleavage* distinct {100}; well-developed basal parting. *Fracture* conchoidal to uneven. Brittle. **H** 5–5½. **G** 4.6–5.4, increasing with content of thorium. *Luster* subadamantine to resinous. *Color* yellow to reddish brown or brown. Transparent to translucent. *Streak* white to light yellow-brown.

Occur.

Monazite is a local accessory mineral in granitic igneous and metamorphic rocks of the Piedmont. It is relatively resistant to weathering and tends to accumulate with other heavy minerals. It is frequently mentioned as a constituent of heavy sands encountered during the cleanup of gold placer operations and is an important constituent of heavy mineral sands of the Coastal Plain region.

Charlton County: 1. Monazite is recovered with zircon and titanium minerals from heavy mineral sands within Pleistocene sedimentary deposits at the Folkston Mine, approximately 3 miles (4.8 km) northeast of Folkston city limits on Georgia Highway 252.

Clarke County: 1. Small grains of monazite, residual after weathered monazite-bearing granite gneiss, are plentiful in streams and drainages in and around the city of Athens (Mertie, 1953).

Coweta County: 1. Small grains of residual monazite are particularly abundant in residuum along the north side of Georgia Highway 16, 3.25 miles (5.2 km) due west of Sharpsburg (Mertie, 1953).

Crawford County: 1. Small pale-yellow to pale-brown monazite crystals are locally abundant in pegmatites in the extreme northwestern corner of the county, approximately 3 miles (4.8 km) southwest of Culloden. A euhedral monazite crystal 1 x 2 inches (2.5 x 5.0 cm) is reported from the Adams property in this general

vicinity (Fortson and Navarre, 1959, p. 1309). Selected specimens contain up to 11 percent monazite (Hurst, 1960, p. 610; discussion in *Econ. Geol.* vol. 55, no. 3).

Elbert County: 1. Small euhedral monazite crystals occur locally within Elberton Granite (Olson and Adams, 1962).

Meriwether County: 1. Small grains and crystals of monazite are particularly abundant in residual heavy mineral sands along the south side of Georgia Highway 18, 3.7 miles (5.9 km) S68°E of Greenville (Mertie, 1953).

Newton County: 1. Monazite can be panned from residual material in ditches along the old Porterdale–McDonough road, 9 miles (14 km) S66°W from Covington. Another similar occurrence along the same road is 7.8 miles (12.5 km) S64°W from Covington (Mertie, 1953).

Rockdale County: 1. A quartz sample containing approximately 5 percent monazite as yellow-brown euhedral crystals up to 0.15 inch (0.4 cm) long was submitted to the Georgia Geological Survey in 1956 from an unspecified location near Conley.

Spalding County: 1. Small grains and crystals of monazite are very abundant in gullies and ditches for several miles south of Zetella (Mertie, 1953).

VIVIANITE

$Fe^{+2}_3(PO_4)_2 \cdot 8H_2O$

Class Hydrous phosphate

Cryst. Monoclinic; prismatic—2/m

Habit Usually prismatic crystals, sometimes flattened. Also earthy and as fibrous crusts.

Phys. *Cleavage* perfect {010}, parallel to side pinacoid. Flexible in thin laminae; sectile. **H** 1½–2. **G** 2.67–2.69. *Luster* vitreous to pearly; also dull and earthy. *Color*less to pale blue or greenish blue, indigo-blue, or bluish black. *Streak* white, changing to dark blue or brown on exposure. Transparent to translucent.

Occur.

Douglas County: 1. Tabular crystals of purple vivianite lying along joint planes occur in drill core from altered wall rock at the Villa Rica massive sulfide deposit, approximately 3 miles (4.8 km) north of Villa Rica and immediately east of Georgia Highway 61.

Fannin County: 1. Shepard (1859) reports that dump material from an old shaft located on lot 239, approximately 9 miles (14 km) southwest of Copperhill, Tennessee, and 1.2 miles (1.9 km) southwest of Higdons Store contains excellent crystals of vivianite filling joint planes. Shepard states that the occurrence is quite similar to vivianite occurrences at Cornwall, England. Associated minerals are chabazite and laumontite. 2. Shepard (1859) also states that a similar occurrence of vivianite has been reported from the Mobile Copper Mine, about 3.5 miles (5.6 km) southwest of Copperhill, Tennessee, on lot 59, 9th district, 2nd section.

McIntosh County: Clay samples containing small aggregates of vivianite crystals were submitted to the Georgia Geological Survey in 1902 from the James Walker property.

Stewart County: 1. Excellent aggregates and single crystals of vivianite reaching 1.5 inches (3.8 cm) in length occur in cavities within large fossil shells weathering out of the Clayton Formation in road cuts along U.S. Highway 27, approximately 2 miles (3.2 km) north of Lumpkin.

ERYTHRITE

$Co_3(AsO_4)_2 \cdot 8H_2O$

Class Hydrous arsenate

Cryst. Monoclinic; prismatic—2/m

Habit Prismatic to acicular {001} and flattened {010}. The crystals are deeply striated or furrowed {001}, also striated on {010} parallel {h01} or {$\bar{h}$01}. Often as radial or stellate groups; in globular or reniform shapes with a drusy surface and columnar or coarse-fibrous structure; also earthy and pulverulent.

Phys. *Cleavage* {101} perfect, also {100} and {$\bar{1}$02} indistinct. Flexible in thin {010} laminae. Translation gliding with T{010}, t{001}. Sectile. **H** 1½–2½, least on {010}. **G** 3.06, 3.178 (artif.). *Luster* weakly adamantine, pearly on {010}; also dull and

earthy. *Color* crimson-red and peach-red; the color becomes paler with increasing content of Ni and is still pale rose or pale pink at Co:Ni ~ 1:1. *Streak* paler than the color. Transparent to translucent in crystals. Single crystals may show color-banding or be tipped by material of a different color.

Occur.

DeKalb County: 1. Thin purplish-pink crystals associated with nickel silicates on weathered metapyroxenite occur on Soapstone Ridge 0.5 mile (0.8 km) south of South River on Moreland Avenue. The material contains cobalt as a primary constituent and is assumed to be at least in part erythrite.

STRENGITE

$Fe^{+3}(PO_4) \cdot 2H_2O$

Class Hydrous phosphate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Crystals variable in habit; octahedral; thick to thin tabular; stout prismatic. Also as spherical and botryoidal aggregates with radial-fibrous structure and a drusy surface, and as crusts.

Phys. *Cleavage* good {010} and poor {001}. **H** 3½. **G** 2.87. *Luster* vitreous (crystals). *Color* peach-blossom red, carmine, violet; also nearly colorless. *Streak* white. Transparent to translucent.

Occur.

Bartow County: 1. Strengite occurs as tabular masses up to 0.3 inch (0.8 cm) thick. It is composed of radial clusters of acicular crystals in a matrix of limonite at the Iron Hill Mine, lots 728 and 729, 21st district, 2.7 miles (4.3 km) northeast of Allatoona (Kesler, 1950, p. 47).

PLUMBOGUMMITE

$PbAl_3(PO_4)_2(OH)_5 \cdot H_2O$

Class Hydrous phosphate

Cryst. Hexagonal—R

Habit As botryoidal, reniform, stalactitic, or globular crusts or masses, often with a concentric structure; also compact massive. The mineral may resemble drops or coatings of gum. Microscopically radial fibrous or spherulitic. Rarely as minute crystals with an hexagonal outline.

Phys. *Cleavage* none. *Fracture* of masses uneven to subconchoidal. Brittle. **H** 4½–5. **G** 4.014; 4.08 (calc.). *Color* grayish white, yellowish gray, or yellow to yellowish to reddish brown; also greenish or bluish. *Luster* dull to resinous, gum-like. *Streak* colorless to white. Translucent.

Occur.

Cherokee County: 1. A mineral whose physical and chemical properties closely match those of plumbogummite has been described from the Canton or Rich Copper Mine, lots 127, 128, 161 and 162, 14th district, 2nd section, one mile (1.6 km) south of Canton by Dana (1892, p. 1081).

CRANDALLITE

$CaAl_3(PO_4)_2(OH)_5 \cdot H_2O$

Class Hydrous basic phosphate

Cryst. Hexagonal; ditrigonal-pyramidal—3/m

Habit Usually massive; rarely as minute trigonal prisms.

Phys. *Cleavage* perfect basal. **H** 5. **G** 2.78–2.92. *Luster* of crystals vitreous; that of massive material grading from vitreous in chalcedonic types to dull and chalky. *Color* yellow, varying to yellowish white, white, and gray.

Occur.

Crandallite associated with microcrystalline wavellite occurs in very minute amounts over large areas of the Coastal Plain as a soft, dull white secondary coating on the exterior of small phosphate (carbonate fluorapatite) particles.

APATITE SERIES

$A_5(XO_4)_3(F,OH,Cl)$

A = Ca,Sr,Ba,Pb,Na,Ce,Y; X = P,As,V,Si

Class Phosphate

Cryst. Hexagonal; hexagonal-dipyramidal—6/m

Habit Crystals commonly short to long prismatic; also thick tabular with relatively large base and pyramid faces. Massive, coarse granular to compact; as fibrous crusts, earthy.

Phys. *Cleavage* basal indistinct and prismatic in traces, but varying in ease and quality. *Fracture* conchoidal to uneven. Brittle. **H** 5. **G** 3.1–3.2 for fluorapatite and chlorapatite; 2.9–3.1 for pure hydroxyl-apatite and carbonate-apatite. *Luster* vitreous to subresinous. *Color* sea-green, asparagus-green, bluish-green, grayish green; also violet blue, violet, amethystine; sometimes colorless, pale greenish white, gray, brown, various shades of red, clear blue, dark blue; also in manganoan varieties dark greek to deep blue-green. Transparent to translucent. *Streak* white. Some apatite is fluorescent in ultraviolet light, cathode rays, or X-rays; also occasionally phosphorescent and sometimes strongly thermoluminescent and triboluminescent.

Occur.

Apatite series minerals are widely dispersed throughout Georgia. Fluorapatite [$Ca_5(PO_4)_3F$] is a common accessory in many granites and pegmatites and is the dominant phosphate mineral (carbonate fluorapatite) in the potentially exploitable phosphate deposits of the Coastal Plain. Hydroxyl-apatite [$Ca_5(PO_4)_3(OH)$] is a significant but rare mineral in highly altered margins of ultramafic plutons. Chlorapartite [$Ca_5(PO_4)_3Cl$] has been identified as a constituent of some gold veins in the Dahlonega area.

Because of the complexity of possible chemical substitutions in the apatite series, few detailed studies of particular species are reported in the literature. For this reason, most occurrences described below are for the series in general unless otherwise noted.

Cherokee County: 1. Apatite occurs rather abundantly in the Amphlett Mica Mine on lot 46, Conn Creek district, 0.4 mile (0.64 km) S30°E of Conn Church. Bright green apatite associated with reddish-brown garnet is reported as an accessory mineral throughout the pegmatite. Heinrich and Jahns (1953, p. 378) report an unusual mass of pegmatite at the north end of the south cut at this deposit. This mass, approximately 4 feet (1.2 m) in diameter, was composed chiefly of garnet crystals and granular apatite with accessory beryl, columbite and pyrite. 2. Exceptional transparent crystals of light yellow hydroxyl-apatite up to one inch (2.5 cm) in diameter occur in green talc at the Verde Antique Quarry, lot 444, 15th district, 2 miles (3.2 km) southwest of Holly Springs (Mitchell *et al.*, 1943, p. 356–371). This is the finest occurrence of this mineral yet discovered.

DeKalb County: 1. Clear, greenish-yellow apatite in well formed crystals reaching one inch (2.5 cm) in length and 0.6 inch (1.5 cm) in diameter are reported from near Dunwoody (Furcron, 1948, p. 7). 2. Pale yellowish-green to colorless masses of strontium-bearing fluorapatite occur in pegmatites and associated granitic gneiss exposed in old quarries on Arabia Mountain (Cofer and Renshaw, 1953, p. 312-313). The mineral is fluorescent, thermoluminescent, and triboluminescent.

Fannin County: 1. Coarsely fibrous, columnar, and hexagonal prismatic greenish-white apatite is reported as an accessory mineral in the Mt. Pisgah copper prospect, approximately 1.2 miles (1.9 km) southwest of Higdons Store (Shephard, 1859, p. 4).

Hart County: 1. Lesure (1962, p. 13) reports light green apatite as an accessory mineral associated with garnet, pyrrhotite and beryl in the intermediate perthite–quartz zone of the pegmatite exploited at the Taylor Mica Mine. The mine is situated 1.2 miles (1.9 km) S75°W of Crossroads Church, approximately 5.3 miles (8.5 km) northwest of Hartwell.

Jasper County: 1. Slender, hexagonal apatite prisms are reported from the Appalachian Minerals Company's feldspar quarry near Monticello. The crystals are as much as 0.3 inch (0.8 cm) long and 0.2 inch (0.5 cm)

in diameter, colorless, and scattered at random through light colored gneiss (Hurst, 1956e, p. 90). 2. Light blue apatite prisms up to 4 inches (10 cm) in diameter were reportedly encountered in the feldspar mine at Enon Church, approximately 6 miles (9.7 km) south of Monticello on Georgia Highway 83 near Gladesville.

Lamar County: 1. Well-formed apatite crystals up to one inch (2.5 cm) in length exhibiting simple prisms and pinacoids are reported from the uranium-bearing pegmatite on the A. N. Moye property, 5 miles (8 km) southeast of Barnesville (Hurst, 1956e, p. 90). 2. Rare earth bearing apatite is reported by Hurst (1958b, p. 31) from pegmatites in the Barnesville area. The apatite is honey-colored to brown to reddish-brown and occurs in fractured, irregularly shaped grains up to 0.1 inch (0.25 cm) across. Semiquantitative spectrographic analysis indicates the presence of lanthanum, thulium, europium, cerium and unusual amounts of indium. 3.Light green apatite is an accessory mineral in the pegmatite exploited at the Early Vaughn Mica Mine, approximately 3 miles (4.8 km) southeast of Barnesville, 1.8 miles (2.9 km) south of U.S. Highway 41.

Lumpkin County: 1. Pardee and Park (1948, p. 43) describe a 0.6 x 0.4 x 0.2 inch (1.5 x 1.0 x 0.5 cm) chlorapatite crystal from the Battle Branch Gold Mine, lots 523, 524 and 456, 12th district. Reference is made to other apatite occurrences in Georgia gold veins but no specifics are given.

Monroe County: 1. Gray-green apatite crystals as much as one inch (2.5 cm) in diameter and 3 inches (7.6 cm) long occur in the pegmatite exploited at the Battles Mica Mine, 2.75 miles (4.4 km) N50°W of Culloden (Heinrich, Klepper and Jahns, 1953, p. 367). 2. Apatite is reported as an accessory mineral in the mica-bearing pegmatite at the Goodwin prospect, approximately 2.5 miles (4 km) due west of Forsyth and 0.25 mile (0.4 km) north of U.S. Highway 41 (Furcron and Teague, 1943, p. 69).

Oconee County: 1. Apatite and tourmaline are described as accessory minerals in the wall zones of a pegmatite at the Dickens Mica Mine near High Shoals in the southwestern corner of the county (Heinrich and Jahns, 1953, p. 388).

Putnam County: 1. Well-formed, blue-green apatite crystals up to 4 inches (10 cm) in diameter occur in the core of a large pegmatite recently exploited for white quartz, approximately 3.5 miles (5.6 km) N30°E of Rock Eagle Camp.

Rabun County: 1. Sections of sea-green, transparent to translucent apatite crystals up to 4 inches (10 cm) in diameter have been recovered from the Laurel Creek Corundum Mine, lot 72, 3rd district, about one mile (1.6 km) southwest of Pine Mountain (King, 1894, p. 57). The crystals are typically encased with phlogopite.

Upson County: 1. Small masses of pale-green apatite and spessartine occur in the wall zone of the pegmatite exploited at the Adams Mica Mine, 2.5 miles (4 km) N3°E of the main-highway–railroad crossing at Yatesville. 2. Light green, hexagonal apatite crystals occur as inclusions in muscovite at the Benny Baron or Walker Wakefield Mica Mine in the Jug district, 5.5 miles (8.8 km) S68°E of Thomaston, 0.5 mile (0.8 km) north of Gatland Church (Furcron and Teague, 1943, p. 35). 3. Light-green apatite is an accessory mineral in a pegmatite at the Blount Number One Mica Mine, approximately 5 miles (8 km) east of Thomastor (Heinrich, Klepper and Jahns, 1953, p. 348). 4. Excellent examples of apatite in yellow-green to dark-green crystals up to 2 inches (5 cm) long and 0.5 inch (1.3 cm) in diameter occur in the Mitchell Creek Mica Mine, 7.25 miles (11.6 km) S65°E of Thomaston, one mile (1.6 km) northeast of Waymansville on a small branch of Tobler Creek. Apatite is unusually abundant throughout the entire axial plane portion of the pegmatite dike. Euhedral apatite inclusions in muscovite books are locally abundant (Heinrich, Klepper and Jahns, 1953, p. 346). 5. Small, green apatite crystals occur as inclusions in muscovite books at the Charlie Nims mica prospect, 3.8 miles (6.1 km) southeast of Yatesville. 6. Small, glassy, pale-green apatite crystals are common near the border zone of the pegmatite exposed in the Joe Persons Mica Mine, 7.3 miles (11.7 km) S76°E of Thomaston, 0.2 mile (0.32 km) by road beyond the Mitchell Creek Mine. 7. Apatite is noted as a common accessory mineral in the pegmatite at the Mauldin Mica Mine, 4 miles (6.4 km) east of Thomaston and about one mile (1.6 km) off the Thomaston–Butler Highway (Furcron and Teague, 1943, p. 28). 8. Apatite occurs as an accessory mineral in the Stevens or Rock Mica Mine, 3.5 miles (5.6 km) west of Yatesville, 0.25 mile north (0.4 km) north of the Yatesville–Thomaston Highway (Furcron and Teague, 1943, p. 41).

White County: 1. Transparent light-green apatite of gem quality is reported from a road cut along Georgia Highway 17, several miles southeast of Nacoochee (Furcron, 1955, p. 77). The occurrence is in biotite gneiss containing pegmatitic granite.

PYROMORPHITE

$Pb_5(PO_4)_3Cl$

Class Chlorophosphate

Cryst. Hexagonal; hexagonal-dipyramidal—6/m

Habit Prismatic crystals; often globular, reniform, and botryoidal; granular.

Phys. *Cleavage* indistinct. *Fracture* uneven to subconchoidal. Brittle. **H** 3½–4. **G** 6.7–7.1. *Luster* resinous. *Color* dark green, yellow-green, light gray, brown, brownish red, and various shades of yellow and orange. *Streak* white. Subtransparent to translucent.

Occur.

Pyromorphite occurs locally in the crystalline Piedmont as a secondary mineral formed during the oxidation of the upper portions of galena-bearing veins. All known occurrences are related to former areas of gold or copper mining.

Cherokee County: 1. Dana (1892) mentions the occurrence of pyromorphite in ore of the Rich or Canton Copper Mine, lots 127, 128, 161 and 162, 14th district, 2nd section, approximately one mile (1.6 km) south of Canton.

Gwinnett County: 1. Pyromorphite occurs as aggregates of light tan crystals to 0.25 inch (0.6 cm) long on quartz in the Piedmont Gold Mine, lot 304, 7th district, approximately 2 miles (3.2 km) west of Buford. A specimen from this occurrence is on display in the Emory University geology museum.

Lincoln County: 1. Small pyromorphite crystals in seams or crevices in quartz are mentioned by Jones (1909, p. 252) as a rare constituent of veins in the Magruder Gold Mine, approximately 2.5 miles (4 km) east of Metasville.

Lumpkin County: 1. Pyromorphite in seams and as green coatings was locally abundant near water level in quartz veins of the Singleton Gold Mine, lots 1084, 1051 and 1085, near Dahlonega (Yeates, McCallie and King, 1896, p. 407). 2. Tiny greenish-yellow crystals and seams of pyromorphite are reported in the Battle Branch Gold Mine, lots 523, 524 and 545, 12th district, by Pardee and Park (1948, p. 43). It is quite probable that pyromorphite is a rare secondary mineral in other gold deposits of the Dahlonega district in which galena is a locally common accessory mineral below the water table.

McDuffie County: 1. Pyromorphite has been known for many years from the formerly extensive gold mining operations in the Columbia Gold Mine area. This area lies immediately east of U.S. Highway 78 and immediately south of the Little River arm of Clark Hill Reservoir (Hurst, Crawford and Sandy, 1966, p. 50). The museum in the State Capitol has on display a small pyromorphite specimen collected in the Columbia mine in 1897. The mineral is in slender yellow-green crystals in parallel aggregates on a fracture surface of iron-stained quartz. 2. An identical material was collected from the dump of the Parks Gold Mine in the same area in 1968. 3. Excellent pyromorphite crystals exhibiting cavernous skeletal growth and an intense green color occur with crystalline cerussite and barite on the dumps of the Landers Gold Mine.

LAZULITE

$MgAl_2(PO_4)_2(OH)_2$

Class Basic phosphate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals usually acute pyramidal; also massive, compact, granular.

Phys. *Cleavage* poor prismatic. *Fracture* unever. Brittle. **H** 5½–6. **G** 3.08, 3.14 (calc.). *Color* azure-blue, sky-blue, bluish white. *Luster* vitreous. *Streak* white. Subtranslucent to opaque.

Occur.

DeKalb County: 1. Herrmann (1954, p. 94) reports the occurrence of blue lazulite grains in Stone Mountain quartz monzonite at the south ledge of the Kellogg Quarry on the east side of Stone Mountain.

Lincoln County: 1. The occurrence of exceptional lazulite crystals on Graves Mountain, immediately south of U.S. Highway 378 between Washington and Lincolnton, has been known for many years. The crystals are most abundant in sericite-kyanite-quartz rock where they constitute between 1 percent and 5 percent of the bulk. Zones 1 to 2 feet (0.3 to 0.6 m) thick on the southeast side of the mountain average as much as 15 percent lazulite.

Lazulite crystals are generally distributed in a wide zone trending northeast-southwest across the mountain. They are not restricted to a single bed or group of beds, but are mainly in the silica-rich bands. They are not found in quartz veins. The crystals are pyramidal to tabular, commonly twinned, and average less

than 0.25 inch (0.6 cm) across. Exceptional crystals reach lengths of 2.5 inches (6.4 cm). Fresh crystals are dusty blue becoming azure blue, grayish-blue, or mottled blue and white upon weathering (Hurst, 1958d, p. 18).

WAVELLITE

$Al_3(PO_4)_2(OH)_3 \cdot 5H_2O$

Class Hydrous basic phosphate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Crystals rare; stout to long prismatic {001}, with {110} striated {001}. Usually as hemispherical or globular aggregates with a radial fibrous or stellate structure; also as crusts or stalactitic; rarely as chalcedonic or opaline masses.

Phys. *Cleavage* {110} perfect, {101} good, {010} distinct. *Fracture* uneven to subconchoidal. Brittle. **H** 3¼–4. **G** 2.36; 2.37 (calc.). *Luster* vitreous inclining toward pearly and resinous. *Color* greenish white and green to yellow, also yellowish brown, brown, brownish black, blue, white, colorless. *Streak* white. Translucent.

Occur.

Chattooga County: 1. Samples of iron oxide containing wavellite were submitted to the Georgia Geological Survey for analysis in 1922 from an undisclosed location near Gore. 2. Similar material was submitted from the Alexander property in 1913.

Fannin County: 1. Considerable wavellite is reported to occur with manganiferous limonite ores formerly prospected on lot 297, 8th district (Haseltine, 1924, p. 90).

Gilmer County: 1. Wavellite occurring in cavities and between layers of schist is described from the iron mine of the old Ellijay Mining Company's property on lots 84, 85 and 60, 11th district, 2nd section, on the north bank of Cartecay River, approximately 0.5 mile (0.8 m) southeast of Ellijay (Haseltine, 1924, p. 101-102).

Grady County: 1. Wavellite samples from lots 175 and 145, 18th district, near Donaldsonville, were submitted to the Georgia Geological Survey for analysis in 1927.

Polk County: 1. Compact white aggregates of radiating wavellite associated with cacoxenite occur abundantly in vuggy limonitic iron ore at the Brewer iron prospect on lots 951, 974 and 1025, 21st district, 1.25 miles (2 km) from Grady Station.

Wilkinson County: 1. Samples submitted to the Georgia Geological Survey from an undisclosed location near Toomsboro in 1930 were identified as wavellite by chemical analysis.

METATORBERNITE

$Cu(UO_2)_2(PO_4)_2 \cdot 8H_2O$

Class Hydrous phosphate

Cryst. Tetragonal; ditetragonal-dipyramidal—4/m 2/m 2/m

Habit Crystals are thin flattened tablets; often in rosettes or sheaf-like aggregates of irregularly curved and composite crystals; also as lamellar aggregates.

Phys. *Cleavage* basal perfect. Rather brittle. **H** 2½. **G** 3.7–3.8. *Luster* vitreous to subadamantine, pearly on basal plane. *Color* pale green to dark green. Transparent to translucent. Not fluorescent.

Occur.

Lamar County: 1. Small plate-like crystals of lime-green metatorbernite fill fractures and occupy cleavage planes in feldspar at a pegmatite exploited for mica on the A. N. Moye property, about 5 miles (8 km) southeast of Barnesville (Furcron, 1955, p. 42). Associated minerals are uraninite, beta-uranophane, meta-autunite and soddyite.

META-AUTUNITE

$Ca(UO_2)_2(PO_4)_2 \cdot 2\text{-}6H_2O$

Class Hydrous phosphate

Cryst. Tetragonal; ditetragonal-dipyramidal—4/m 2/m 2/m

Habit Occurs as dehydration pseudomorphs after autunite.

Phys. *Cleavage* basal perfect. **H** 2–2½. **G** 3.57 (calc. for 6½ H_2O). *Luster* pearly to dull. *Color* lemon-yellow to greenish yellow and yellowish green. Translucent to opaque in thick fragments. Fluoresces yellowish green in ultraviolet light, the color being less intense than autunite.

Occur.

Cherokee County: 1. Autunite (meta-autunite) occurs sparingly at the Amphlett Mica Mine, 0.4 mile (0.64 km) S30°E of Conn Church, 4.3 miles (7 km) S86°E of Ball Ground. It is associated with garnet, apatite, columbite and pyrite as tiny flakes coating beryl crystals (Heinrich and Jahns, 1953, p. 378).

Lamar County: 1. Meta-autunite occurs as small, yellow micaceous grains coating fractures and cleavage planes in feldspar at a pegmatite previously exploited for mica on the property of A. N. Moye, about 5 miles (8 km) southeast of Barnesville (Furcron, 1955, p. 42).

CACOXENITE

$Fe^{+3}_9(PO_4)_4(OH)_{15} \cdot 18H_2O$

Class Hydrous basic phosphate

Cryst. Hexagonal

Habit Tiny crystals acicular {0001}, sometimes with a hexagonal cross section and indistinct pyramidal faces. As tufted or radial aggregates or fibrous coatings; spherulitic.

Phys. *Cleavage* not observed. **H** 3–4. **G** 2.2–2.4, 2.26 (calc.). *Luster* silky. *Color* yellow to brownish yellow, golden yellow, reddish yellow, rarely greenish.

Occur.

Bartow County: 1. Cacoxenite occurs in small, concentrically radiating fibrous tuffs of golden color in a breccia zone at an unnamed iron prospect within lot 1124, 4th district, 2 miles (3.2 km) southwest of Emerson on the west side of Pumpkinvine Creek (Hurst and Crawford, 1970, p. 112).

Murray County: 1. Cacoxenite is reported from an iron–manganese prospect on lots 163, 165 and 196, 27th district, 2nd section, by Furcron (1960b, p. 129).

Polk County: 1. Excellent masses of golden-yellow cacoxenite tuffs occur with crystalline wavellite in several prospects on the old R. H. Brewer property, lots 951, 974 and 1025, 21st district, about 1.25 miles (2 km) from Grady Station. The minerals occur in the upper portion of a siliceous iron oxide deposit near the crest of a steep ridge.

SCHEELITE
$CaWO_4$

Class Tungstate

Cryst. Tetragonal; tetragonal-dipyramidal—4/m

Habit Octahedral crystals; also massive, granular.

Phys. *Cleavage* distinct {101}. *Fracture* uneven to subconchoidal. **H** 4½–5. **G** 5.5–6.1, decreasing with increasing substitution of Mo. *Luster* vitreous. *Color*less to white, yellowish white, pale yellow, brownish, pale green, gray, reddish, orange-yellow. *Streak* white. Transparent. Fluoresces bright bluish-white under short-wave ultraviolet radiation; the fluorescence inclines to white with increasing content of Mo.

Occur.

Cherokee County: 1. Espenshade (1950, p. 56) reports tungsten from tailings of roasted ore from the Creighton Gold Mine, lots 466 and 467, in extreme east-central Cherokee County. The geology of the Creighton gold deposit suggests that any tungsten present would be in the form of scheelite. 2. Tungsten, apparently as scheelite, is also reported by Espenshade (1950, p. 56) from tailings of the Cherokee Gold Mine, lot 428, 15th district.

Habersham County: 1. A small amount of scheelite is reported in alluvial samples collected throughout Habersham County by Hurst and Crawford (1964, p. 13). Twenty-five widely scattered locations are reported for which stream sediment samples contained scheelite.

Lumpkin County: 1. Minor scheelite is reported by Espenshade (1950, p. 56) from the Findley tunnel at the Findley Gold Mine on lots 1047, 1048 and 1087, 12th district, near Dahlonega.

McDuffie County: 1. A very small amount of scheelite occurs on the dumps of the Hamilton and Columbia Gold Mines, approximately 11 miles (17.7 km) northwest of Thompson, immediately north of U.S. Highway 78.

White County: 1. Eleven samples of alluvium from scattered locations within White County were found to contain minor scheelite (Hurst and Otwell, 1964, p. 11). A search within the drainage area of the scheelite occurrences did not reveal in-place mineralization. 2. Grains of scheelite up to 0.25 inch (0.6 cm) in diameter occur in amphibolite which has been cut by numerous calcite and quartz veins along U.S. Highway 29, 0.3 mile (0.5 km) northwest of Tesnatee Church. Associated minerals are pyrite and chalcopyrite (Hurst and Otwell, 1964, p. 14). 3. Scheelite is reported as a constituent of heavy mineral concentrate from the Loud Gold Mine, lots 39 and 40, 1st district, about 4 miles (6.4 km) southwest of Cleveland (Espenshade, 1950, p. 56).

POWELLITE
$CaMoO_4$

Class Molybdate

Cryst. Tetragonal; tetragonal-dipyramidal—4/m

Habit Usually pyramidal; also thin tabular {001}. {111} sometimes striated parallel to intersection with vertical plane {110}. Also massive, with a foliated structure pseudomorphous after molybdenite, or pulverulent to ocherous. As crusts of merged crystals.

Phys. *Cleavages* indistinct reported on {112}, {011}, and {001}. *Fracture uneven.* **H** 3½–4. **G** 4.23 ±0.02. *Color* straw-yellow, brown, greenish yellow, pale greenish blue; also dirty white to gray, blue, and nearly black (deep blue in transmitted light). *Luster* sub-adamantine on crystal faces, greasy on fracture surfaces; foliated pseudomorphous material often has a pearly luster. Transparent. Fluoresces creamy yellow to golden yellow in ultraviolet light.

Occur.

Greene County: 1. Very minor powellite inclusions in molybdenite are reported from the margins of several pegmatites exposed at an aggregate quarry in Siloam Granite, approximately one mile (1.6 km) east of Siloam, 0.5 mile (0.8 km) south of Interstate Highway 20 (Guinn, 1973, p. 81).

FERRIMOLYBDITE

$Fe_2(MoO_4)_3 \cdot 8H_2O$ (?)

Class Hydrous molybdate

Cryst. Orthorhombic

Habit Massive, as fibrous crusts and aggregates; as an earthy powder or coating.

Phys. *Cleavage* none. Very soft. **G** 3.0–4.5. *Color* canary-yellow, straw yellow, greenish yellow. *Luster* silky or earthy. *Streak* pale yellow.

Occur.

Gwinnett County: 1. Ferrimolybdite and molybdenite were reported in rock exposed during the construction of Buford Dam.

Putnam County: 1. Lemon-yellow, pulverulent ferrimolybdite coats cavity walls and molybdenite grains in a series of quartz veins and residual quartz boulders along Georgia Highway 16, immediately west of Crooked Creek. Associated minerals are pyrite and chalcopyrite.

OLIVINE GROUP

Forsterite — Mg_2SiO_4

Fayalite — Fe_2SiO_4

Class Nesosilicate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Crystals flattened, elongated. Massive, compact, or granular; in embedded grains.

Phys. *Cleavage* {010} distinct. *Fracture* conchoidal. Brittle. **H** 6½–7. **G** 3.27–3.37. *Luster* vitreous. *Color* olive green, grayish green, sometimes brownish. *Streak* uncolored. Transparent to translucent.

Occur.

The olivine minerals forsterite and fayalite are locally abundant and essential constituents of mafic and ultramafic igneous rocks of the crystalline Piedmont and Blue Ridge. Due to their high susceptibility to weathering, they are not normally recognized in outcrop. The magnesium-rich end member forsterite, is the predominant mineral in dunites of Towns and Rabun Counties, an important accessory mineral in diabase dikes, a locally important mineral in noritic intrusive rocks of the central Piedmont, and is found as remnant grains in peridotites and serpentinites.

The following occurrences are those in which olivine minerals may be found at the surface, or which are geologically significant due to the size of the olivine-bearing intrusive body or mineralogic relationships. Numerous olivine-bearing mafic and ultramafic rocks have been described by Hopkins (1914) and the economic occurrence of olivine in Georgia has been discussed more recently by Hunter and Rankin (1941).

Barrow County: 1. Excellent aggregates of coarse-grained, fresh olivine occur in an asbestos prospect on the L. M. Arnold property, approximately 1.25 miles (2 km) east of Statham. The occurrence is a small dunite that is marginally altered to various asbestos minerals. Olivine from this locality represents the coarsest-grained material in the state. Some samples contain glassy, subhedral to euhedral olivine crystals which reach a maximum dimension of 0.3 inch (0.8 cm).

Cherokee County: 1. An unusual enstatite-rich rock has been described from the W. T. Worley property, 7 miles (11 km) east of Canton, by Hopkins (1914, p. 55). Olivine occurs sporadically as aggregates of yellowish grains. Associated minerals are magnetite and amphiboles. Most olivine aggregates are entirely enclosed within exceptionally large enstatite crystals.

Cobb County: 1. A small, unusual mafic pluton has been prospected for asbestos on the J. H. Cantrell property, approximately 1.5 miles (2.4 km) south of Smyrna. Unaltered rock at this locality is composed of olivine and enstatite and is classified as harzburgite. The intrusion is approximately 100 feet (30 m) in greatest dimension (Hopkins, 1914, p. 179).

DeKalb County: 1. Olivine has been noted in thin section from ultramafic rock collected on Soapstone Ridge, approximately 0.5 miles (0.8 km) south of South River on Moreland Avenue in east Atlanta.

Fulton County: 1. Locally unaltered olivine is reported from an old asbestos prospect on the property of T. D. Longino, lot 130, Red Oak district, 1.5 miles (2.4 km) south of Red Oak (Hopkins, 1914, p. 182). Asbestos occurs where alteration of olivine-rich rock to anthophyllite has taken place.

Jackson County: 1. A locally altered peridotite dike containing up to 10 percent olivine is reported on lot 253, Newton district, approximately 4 miles (6.4 km) southeast of Nicholson (Hopkins, 1914, p. 175).

Jasper County: 1. Olivine is a locally important constituent of various units within the large instrusive complex at Gladesville, approximately 5 miles (8 km) south of Monticello. It is most abundant in olivine gabbro intersected in a Georgia Geological Survey diamond drill hole approximately 0.5 mile (0.8 km) south of the Feldspar Corporation Plant. Olivine-bearing rocks may be found over an extensive area approximately 8 miles (13 km) long and up to 3 miles (4.8 km) wide (Matthews, 1967).

Rabun County: 1. An extensive deposit of dunite is described by Hunter and Rankin (1941, p. 112) in the Lake Burton area adjacent to U.S. Highway 76, approximately 12 miles (19 km) west of Clayton. The deposit is approximately 2600 feet (792 m) long, 800 feet (244 m) wide and crops out predominantly south of the highway

along the sides and crest of a sharp ridge. 2. Marginally altered dunite crops out over an area approximately 2500 feet (762 m) by 1200 feet (366 m) on Laurel Creek, centering in lot 72, 3rd district, about one mile (1.6 km) southwest of Pine Mountain. Relatively sound, interlocking crystalline olivine makes up the central portion of the intrusion. 3. Dunite is locally exposed at the old Hicks Asbestos Mine northeast of the Laurel Creek Mine, lot 81, 3rd district. 4. Altered dunite containing irregular, locally serpentinized olivine grains is exposed on the Darnell property, 5 miles (8 km) west of Dillard, lot 56, 2nd district. 5. Locally serpentinized dunite has been prospected for asbestos on the old R. H. Lamb property, lot 188, 2nd district, 4 miles (6.4 km) northwest of Dillard (Hopkins, 1914, p. 148). The mafic intrusive body is approximately 2000 feet (610 m) long by 450 feet (137 m) wide.

Towns County: Olivine gabbro, troctolite, and altered dunites are locally exposed over an extensive area in the northern part of the county near Hiawassee and Young Harris (Hartley, 1973). 1. Deeply weathered dunite and more resistant troctolite may be observed along the shore of Lake Chatuge in the vicinity of the lower Bell Creek Corundum Mine, approximately 4 miles (6.4 km) north of Hiawassee on lot 6, 18th district, just west of Bell Scene Church. 2. Similar olivine-rich rocks are exposed in the vicinity of the Hogg Creek Corundum Mine, approximately 3 miles (4.8 km) west of Hiawassee on lot 92, 17th district. 3. Other interesting exposures of olivine rocks are described in detail by Hartley and Penley (1974).

Troup County: 1. Olivine is a locally important constituent of altered perodotite and dunite at the various chromite prospects near Louise, approximately 8 miles (13 km) north of LaGrange (Ballard, 1948).

Union County: Dunite, troctolite and other olivine-bearing rocks crop out locally along the southern portion of the Brasstown Antiform in the northeastern part of the county. Specific occurrences are given by Hartley and Penley (1974).

ANDALUSITE

Al_2SiO_5

Class Nesosilicate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Crystals terminated, nearly square prisms. Massive; sometimes radiated and granular.

Phys. *Cleavage* {110} distinct. *Fracture* uneven. Brittle. **H** 7½. **G** 3.16–3.20. *Luster* vitreous. *Color*less, gray, pink, rose-red, violet, reddish brown, green. *Streak* uncolored. Transparent to opaque.

Occur.

Andalusite is a relatively common mineral in certain metamorphic terrains; however, its occurrence within the crystalline rocks of Georgia appears to be quite limited. In addition to the two specific locations described below, the presence of andalusite was noted by Hurst, Sandy and Crawford (1966, p. 450) in alluvial samples collected at several places in Wilkes, Lincoln and McDuffie Counties during an economic study of the Central Savannah River area. The most frequent occurrence was in eastern Wilkes County along the trend of mineralization at Graves Mountain.

Baldwin County: 1. Andalusite-bearing rocks crop out over an area of several square miles in and near Milledgeville, particularly between the State Sanitarium and the Oconee River. Hurst (1956d, p. 125) reports that andalusite occurs here as both nodules and porphyroblasts. The nodules are flattened elipsoidal masses of variable size scattered irregularly through gneiss and schist. The largest are up to one foot (0.3 m) thick. The core of each nodule is granular, pale red andalusite in which a few small grains of bright blue corundum are included. THe porphyroblasts occur in biotite–muscovite–quartz schist, range in size from 0.03 to 0.3 inches (0.08 to 0.8 cm), and make up as much as 20 percent of the rock.

Lincoln County: 1. Andalusite is an accessory mineral at Graves Mountain on the southeast side of U.S. Highway 378 between Lincolnton and Washington. It occurs as small white-to-gray inclusions in lazulite crystals, approximately 100 feet (30 m) east of the highest summit, and is a minor constituent of thin flesh-colored alunite, gibbsite and pyrophyllite veinlets which transect the quartz–kyanite rock about 400 feet (122 m) from the old adit (Hurst, 1958d, p. 15). Both of these occurrences now lie within the mined out portion of the mountain.

SILLIMANITE
Al_2SiO_5

Class Nesosilicate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Commonly in long slender crystals not distinctly terminated; often in close parallel groups, passing into fibrous and columnar massive forms; sometimes radiating.

Phys. *Cleavage* {010} perfect. *Fracture* uneven. **H** 6–7½. **G** 3.14–3.24. *Luster* vitreous. *Color* hair-brown, grayish brown, grayish white, white, grayish green, pale olive-green. *Streak* uncolored. Transparent to translucent.

Occur.

Sillimanite is relatively common within the high-grade metamorphic rocks of Georgia, occurring as either an accessory mineral (var. fibrolite) in muscovite-rich schist or a relatively coarse-crystalline, essential mineral in sillimanite schist. The mineral has been investigated several times as a potentially economic source of refractory and ceramic raw materials. Extensive deposits of sillimanite schist and sillimanite-bearing muscovite schist are known in Towns, Hart, Elbert, Madison and Franklin Counties. Additional occurrences of sillimanite within metamorphic rocks have been reported from many scattered locations throughout the Piedmont.

Elbert County: Numerous minor occurrences of sillimanite (var. fibrolite) are known in Elbert County. An important zone of sillimanite schist which crosses the county in a northeasterly direction has been described for Elbert and adjacent Hart and Madison Counties by Furcron and Teague (1945).

1. Very good outcrops of sillimanite schist are exposed along a road on the north side of Deep Creek, about one mile (1.6 km) S62°E of Smiths School (Furcron and Teague, 1945, p. 17). The beds strike N30°E and are approximately 0.25 mile (0.4 km) wide. The principal zone is intruded by granite. Several other bands of sillimanite schist are included in granite on the northwest side of the major sillimanite-rich zone. 2. Excellent exposures of sillimanite schist occur along a road and near a small stream 3 miles (4.8 km) S45°E of Bowman. Outcrops dip near vertical and strike N18°E. 3. The northernmost exposures of sillimanite schist in Elbert County are along the road one mile (1.6 km) northeast of Harper. The unit strikes N40°E of this locale. Numerous iron-stained fragments of sillimanite schist litter the soil.

Franklin County: 1. Furcron (1960c, p. 19) reports that many fine exposures of sillimanite–muscovite schist are known in Franklin and Madison Counties. Sillimanite-bearing units may be observed along the road between Lavonia and Cannon, and along Georgia Highway 17 between Cannon and Royston.

Gilmer County: 1. Unusually well-developed, terminated sillimanite crystals are found on the J. H. Fowler farm, 7 miles (11 km) east of Ellijay. The crystals are gray, translucent to transparent, and 0.5 inch (1.2 cm) in length (Hurst, 1957c, p. 55).

Hart County: 1. Sillimanite (var. fibrolite) occurs as fine-grained, ivory-colored fibrous masses of tiny needles within an area extending from the southern limits of Hartwell to approximately 0.5 mile (0.8 km) south of Cedar Creek (Grant, 1958, p. 64). Chunks of fibrolite up to 1.5 feet (0.45 m) in diameter occur in the soil. These may be best seen across the road on a low ridge east of the Funkhouser Mica Plant. 2. A belt of sillimanite–graphite schist occurs near the town of Bowersville (Grant, 1958). The largest single outcrop of this unit is about 150 feet (46 m) wide and may be observed on the east side of Georgia Highway 17 inside the Bowersville city limits. The sillimanite content ranges up to 13 percent with an estimated grain size of 100–200 mesh. 3. Excellent samples of sillimanite schist may be collected along both sides of the road just northeast of North Beaver Dam Creek. 4. Outcrops of sillimanite schist may be seen near a road junction just north of Robinson Creek. The rock strikes N34°E with a float-indicated width of 600 feet (183 m) (Furcron and Teague, 1945, p. 18). 5. Good exposures of massive sillimanite schist occur on the property of Dr. Joe Jenkins near Coldwater Creek (Furcron and Teague, 1945, p. 18). 6. Sillimanite–mica schist containing large sillimanite metacrysts forms a belt passing through and terminating near Bio Church in the southern part of Elbert County. This belt enters Hart County from Madison and Elbert Counties to the south and west, and attains a width of approximately one mile (1.6 km) and a length of approximately 5 miles (8 km) within Hart County (Grant, 1958). 7. Many additional exposures of sillimanite-bearing metamorphic rocks are known within Hart County. The geologic map of this county by Grant (1958) indicates that at least 60 percent of the county is underlain by rocks having at least a minor sillimanite content.

Lamar County: Sillimanite has been noted from many outcrops of biotite gneiss within the mica pegmatite district of this county (Furcron, 1960c, p. 20).

Lincoln County: 1. Sillimanite (var. fibrolite) occurs as felted aggregates and planar concentrations in a sericite–quartz–muscovite schist, generally constituting an interlayered zone with hornblende and biotite

gneisses, in the extreme northeast corner of the county where Broad River, Pistol Creek, and Newford Creek join the Savannah River. The sillimanite-bearing zones average about 100 feet (30 m) in width and are continuous for at least 1.5 miles (2.4 km). An increase in sillimanite content is usually accompanied by an increase in magnetite content (Hurst, Crawford and Sandy, 1966, p. 57). 2. A zone of sillimanite-bearing rocks interlayered with hornblende and biotite gneisses has been mapped along Fishing Creek near Georgia Highway 79 (Hurst, Crawford and Sandy, 1966, p. 57).

Madison County: The belt of sillimanite-bearing schist previously described in Elbert and Hart Counties crosses the central part of Madison County between Comer and Carlton.

1. Furcron and Teague (1945, p. 17) report that the southern terminus of this belt appears to be near the point where it crosses Georgia Highway 36, 2.4 miles (3.9 km) east of the highway intersection in Comer. South of Georgia Highway 36 and the south branch of Broad River, sillimanite crystals become highly altered to sericite, and the trend gives way to granite outcrops to the southwest in Oglethorpe County. 2. Sillimanite-bearing schist is exposed at the road junction 3 miles (4.7 km) N74°E of Comer (Furcron and Teague, 1945, p. 17). 3. Sillimanite-bearing schist striking N27°E crosses the road on the north side of Holley Creek, 1.5 miles (2.4 km) west of Broad River (Furcron and Teague, 1945, p. 17). Two other zones, separated by granite, occur in the belt northwest of this locality.

Monroe County: Sillimanite is a common accessory mineral in the biotite gneiss country rock of the pegmatite district in Monroe County.

Paulding County: 1. A thin band of sillimanite-quartz-muscovite schist bounded by, and parallel to, layers of garnet-mica schist, hornblende gneiss and altered rocks has been described from the southeastern part of Paulding County by Hurst and Crawford (1970, p. 152). Sillimanite prisms as large as 1 x 0.5 x 0.25 inch (2.5 x 1.2 x 0.6 cm) comprise 20–40 percent of portions of this unit. Residual boulders of radiating fibrous sillimanite are up to 3 feet (1 m) in diameter. The schist is partly kyanitic.

Towns County: A zone of sillimanite-bearing muscovite schist has been described from Towns County by Furcron and Teague (1945, p. 23–27). The general strike of the sillimanite-bearing zone is N40°E with a dip generally steep to the southeast. The zone continues northeastward from Davy Mountain into Macon County, North Carolina.

1. Residual sillimanite and crystals of blue kyanite occur in the road near an abandoned home site in the valley of Winchester Creek. These crystals are derived from an approximately 45-foot (13.7 m) wide zone of muscovite-quartz schist (Furcron and Teague, 1945, p. 26). 2. Northeast of the above locality and on the northeast side of Hunter Knob, a 100-foot (30 m) thick zone of muscovite-quartz-sillimanite schist containing a small amount of graphite is exposed in a country road. Sillimanite is distributed throughout this zone and locally constitutes lenses up to 4 inches (10 cm) thick (Furcron and Teague, 1945, p. 26). 3. Sillimanite-bearing schist may be found along the abandoned highway southwest of Brasstown Church, in the churchyard, and in the highway cut northeast of the church (Furcron and Teague, 1945, p. 26–27). 4. Numerous exposures of sillimanite schist are along the North Carolina–Georgia state line in the vicinity of Davy Mountain. More accessible portions of the zone at Davy Mountain extend from the gap near the state line northeastward to Kimball Gap (Furcron and Teague, 1945, p. 27).

Union County: 1. Watson (1912, p. 241–244) describes an occurrence of native gold and sillimanite associated with a pegmatite at a location 4 or 5 miles (6.4 or 8 km) south of Blairsville.

Upson County: Sillimanite is a common accessory mineral in gneiss surrounding and making up the host rock of the well-known pegmatite district of Upson County.

White County: 1. Numerous samples of hard compacted fibrolite have been found in the gold placers of Nacoochee Valley a few miles south of Helen. 2. White, yellow, and brown masses of fibrolite can be collected from the surface and from a road cut approximately 9.1 miles (14.6 km), by road, southeast of Cleveland (Hurst and Otwell, 1964, 0. 92). 3. A belt of sillimanite-bearing schists 1.5–2 miles (2.4 to 3.2 km) wide strikes N60°E across the southeast portion of the county. The sillimanite occurs as fine needles, small knots, and silky coatings on quartz and slippage surfaces. Occasionally large but poorly formed crystals are found (Hurst and Otwell, 1964, p. 65).

KYANITE

Al_2SiO_5

Class Nesosilicate

Cryst. Triclinic; pinacoidal—$\bar{1}$

Habit Long bladed crystals and coarsely bladed columnar to subfibrous.

Phys. *Cleavages* {100} perfect and {010} good. **H** varies from 4 to 7 depending on direction. **G** 3.56–3.67. *Color* blue, green. *Streak* uncolored. Translucent to transparent. Pleochroism distinct in colored varieties.

Occur.

Kyanite is one of the most widely distributed, metamorphic rock-forming minerals within the crystalline rocks of Georgia. Its relative resistence to weathering makes it a common constituent of heavy mineral concentrations. Four types of kyanite occurrences have been described. The first, and currently most economic, is that of small kyanite crystals thickly disseminated in quartzite as exploited by C. E. Minerals at Graves Mountain, Lincoln County.

Perhaps the best known kyanite occurrence to mineral collectors is that of aggregates of coarse, intergrown crystals of blue, gray, or blue-striped color associated with quartz pods or pegmatite. A third occurrence is that of massive kyanite resembling the variety imported from India. The last type of occurrence is kyanite-bearing muscovite and muscovite–biotite schists. Occurrences of this last type are particularly abundant in Habersham and Rabun Counties.

Specific localities described below are those for which at least some reconnaissance field work has been conducted by geologists whose data have been published by either state or federal agencies. Numerous additional occurrences for which inadequate data are available are known throughout the crystalline Piedmont and Blue Ridge.

Banks County: 1. Unusually clear, blue kyanite crystals occur abundantly in vermiculite and associated sericite on the Thurmond Standridge property, about 4.5 miles (7 km) east of Lula (Furcron, 1960c, p. 17).

Cherokee County: 1. A quartz vein containing well crystallized kyanite has been prospected discontinuously for a distance of about 500 feet (152 m) at a location 3.5 miles (5.6 km) west-southwest of Ball Ground (Prindle *et al.*, 1935, p. 25). 2. A belt of schist containing large kyanite masses occurs in the northeastern portion of Cherokee County (Furcron and Teaque, 1945). Lumps of massive kyanite are common in soil from the Pickens County line near the road to Four Mile Church southward for approximately 2 miles (3.2 km). 3. Additional occurrences of massive kyanite are reported by Furcron and Teague (1945) from the vicinity of Shilo, Conn, and Sharp Mountain Churches.

Cobb County: 1. Quartz–kyanite schist occurs in disconnected bands in northeastern Cobb County southwest of the Fulton County line and northeast of Marietta (Hurst, 1956). 2. Microscopic kyanite crystals are abundant in wall rock of the Marietta Pyrite Mine, about 2.5 miles (4 km) southwest of Marietta (Shearer and Hull, 1918, p. 137).

Dawson County: 1. Boulders of residual massive kyanite occur in soil over an area approximately one square mile, 2 miles (3.2 km) south of Afton (Furcron and Teague, 1945). 2. Numerous other scattered occurrences of massive kyanite are reported from Dawson County, particularly from the vicinity of Emma, Junio, and along Georgia Highway 53 in the central portion of the county. 3. The occurrence of massive "india-type" kyanite in Georgia was first noted on the property of A. J. Elkins in the extreme western part of Dawson County.

Fannin County: 1. Excellent samples of crystalline blue kyanite occur at numerous prospects on the south slope of Hogback Mountain. 2. A small amount of prospecting for blue crystalline kyanite was conducted many years ago on the P. H. Thomas property, approximately 1.5 miles (2.4 km) northwest of Hogback Mountain (Prindle *et al.*, 1935, p. 21). 3. Excellent kyanite crystals in vein quartz have been prospected in the Boardtown Creek vicinity, 4 miles (6.4 km) southwest of Blue Ridge (Prindle, 1935, p. 22). Most prospecting has been confined to the Frank Bailey property. 4. Prindle *et al.*, (1935, p. 22) describes several northeast-trending beds of rock containing local masses of well crystallized kyanite 4 to 6 miles (6.4 to 9.7 km) north of Blue Ridge, on the west side of Hot House Creek Valley. 5. Hurst (1955a, p. 34–35) describes abundant kyanite within the Hughes Gap Formation in the Mineral Bluff Quadrangle. Abundant kyanite occurs along the east side or top of the formation where a 3-foot (1 m) thick band of quartz-kyanite schist locally contains aggregates of randomly oriented, blue-bladed kyanite crystals from 1 to 4 inches (2.5 to 1.0 cm) long. One such occurrence is 600 feet (183 m) southeast of Union and about 0.25 mile (0.4 km) northeast of where the kyanite-bearing unit crosses Mill Creek.

Fulton County: 1. Residual kyanite marking a zone of kyanite–garnet–muscovite schist is reported by Crickmay (Prindle, *et. al.*, 1935, p. 36-37) on the property of T.M. Carter, lot 35, 17th district, near Dunwoody. 2. Small kyanite crystals ranging up to 0.2 inch (0.5 cm) in length are exposes at the Johns Creek Bridge on Parsons Road, lot 279, 1st district, about 7 miles (11 km) southeast of Alpharetta (Furcron, 1960, p. 16).

Habersham County: One or more extensive belts of kyanite-bearing schist extend in an arcuate pattern from south-central Habersham County through central Rabun County. Residual and saprolitic material has been mined for kyanite at several places along these belts. The kyanite-bearing rocks are designated as the

Garnet-Aluminous Schist Member of the Tallulah Falls Formation by Hatcher (1971) and generally outline the Tallulah Falls dome or nappe. The extremely widespread nature of the kyanite-bearing unit makes description of individual properties beyond the scope of this publication. Details of former mining activities and distribution of residual kyanite may be found in publications by Prindle *et al.* (1935), Furcron (1960c), and Hurst and Crawford (1964). Locations for exceptional specimens of kyanite worthy of display or mineralogic study are presented below.

1. Unusual coarse aggregates of bright blue kyanite crystals occur in a prospect pit along the crest of a small ridge 4,000 feet (1219 m) S35°E of Wikles Store on Georgia Highway 197 (Hurst and Crawford, 1964, p. 93). 2. Unusual and attractive samples of clear and blue kyanite in pegmatite may be obtained from the north crest of Alec Mountain near Georgia Highway 17, immediately east of Amos Creek (Hurst and Otwell, 1964, p. 109). 3. Exceptional blue striped kyanite crystals in pegmatite and in massive aggregates may be obtained from several prospects approximately 0.5 mile (0.8 km) north of Georgia Highway 197 near Bethlehem Church (Hurst and Crawford, 1964, p. 114). 4. Kyanite blades up to 4 inches (10 cm) in length occur abundantly in the vicinity of prospect pits located approximately 3 miles (4.8 km) north of Clarkesville and 2000 feet (610 m) northwest of Genes Food Store (Hurst and Crawford, 1964, p. 119). 5. Aggregates of large, blue-striped kyanite crystals occur loose in soil along a county road approximately 3 miles (4.8 km) east of Hollywood and 0.5 mile (0.8 km) south of Liberty Creek (Hurst and Crawford, 1964, p. 119).

Haralson County: 1. Thin layers of kyanitic schist are interbedded with garnet-kyanite-quartz schist and mica schists in the southeastern corner of Haralson County (Hurst and Crawford, 1970, p. 152). Sericite pseudomorphs after kyanite up to 3 inches (7.6 cm) long are locally abundant. Gray-to-bluish kyanite blades are scattered in the residuum.

Lincoln County: 1. Kyanite is currently mined at Graves Mountain, a large monadnock of kyanite-quartz rock, immediately south of U. S. Highway 378 a short distance west of Lincolnton. An estimated 10 percent of the coarse-grained rock underlying this mountain is kyanite (Hurst, 1959, p. 17). Wide zones reportedly contain 20 to 40 percent kyanite. Kyanite typically occurs as small, poorly-formed porphyroblasts in quartzite. In coarse-grained rocks near the top of the mountain, kyanite is subhedral to euhedral in single crystals or groups partly disseminated through the rock but mainly concentrated along fracture planes. The margins of quartz veins are marked by conspicuous concentrations of coarse kyanite. Fresh kyanite is pale blue except in lazulite-rich zones where it may be colorless to pale green. Weathered kyanite blades are various shades of brown and red. Collecting at this locality is by permission only. 2. Kyanite, similar to that currently mined at Graves Mountain, occurs in a quartzose zone at least 150 feet (46 m) and 1200–1400 feet (366–427 m) long on the Claude Rhodes property, 7 miles (11 km) southeast of Lincolnton, one mile (1.6 km) southeast of Kenna, and east of Georgia Highway 220 Spur (Hurst, Crawford and Sandy, 1966, p. 297). Coarse-bladed masses of kyanite and coarsely crystalline pyrophyllite in approximately equal abundance are dominant in the residuum. 3. A similar occurrence of kyanite-bearing, quartz-rich metamorphic rock is 2 miles (3.2 km) N70°E of Metasville on the M. G. and J. J. Dorn property (Hurst, Crawford and Sandy, 1966, p. 296).

Lumpkin County: Kyanite crystals up to 3 inches (7.5 cm) in length are reported from the bottom of two shoots in the Battle Branch Gold Mine, lots 523, 524 and 456, 12th district (Pardee and Park, 1948, p. 42).

Pickens County: 1. Coarsely crystalline kyanite has been prospected immediately southeast of Harmony School, approximately 2 miles (3.2 km) northwest of Tate (Prindle *et al.*, 1935, p. 24). 2. Coarsely crystalline kyanite occurs as boulders in residuum immediately southeast of Refuge Church on the south side of the road leading to Tate (Prindle *et al.*, 1935, p. 24). 3. Massive kyanite occurs in a belt extending from Federal School due south to the Cherokee County line in the southeast corner of the county (Furcron and Teague, 1945). 4. An arcuate band of massive kyanite in residuum extends from near the Pickens-Cherokee county line northward to approximately one mile (1.6 km) south of Marble Hill (Furcron and Teague, 1945). 5. A northwest-trending belt marked by residual boulders of massive kyanite extends for approximately 2 miles (3.2 km) immediately east of and parallel to Long Swamp Creek, approximately 4 miles (6.4 km) southeast of Jasper (Furcron and Teague, 1945). 6. An approximately 0.5 square mile area midway between Hendrix and Sharp Top Mountains is marked by residual boulders of massive kyanite (Furcron and Teague, 1945). 7. A small area containing residual boulders of massive kyanite is immediately south of Sharp Top Mountain (Furcron and Teague, 1945). 8. A single occurrence of massive kyanite is reported from the extreme northern part of the county, 6 miles (9.7 km) due north of Jasper (Furcron and Teague, 1945).

Rabun County: The extensive kyanite-bearing schists previously described for Habersham County extend into Rabun County. Individual exposures and residual concentrations of kyanite are far too numerous to specifically describe. The kyanite-bearing units enter the county from the south immediately west of Oakey Mountain, trend in a northeast direction to the vicinity of Powell Gap School, continue in this direction to Liberty School, turn southeast and terminate immediately east of Tiger. The kyanite-bearing units

conform to the Garnet–Aluminous Schist Member of the Talullah Falls Formation, generally bounding the Tallulah Falls dome or nappe (Hatcher, 1971). Details of specific occurrences and former prospecting for economic kyanite within these belts are given by Prindle *et al.* (1935) and Furcron (1960c).

Talbot County: 1. Kyanite-bearing schist and massive kyanite aggregates associated with quartz veins occur on lot 99, 23rd district, on property owned by S. W. Woodall of Woodland. The property is in a small valley 0.25 mile (0.4 km) south of Hogan Mountain (Prindle *et al.*, 1935, p. 33). The kyanite-bearing schist occupies a zone about 200 feet (61 m) stratigraphically above the Manchester Formation and is about 30 feet (9 m) thick. 2. Aggregates of coarsely crystalline kyanite are reported from the Garrett property on the south side of Oak Mountain, lot 155, 22nd district. The property is 9 miles (14 km) west of Woodland and 5 miles (8 km) southeast of Shiloh (Furcron, 1960c, p. 15).

Towns County: 1. Coarsely crystalline kyanite associated with quartz veins has been prospected by the A. C. Spark Plug Company on the northeast spur of Gumlog Moutain in the extreme western portion of the county, approximately 6 miles (9.7 km) northwest of Young Harris.

Union County: 1. The previously described occurrence on Gumlog Mountain in Towns County extends into Union County. Extensive prospecting by the A. C. Spark Plug Company has been conducted in this area. Tourmaline and corundum are associated with the coarsely crystalline kyanite (Prindle *et al.*, 1935, p. 22). 2. Coarsely crystalline aggregates of blue-bladed kyanite occur in the general area of Akin Mountain (Prindle *et al.*, 1935, p. 22). Excellent samples may be obtained south of the road 0.5 mile (0.8 km) east of Akin Mountain. Other localities are along the north base of the hill extending from Akin Mountain to Willscot Mountain (Furcron, 1960c, p. 15).

Upson County: 1. Excellent samples of kyanite in stout prisms which average 1.2 inches (3 cm) long, 0.3 inch (0.8 cm) wide and 0.2 inch (0.5 cm) thick occur with staurolilte and garnet in soil on the Dolly Cherry property, lot 38, 16th district, 3.5 miles (5.6 km) southwest of Thomaston. The crystals are typically deep blue in color, gemmy in character, and commonly are bent or crinkled into small folds. An excellent description of this property has been presented by Ingram (1950, p. 85). 2. Kyanite crystals in soil overlying the Manchester Schist are reported by Crickmay (Prindle *et al.*, 1935, p. 34) from the property of M. Richardson, on the west slope of Pine Mountain about 1 mile (1.6 km) north of Crest. The crystals are partly coated with flakes of muscovite and graphite, have a nearly square cross section, and average 2 inches (5.0 cm) in length and 0.5 inch (1.2 cm) in width. Practically all of the kyanite appears to be restricted to local quartz veins which are sparsely distributed through the schist. 3. A similar occurrence has been noted on lot 148, 15th district, approximately 0.5 mile (0.8 km) east of the Richardson residence (Furcron, 1960c, p. 15). 4. Residual crystals of kyanite are found at the surface 0.5 mile (0.8 km) west of Crest on the western half of lot 180, 15th district, on property owned by George B. Smith (Furcron, 1960c, p. 15). 4. Abundant concentrations of kyanite are reported in schist-gneiss migmatite in road cuts along Route 19 just north of the Goat Rock Fault (Clarke, 1952, p. 89). Exposures are deeply weathered, and kyanite has been altered almost entirely to a white clay mineral.

Wilkes County: 1. Kyanite occurs for an intermittent outcrop length of about 1 mile (1.6 km) on the property of Christine Freeman, formerly the Wingfield Plantation, along Georgia Highway 80, 6.2 miles (10 km) S33°E of Washington (Johnston; in Prindle *et. al.*, 1935, p. 30). The kyanite is in quartz-sericite schist which ranges from almost pure quartzite or kyanite-quartzite to kyanitic quartz-sericite schist. The zone strikes N60–65°E, dips steeply to the northwest, and is concordant with the enclosing schists and gneisses. The width of the zone is 20 to 80 feet (6 to 24m). Rutile is a common but minor accessory mineral. Pyrophyllite is intimately associated with the kyanite but does not occur in discrete veins as at Graves Mountain.

STAUROLITE

$(Fe,Mg,Zn)_2Al_9Si_4O_{23}(OH)$

Class Nesosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals short prismatic; cruciform twins common, with angles between crystals commonly near 60°; 90° twins and multiple twinning less common.

Phys. *Cleavage* distinct {010}. *Fracture* subconchoidal. Brittle. **H** 7–7½. **G** 3.65–3.77. *Luster* resinous. *Color* dark reddish brown to brownish black. *Streak* uncolored to grayish. Translucent.

Occur.

Staurolite is a widespread and locally important rock-forming mineral. Its primary occurrence is confined to regionally metamorphosed rocks of relatively high grade. There are numerous occurrences where residual staurolite crystals may be found in soil overlying such rock units, particularly in Fannin, Cherokee, Pickens and Gilmer Counties. Several occurrences within these counties are noted for outstanding examples of well-formed crystals and unusual twin habits. Staurolite is also an important constituent of several heavy sand concentrate operations within the southeastern Coastal Plain. Staurolite also occurs within the altered wall rock of several massive sulfide deposits in west-central Georgia such as the Little Bob in Paulding County and the Villa Rica in Douglas County.

Cherokee County: There are numerous staurolite occurrences south and west of Ball Ground. 1. Abundant staurolite crystals occur along the road on the east side of Sharp Mountain Creek, approximately one mile (1.6 km) west of Fairview Church, approximately 1.7 miles (2.7 km) north of Ball Ground. 2. Excellent, though small, staurolite crystals occur on the farm of J. M. Spear on the north side of Bluff Creek, 4.5 miles (7.2 km) west of Ball Ground. 3. Staurolite crystals may be panned and collected from residuum at a number of commercial mineral hunting grounds in the Ball Ground vicinity.

Fannin County: Schists containing large staurolite crystals are widely distributed in northeast-trending belts through Fannin County. The geologic map of the Mineral Bluff Quadrangle by Hurst (1955a) shows two such belts and delineates zones in which staurolite is particularly abundant. Staurolite-bearing schists within this quadrangle are restricted to the Dean and Hughes Gap Formations of Precambrian age. The staurolite crystals vary in number, size, and color from bed to bed. The usual color, where they are not altered, is dark red-brown to almost black. They are mostly 1.5 to 2 inches (3.8 to 5 cm) long and 0.4 to 0.75 inch (1 to 2 cm) thick.

1. Excellent twinned and single staurolite crystals may be found on the farm of J. Fred Hackney, approximately 2.5 miles (4 km) northeast of Blue Ridge. 2. Well-formed, large staurolite crystals occur loose in the soil on the E. D. Richards property, approximately 0.5 mile (0.8 km) northwest of Mineral Bluff. 3. One of the finest staurolite occurrences in Georgia is approximately 0.8 mile (1.3 km) west of Coles Crossing, approximately 2.5 miles (4 km) north of Mineral Bluff. 4. Approximately 1.5 miles (2.4 km) north of Mineral Bluff on the C. S. Ray property, excellent staurolite crystals may be found loose in the soil and in a sericite schist matrix. 5. Exceptional, brownish-red, translucent staurolite crystals up to 2 inches (5 cm) long occur in a narrow northeast - trending zone approximately 4 miles (6.4 km) southwest of Epworth. Garnet crystals up to 5 inches (12.7 cm) in diameter and including gemmy staurolite crystals occur locally within this zone.

Hart County: 1. An elliptical, north-trending zone of staurolite schist is approximately 4 miles (6.4 km) east of Royston and centers near the crossroads community of Gold Mine (Grant, 1958). Staurolite crystals up to 1.5 inches (3.8 cm) in length may be found in residuum overlying this unit, though their abundance is not as great as in the previously described occurrences of Fannin County.

Upson County: 1. Exceptional staurolite crystals associated with deep blue kyanite occur in soil on the Dolly Cherry property, lot 38, 16th district, 3.5 miles (5.6 km) southwest of Thomaston. Crystals at this occurrence are up to 3.5 inches (8.9 cm) in length. Most crystals are single though 60° twins are not uncommon. The color of the staurolite is a somewhat unusual brownish-red to blood-red with smaller crystals being translucent to transparent (Ingram, 1950, p. 85).

Warren County: 1. Mica schist containing small, euhedral staurolite crystals is exposed over a 0.5 mile (0.8 km) zone adjacent to the margins of a porphyritic granite northeast of Norwood (Crawford, Hurst and Ramspott, 1966, p. 5). 2. Staurolite schist of similar character is abundant as float where the Little River Series is exposed in the panhandle of Warren County, about 15 miles (24 km) southeast of the above location (Crawford, Hurst and Ramspott, 1966, p. 5).

TOPAZ

$Al_2SiO_4(F,OH)_2$

Class Nesosilicate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Crystals commonly prismatic. Also columnar, coarse or fine granular.

Phys. *Cleavage* perfect basal. *Fracture* subconchoidal to uneven. Brittle. **H** 8. **G** 3.5–3.6. *Luster* vitreous. *Color*less, white, pale blue, pale green, yellow, brown, pink. *Streak* uncolored. Transparent to translucent.

Occur.

Cobb County: 1. Furcron (1952, p. 59) reports that Mr. L. V. Webb found a portion of a clear topaz crystal on Kennesaw Mountain during a Georgia Mineral Society Field Trip on January 20, 1952.

Lumpkin County: 1. Galpin (1915, p. 157) mentions a very perfect topaz crystal found in a vug at the Williams Mica Mine, approximately 9.5 miles (15 km) north-northwest of Dahlonega, 20 yards (18 m) east of the Cooper Gap road. It is reported that this crystal was cut and placed on exhibit in the museum of the Georgia State Capitol. 2. At least one large topaz was found prior to 1871 in a gold placer along the Etowah River above Palmers Mill. The notes of W. S. Yeates, former State Geologist, indicate that this sample weighed about 2 pounds (0.9 kg) and was sold by a little boy for 10 cents. The stone was sent to Philadelphia and sawed in half, one half being made into jewelry and the other held by Colonel Vernom of Talbot County. The uncut half passed into the hands of Judge A. Rudolph of Gainesville, Georgia. This specimen was once on loan to Hiram College in Ohio as an example of topaz.

GARNET GROUP

Alamandine — $Fe^{+2}_3Al_2(SiO_4)_3$
Grossular — $Ca_3Al_2(SiO_4)_3$
Pyrope — $Mg_3Al_2(SiO_4)_3$
Spessartine — $Mn_3Al_2(SiO_4)_3$

Class Nesosilicate
Cryst. Isometric; hexoctahedral—4/m $\bar{3}$ 2/m
Habit Crystals usually dodecahedrons or trapezohedrons. Often in irregular embedded grains. Also massive, coarse or fine granular.
Phys. *Cleavage* none but shows occasional parting. *Fracture* conchoidal to uneven. Often brittle. **H** 6.5-7.5. **G** 3.15-4.3. *Luster* vitreous to resinous. *Color* red, brown, yellow, white, green, black; often bright. *Streak* white. Transparent to subtranslucent.
Occur.

The garnet group is an exceedingly widespread family of minerals in both metamorphic and igneous rocks. Various members are common, locally in large crystals, in metamorphosed mafic rocks and have been found in well-formed crystals at numerous pegmatites previously exploited for mica. Most Georgia occurrences are described simply as garnet, or else the description shows that they contain molecules of more than one member. For these reasons, garnet group species are not described separately, although identification is retained if given by the original authors. The most interesting examples of the many known occurrences are given below.

Cherokee County: 1. An unusual garnet exhibiting only {100} and {111} (cube and octahedron) forms is reported from an unspecified location between Canton and Ball Ground (Hurst, 1956a, p. 19). The crystal is approximately 0.8 inch (2 cm) in diameter, dark red, and of gem quality. Its index of refraction is 1.802 and unit cell dimension is 11.59 Å. The crystal is identified an almandine. 2. Well-formed garnet crystals are locally abundant in pegmatites exploited at the Amphlett Mica Mine, lot 64, Conn Creek district, 0.4 mile (0.64 km) S32°E of Conn Church. A superb, brown 2-inch (5 cm) trapezohedron from this mine is in the museum of the Georgia State Capital. 3. Irregular granular masses of light purple-pink garnet weighing up to 2 pounds (0.9 kg) have been found on the Kellog property, lot 113, 21st district.

Cobb County: 1. Somewhat weathered though well-formed garnets up to 1.5 inches (3.8 cm) in diameter have been found on the Phillips property near Antioch Church close to the Paulding County line.

Coweta County: 1. Relatively fresh garnet crystals up to 2 inches (5 cm) in diameter have been found on the Harvey Neill Farm, Route 2, Senoia. The location is known as the old J. P. Morgan place and is approximately one mile (1.6 km) northwest of town.

DeKalb County: Garnet is locally abundant as granular segregations and in pegmatites in Lithonia Gneiss quarried at numerous places in the county. 1. Almandine segregations, apparently resulting from convective currents, have been described from Arabia Mountain and Little Stone Mountain by Lester (1939, p. 841). Excellent almandine crystals up to 2 inches (5 cm) in diameter have been found in pegmatites on Arabia Mountain.

Douglas County: 1. Rock composed of approximately 50 percent garnet crystals up to 0.5 inch (1.3 cm) in diameter occurs northeast of the main working of the Villa Rica or Sulphur Mining and Railroad Company

Pyrite Mine, approximately 3 miles (4.8 km) north-northeast of Villa Rica, adjacent to Georgia Highway 61. Small garnet crystals, presumed to be grossular, are described in ore from this mine by Shearer and Hull (1918, p.93). Recent work has shown that these garnets are complex, consisting of approximately 66 percent almandine and 34 percent pyrope (Cook, 1970, p. 56).

Fannin County: 1. Exceptional modified dodecahedra of almandine occur in soil over the Hughes Gap Formation, approximately 3 miles (4.8 km) southwest of Epworth. Crystals locally are of gem quality and reach 1.5 inches (3.8 cm) in diameter. Most crystals contain euhedral inclusions of transparent brown staurolite. Similar garnet crystals reaching 5 inches (12.7 cm) in diameter occur in soil approximately 4 miles (6.4 km) southwest of Epworth in the vicinity of Higdons Store. 2. Crystals of grossular (essonite) are reported from an unspecified location in the county by McCallie (1910, p. 123).

Fayette County: 1. Masses of light pink anhedral garnet weighing up to 5 pounds (2.3 kg) have been found on the J. E. Atkinson property near Fayetteville.

Fulton County: 1. Massive pink garnet has been reported from the Eva B. Wilson Farm. Samples of this material are on display in the museum of the Georgia State Capitol.

Habersham County: 1. Weathered garnet crystals up to 3 inches (7.6 cm) in diameter occur in soil at the old asbestos and corundum prospects approximately 2,000 feet (610 m) north-northeast of Wikles Store on Georgia Highway 197 (Hurst and Crawford, 1964, p. 88). 2. Irregular weathered masses of garnet up to 3 inches (7.6 cm) in diameter occur along a country road between Batesville and Piedmont Orchards, about 1200 feet (366 m) south of Cove Branch. Most of the masses show no crystal faces. Some garnets contain small sunbursts of black tourmaline (Hurst and Crawford, 1964, p. 103).

Hall County: 1. Massive spessartine in veins up to 3 feet (0.9 m) wide were prospected with W.P.A. labor on the Homer Landford property, approximately 8 miles (13 km) east of Gainesville near Tadmore School. 2. Similar vein-like occurrences of massive spessartine were prospected with W.P.A. labor on the Tom Randolph property, 9 miles (14.4 km) east of Gainesville, 3 miles (4.8 km) south of Gillsville.

Jasper County: 1. Aggregates of loosely consolidated, well-formed, trapezohedral garnet crystals up to 0.8 inch (2 cm) in diameter occur in pegmatites exploited at several of the operating and abandoned feldspar mines at Gladesville, approximately 7 miles (11 km) southwest of Monticello.

Lincoln County: 1. Small, pink spessartine garnet crystals occur with gahnite in chlorite–sericite schist in and adjacent to mineralized zones at the Magruder Gold Mine in the extreme western part of the county, approximately 2.5 miles (4 km) east of Metasville (Cofer, 1953, p. 309).

Lumpkin County: 1. Well-formed, dark-red garnet dodecahedra up to 0.5 inch (1.3 cm) in diameter occur in quartzitic schist along a ridge approximately 0.25 mile (0.4 km) northwest of the Chestatee River, 1.75 miles (2.8 km) below its junction with Tesnatee Creek. 2. Small masses of gem quality red garnet are reported from near Porter Springs by McCallie (1910, p. 123). 3. Bright red, well-developed almandine crystals occur in veinlets which cross-cut foliation and are closely associated with ore in the Battle Branch Gold Mine, lots 457 and 524, 12th district, approximately 2 miles (3.2 km) south of Auraria (Pardee and Park, 1948, p. 42). 4. Locally gem quality almandine crystals occur in saprolite overlying schists near Dahlonega (Richard, 1911, p. 1135).

Oconee County: 1. Well-formed, trapezohedral garnet crystals up to 2.5 inches (6.4 cm) in diameter occur in soil near the Branch mica prospect, 1.25 miles (2 km) southwest of Bishop.

Paulding County: 1. Perhaps the best known garnet specimen location in Georgia is on the ridge known locally as Garnet Hill, lot 673, approximately 3 miles (4.8 km) northwest of Hiram and immediately south of the Little Bob Pyrite Mine. Weathered garnet crystals up to 4 inches (10 cm) in diameter displaying simple dodecahedral form occur loose in soil derived from chlorite and amphibole schists. Numerous prospects for abrasive garnet are on the north side of the ridge. Crystals up to one inch (2.5 cm) in diameter containing gem zones can be found in partially weathered chlorite schist within and on the dumps of these prospects. Similar garnet occurrences are along strike from this location, particularly to the southwest. Beautiful, pure deep-red crystals, largely flawless and reaching as much as 0.5 inch (1.3 cm) in diameter, are reported in the vicinity of the Little Bob Pyrite Mine by Sinkankas (1959, p. 284). 2. Very fine, dark red almandine crystals of facet grade occur loose in the soil at an unspecified point 6 miles (9.7 km) southeast of Dallas (Sinkankas, 1959, p. 284). Extremely deep-red, flawless stones up to 10.54 carats have been cut from this material. 3. Weathered garnet crystals up to one inch (2.5 cm) in diameter occur on the dumps and in soil near the Askew pyrite prospect, lot 166, 3 miles (4.8 km) west of Villa Rica.

Pickens County: 1. Excellent garnet crystals up to 2 inches (5 cm) in diameter occur loose in soil near the pegmatite exploited for mica at the Cagle Mine, 4.8 miles (7.7 km) S65°W of Tate, approximately 2 miles (3.2 km) east of Bethany Church. Kyanite, quartz, and rutile crystals are associated with these garnets.

Rabun County: 1. Weathered, imperfect garnet crystals up to 6 inches (15 cm) in diameter occur in soil at Carries Camp on the Burton Road near Tiger.

Taliaferro County: 1. Garnet, presumably spessartine, is reported below the oxidized zone in the old iron-manganese prospects on the Judge John C. Hart property, approximately 6.5 miles (10 km) northwest of Cawfordville, 1.2 miles (1.9 km) west of the crossroads at Springfield Church.

Towns County: 1. Brownish-red spessartine containing small inclusions of secondary radioactive minerals occurs in quartz float on the McGaha property, approximately 3.4 miles (5.5 km) northwest of Young Harris by way of Warne Road. The deposit is on the mountain side approximately 0.5 mile (0.8 km) southeast of the McGaha residence (Furcron, 1951, p. 130).

Troup County: 1. Excellent garnet crystals as much as 2 inches (5 cm) in diameter occur along the southern margin of the quartz core of the largest pegmatite exploited at the old Hogg or Minerals Processing Company mica-beryl deposit, 8.6 miles (14 km) south of LaGrange, 1.3 miles (2 km) south of Smiths Store crossroads.

Union County: 1. A suberb, 2-inch (5-cm) diameter, trapezohedral garnet crystal from an unspecified location in Union County is exhibited in the museum of the Georgia State Capitol.

Upson County: 1. Weathered trapezohedral garnet crystals up to one inch (2.5 cm) in diameter occur with staurolite and kyanite in soil on the Dolly Cherry property, lot 38, 16th district, 3.5 miles (5.6 km) southwest of Thomaston near Shepherd School (Ingram, 1950, p. 85). Garnet crystals also occur in both kyanite and staurolite crystal aggregate matrices. 2. Coarse-grained, reddish-brown garnet crystals occur with black tourmaline in the south pegmatite body exploited in the Stevens-Rock Mica Mine, approximately 4 miles (6.4 km) N67°W of Yatesville (Heinrich, Klepper and Jahns, 1953, p. 354). 3. Crystals of spessartine and small masses of pale-green apatite occur in the wall zone of a pegmatite exploited for muscovite in the Adams Mine, 2.5 miles (4 km) N3°E of Yatesville.

White County: 1. Garnet crystals up to 0.75 inch (2 cm) in diameter occur in roadcuts along U.S. Highway 129, approximately 0.5 mile (0.8 km) north of the White-Hall County line.

Wilkes County: 1. Yellow-brown grossular garnet occurs with coarsely crystalline epidote in massive white quartz at the Young's Chapel copper prospect, approximately 3.5 miles (5.6 km) west of Washington along the ridge between Youngs Chapel and Beaver Dam Creek.

CHONDRODITE

$(Mg,Fe)_3SiO_4(OH,F)_2$

Class Nesosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals varied in habit, usually highly modified. Also massive. Twinning on {001} common, lamellar.

Phys. *Cleavage* {100} indistinct. **H** 6–6½. **G** 3.16–3.26. *Color* yellow, brown, red. Transparent to translucent. *Luster* vitreous.

Occur.

Habersham County: 1. A straw brown mineral described as "possibly chondrodite" is reported in drill core from several holes put down in Brevard Marble on the Wilbank's property, approximately 2.5 miles (4 km) southwest of Alto, immediately north of the Habersham-Hall County line (Hurst and Crawford, 1964, p. 61). Associated materials are phlogopite, pyrite and graphite.

ZIRCON

$ZeSiO_4$

Class Nesosilicate

Cryst. Tetragonal; ditetragonal-dipyramidal—4/m 2/m 2/m

Habit Commonly in square prisms, sometimes pyramidal. Also in irregular forms and grains.

Phys. *Cleavage* none. *Fracture* conchoidal. Brittle. **H** 7.5. **G** 4.6–4.7. *Luster* adamantine. *Color*less, pale yellowish gray, yellowish green, brownish yellow, reddish brown. *Streak* uncolored. Transparent to subtranslucent and opaque.

Occur.

Zircon is an exceedingly widespread though inconspicuous mineral throughout the rocks of Georgia. It occurs as an accessory constituent in many felsic igneous rocks and as detrital grains in most clastic sediments and metasedimentary rocks. Zircon is recovered economically from Pleistocene heavy-sand accumulations in Charlton County near Folkston. In almost every instance, the mineral occurs in grains that are too small to identify without the aid of magnification. Opaque, megascopic zircon crystals were apparently found in the 19th century at the Glade Gold Mine in Hall County (McCallie, 1910, p. 124).

SODDYITE

$(UO_2)_5Si_2O_9 \cdot 6H_2O$

Class Nesosilicate (?)

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Crystals bipyramidal {111} with horizontal striations, sometimes with small base {001}. Rarely thick tabular on {001}. Crystals often platy or prismatic. As subparallel aggregates, divergent clusters, or radial fibrous aggregates; also massive to earthy.

Phys. *Cleavage* {001} perfect, {111} good. **H** 3.5. **G** 4.70. *Color* amber yellow, canary yellow, yellowish-green to dull yellow. *Luster* vitreous to resinous. Transparent to opaque. *Streak* pale yellow. Not fluorescent.

Occur.

Lamar County: 1. Soddyite associated with beta-uranophane has been identified by x-ray powder difraction and spectrography in samples from the A. N. Moye Mica Mine, about 5 miles (8 km) southeast of Barnesville. The soddyite occurs as yellow inclusions in muscovite and was the second known occurrence of this mineral in the United States at the time of its identification at this property (Furcron, 1955, p. 42). Minor uraninite, metatorbernite and meta-autunite also occur at this location. Samples submitted to the Atomic Energy Commission contained 0.22 percent uranium. The mica workings are now abandoned and filled with water, and most uranium-bearing material has been removed from the dump.

TITANITE

$CaTiSiO_5$

Class Nesosilicate

Cryst. Monoclinic; prismatic—2/m

Habit In wedge-shaped flattened crystals. Sometimes massive and compact.

Phys. *Cleavage* {110} distinct. **H** 5–6. **G** 3.4–3.6. *Luster* adamantine. *Color* brown, yellow, gray, yellowish green, black, *streak* white.

Occur.

Titanite (sphene) is a widely distributed though seldom recognized accessory constituent of numerous igneous and metamorphic rocks of the crystalline Piedmont and occurs as detrital grains in sedimentary rocks of the Paleozoic and Coastal Plain areas. It is frequently observed in thin sections of granite, granite gneiss, and amphibole-rich gneisses. Localities described below are those at which megascopic euhedral titanite may be found.

Cobb County: 1. Excellent titanite crystals up to 1.5 inches (3.8 cm) in maximum dimension have been collected for many years on and in the vicinity of Kennesaw Mountain. The mineral occurs as randomly oriented, brown crystals in pegmatitic zones on the mountain, and in local quarries and road cuts along U.S. Highway 41.

Columbia County: 1. Granitic rock quarried during the construction of Clark Hill Dam locally contains megascopic titanite in brown crystals up to 0.3 inch (0.8 cm) in length.

DeKalb County: 1. Titanite is a locally conspicuous accessory mineral in quartz-oligoclase-garnet-bearing zones within the Lithonia Gneiss (Herrmann, 1954, p. 13). 2. Pyroxene-hornblende gneiss containing up to 9.6 percent titanite is exposed in a road cut 2500 yards (2286 m) N48°W of Lithonia Post Office (Herrmann, 1954, p. 24).

Greene County: Euhedral, brown titanite crystals up to 0.2 inch (0.5 cm) in length occur randomly distributed within the Siloam Granite centering near the town of Siloam.

Wilkes County: Euhedral titanite crystals are common accessory components of the Danburg Granite, which extends over approximately 50 square miles in northeastern Wilkes and adjacent Lincoln Counties. It is an oval pluton of coarsely porphyritic biotite granite. Titanite is particularly evident as brown euhedral crystals up to 0.2 inch (0.5 cm) long at the Wheless quarry on the Clinton Wheless property in the community of Danburg.

VESUVIANITE

$Ca_{10}Mg_2Al_4(SiO_4)_5(Si_2O_7)_2(OH)_4$

Class Sorosilicate

Cryst. Tetragonal; ditetragonal-dipyramidal—4/m 2/m 2/m

Habit Crystals usually short prismatic; also pyramidal. Commonly massive, granular, cryptocrystalline, columnar.

Phys. *Cleavage* {110} indistinct; {100} and {001} very indistinct. *Fracture* uneven to conchoidal. Brittle. **H** 6–7. **G** 3.33–3.45. *Color* various shades of green, brown, white, yellow, red, rarely blue. Transparent to translucent. *Luster* vitreous; sometimes resinous. *Streak* white.

Occur.

This relatively significant rock-forming silicate is reported from surprisingly few locations in Georgia. Its occurrence should be restricted to the crystalline Piedmont and Blue Ridge.

Towns County: 1. One of the earliest (1895) minerals catalogued by the Georgia Geological Survey is a sample of vesuvianite-bearing rock collected near Harrison, lot 57, 18th district.

Upson County: 1. Interesting contact metamorphic rock containing up to 8 percent vesuvianite is described by Clarke (1952, p. 26) from the margin of the Jeff Davis Granite, approximately 0.5 mile (0.8 km) south of Dog Crossing, 6 miles (9.7 km) N30°E of Thomaston. Associated minerals are diopside, garnet, and scapolite.

ZOISITE

$Ca_2Al_3(Si_3O_{12})(OH)$

Class Inosilicate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Crystals prismatic, deeply striated or furrowed vertically; seldom distinctly terminated. Also massive; columnar to compact.

Phys. *Cleavage* perfect basal. Brittle. **H** 6–6½. **G** 3.25–3.36. *Luster* vitreous. *Color* grayish white, greenish gray, brown. *Streak* uncolored.

Occur.

Zoisite is a relatively common mineral in the metamorphic rocks of the Piedmont and is locally abundant as an alteration mineral encountered near the margins of mafic plutons. Zoisite is normally recognized only during the microscopic examination of rocks in thin section; however, several occurrences contain coarsely crystalline material of particular mineralogical interest.

Bartow County: 1. An unusual variety of metasiltstone containing abundant zoisite and a small amount of greenish-brown phlogopite crops out in the bed of Hawks Branch, 0.8 mile (1.3 km) north of Campbell Hill near the Cartersville Mining District (Kesler, 1950, p. 37).

Cherokee County: 1. Zoisite as small grains, irregularly shaped elongate pieces, and larger aggregates of columnar crystals is relatively abundant in hornblende-zoisite schist on the dumps of the old Franklin-Creighton Gold Mine, centering on lots 466 and 467 in extreme eastern Cherokee County (Jones, 1909, p. 64).

Fannin County: 1. Coarsely crystalline sprays of zoisite occur with diopside and other calcium-rich silicates on the dumps of the Number 20 Copper Mine, lot 20, 9th district, 2nd section, and nearby Mobile Copper Mine, lot 59, 9th district, 2nd section.

Lumpkin County: 1. Zoisite is locally abundant in ore and wall rock of the Battle Branch Gold Mine, lots 457 and 524, 12th district, approximately one mile (1.6 km) south of Auraria (Pardee and Park, 1948, p. 38).

Rabun County: 1. Fine-grained zoisite is locally abundant in hornblende gneiss exposed in and around Lake Burton (Hopkins, 1914, p. 21).

Towns County: 1. Float boulders of coarsely crystalline, fibrous zoisite surfically coated with fine-grained actinolite occur around the Hogg Creek Corundum Mine, lot 92, 17th district, about 2 miles (3.2 km) west of Hiawassee (King, 1894, p. 89).

CLINOZOISITE

$Ca_2Al_3Si_3O_{12}(OH)$

Class Sorosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals prismatic, deeply striated or furrowed vertically; seldom distinctly terminated. Also massive; columnar to compact.

Phys. *Cleavage* perfect basal. Brittle. **H** 6–6½. **G** 3.25–3.36. *Luster* vitreous. *Color* grayish white, greenish gray, brown. *Streak* uncolored.

Occur.

Clinozoisite has been described in thin section as an accessory mineral of numerous metamorphic rocks of the crystalline Piedmont. It occurs in widely scattered locations and in a diverse array of metasedimentary and metavolcanic rocks of the epidote-amphibolite facies of regional metamorphism. It is also associated with retrograde readjustments of basic igneous rocks and is commonly associated with actinolite and other inosilicates. Clinozoisite has not been reported in occurrences yielding megascopically significant specimens.

EPIDOTE

$Ca_2(Al,Fe)_3Si_3O_{12}(OH)$

Class Sorosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals usually elongated parallel to b. Also fibrous and coarse to fine granular.

Phys. *Cleavage* perfect basal, with base usually parallel to length of crystal. *Fracture* uneven brittle. **H** 6-7. **G** 3.35-36. *Luster* vitreous to resinous. *Color* pistachio-green, brownish green, greenish black, brown, yellowish, gray, and white. *Streak* uncolored or grayish. Transparent to translucent.

Occur.

Epidote is a widely distributed mineral within the igneous and metamorphic rocks of the Georgia Piedmont and Blue Ridge. It is typically a secondary mineral, commonly derived by the alteration of calcium–iron–aluminum silicates. Epidote is particularly common as an accessory mineral in most hornblende-bearing rocks. Metavolcanics of the Little River Series locally contain abundant epidote, as do certain granites and granitic gneisses near the Fall Line. Narrow dikes of rock composed predominantly of epidote and lesser quartz and garnet are common in areas of high-grade metamorphism.

Banks County: 1. Epidote crystals were submitted to the Georgia Geological Survey in 1899 from the T. J. Carr Farm, one mile (1.6 km) from Maysville.

Coweta County: 1. Large, locally euhedral crystals of epidote are abundant in granites near Newnan and Grantville (Watson, 1902, p. 258).

DeKalb County: 1. Epidote is common as granular aggregates with garnet in calcium- and iron-rich veins exposed in quarries in Lithonia Gneiss. Similar occurrences are in Rockdale and Walton Counties.

Fulton County: 1. Epidosite, a rock composed of epidote and quartz, occurs in considerable abundance on the Padgett property, approximately 7.5 miles (12 km) north of Alpharetta. The material is suitable for making cabachons.

Habersham County: 1. Unusually attractive unakite, a rock consisting of pink feldspar, quartz and epidote, may be found as float along Sutton Mill Creek near Bethlehem Church, approximately 2 miles (3.2 km) northwest of Clarkesville (Hurst and Crawford, 1964, p. 114).

Jackson County: 1. Epidote crystals of exceptional quality were found many years ago near Commerce. Only two specimens from this find are known today. One is a superb crystal approximately 2 x 1.75 x 1.5 inches (5 x 4.4 x 3.8 cm) (Museum No. 4386) located in the museum of the Georgia State Capitol. A second, almost identical crystal is in the collection of Frank Ingram of Griffin. The crystals were supposedly found when a wagon load of peaches broke into a vug. The donor of the sample currently in the museum collection was A. G. Wood of Commerce. The occurrence was rediscovered approximately 25 years ago by Gilbert W. Withers at which time two crystals were acquired from the owner. Mr. Withers no longer remembers the whereabouts of the property.

Jones County: 1. Veins of massive epidote several inches wide are relatively abundant in portions of the Western and Brooker Company Ruby Quarry approximately 5 miles (8 km) northeast of Macon, east of the intersections of Georgia Highway 49 and old Highway 18. Local pockets contain small euhedral crystals with calcite and pink feldspar.

Paulding County: 1. Crystalline masses of epidote occur in extensively altered hornblende gneiss on lot 1012, 19th district, near Bud (Hopkins, 1914, p. 181).

Rabun County: 1. An apparently lost location for gem epidote was described by Kunz in 1889. The epidote, which occurred in brilliant crystals up to one inch (2.5 cm) in length and 0.5 inch (1.2 cm) in diameter, was discovered by Rev. C. D. Smith at a point about one mile (1.6 km) from Rabun Gap. Crystals reportedly were found in veins of pink granite on the south slope of the Blue Ridge Mountains. Several attempts have been made to locate this occurrence without success. The location should be within about 0.5 mile (0.8 km) of Mountain City. 2. Light-green aggregates of opaque, euhedral epidote have been found on the east end of Black Rock Mountain a short distance north of Clayton. Several specimens of this material are in the museum of the Georgia State Capitol.

Taliaferro County: 1. Excellent aggregates of dark green crystalline epidote occur in residual boulders of massive quartz on the Armour property in the northern panhandle of the county, approximately 0.3 mile (0.48 km) east of Carters Grove (Hurst, Crawford and Sandy, 1966, p. 443). Individual crystals reach lengths of 2 inches (5 cm) and afford excellent specimen-grade material.

Troup County: 1. Tabular, gemmy epidote crystals, up to 1.5 inches (3.8 cm) in length, line joints in granitic gneiss formerly exploited at the Yellow Jacket Quarry, immediately west of U.S. Highway 29 on the northerr outskirts of Hogansville.

Wilkes County: 1. Excellent aggregates of euhedral deep-green epidote occur with grossular garnet in massive quartz at the Youngs Chapel copper prospect, approximately 3.5 miles (5.6 km) west of Washington along the ridge between Youngs Chapel and Beaver Dam Creek.

ALLANITE

$(Ce,Ca,Y)_2(Al,Fe)_3(SiO_4)_3(OH)$

Class Sorosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Flat tabular crystals, also massive and in embedded grains.

Phys. *Cleavage* indistinct. *Fracture* conchoidal. Brittle. **H** 6½. **G** 2.7-4.0 *Luster* vitreous to pitchy. *Color* brownish black. *Streak* gray brown.

Occur.

Cherokee County: 1. Allanite is reported in gold ore of the 301 Mine, lot 301, 15th district (Pardee and Park, 1948, p. 43).

Cobb County: 1. Coarse-grained, glossy black allanite associated with sphene occurs along U.S. Highway 41 approximately 0.25 mile (0.4 km) north of Bells Ferry Road.

Elbert County: 1. Allanite is a locally important accessory in granite of the Elberton area (Silver and Grunenfelder, 1957, p. 1796).

Lumpkin County: 1. Yeates, McCallie and King (1896, p. 307) mention allanite as a rare accessory mineral in the gold deposits of this county.

Monroe County: 1. Allanite has been found approximately 9 miles (14 km) north of Forsyth on the dump of the Smith Mica Mine (Heinrich and Jahns, 1953, p. 373).

Towns County: Allanite comprises about one percent of clinozoisite-rich rocks locally exposed around Lake Chatuge (Hartley, 1973, p. 15). Allanite is almost isotropic (metamict) and forms the core of clinozoisite crystals.

AXINITE GROUP

Ferroaxinite	$Ca_2Fe^{+2}Al_2BSi_4O_{15}(OH)$
Manganaxinite	$Ca_2MnAl_2BSi_4O_{15}(OH)$
Tinzenite	$(Ca,Mn,Fe)_3Al_2BSi_4O_{15}(OH)$

Class Cyclosilicate

Cryst. Triclinic; pedial—$\bar{1}$

Habit Crystals usually tabular, wedge-shaped, often in bladed aggregates. Also massive, lamellar; sometimes granular.

Phys. *Cleavage* {100} good; {001}, {110}, and {011} poor. *Fracture* uneven to conchoidal. Brittle. **H** 6½–7. **G** 3-26–3.36. *Color* usually violet-brown; also colorless, pale yellowish, or pale violet to reddish. Transparent to translucent. *Luster* vitreous. *Streak* uncolored.

Occur.

DeKalb County: 1. Small euhedral crystals of an axinite group mineral are reported from pegmatites cutting granite and gneiss at Stone Mountain and Lithonia (Walter, 1956, p. 32). Detailed mineralogical descriptions are not given; however, since the author also describes physically similar titanite as an accessory mineral at these locations the occurrence of an axinite group mineral is accepted.

BERYL

$Be_3Al_2Si_6O_{18}$

Class Cyclosilicate

Cryst. Hexagonal; dihexagonal-dipyramidal—6/m 2/m 2/m

Habit Crystals usually long prismatic, often striated vertically, rarely transversely; distinct terminations exceptional. Occasionally in large masses, coarse columnar or granular to compact.

Phys. *Cleavage* poor basal. *Fracture* conchoidal to uneven. Brittle. **H** 7.5–8. **G** 2.65–2.85; usually 2.69–2.70. *Luster* vitreous, sometimes resinous. *Colors* emerald-green, pale green, passing into light blue, yellow, white, peach, and pale rose-red. *Streak* white. Transparent to subtranslucent.

Occur.

Beryl is known from approximately 60 occurrences in 22 counties within the crystalline Piedmont. It is commonly an accessory mineral in mica-bearing zoned pegmatites. A substantial quantity of strategic beryl was mined in Georgia after World War II and sold at the government depot at Spruce Pine, North Carolina. The gem varieties, emerald and aquamarine, are reported but are of very uncommon occurrence.

Banks County: 1. Fragments of yellow-green beryl are reported from the J. T. Cheatham property, Route 3, Commerce (Furcron, 1959, p. 91). The occurrence is approximately 3 miles (4.8 km) from the Jackson County line, 5 miles (8 km) east of Commerce along Georgia Highway 59, and 0.5 mile (0.8 km) off Browns Road.

Barrow County: 1. Crystals of beryl and associated black tourmaline occur in a 2-foot (0.6-m) thick pegmatite dike in hornblende gneiss, approximately 6 miles (9.7 km) southwest of Jefferson on Georgia Highway 11, 100 yards (91 m) northwest of a small stream which is 1.5 miles (2.4 km) from the Barrow County line (Furcron, 1959, p. 92).

Cherokee County: 1. Beryl crystals up to 3 inches (7.6 cm) in diameter are reported from the Amphlett Mica Mine, approximately 0.4 mile (0.64 km) S30°E of Conn Church, 4.3 miles (7 km) S86°E of Ball Ground (Heinrich and Jahns, 1953, p. 378). 2. Strategic beryl, including one large crystal weighing 60 pounds (27 kg), has been produced from the Bennett Mica Mine, lot 229, 13th district, 2nd section, 5.6 miles (9 km) S85°W of Nelson. The U.S. Bureau of Mines reports that 130 pounds (59 kg) of beryl were sold from this property to the G.S.A. purchasing depot in Spruce Pine between 1952 and 1957. 3. A large irregular pegmatite at the Cochran Mica Mine, 2.5 miles (4 km) N60°E of Ball Ground and 0.85 mile (1.4 km) northwest of Cherry Grove School, has been exploited periodically for both beryl and mica. It is reported by its original operator, J. Hines Woods, that in the early days of operation (1933) very large, well-formed beryl crystals could be

picked up at the surface and that a North Carolina miner removed a truck load of large crystals. The property is credited with a production of 4064 pounds (1843 kg) of beryl between 1952 and 1957. Excellent specimens of sharp, yellow-green crystals terminated by basal pinacoids may be obtained at this property. Permission to collect is required. 4. Beryl is reported from the Hendrix Mica Mine on lot 275, 3rd section, Ball Ground district (Furcron, 1959, p. 92).

Clarke County: 1. Beryl is reported by Furcron (1959, p. 92) from a locality on Alps Road across from the "New Airport" where numerous fragments of quartz are scattered about a field. The beryl is in yellow-green crystals of gem quality up to 0.25 inch (0.6 cm) in diameter and 1.5 inch (3.8 cm) in length. It is probable that the locality referred to is the site of the Alps Road Shopping Center.

Columbia County: 1. Beryl is reported from a small pegmatite in central Columbia County near the headwaters of Little Kiokee Creek by Hurst, Crawford and Sandy (1966, p. 356).

DeKalb County: 1. Beryl has been reported from several small pegmatites encountered in numerous dimension stone and aggregate quarries. It is frequently seen in the quarries at Arabia Mountain and has also been reported in small pegmatites not far from Stone Mountain on Rock Bridge Road between Bermuda and Macedonia Church.

Elbert County: 1. Beryl is reported by Furcron and Teague (1943, p. 168) from the Alexander Mica Mine, located between the Elberton–Iva road and the Chapman Mica Mine. 2. Minor beryl occurs in the pegmatite exploited at the Chapman Mica Mine, approximately 10 miles (16 km) north of Elberton and 0.25 mile (0.4 km) due south of Rock Branch settlement on the east side of Coldwater Creek (Furcron, 1959, p. 92). 3. Beryl crystals up to 6 inches (15 cm) in diameter are reported from the dumps of the Cooley Mica Mines on the N. M. Cooley Farm, 1.5 miles (2.4 km) west of the Savannah River, 2 miles (3.2 km) east of the Rock Branch section (Furcron, 1959, p. 92). 4. Blue beryl crystals approaching gem quality are reported from Dewy Rose, approximately 500 feet (152 m) N15°E of the J. H. Tate home. 5. Galpin (1915, p. 112) describes beryl approaching aquamarine in quality from the vicinity of Harmony Church. No details are given. 6. Large fragments of beryl crystals are reported from several prospects adjacent to the Rock Branch Church (Furcron, 1959, p. 92). 7. Small beryl crystals are exposed in the quartz core of a pegmetite exploited for mica in the M. L. Gaines Mine, 0.5 mile (0.8 km) north of the Elberton–Iva highway (Griffitts, 1953, p. 304).

Fannin County: 1. Crystals of deep-green beryl up to 0.25 inch (0.6 cm) in diameter and described as emerald are reported from the Springer Mountain Mica Mine in the Chattahoochee National Forest, lot 121, 6th district, 1st section (Hurst, 1957a, p. 95). Samples from this occurrence were submitted to the Georgia Geological Survey by Mr. J. H. Falour who reported that the crystals were encountered at several points in the mine but always sparingly.

Forsyth County: 1. Well-formed crystals of yellow-green beryl are reported from a pegmatite exposed in road cuts on the north side of the Silver Shoals Church–Oscarville road just east of its crossing with Four Mile Creek (Furcron, 1959, p. 93).

Habersham County: 1. A clear beryl crystal is reported from quartz float on the Arrendale property, 1.4 miles (2.3 km) south of Batesville on Georgia Highway 197 (Hurst and Crawford, 1964, p. 43). 2. Small beryl crystals occur with tourmaline in a pegmatite along Georgia Highway 197, about 5.2 miles (8.4 km) north of the North Georgia Trade School (Hurst and Crawford, 1964, p. 93).

Hart County: 1. Light green crystals of beryl are reported in the quarry from which stone for Hartwell Dam was taken. 2. Beryl is reported as an accessory mineral in the Taylor Mica Mine by Lesure (1962, p. 12). This mine is 1.2 miles (1.9 km) S75°W of Crossroads Church and slightly over 5.3 miles (8.5 km) northwest of Hartwell. 3. Gem quality beryl crystals are reported by Furcron (1959, p. 93) from the Water Hole Mica Mine near Crossroads community.

Jackson County: 1. Well-formed crystals of blue and green beryl up to 4 inches (10 cm) in diameter have been obtained from several prospects and as float in plowed fields in the immediate vicinity of Harris School, approximately 5.5 miles (8.9 km) east of Jefferson at Brockton. 2. A series of pegmatites exposed on the west side of U.S Highway 441 immediately north of Nicholson contains small beryl crystals approaching aquamarine in quality. 3. Green beryl occurs in several pegmatites on the W. R. Potts property, approximately 0.25 mile (0.4 km) north of Harris School at Brockton. 4. A zoned pegmatite containing masses of green and dark blue beryl has been prospected on the M. F. Webb property, approximately 0.3 mile (0.5 km) N23°W of the Webb home, 5.5 miles (8.9 km) east of Jefferson on the Brockton Road, immediately east of Brockton School (Furcron, 1959, p. 93).

Jasper County: 1. Beryl crystals occur in 4 zoned pegmatites northeast of Hillsboro near the Barron Fullerton home, at what is known locally as the Parker Mica Mine (Furcron, 1959, p. 93).

Lamar County: 1. Green, yellow and blue beryl crystals approaching gem quality have been found in a number of pegmatites on the J.T. Means and G. Dumas properties immediately west of Ramah Church near

the Early Vaughn Mica Mine. Beryl was originally reported from an old shaft 500 feet (152 m) S20°W of the old Means homesite. 2. A small amount of common beryl was discovered at the Early Vaughn Mica Mine, approximately 6 miles (9.7 km) southeast of Barnesville, 1.8 miles (2.9 km) south of the Barnesville–Forsyth highway.

Meriwether County: 1. Light green beryl approaching aquamarine is reported from the property of Earnest Strozier, Route 3, Greenville, on the north road 0.25 mile (0.4 km) from Massingale or Red Oak Pond. Beryl and large garnet crystals occur in a field 0.15 mile (0.24 km) N75°E of a dwelling on this road (Furcron, 1959, p. 93).

Monroe County: 1. Fragments of pale greenish-blue beryl, some as much as 2 inches (5 cm) in diameter, are reported from the dumps of the Battle and Chatfield Mica Mines, approximately 2.75 miles (4.4 km) N50°W of Culloden (Heinrich, Klepper and Jahns, 1953, p. 367).

Morgan County: 1. Well-formed crystals of green and golden beryl occur in a small mica prospect on the old Adair Plantation several miles west of Apalachee. One perfectly clear crystal 1.5 inches (3.8 cm) long is reported (Furcron, 1959, p. 93). 2. Numerous small crystals of beryl occur in a pegmatite on the Carter property near Bostwick (Heinrich and Jahns, 1953, p. 388). 3. Approximately 200 pounds (91 kg) of common beryl were mined under a D.M.E.A. loan immediately southeast of the bridge at High Shoals.

Oconee County: 1. Beryl crystals up to 3 inches (7.6 cm) in diameter and 8 inches (20 cm) long were found in the Dickens Mica Mine, approximately 3.5 miles (5.6 km) northwest of High Shoals. 2. Beryl is reported by Furcron (1959, p. 93) on the Grady Thomas place. This is probably the site of former mica prospecting on the D. S. Thomas Farm, approximately 3 miles (4.8 km) northwest of High Shoals as reported by Heinrich and Jahns (1953, p. 388).

Pickens County: 1. A large amount of beryl was reportedly encountered in the early working of the Bozeman or Jones Mica Mine, 3 miles (4.8 km) S60°E of Tate on lot 21, 4th district, 2nd section. One piece reportedly weighed 50 pounds (23 kg). A large, hexagonal beryl crystal weighing 60 pounds (27 kg) was found in the immediate vicinity just east of the Burleson Mine on a slope between the Link Bozeman place and Federal School (Furcron, 1959, p. 94). 2. Excellent gem quality, blue and golden beryl occurs on the R. H. Cook Farm, approximately 4 miles (6.4 km) west of Tate, lot 202, district 13, in the bed of Rock Creek. According to Furcron (1959, p. 94) the beryl occurs in crystals up to 3 inches by 6 inches (7.6 by 15 cm) and is generally scattered throughout the entire pegmatite outcrop. Most of the gem varieties are yellow and clear; deep golden beryl occurs, although clear honey-yellow type is most abundant. The aquamarine is clear- to celestite-blue. Beryl is closely associated with potash feldspar, and one yellow-green crystal exhibits rhythmical intergrowths of both minerals. 3. Beryl has been known for many years as an accessory mineral in the Denson Mica Mine, adjoining the above described Cook property. The Denson Mica Mines lie just north of the Cherokee County line and one mile (1.6 km) S60°E from Bethany Church near Rock Creek, 12th district, 2nd section. The U.S. Bureau of Mines reports that 1567 pounds (710 kg) of beryl from this property were sold to the Purchasing Depot at Spruce Pine between 1952 and 1957 (Furcron, 1959, p. 94). 4. Light green beryl crystals up to 2 inches (5 cm) in diameter occur in quartz float approximately 0.4 mile (0.64 km) east of the Denson Mica Mines in the bend of Rock Creek on Austin Blan's property (Furcron and Teague, 1943, p. 109). 5. Beryl is reported from the J. L. Mulleneux mica prospect, 1.6 miles (2.6 km) S25°W of Talking Rock, 1.5 miles (2.4 km) S87°E of Antioch Church.

Rabun County: 1. Crystals of common beryl and pale green aquamarine were encountered in the old Mark Beck Mica Mine, lot 74, 4th district, 7.5 miles (12 km) southeast of Clayton (Furcron and Teague, 1943, p. 155–156). 2. A pale blue aquamarine crystal was reported from the W. T. Smith property, Moccasin district (McCallie, 1910. p. 123).

Spalding County: 1. Aquamarine associated with tourmaline and rose quartz is reported from lot 84, Union district (G.M.D. 490), 2 miles (3.2 km) north and slightly west of Vaughn (Furcron, 1959, p. 94). 2. Similar beryl-bearing pegmatites are reported on Rover Road, 2.5 miles (4 km) southwest of Griffin (Heinrich and Jahns, 1953, p. 392).

Stephens County: 1. Two cloudy, blue beryl crystals connected by parallel growth in a matrix of quartz, were found in a pasture behind Avalon School on the Joe Stowe place (Furcron, 1959, p. 94).

Troup County: 1. Crystals of green beryl were recovered when excavations were made for the runways of LaGrange Airport. Just north of this airport, on the west side near its junction with a road to the east, beryl and rose quartz have been found as float. Several good specimens of gem aquamarine have been found here (Furcron, 1959, p. 95). 2. Green to white beryl in crystals ranging up to 12 inches (30 cm) in diameter have been recovered from the W. Hugh Allen property (Word Prospect), 9.2 miles (14.8 km) S34.5°W of the LaGrange City Square, 100 feet (30 m) southwest of the South Bridge abuttment over a tributary to Long Cane Creek. This area has been prospected by the U.S. Bureau of Mines. It is reported that 1033 pounds (470 kg) of beryl

were produced. 3. Approximately 600 pounds (272 kg) of beryl were reportedly removed from the Brown property, 0.6 mile (0.97 km) north of Smiths Crossroads on the Whitesville road. The occurrence is in a woods about 0.2 mile (0.32 km) east of the road (Furcron, 1959, p. 95). 4. The most successful beryl operation in Georgia was the Hogg property, known as the Foley or Minerals Processing Company Mine, lot 184, 4th district, one mile (1.6 km) south of Smiths Crossroads. Beryl occurs closely associated with the quartz cores of a series of large, zoned pegmatite bodies. Crystals as large as 18 inches (46 cm) in diameter and weighing over 100 pounds (45 kg) are reported. The U.S. Bureau of Mines reports that between 1952 and 1957 the Ashville office purchased 172,401 pounds (78,200 kg) of beryl from this property. At least 3,000 pounds (1360 kg) of clear and smoky blue aquamarine have been recovered. 5. Beryl is reported from the south side of a draw near the chromite prospect at Louise and along trails towards the Hogansville Road to the east of this prospect (Furcron, 1959, p. 95). 6. Small yellow beryl crystals have been prospected in a pegmatite on the L. M. Mulkey property on Georgia Highway 219, 5 miles (8 km) south of LaGrange and 0.75 mile (1.2 km) south of Bryants Corner, adjoining the Hogg mine. 7. Beryl occurs in a poorly exposed, zoned pegmatite on the property of Alvin Smith, 6.65 miles (10.7 km) N84°W of the City Square in LaGrange, 450 feet (137 m) S70°W of the log cabin known as Casselwood. The pegmatite is exposed in the bed of the Chattahoochee River. 8. Beryl has been prospected in a small zoned pegmatite on the property of Guy C. Stephens, about 100 yards (91 m) south of Smiths Crossroads on the west side of the Whitesville Road (Furcron, 1959, p. 95). 9. Blue beryl has been prospected on the property of Walter Waugh, 3.0 miles (4.8 km) N15°E of the LaGrange City Square. Approximately 50 pounds (23 kg) of beryl have been recovered (Furcron, 1959, p. 95). 10. Green beryl crystals have been found in small pegmatite stringers on the south side of Youngs Mill Road, approximately 0.5 mile (0.8 km) east of U.S. Highway 47 (Furcron, 1959, p. 95).

Upson County: 1. Dark green to blue beryl in crystals 0.5 to 1.5 inches (1.2 to 3.8 cm) in diameter and 3 to 15 inches (7.6 to 38 cm) long occur in and around quartz pods in the pegmatite exploited at the Adams Mica Mine, 2.5 miles (4 km) N3°E of Yatesville. 2. Blue-green beryl in crystals up to 4 inches (10 cm) long and 1.5 inches (3.8 cm) in diameter occur with massive quartz pods in a well-zoned pegmatite exploited for mica at the Blount No. 1 Mine, approximately 5 miles (8 km) east of Thomaston (Heinrich, Klepper and Jahns, 1953, p. 348). 3. Beryl is reported from the Colbert Mica Mine, 9 miles (14.4 km) N65°E of Thomaston and several hundred yards east of the Southern Railroad (Heinrich, Klepper and Jahns, 1953, p. 355). 4. Pale bluish-green beryl crystals associated with black tourmaline occur in massive quartz pods in the pegmatite exploited at the B. S. Gipson mica prospect, 3.1 miles (5 km) S45°E of Thomaston (Heinrich, Klepper and Jahns, 1953, p. 337). 5. Crystals of olive-green to light blue beryl up to 7 inches (17.8 cm) in diameter occur in massive quartz zones in the pegmatite exploited at the Herron Mica Mine, 0.25 mile (0.4 km) east of Yatesville, several hundred feet south of Georgia Highway 74 (Heinrich, Klepper and Jahns, 1953, p. 355). 6. Greenish-blue beryl is reported from the Stephens-Rock Mica Mine, 4 miles (6.4 km) N67°W of Yatesville (Heinrich, Klepper and Jahns, 1953, p. 354).

Walton County: 1. Several aquamarine crystals have been found in residuum and weathered pegmitite fragments on the property of G. Calvin Malcolm near New Hope School. Furcron (1959, p. 95) describes an aquamarine crystal 2.2 inches (5.6 cm) long which is light gray at one end and pale green transparent aquamarine for the remainder of the crystal.

CORDIERITE

$Mg_2Al_4Si_5O_{18}$

Class Cyclosilicate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Embedded grains and massive.

Phys. *Cleavage* {010} poor. Brittle. **H** 7–7½. **G** 2.55–2.75. *Luster* vitreous. *Color* blue to whitish gray.

Occur.

Cordierite has been reliably reported from only two occurrences in Georgia. This metamorphic mineral may be suspected as a local accessory constituent of a relatively large number of metamorphic rocks of the Piedmont. Cordierite is extremely difficult to identify except by optical or x-ray powder techniques, and is generally not recognized in hand-specimens.

Lincoln County: 1. Cordierite occurs as equant to elipsoidal grains, generally less than 0.03 inch (0.08 cm) in diameter, in a fine-grained, contorted biotite gneiss in outcrops along Curry Creek and Georgia Highway

79, 3 miles (4.8 km) north of Lincolnton (Salotti and Fouts, 1967, p. 1241–1243). Both biaxial (+) and (–) cordierite occurs in the same samples.

Monroe County: 1. Pale blue cordierite has been described as a primary constituent of a garnetiferous sillimanite–biotite–plagioclase gneiss exposed in a shaft at the old Persons Mica Mine, approximately 4 miles (6.4 km) north of Culloden, one mile ((1.6 km) south of the Monroe-Lamar County line (Hurst, 1956b, p. 73-90). Cordierite occurs in knots and irregular-shaped masses up to 0.75 inch (1.9 cm) across and is locally altered to fine-grained muscovite along microfractures and grain boundaries.

TOURMALINE GROUP

$$(Na,Ca)(Mg,Fe^{+2},Fe^{+3},Al,Li)_3Al_6(BO_3)_3Si_6O_{18}(OH,F)_4$$

Class Cyclosilicate

Cryst. Hexagonal—R; ditrigonal-pyramidal—3m

Habit Crystals usually prismatic, often slender to acicular; rarely flattened, the prism nearly wanting. Prismatic faces strongly striated vertically. Radiating groups common. Sometimes massive or columnar. In the colored crystals, the colors often change from one end to the other or from the center outward.

Phys. *Cleavages* two indistinct. *Fracture* uneven to conchoidal. Brittle. **H** 7–7½. **G** 2.9–3.3 *Luster* vitreous to resinous. *Color* black, brownish black, bluish black, most common; brown; red, pink, blue, green and, rarely, white or colorless. Zonal arrangement of different colors widely varies both as to the colors and to the crystallographic directions. *Streak* uncolored. Transparent.

Occur.

Tourmaline group minerals are relatively common as accessories in granites, pegmatites and some metamorphic rocks of the Piedmont. Most identified species are black or brown, belonging to the schorl–dravite series. Although colored tourmaline is reported, detailed chemistry and species identification for these finds are lacking.

Cherokee County: 1. The largest tourmaline crystals yet reported in Georgia have been found at the Cochran Mica–beryl Mine, lot 294, 2nd district, 4th section, approximately 2.5 miles (4 km) N78°E of Ball Ground. The crystals are black, up to one foot (0.3 m) in diameter, and 3 feet (0.9 m) in length. Small crystals exhibit excellent form although the larger ones are relatively crude and marginally altered to muscovite. Some crystals contain quartz cores. 2. Black tourmaline in well-formed crystals up to 2 inches (5 cm) in diameter and 8 inches (20 cm) in length are abundant in the pegmatites formerly exploited for mica at the Amphlett Mine, approximately 0.4 mile (0.64 km) S30°E of Conn Church and 4.3 miles (7 km) S86°E of Ball Ground. 3. Black tourmaline is abundant in quartz-rich layers in pegmatite exploited in the South Amphlett mica prospect, about 800 feet (244 m) southwest of the main Amphlett Mica Mine. 4. Black tourmaline is relatively abundant in the Reevis mica prospect along the Centerville-Four Mile Church road, 3.75 miles (6 km) N52°E of Ball Ground.

Clarke County: 1. Bright green, straw-size prisms of tourmaline are reported from a railroad cut approximately 2 miles (3.2 km) southeast of Athens by Hurst (1951, p. 206).

Cobb County: 1. Yellow-brown to olive-brown prisms of dravite up to 0.75 inch (1.9 cm) long and 0.25 inch (0.6 cm) wide have been collected from quartzite exposed in a borrow pit about 1.5 miles (2.4 km) southwest of Sweat Mountain.

Dawson County: 1. Pod-like masses of olive-grey, chatoyant tourmaline are found in oligoclase–quartz veins exposed on the south bank of the Etowah River, approximately 0.5 mile (0.8 km) northeast of the Lockheed Reactor Site (Hurst, 1958a, p. 48).

DeKalb County: 1. Rosettes of black tourmaline are locally abundant in irregular pegmatite pods in Stone Mountain Granite exposed in the Ethel Quarry, approximately 3 miles (4.8 km) east of the town of Stone Mountain (Herrmann, 1954, p. 92). 2. Small clusters of black tourmaline crystals are locally abundant in Stone Mountain Granite exposed in the large Kellogg Quarry on the east side of Stone Mountain. 3. Small aplite dikes with radiating black tourmaline crystals are numerous in the easternmost quarry of the Venable Estate on Stone Mountain (Herrmann, 1954, p. 95). 4. Large, black tourmaline crystals up to 6 inches (15 cm) long and more than one inch (2.5 cm) thick occur in pegmatite dikes in the Powell Quarries south of Bradley and Arabia Mountains, near Klondike. Radiating clusters of black tourmaline crystals occur locally within the Lithonia Gneiss at this location.

Hart County: 1. Muscovite crystals containing small, flat dravite crystals occur in the Harper-Pierman mica prospect, approximately 1.5 miles (2.4 km) south of Hartwell, 0.5 mile (0.8 km) east of the Bio School Road. The C-axes of the brown prisms lie parallel to mica cleavage (Furcron and Teague, 1943, p. 163).

Henry County: 1. Small, black, well-formed tourmaline crystals occur in irregular massive quartz lenses exposed in the pegmatite at the old Maddox Mica Mine, 6 miles (9.7 km) north of McDonough, 5 miles (8 km) S25°E of Stockbridge. Associated minerals are beryl and rose quartz.

Meriwether County: 1. Massive black tourmaline is relatively abundant in quartz lenses associated with a pegmatite dike prospected for muscovite on the Snelson property, approximately 5 miles (8 km) west of Woodbury, 0.75 mile (1.2 km) west of Cane Creek Church (Furcron and Teague, 1943, p. 183).

Oconee County: 1. Black tourmaline crystals up to 2 inches (5 cm) in diameter and 8 inches (20 cm) in length occur in massive quartz lenses in a pegmatite exploited at the Dickens Mica Mine, approximately 3.5 miles (5.6 km) northwest of High Shoals. Crystals at this occurrence are fractured perpendicular to the C-axis, displaced, and healed with smokey quartz.

Paulding County: 1. Brown microfibrous tourmaline displaying a silky luster has been reported as float from lots 612 and 649, 19th district.

Pickens County: 1. Black tourmaline crystals occur in residuum over a weathered pegmatite formerly prospected for muscovite on the J. M. Piyon property, lot 64, 4th district, 2nd section, approximately 0.4 mile (0.64 km) west of Marble Hill School (Heinrich and Jahns, 1953, p. 385). 2.Prismatic, black tourmaline crystals occur as inclusions in large muscovite books in the pegmatite prospected for mica on the Fowler and Freeman properties on a north-south ridge east of Long Swamp Creek, 2 miles (3.2 km) east of Nelson (Heinrich and Jahns, 1953, p. 386). Crystals of black tourmaline in milky to smokey quartz are relatively abundant on the dumps of the old Jones or Bozeman Mica Mine, approximately 2 miles (3.2 km) S45°W of Dug Gap, 3 miles (4.8 km) S60°E of Tate, lot 181, 4th district, 2nd section (Furcron and Teague, 1943, p. 110).

Rabun County: 1. Small prismatic crystals of blue tourmaline have been panned from Laurel Creek adjacent to the old Laurel Creek Corundum Mine in the southern part of lot 72, 3rd district, about one mile (1.6 km) southwest of Pine Mountain (S. M. Pickering, personal communication).

Rockdale County: 1. Large, black tourmaline clusters are locally abundant in quartz veins exposed in the Almond Quarry just west of Tan Yard Branch at the southwest edge of Conyers (Herrmann, 1954, p. 118).

Spalding County: 1. Excellent black tourmaline crystals associated with beryl and rose quartz have been found on lot 84, Union district (G.M.D. 490), 2 miles (3.2 km) north and slightly west of Vaughn.

Stephens County: 1. Well-developed black tourmaline crystals occur in quartz float in fields around the fire tower near Avalon.

Troup County: 1. Well-formed black tourmaline crystals are abundant near the margin of the large quartz core in the pegmatite formerly exploited at the Hogg mica–beryl deposits, 1.3 miles (2 km) south of Smith Store crossroads. Principle workings are on lot 184, 4th district. Crystals are typically oriented radially around the core and are most abundant in the vicinity of fractures. Crystals commonly reach one inch (2.5 cm) in diameter and 6 inches (15 cm) in length. 2. Crystals of black tourmaline occur as accessory constituents of a pegmatite prospected for beryl on the Word property, lot 161, approximately 13 miles (21 km) by road from LaGrange (Heinrich and Jahns, 1953, p. 396). 3. Terminated crystals of black tourmaline up to 0.5 inch (1.3 cm) in diameter occur in a pegmatite at the chromite prospect on the Beasley property at Louise (Long, 1971, p. 49). The pegmatite is exposed in a gully approximately 450 feet (137 m) S30°E of Louise Church.

Upson County: 1. Prisms of tourmaline up to 2.5 inches (6.4 cm) in diameter occur in fragments of milky and smoky quartz on the dump of the Castlen Mica Mine, 3.5 miles (5.6 km) N55°W of Yatesville and 2 miles (3.2 km) N25°W of Tobler Mill (Furcron and Teague, 1943, p. 42). 2. Masses and crystals of black tourmaline occur on the dumps of the Stephens or Rock Mica Mine, approximately 3.5 miles (5.6 km) west of Yatesville, 0.2 mile (0.32 km) north of Georgia Highway 74. 3. Crystals of brown tourmaline occur in the massive quartz core of a pegmatite prospected for mica on the Walker property, approximately 2.5 miles (4 km) N4°W of Yatesville and 50 feet (15 m) west of Barnwell Road (Long, 1971, p. 80). 4. Prismatic crystals on black tourmaline occur in quartz fragments on the dump of the old Herron Mica Mine, 0.4 mile (0.64 km) due east of Yatesville (Long, 1971, p. 81). 5. Crystals of black tourmaline are locally abundant in quartz and soil associated with the pegmatite exploited on the Gibson property, 2.6 miles (4.2 km) S43°E of Thomaston, 200 feet (61 m) north of the Waymansville road. Beryl is typically associated with tourmaline in the quartz core of this pegmatite.

Walton County: 1. Extremely well-formed crystals of black tourmaline up to 2 inches (5 cm) in diameter and 4 inches (10 cm) in length have been found on the George Felker Farm, approximately one mile (1.6 km) southwest of Between.

AMPHIBOLE GROUP

Amphibole group minerals are very common rock-forming minerals in metamorphic and igneous rocks. Hornblende and actinolite, particularly abundant in Georgia, are essential minerals in gneisses and schists derived from volcanic and sedimentary rocks in the west-central Piedmont and the Little River Series of the east-central Piedmont. Anthophyllite and cummingtonite are locally important in the altered portions of mafic and ultramafic plutons. Anthophyllite asbestos has been mined at numerous locations.

The amphiboles known to occur in Georgia are listed below:

Species	*Chemical Composition*
Anthophyllite	$(Mg,Fe)_7Si_8O_{22}(OH)_2$
Gedrite	$(Mg,Fe,Al)_7(Al,Si)_8O_{22}(OH)_2$
Cummingtonite	$Mg_7Si_8O_{22}(OH)_2$
Tremolite	$Ca_2Mg_5Si_8O_{22}(OH)_2$
Actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$
Hornblende	$(Ca,Na)_{2-3}(Mg,Fe^{+2},Fe^{+3},Al)_5(Al,Si)_8O_{22}(OH)_2$
Hastingsite	$NaCa_2(Fe,Mg,Al)_5(Al_2Si_6)O_{22}(OH)_2$

ANTHOPHYLLITE
$(Mg,Fe)_7Si_8O_{22}(OH)_2$

Class Inosilicate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Crystals prismatic, rare. Usually massive, fibrous, or lamellar.

Phys. *Cleavage* {110} perfect; {010}, {100} imperfect. **H** 5.5–5.6. **G** 2.85–3.57. *Color* white, gray, greenish, brownish green, clove brown, yellowish brown, dark brown. Transparent to nearly opaque. *Luster* vitreous to silky; somewhat pearly cleavage. *Streak* uncolored or grayish.

Occur.

Asbestiform minerals have been produced in Georgia from small deposits at the altered margins of ultramafic plutons. Historically, asbestos of these deposits has been described as anthophyllite. Detailed mineralogy of most of the known occurrences has not been determined. For this reason, most of the known asbestos deposits will be described herein as anthophyllite. Asbestos occurrences of Georgia were reviewed in detail by Hopkins (1914) and more recently by Teague (1956).

Barrow County: 1. Large lenses of mass-fiber and narrower veinlets of cross-fiber anthophyllite have been mined from the L. M. Arnold and E. R. Arnold properties, about one mile (1.6 km) northeast of Statham, near the headwaters of Fair Creek (Teague, 1956, p. 4). Relatively fresh, coarse-grained olivine occurs near the center of the ultramafic pluton.

Cherokee County: 1. Anthophyllite was prospected about 1940 with W.P.A. labor on the E.G. Bidey property, approximately 6 miles (9.7 km) northeast of Woodstock and 400 yards (366 m) southeast of Modesto School (Teague, 1956, p. 5). 2. A small amount of anthophyllite occurs as float over an ultramafic pluton exposed on the W. P. Worley property, approximately 7 miles (11 km) southeast of Canton on lot 71, 4th district, 2nd section.

Coweta County: 1. Float boulders of anthophyllite have been found on the P. H. Hawk property, approximately 6 miles (9.7 km) southwest of Newnan. 2. Similar anthophyllite has been prospected on lot 211, 2nd district, approximately 2.5 miles (4 km) south of Moreland and just east of Georgia Highway 41. Associated minerals are talc, chlorite and very minor tremolite (Teague, 1956, p. 4).

DeKalb County: 1. Anthophyllite mass-fiber and cross-fiber dikes are locally abundant over a large area on and bordering Soapstone Ridge, southeast of Atlanta and adjacent to Interstate Highway 285.

Habersham County: 1. A moderate quantity of partially weathered anthophyllite asbestos was produced between 1907 and 1928 from a small mine approximately 0.25 mile (0.4 km) south of Hollywood, between U.S. Highway 23 and the old Tallulah Falls Railroad. 2.Anthophyllite has been prospected extensively along a west-trending ridge from Wolfpit Mountain, approximately 1.5 miles (2.4 km) northwest of Soque, 11.5 miles (18.5 km) northwest of Clarksville. 3. Three individual anthophyllite prospects are located on the A.E. Berrong property south of the Soque–Helen road, 8.5 miles (13.7 km) northwest of Clarksville, 2.25 miles (3.6 km) due west of Yellow Mountain. Teague (1956, p. 6) reports a small production from this property. Asbestos is best developed along cracks in massive serpentine and as float adjacent to the rather small ultramafic plutons. 4. Anthophyllite has been extensively prospected near the margins of numerous ultramafic plutons exposed on Mack and Wolfpit Mountains. The prospects are approximately 11 miles (17.7 km) northwest of Clarksville and 1.5 miles (2.4 km) west and southwest of Soque. The area was evaluated in 1948 by the Georgia Department of Mines, Mining, Geology, and the Tennessee Valley Authority. This work indicates that a relatively small reserve of anthophyllite is present. 5. Anthophyllite was prospected extensively many years ago on the estate of E. P. West, lot 118, 11th district, one mile (1.6 km) south of Aerial (Hopkins, 1914, p. 157). The asbestos is within the altered margins of a enstatite-rich pyroxenite. 6. Anthophyllite asbestos associated with serpentine and talc has been prospected on the old G. L. Lyons place, approximately 5 miles (8 km) north of Sautee and 0.5 mile (0.8 km) north of the previously described Berrong property.

Hall County: 1. Veins of anthophyllite up to 5 inches (12.7 cm) in width occur in prospects on Soapstone Hill, approximately one mile (1.6 km) west of Gainesville immediately north of the Dawsonville Highway. Much of the asbestos is highly weathered and locally altered to talc. Excellent corundum was once found at this location.

Hancock County: 1. A relatively minor amount of float anthophyllite has been found on the old Moses W. P. Harris place, approximately 8 miles (12.9 km) northwest of Sparta (Hopkins, 1914, p. 188).

Jackson County: 1. A very small quantity of anthophyllite occurs in a prospect on the M. L. Carter property, approximately 1.5 miles (2.4 km) northeast of Nicholson (Hopkins, 1914, p. 174). 2. Anthophyllite has been prospected at several points on the L. G. Hardman estate, 2.5 miles (4 km) north of Center, 0.5 mile (0.8 km) west of the Southern Railway. Other prospects on the same property are near the junction of the Oconee River and Cabin Creek, and 3.5 miles (5.6 km) southwest of Nicholson near the junction of the Oconee River and Curry Creek (Hopkins, 1914, p. 175).

Meriwether County: 1. A moderate amount of anthophyllite asbestos has been shipped from the R. C. Mitchell property along the Greenville–Rocky Mount road, approximately 7 miles (11 km) northeast of Greenville, 0.25 mile north of Red Oak Creek (Teague, 1956, p. 5). The asbestos is found near the margin of an altered peridotite. This property has been previously described as the Joseph L. Chamblex prospect (Hopkins, 1914). 2. Approximately 10 tons of anthophyllite asbestos were produced in 1946 from the Thrash property, about 7 miles (11 km) northeast of Greenville, approximately 0.25 mile (0.4 km) northeast of Pauls Mill (Teague, 1956, p. 5). 3. Float asbestos of the anthophyllite variety has been found in cultivated fields on the property of R. C. Mitchell, about one mile (1.6 km) east of Pauls Mill, 6 miles (9.7 km) northeast of Greenville along the northeast side of Red Oak Creek (Teague, 1956, p. 5). 4. A small quantity of mass-fiber anthophyllite asbestos occurs near the margin of an altered ultramatic intrusion exposed 200 feet (61 km) north of the grade crossing at Primrose. Associated minerals are talc, olivine and serpentine.

Morgan County: 1. Float boulders of anthophyllite occur with corundum and talc on the G. W. Murelle property 4 miles (6.4 km) east of Newborn, 1.5 miles (2.4 km) east of Broughton.

Paulding County: 1. Anthophyllite asbestos and soapstone occur on the Dean and Hunt properties, one mile (1.6 km) west of Hiram on the south side of the Southern Railway, lots 763 and 750, 2nd district, 3rd section (Hopkins, 1914, p. 180). The asbestos is associated with a narrow ultramafic dike which forms the backbone of a low ridge approximately 0.75 mile (1.2 km) long.

Rabun County: 1. Mass-fiber anthophyllite asbestos has been prospected on the old Beavett or Landers property, approximately 2.6 miles (4 km) west of Dillard, 0.5 mile (0.8 km) north of Betty Creek and 0.25 mile (0.4 km) west of the McCoy Asbestos Mine. 2. A moderate production of anthophyllite asbestos is reported from an occurrence approximately 0.8 mile (1.3 km) due west of the junction of the West Fork and North Fork of the Chattooga River (Teague, 1956, p. 6). The asbestos occurs in veins up to 7 inches (18 cm) thick near the hanging wall contact of a small untramafic pluton. 3. A small occurrence of anthophyllite is reported along Darnell Creek, approximately 4.5 miles (7 km) southeast of Dillard, one mile (1.6 km) southwest of Rabun Bald (Teague, 1956, p. 6). 4. A moderate production of anthophyllite asbestos is reported from the northwest corner of lot 177, approximately 3 miles (4.8 km) west of Dillard, about 0.6 mile (0.97 km) north of the Betty Creek road. The asbestos is associated with the altered margins of a relatively large ultramafic pluton exposed on both sides of Burrell Branch. 5. A very small amount of anthophyllite asbestos has been produced from

the Gennett prospect, approximately 200 feet (61 m) north of the Clayton–Pine Mountain road, 4.4 miles (7 km) east of Clayton (Teague, 1956, p. 6). 6. A moderate production of anthophyllite asbestos is reported from the Hicks Mine, approximately 4 miles (6.4 km) by road northeast of Pine Mountain, one mile (1.6 km) south of the road to the Glades (Teague, 1956, p. 7). Long-fiber asbestos was shipped from this property in about 1885. Vermiculite is a locally abundant accessory mineral. 7. Anthophyllite has been prospected from the margins of a small ultramafic intrusive on the Frank Kelly property near the headwaters of Mud Creek, about 4 miles (6.4 km) east of Dillard. The prospect was examined with W.P.A. labor in 1940. The intrusion is not large and is composed essentially of amphibole, asbestos, chlorite, olivine, serpentine, talc and minor vermiculite. 8. Anthophyllite has been prospected over a small ultramafic pluton locally exposed on the George Lowell property, 4 miles (6.4 km) southwest of Tiger (Teague, 1956, p. 7). 9. Approximately 500 tons of anthophyllite asbestos have been produced from a working known as the McCoy Mine, approximately 2.5 miles (4 km) west of Dillard, about 0.5 mile (0.8 km) west of Betty Creek Road. Asbestos occurs in an altered ultramafic intrusion containing locally abundant chlorite and vermiculite along the contacts. 10. A small production of anthophyllite asbestos is reported from the Nicholson Mine located one mile (1.6 km) southeast of Pine Mountain, southeast of Laurel Creek about one mile (1.6 km) southwest of the Laurel Creek corundum deposit (Teague, 1956, p. 7). Magnetite and manganese oxides are locally abundant within the asbestos-rich rock. 11. A small discontinuous vein of cross-fiber anthophyllite asbestos about 12 inches (30 cm) thick was prospected in 1941 with W.P.A. labor at a point approximately 6 miles (9.7 km) southeast of Clayton within the Chattahoochee National Forest. 12. Anthophyllite has been produced from an altered ultramafic intrusion at the Reid Mine, approximately 1.5 miles (2.4 km) northeast of Pine Mountain, about one mile (1.6 km) due north of the Laurel Creek corundum deposit (Teague, 1956, p. 7). Vermiculite is a locally abundant accessory mineral.

Towns County: 1. Long-fiber anthophyllite asbestos is reported from the ultramafic pluton exposed at the Bell Creek corundum deposit, approximately 4 miles (6.4 km) northeast of Hiawassee on lot 6, 18th district. 2. Long-fiber anthophyllite asbestos has been prospected immediately north of the Hogg Creek Corundum Mine, lot 92, 17th district, 2 miles (3.2 km) west of Hiawassee. 3. A small amount of anthophyllite was encountered during active prospecting for corundum in the late 19th century on lot 42, 18th district (Hopkins, 1914, p. 151).

Troup County: 1. White, short-fiber anthophyllite asbestos is relatively abundant as float on the dumps of the old chromite prospects near Louise. Most former prospecting has been on the Beasley property, 7.35 miles (12 km) N66°E from LaGrange and about 450 feet (137 m) S30°E of Louise Church. The asbestos occurs as veins in altered peridotite. 2. Boulders of anthophyllite asbestos are locally abundant on the Higginbothem Estate (now subdivided), approximately one mile (1.6 km) north of the city limits of West Point, extending westward from U.S. Highway 29 to the floodplain of the Chattahoochee River. Asbestos-bearing rocks have been reported on lots 275, 285, 286, and 315, 5th district, a strike distance of approximately one mile (1.6 km) (Teague, 1956, p. 4). A deposit approximately 300 yards (274 m) west of the old Higginbothem home was prospected in about 1940 with W.P.A. labor. Asbestos is also abundant on the Albarado property, approximately 4,000 feet (1219 m) north of the old Higginbothem house. 3. Good quality anthophyllite asbestos containing fibers which locally exceed 6 inches (15 cm) in length occurs within sevveral altered ultramafic intrusions over an area of approximately 50 acres on the R. F. Floyd property, approximately 12.85 miles (20.6 km) S26°E from LaGrange, about 3.5 miles (5.6 km) west of Chipley along the Troup–Harris County line.

Walton County: 1. Anthophyllite asbestos has been prospected over a small, altered ultramafic pluton on property formerly owned by Perry Breedlove, lot 160, 3rd district, approximately 4.5 miles (7.2 km) east of Monroe. Veins up to 3 inches (7.6 cm) in width are exposed in old prospect pits. Talc and corundum are locally abundant.

GEDRITE

$(Mg,Fe,Al)_7(Al,Si)_8)_{22}(OH)_2$

Class Inosilicate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Crystals prismatic, rare. Usually massive, fibrous, or lamellar.

Phys. *Cleavage* {110} perfect; {010}, {100} imperfect. **H** 5.5–5.6. **G** 3.15–3.57. *Color* white, gray, greenish, brownish green, clove brown, yellowish brown, dark

brown. Transparent to nearly opaque. *Luster* vitreous to silky; somewhat pearly on cleavage. *Streak* uncolored or grayish.

Occur.

Douglas County: 1. Gedrite has been identified as the dominant amphibole group mineral in intensely altered wall rock of the Villa Rica massive sulfide deposit, approximately 3 miles (4.8 km) north-northwest of Villa Rica, immediately east of Georgia Highway 61 (Cook, 1970, p. 59). The mineral is light gray in thin section and occurs in subhedral grains up to 0.3 inch (0.8 cm) in length. Associated minerals are staurolite, biotite, chlorite and garnet.

CUMMINGTONITE

$Mg_7Si_8O_{22}(OH)_2$

Class Inosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals fibrous or lamellar; often in radiating masses.

Phys. *Cleavage* good {110}. **H** 5.5. **G** 3.28–3.387. *Color* white, light gray, light brown, dark green to nearly black.

Occur.

DeKalb County: 1. Probable cummingtonite is the dominant amphibole-group mineral in a small, altered ultramafic pluton, approximately 1.4 miles (2.25 km) S27°E of Stone Mountain (Prowell, 1971, p. 40). 2. Herrmann (1954, p. 28) describes cummingtonite in a garnet-cummingtonite gneiss near Norris Lake Dam.

Fulton County: 1. Cummingtonite occurs with antigorite, diopside, enstatite, pigeonite, olivine and talc in an altered ultramafic pluton at the Welcome-All Recreation Area, approximately 0.95 mile (1.5 km) N87°W of Red Oak (Prowell, 1971, p. 26).

TREMOLITE

$Ca_2Mg_5Si_8O_{22}(OH)_2$

Class Inosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals usually long prismatic to acicular; also fibrous.

Phys. *Cleavage* perfect {110}. **H** 5–6. **G** 3.0–3.4. *Color* white to gray. Insoluble in acids.

Occur.

Tremolite has been reported as a local constituent of regional metamorphic rocks of the Piedmont, typically within rocks that were originally rich in calcium and magnesium. It also occurs as coarsely crystalline aggregates near the margins of altered mafic and ultramafic plutons.

Cherokee County: 1. Aggregates of slender tremolite prisms, locally altered to talc, are abundant around the periphery of a small ultramafic pluton exposed on lot 567, 15th district, approximately 2 miles (3.2 km) southwest of the Verde Antique Quarry at Holly Springs (Hopkins, 1914, p. 278). 2. Tremolite in fibrous masses is relatively abundant at the margins of a small mafic pluton exposed on lot 554, 15th district, 2nd section, approximately 2 miles (3.2 km) northeast of Toonigh. 3. Coarsely crystalline, colorless prisms of tremolite occur in marble approximately 9 miles (14 km) north of Canton. Samples of this material were submitted to the Georgia Geological Survey in 1896.

Coweta County: 1. Coarsely crystalline tremolite is relatively abundant on the dumps of an old asbestos prospect on the Tremell property, 2.7 miles (4.3 km) S25°E of Moreland (Teague, 1956, p. 4).

Fannin County: 1. Coarsely crystalline sprays of tremolite are abundant with zoisite, diopside, and calcite on the dumps of the Number 20 Copper Mine, lot 20, 9th district, 2nd section. 2. Long masses of light-colored tremolite crystals are quite conspicuous on weathered surfaces of marble exposed on lot 198, 8th district, 2nd section, near the junction of Cutcane and Hemptown Creeks (McCallie, 1894, p. 25). 3. Coarsely crystalline tremolite in marble has been submitted to the Georgia Geological Survey for identification from unspecified occurrences in the vicinity of Mineral Bluff.

Paulding County: 1. Samples containing tremolite prisms in massive vein quartz were submitted to the Georgia Geological Survey from the Yorkville Gold Mine, lot 331, 19th district, approximately 2.5 miles (4 km) east of Yorkville.

Pickens County: 1. Tremolite is mentioned as a common constituent of marbles quarried in the vicinity of Marble Hill (McCallie, 1894, p. 40). 2. Bayley (1928, p. 88) describes colorless transparent crystals of tremolite standing out on the surface of weathered marble outcrops in the immediate vicinity of the New York Quarry near Marble Hill. Some of the tremolite crystals are at least one inch (2.5 cm) long. Float aggregates of fibrous tremolite containing crystals up to 3 inches (7.6 cm) long in a matrix of interstitial calcite are described. Local thin bands contain light-green tremolite in association with phlogopite.

Rabun County: 1. King (1894, p. 82) reports that tremolite is abundant in the altered margins of the dunite exposed at the old corundum mine on Laurel Creek, lot 72, 3rd district, near Pine Mountain.

ACTINOLITE

$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$

Class Inosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals usually long prismatic to acicular; also fibrous.

Phys. *Cleavage* perfect {110}. **H** 5–6. **G** 3.0–3.4. *Color* bright green to grayish white. Sometimes transparent. Insoluble in acids.

Occur.

Actinolite is a very widely distributed member of the amphibole group. It has been described from numerous occurrences near the altered margins of mafic and ultramafic plutons and within extensive zones of metavolcanics and metasediments, particularly within the Little River Series and the west-central Georgia Piedmont. Selected occurrences typical of the mineral are given below.

Carroll County: 1. Large aggregates of long, slender, bright-green actinolite needles occur around the Foodtown Shopping Center, 0.6 mile (0.97 km) N77°W of Villa Rica. The actinolite is locally altered to talc. 2. Similar actinolite–talc outcrops are described by King (1894, p. 104) on lot 165, 2nd district. Actinolite at this location is described as crystals up to 3 inches (7.6 cm) in length and 0.3 inch (0.76 cm) in diameter embedded in pure granular white talc. 3. Small bladed crystals of actinolite, locally altered to talc and chlorite, occur in the altered portions of an ultramafic pluton exposed on the Gayle Burns (J. S. Pitts) property, approximately 1.4 miles (2.25 km) N85°E of Carrollton on lot 110, 5th district.

Fannin County: 1. Coarsely-crystalline green actinolite is a locally abundant gangue mineral on the dumps of the Number 20 Copper Mine, lot 20, 9th district, 2nd section, aproximately 3 miles (4.8 km) southwest of Copperhill, Tennessee.

Murray County: 1. Fibrous green actinolite occurs locally at the numerous operating and abandoned talc properties in the Chatsworth district. Actinolite has been reported in relative abundance on lots 294, 295, 296, and 297 (Hopkins, 1914, p. 211).

Paulding County: 1. Actinolite crystals are locally abundant in altered portions of an ultramafic pluton exposed on lots 1171 and 1172, 3rd district, 3rd section, approximately 3.5 miles (5.6 km) northeast of Dallas (Hopkins, 1914, p. 281). Associated minerals are talc, anthophyllite and chlorite. 2. Actinolite is common in altered metavolcanic rock exposed over an extensive area in the central part of the county. Excellent outcrops of actinolite-rich rock may be found in the vicinity of the Little Bob Pyrite Mine, approximately 2 miles (3.2 km) northwest of Hiram. Similar material may be found along strike both to the northeast and southwest. The actinolite is typically dark-green. Prismatic crystals up to several inches in length occur in locally garnetiferous chlorite schist.

Troup County: 1. Rock containing prismatic crystals of blue-green actinolite is locally abundant in and around the talc and asbestos occurrences on the Higgenbothem Estate, approximately 0.5 to 2 miles (0.8 to 3.2 km) northeast of West Point on both sides of U.S. Highway 29. The actinolite and associated minerals are related to altered mafic and ultramafic rocks which cover an area of approximately 3 square miles (7.7 sq. km). Actinolite is most abundant 4,600 feet (1402 m) N59°E from the east abuttment of the Chattahoochee River Bridge (Long, 1971, p. 32-33).

Walton County: 1. Exceptionally bright-green actinolite in aggregates of crystals up to 2 inches (5 cm) in length occurs near the margins of a small ultramafic pluton formerly prospected for corundum, talc and asbestos on the old Perry Breedlove place, lot 160, 3rd district, 4.5 miles (7 km) east of Monroe.

HORNBLENDE

$(Ca,Na)_{2-3}(Mg,Fe^{+2},Fe^{+3},Al)_5(Al,Si)_8O_{22}(OH)_2$

Class Inosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals commonly short to long prismatic; also in long blades, columnar, fibrous, or massive granular.

Phys. *Cleavage* perfect {110}. *Fracture* subconchoidal, uneven. Brittle. **H** 5–6. **G** 3.0–3.5. *Luster* vitreous to pearly on cleavage faces; silky when fibrous. *Color* bright or dark green, bluish green, grayish black and black. Subtranslucent. Insoluble in acids.

Occur.

Hornblende is one of the most widely distributed and abundant amphibole group minerals of the crystalline rocks in the Piedmont and Blue Ridge. Hornblende is most abundant in amphibolite-grade metamorphic rocks such as those of the extensive Little River Series of metavolcanics and metasediments exposed over wide areas in Lincoln, Wilkes and McDuffie Counties. Similar hornblende-rich rocks are extensively exposed in west-central Georgia and are particularly associated with sulfide occurrences in Paulding, Carroll, Haralson, Douglas, Bartow and Cobb Counties. Hornblende is an important constituent of host and wall rocks of gold vein occurrences in the Dahlonega district, Lumpkin County. The mineral is locally abundant in portions of layered mafic complexes, particularly in Jasper and Monroe Counties and is an important constituent of altered margins of ultramafic plutons, particularly in Towns, Rabun and Habersham Counties. Relatively few unique or unusual occurrences of hornblende have been reported. Several worthy of mention are described below.

Paulding County: 1. Exceptional crystals of dark greenish-black hornblende prisms up to 4 inches (10 cm) long occur on the dumps of the Little Bob Pyrite Mine, 2nd district, 3rd section, approximately 3 miles (4.8 km) northwest of Hiram. 2. Similar large hornblende crystals occur in aggregates with reddish garnet and chlorite on dumps of the Swift massive sulfide Prospect, lots 1184, 1197, 1198 and 1199, 19th district, 3rd section, approximately 1.25 miles (2 km) east of Draketown. 3. Excellent hornblende and garnet crystals occur in quartzitic rock on the dump of the Liberty pyrite prospect, lots 482, 483, and 527, 2nd district, 3rd section, approximately 0.5 mile (0.8 km) northeast of the Little Bob Pyrite Mine.

Towns County: 1. Exceptional crystals of black hornblende in white quartz are relatively abundant on the dump and as float around the lower Bell Creek Corundum Mine, approximately 7 miles (11 km) northwest of Hiawassee (Grant, 1949b, p. 6). Crystal fragments up to 8 inches (20 cm) in length are common. This is probably the location described by King (1894, p. 90) as the J. N. Gibson property, lot 42, 23rd district. King reports the presence of large black hornblende crystals associated with plagioclase feldspar and irregular grains of grayish-white and blue corundum.

HASTINGSITE

$NaCa_2(Fe,Mg,Al)_5(Al_2Si_6)O_{22}(OH)_2$

Class Inosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals short to prismatic. Also massive compact. Twinning on {100} common, simple lamellar.

Phys. *Cleavage* {110} perfect; {001} and {100} parting. **H** 5–6. **G** 3.140 (calc.). *Color* dark green, black. Translucent to nearly opaque. *Luster* vitreous.

Occur.

Cherokee County: 1. Hastingsite constitutes up to 28 percent of a calc-silicate bed in the Andrews Schist at the northern tip of the Keithsburg Marble Belt, approximately one mile (1.6 km) southeast of Nelson (Fairley, 1965, p. 47). Associated minerals are zoisite and quartz.

PYROXENE GROUP

Members of the Pyroxene Group are common rock-forming minerals found in igneous and metamorphic rocks. They are particularly abundant in mafic and ultramafic plutons, diabase dikes, and charnockitic rocks of the Piedmont and Blue Ridge. One member of the group, enstatite, is a common mineral in both metallic and stoney meteorites. Minerals of the Pyroxene Group are so common that only examples of typical or interesting occurrences can be given.

The species known to occur in Georgia are listed below:

Species	*Chemical Composition*
Enstatite	$Mg_2Si_2O_6$
Hypersthene	$(Mg,Fe)_2Si_2O_6$
Augite	$(Ca,Na)(Mg,Fe,Al,Ti)(Si,Al)_2O_6$
Diopside	$CaMgSi_2O_6$
Pigeonite	$(Mg, Fe,Ca)\ (Mg,Fe)Si_2O_6$
Spodumene	$LiAlSi_2O_6$

ENSTATITE
$Mg_2Si_2O_6$

Class Inosilicate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Distinct crystals rare; prismatic. Generally massive. Fibrous or lamellar.

Phys. *Cleavage* perfect {210}. *Fracture* uneven. Brittle. **H** 5½. **G** 3.1–3.3. *Luster* pearly to vitreous. *Color* greenish or brownish gray to brown. *Streak* uncolored, grayish. Translucent to nearly opaque.

Occur.

Enstatite is exceedingly common in numerous small, partially altered mafic and ultramafic plutons of the Piedmont and Blue Ridge in Georgia. It is historically described in the published literature as the dominant pyroxene in most altered pyroxenites that have been prospected for talc and asbestos. It is a locally important constituent of gabbros, particularly in Jasper and Monroe Counties, and of ultramafic and related rocks in the vicinity of Lake Chatuge, Towns County. Examples typical of the occurrence of enstatite are given below.

Carroll County: 1. Remnant enstatite is locally abundant in a large, altered pyroxenite intrusion exposed at the Foodtown Shopping Center, 0.75 mile (1.2 km) west of Villa Rica on U.S. Highway 78. Extensive alteration has resulted in the formation of talc, asbestos, actinolite and serpentine. 2. A similar, though less altered, enstatite rock is exposed on the A. H. Walker property, 3.5 miles (5.6 km) south of Carrollton, lot 32, 10th district (Hopkins, 1914, p. 287).

Cherokee County: 1. A large pyroxenite pluton, composed mostly of large, platy enstatite crystals which enclose grains of olivine and magnetite, is exposed on the W.P. Worley property, approximately 7 miles (11 km) east of Canton on lot 71, 4th district, 2nd section, (Hopkins, 1914, p. 172).

Cobb County: 1. A small hartzburgite pluton containing essential enstatite is described by Hopkins (1914, p. 179) on the J. H. Cantrell property, approximately 1.5 miles (2.4 km) south of Smyrna. Asbestos has been prospected at this location.

DeKalb County: 1. Enstatite is locally abundant within the large, altered mafic pluton known as Soapstone Ridge, immediately southeast of Atlanta adjacent to Interstate Highway 285.

Fulton County: 1. Enstatite is a locally important constituent of the altered ultramafic pluton exposed at Welcome-All Recreation Area, 0.95 mile (1.5 km) N87°W from Red Oak (Prowell, 1971, p. 26).

Habersham County: Enstatite is the dominant pyroxene in a highly altered pyroxenite body exposed on lot 118, 11th district, one mile (1.6 km) south of Aerial (Hopkins, 1914, p. 157). The enstatite is locally altered to anthophyllite.

Rabun County: 1. A large pyroxenite pluton composed predominantly of enstatite is exposed on Pig Pen Mountain, one mile (1.6 km) southeast of Pine Mountain. Enstatite occurs as large bladed crystals associated

with talc and deep-green chlorite (Hopkins, 1914, p. 52). 2. Aggregates of augite and enstatite (bronzite) are locally abundant in olivine websterite collected from an unspecified occurrence near Rabun Gap (Hopkins, 1914, p. 56). 3. Enstatite is the dominant pyroxene within the margins of a mafic pluton exposed at the old Hicks Asbestos Mine northeast of the Laurel Creek Corundum Mine, lot 81, 3rd district.

HYPERSTHENE
$(Mg,Fe)_2Si_2O_6$

Class Inosilicate

Cryst. Orthorhombic; rhombic-dipyramidal—2/m 2/m 2/m

Habit Crystals rare; prismatic; tabular. Generally massive, foliated.

Phys. *Cleavage* prismatic {210}. *Fracture* uneven. Brittle. **H** 5–6. **G** 3.4–3.9. *Luster* pearly to vitreous. *Color* brownish green, grayish black, greenish black, brown. *Streak* grayish. Translucent to nearly opaque.

Occur.

Hypersthene is a relatively common and important rock-forming mineral in widely distributed mafic igneous plutons, and within charnockite (hypersthene granite) and related rocks of Upson and Talbot Counties. Hypersthene is undoubtedly more widespread than the published literature would indicate, primarily because hypersthene was originally considered a variety of enstatite and as such, many old petrographic descriptions refer simply to enstatite.

Towns County: Hypersthene is a locally important constituent of olivine gabbro in the vicinity of Lake Chatuge (Hartley, 1973, p. 18).

Troup County: 1. Hopkins (1914, p. 57) presents a detailed description of an altered pyroxenite containing abundant hypersthene at an unspecified location 1.5 miles (2.4 km) north of West Point.

Upson County: Hypersthene is an essential component of charnockite and related rocks exposed over broad areas of central Upson and eastern Talbot Counties. The hypersthene-bearing rocks include charnockite, hypersthene quartz monozonite, hypersthene granodiorite, and hypersthene gabbro. Hypersthene content varies from only 2 percent in some charnockite to 23 percent in norite.

The major mass of charnockitic rock underlies an area of approximately 9 square miles extending from Thomaston eastward. The unit is apparently intrusive into surrounding granitic rocks. Approximately 1.5 miles (2.4 km) south of the main mass is a smaller occurrence near Redbone Crossroads. A linear trend of hypersthene-rich rocks extends for at least 8 miles (12.8 km) from near Flint Hill School in the western part of Upson County to the vicinity of Pleasant Hill in Talbot County (Clarke, 1952, p. 36-60).

AUGITE
$(Ca,Na)(Mg,Fe,Al,Ti)(Si,Al)_2O_6$

Class Inosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals usually short prisms; also granular, coarse or fine.

Phys. *Cleavage* distinct {110}. *Fracture* uneven to conchoidal. Brittle. **H** 5-6. **G** 3.2-3.4, varying with the composition. *Luster* vitreous to resinous; often dull. *Color* usually various dull shades of green. Transparent to opaque.

Occur.

Augite is a rather widely distributed, and locally is an abundant constituent of some mafic igneous rocks, particularly diabase dikes of the Piedmont.

Bartow County: 1. Partially uralitized augite in grains up to 0.4 inch (1 cm) in diameter is a major constituent of a rock originally described by Kesler (1950, p. 21) as andesine-augite gneiss. The rock crops out locally east of the Cartersville Mining District and may be observed in road cuts approximately 0.5 mile (0.8 km) north of Corbin School, at Double Springs Church, and at various spots along the shore of Allatoona Lake.

Cherokee County: 1. Augite is an important constituent of a basalt or diabase dike exposed in a road cut several hundred feet southeast of Conn Creek School. Augite occurs here as a granular filling between fresh, divergent plagioclase laths. This rock is mineralogically similar to diabase dikes in other parts of the Piedmont.

Columbia County: 1. Augite is described as an essential constituent of unaltered portions of the ultramafic rock underlying Hatcher Mountain, a member of the Burt and Dixie Mountain Group, extending from near Pollards Corners east to the Savannah River (Hopkins, 1914, p. 23). Associated minerals are anorthite, hornblende, epidote, zoisite, chlorite and magnetite. Alteration to serpentine is locally extensive.

Elbert County: 1. Remnant augite within the central portions of hornblende aggregates is described in a gabbro collected at an unspecified location 8 miles (13 km) southeast of Elberton by Hopkins (1914, p. 33).

Greene County: 1. Augite is the dominant pyroxene in metapyroxenite exposed locally near Flint Lake in the Bethesda Church area (Medlin and Hurst, 1967, p. 21). Alteration to fibrous hornblende and epidote-clinozoisite is extensive. Outcrops may be observed in the spillway of Flint Lake, 500 feet (152 m) east of the spillway, and south along the road to Georgia Highway 44.

Rabun County: 1. Augite and enstatite occur as small grains and as larger aggregates in olivine websterite exposed near Rabun Gap (Hopkins, 1914, p. 56). Augite predominates over enstatite in this rock. Both minerals have been extensively altered to hornblende and biotite.

DIOPSIDE

$CaMgSi_2O_6$

Class Inosilicate

Cryst. Monoclinic; prismatic—2/m

Habit In prismatic crystals; also granular and columnar to lamellar massive.

Phys. *Cleavage* {110} good. *Fracture* uneven to conchoidal. Brittle. **H** 5–6. **G** 3.25–3.55. *Luster* vitreous, inclining to resinous; often dull. *Color* white, yellowish, grayish white to pale green, dark green, and nearly black; rarely colorless or blue. *Streak* white to gray and grayish green. Transparent to opaque.

Occur.

Diopside occurs locally within mafic plutons of the Piedmont and Blue Ridge and as a contact metamorphic mineral, predominantly in metasedimentary rocks originally rich in dolomite or other magnesium-bearing carbonates.

DeKalb County: 1. Diopside is a locally important constituent of pyroxene-hornblende gneiss occurring as bands within garnet-mica schist and porphyroblastic biotite gneiss in an approximately 0.5 mile (0.8 km) zone bordering the Lithonia Gneiss (Herrman, 1954, p. 21). Diopside constitutes up to 31 percent of this unit where it is exposed in a road cut 2,500 yards (2286 m) N48°W of Lithonia Post Office.

Fannin County: 1. Very coarsely crystalline diopside is locally abundant on the dumps of the Number 20 Copper Mine, lot 20, 9th district, 2nd section (Shearer and Hull, 1918, p. 213).

Fulton County: 1. Diopside is a constituent of the altered ultramafic pluton at the Welcome-All Recreation Area, approximately 0.95 mile (1.5 km) N87°W of Red oak (Prowell, 1971, p.26). 2. Coarsely crystalline diopside in quartz has been collected from the F.A. White property, approximately 3 miles (4.8 km) west of Fairburn.

Pickens County: 1. Diopside is mentioned by McCallie (1894, p. 40) as an uncommon accessory mineral within impure portions of marble quarried at Marble Hill. It is typically associated with relatively abundant tremolite.

Towns County: 1. Rosettes of diopside and enstatite occur in olivine gabbro at the Hogg Creek Corundum Mine, 2.5 miles (4 km) west of Hiawassee, lot 92, 17th district (Hopkins, 1914, p. 39). 2. Diopside is a locally important constituent of gabbro, olivine gabbro and troctolite extensively exposed in the Lake Chatuge area (Hartley, 1973, p. 18–19).

Upson County: 1. Diopside constitutes 12 percent of a contact metamorphic rock exposed approximately 0.5 mile (0.8 km) south of Dog Crossing, 4 miles (6.4 km) northeast of Thomaston (Clarke, 1952, p. 26). Associated minerals are garnet, scapolite, and vesuvianite.

PIGEONITE
$(Mg,Fe,Ca)(Mg,Fe)Si_2O_6$

Class Inosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals short prismatic. Usually as disseminated microphenocrysts and small grains. Twinning on {001} or {100}, simple or lamellar.

Phys. *Cleavage* {110} good; {001}, {010}, and {100} parting. **H** 6. **G** 3.54 (calc.). *Color* brown, light purplish brown, greenish brown, black. Translucent to nearly opaque. *Luster* vitreous to dull.

Occur.

Fulton County: 1. Pigeonite has been identified as a minor constituent of an altered ultramafic pluton exposed at the Welcome-All Recreation Area, 0.95 mile (1.5 km) N87°W of Red Oak (Prowell, 1971, p. 26). Associated minerals are antigorite, cummingtonite, diopside, enstatite, oliving and talc.

SPODUMENE
$LiAlSi_2O_6$

Class Inosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals prismatic, often flattened and vertically striated. Crystals sometimes very large.

Phys. *Cleavage* perfect {110}. Well-developed parting parallel to {100}. *Fracture* uneven to subconchoidal. Brittle. **H** 6½–7. **G** 3.0–3.2. *Luster* vitreous, on cleavage surfaces somewhat pearly. *Color* white, yellowish, greenish, emerald-green, lilac-pink.

Occur.

Cherokee County: 1. Spodumene has been reported in the vicinity of Ball Ground from a location that is now lost. Numerous complex zoned pegmatites have been prospected in the Ball Ground district and the presence of minor spodumene would not be unusual.

RHODONITE
$(Mn,Fe,Ca,Mg)SiO_3$

Class Inosilicate

Cryst. Triclinic; pinacoidal—$\bar{1}$

Habit Crystals commonly tabular parallel to {001}, usually rough with rounded edges. Commonly massive, cleavable to compact; also fine to coarse granular.

Phys. *Cleavage* {110} and {$1\bar{1}0$} perfect; {001} good. **H** 5.5–6.5. **G** 3.726 (calc.). *Color* pink to rose red to brownish red, often veined by black alteration products; rarely yellow, gray. Transparent to translucent. *Luster* vitreous; somewhat pearly on cleavages.

Occur.

The first two occurrences given below represent some of the earliest entries in the museum catalog of the Georgia Geological Survey. The samples could not be located during research for this book and the identification of the mineral is questionable.

DeKalb County: 1. Samples identified as rhodonite were submitted in 1896 from an unspecified location near Lilburn.

Douglas County: 1. Samples identified as rhodonite were submitted in 1895 from an unspecified location in Douglas County.

Lincoln County: 1. Minor rhodonite occurs with other manganese silicates and rhodochrosite below water level in the Colley Manganese Mine adjacent to Georgia Highway 47, approximately 3.5 miles (5.6 km) east of Lincolnton.

Wilkes County: 1. Mineralized chlorite schist cut by stringers of garnet and rhodonite are reported at a depth of 130 feet (40 m) in a diamond drill hole at the Chambers zinc prospect, approximately 0.5 mile (0.8 km) west of the Magruder Gold Mine on Butlers Creek (Peyton and Cofer, 1950, p. 22).

URANOPHANE

$Ca(UO_2)_2Si_2O_7 \cdot 6H_2O$

Class Inosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals are acicular to hairlike, and occur as stellate or tufted aggregates or as crusts. Also masive, microcrystalline, with a fibrous or felted structure and appearing dense to the unaided eye; as soft, shredded, or felted coatings.

Phys. *Cleavage* {100} perfect. Brittle. **H** 2½. **G** 3.7–3.9. *Luster* vitreous, pearly on cleavage; massive material may appear dull, earthy or waxy. *Color* lemon yellow to pale straw yellow and honey brown; also greenish yellow to yellowish green; orange yellow. Crystals weakly fluorescent green in ultraviolet light; massive material usually not fluorescent.

Occur.

The occurrence of uranophane is restricted to pegmatites and related granitic intrusive rocks of the crystalline Piedmont.

DeKalb County: Uranophane associated with hyalite coats major joints in quarries on the northwest side of Stone Mountain. 1. Watson (1902, p. 115–116) reports that uranophane is particularly abundant on joint surfaces in the Hayne Quarry, on the northwest slope of Stone Mountain. 2. Uranophane coats joint planes exposed in the Britt Quarry, approximately 1.5 miles (2.4 km) east of Stone Mountain (Herrmann, 1954, p. 91). 3. Yellow-green coatings of uranophane are common on the horizontal sheeting planes exposed in Stone Mountain quartz monzonite at the Flat Rock Quarry, 0.5 mile (0.8 km) north of the carving on Stone Mountain (Herrmann, 1954, p. 93).

Upson County: 1. Thin films of uranophane coat fractures in dump material at the W. E. Adams Mica Mine, 2.5 miles (4 km) N3°E of the main highway–railroad crossing at Yatesville.

BETA-URANOPHANE

$Ca(UO_2)_2Si_2O_7 \cdot 6H_2O$

Class Inosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals usually small prismatic, elongated along C-axis, with square or rectangular cross section. As felt-like coatings or radial to fan-shaped aggregates of acicular crystals; and as dense aggregates, often pseudomorphous after uraninite.

Phys. *Cleavage* {010} perfect; {100} reported. **H** 2.5–3. **G** 3.93 (meas.). *Fracture* conchoidal. Brittle. *Color* yellowish green to yellow. Transparent to translucent. *Luster,* crystals vitreous; fibrous aggregates silky; dense massive aggregates greasy to waxy. Fluorescent weak green in ultraviolet light.

Occur.

Lamar County: 1. Beta-uranophane as thin, lemon-yellow films coats fractures in pegmatite at the A. N. Moye Mica Mine, about 5 miles (8 km) southeast of Barnesville (Furcron, 1955, p. 42).

KAOLINITE
$Al_2Si_2O_5(OH)_4$

Class Phyllosilicate

Cryst. Triclinic; pinacoidal

Habit Crystals in thin pseudohexagonal scales or plates. Usually in compact-clay-like masses.

Phys. *Cleavage* perfect basal. Flexible, inelastic. **H** 2-2½. **G** 2.61. *Luster* of plates, pearly; of mass, pearly to dull earthy. *Color* white, grayish, yellowish; sometimes brownish, bluish, or reddish. Scales transparent to translucent. Usually plastic with greasy feel.

Occur.

Kaolinite is Georgia's most important industrial mineral. It was originally mined in the 18th century for the British pottery trade and has been mined almost continuously since that time. Today, Georgia produces more kaolinite than any other state. The gross value of this clay exceeds that of any other mineral commodity. In addition to its economic occurrence, kaolinite is one of the most abundant and widespread soil-forming minerals. It is particularly notable in soils overlying feldspathic rocks such as granite and granite gneisses.

Kaolinite is produced commercially from Cretaceous and Eocene formations in the northern Coastal Plain, predominantly in a belt extending from slightly southeast of Macon to slightly west of Augusta. In addition to the deposits currently yielding pure kaolinite, structural and refractory clays rich in kaolinite are produced in Bartow, Bibb, Columbia, Douglas, Floyd, Fulton, Hancock, Muscogee, Polk, Thomas and Walker Counties (Martin and Stafford, 1972). Occurrences described below are those in which relatively pure kaolinite is currently produced in quantity.

Baldwin County: 1. Kaolinite has been extensively mined at the Wood Pit just south of Stephens Pottery, east of Georgia Highway 243 near the Baldwin–Wilkinson County line.

Houston County: 1. Kaolinite is produced in two pits located 4.75 and 6.75 miles (7.6 and 10.8 km) northeast of Perry city limits, approximately one mile (1.6 km) west of Georgia Highway 241.

McDuffie County: 1. High purity kaolinite for use as paper filler and coater is mined from the Poss Pit, approximately 5.75 miles (9.25 km) south of the Thompson city limits and 3.75 miles (6 km) southwest of Dearing, between Georgia Highways 12 and 17 on Shoals Road.

Richmond County: 1. Kaolinite-rich clays are produced from the Albion Kaolin Pit at the west city limits of Hepzibah, 0.5 mile (0.8 km) north of Georgia Highway 88.

Twiggs County: Kaolinite has been mined extensively from occurrences in the northern half of the county. Principal operations are those of United Sierra DIvision of Cyprus Mines Corporation, approximately 10 miles (16 km) north-northwest of Jeffersonville between Georgia Highways 23 and 80; mines of the Freeport Kaolin Company, approximately 6 miles (9.7 km) southwest of Gordon and between 8.25 and 9.5 miles (13.3 and 15 km) north of Jeffersonville city limits; the numerous mines of the Georgia Kaolin Company in the northern part of the county; and the mines of the J. M. Huber Corporation between 6 and 9.5 miles (9.7 and 15 km) northwest of Jeffersonville city limits, between U.S. Highways 80 and 23.

Warren County: 1. Kaolinite is produced from 3 facilities in extreme southeastern Warren County between Georgia Highway 17 and 47, south of Big Brier Creek.

Washington County: Kaolinite is produced from at least 9 major facilities from 4 to 10 miles (6.4 to 16 km) west of Sandersville, centering around the community of Deepstep.

1. Kaolinite is mined from several open pits, 4.75 and 7.75 miles (7.6 and 12.4 km) west of Sandersville from north of Deepstep to south of Georgia Highway 24. 2. Similar kaolinite is produced from mines of Anglo American Clays Corporation between 5.5 and 11 miles (8.9 and 17.7 km) west and northwest of Sandersville, from 4 miles (6.4 km) west of Georgia Highway 115 to just north of Georgia Highway 24. 3. Champion Papers, Inc., produces high-quality kaolinite from the Armstrong Mine, approximately 10.75 miles (17.3 km) west of Sandersville and 0.5 mile (0.8 km) south of Georgia Highway 24. 4. High quality kaolinite is produced from the Renfroe-Bateman and Roughton Mines of the United Sierra Division of Cyprus Mines Corporation between 5.5 and 7 miles (8.9 and 11 km) north and west of Sandersville. 5. Similar kaolinite is produced by the Engelhard Minerals and Chemical Corporation from the Fowler, Jenkins, and Wiggins Pits, approximately 12 miles (19 km) west of Sandersville and one mile (1.6 km) north of Georgia Highway 24. 6. Thiele Kaolin Company produces high quality kaolinite from the Hodges Pit, approximately 7 miles (11 km) west of Sandersville on Georgia Highway 24; and from the Veal Pit approximately 8 miles (13 km) west of Sandersville and 0.5 mile (0.8 km) west of Georgia Highway 24.

Wilkinson County: High-grade kaolinite is produced from approximately 15 major operations owned by 7 individual companies along a belt through the central part of Wilkinson county, centering near the town of Irwinton.

1. Kaolinite is produced from the Wall Pits of the United Sierra Division of Cyrus Mines Corporation, approximately 4 miles (6.4 km) northeast of Jeffersonville on Porter Creek, one mile (1.6 km) east of the Twiggs County line. 2. Similar kaolinite is produced by the Engelhard Minerals and Chemical Corporation from its Klondike, Gibralter, and Prim Pits, 4.75 miles (7.6 km) north of Irwinton, 6.34 miles (10.2 km) northeast of Irwinton and 1.75 miles (2.8 km) northeast of Toomsboro respectively. 3. Kaolinite is mined from the Semmes Pit by Evans Clay Company, 6.75 miles (10.9 km) southwest of Irwinton city limits on Porter Creek. 4. Kaolinite is produced from the Bentley Pit of Fountain Kaolin Company, approximately 3 miles (4.8 km) northeast of Irwinton city limits, 2 miles (3.2 km) east of U.S. Highway 441 and west of Dry Branch Creek. 5. Kaolinite is mined extensively by the Freeport Kaolin Company in an area 9.5 miles (15.2 km) west of Irwinton, 6.5 miles (10.4 km) south of Gordon and 2.5 miles (4 km) south of Georgia Highway 57, along Georgia Highway 18. 6. Kaolinite is mined by the Georgia Kaolin Company over an extensive area centering 10 miles (16 km) west of Irwinton city limits and 0.5 mile (0.8 km) south of Georgia Highway 57 and along the Wilkinson–Twiggs County line, approximately 1.5 miles (2.4 km) west of Georgia Highway 18. 7. High quality kaolinite is produced from the Cobb Pit of M. and M. Clays, Inc., approximately 5.5 miles (8.9 km) west of Irwinton city limits, north of Big Sandy Creek.

HALLOYSITE

$Al_2Si_2O_5(OH)_4$

Class Phyllosilicate

Cryst. Monoclinic; domatic—m

Habit Massive, clay-like or earthy.

Phys. *Cleavage* none. *Fracture* conchoidal **H** 1-2. **G** 2.1 (to 2.6 after dehydration at 110°). *Luster* somewhat pearly, or waxy to dull. *Color* grayish, greenish, yellowish, bluish, reddish. Translucent to opaque.

Occur.

Halloysite is a particularly widespread constituent of soils developed over a wide variety of rock types. It has been reported by various workers concerned with the details of weathering processes and as a mineral associated with residual iron and manganese deposits in the Cartersville Mining District. Halloysite has been mined in Chatooga County near Gore. Although halloysite is mentioned frequently in the older literature, identification techniques of sufficient sophistication to positively identify this mineral were not available when the old descriptions were made. For this reason, only occurrences of known halloysite in significant quantities are given below.

Bartow County: 1. Rather extensive halloysite deposits of good quality have been reported from near Bartow in the Cartersville Mining District. Electron photomicrographs of this material collected on the Frank Smith property were published in the Georgia Mineral Newsletter (1959, p. 43). 2. Hurst and Crawford (1970, p. 116) report the occurrence of halloysite in a major zone of movement exposed in the Bartow Number 3 Mine, lots 901, 902 and 971, 4th district. The clay is iron-stained and apparently impure. 3. Halloysite in compact masses and banded botryoidal form fills fissures and cavities in breccia exposed in the Black Bank Iron Mine on lot 186, 22nd district, 3.3 miles (5.3 km) east of White (Hurst and Crawford, 1970, p. 132).

Chatooga County: 1. Halloysite is found in considerable quantity along the east side of Taylor Ridge about 6 miles (9.7 km) north of Gore. The occurrence occupies an approximately 3 mile (4.8 km) long zone within the Armuchee Chert Formation. Detailed examination of the mineral suggests that it may be the end product of the dehydration of endellite. Although relatively extensive prospecting has been conducted along the length of the trend, the largest production has been from 2 major openings near the central part of the occurrence. Production is estimated at less than 1,000 tons (Broadhurst and Teague, 1954, p. 56).

ENDELLITE

$Al_2Si_2O_5(OH)_4 \cdot 2H_2O$

Class Phyllosilicate

Cryst. Monoclinic

Habit Tabular, ultramicroscopic in size. As compact to mealy masses.

Phys. *Cleavage* none. *Fracture* earthy. **H** 2-2.5. **G** 2.11 to 2.17 (meas.). *Color* colorless, to white; sometimes tinted various colors by impurities. Transparent to translucent. *Luster* pearly to dull.

Occur.

Endellite may be a relatively common, secondary clay mineral produced by weathering of granitic rocks of the crystalline Piedmont and Blue Ridge. It has been shown by Grant (1975, p. 21) that the quite pure endellite of secondary origin fills fractures and joints in the "B" soil horizon and in saprolite overlying the Panola adamelite pluton, approximately 15 miles (24 km) southeast of Atlanta in northern Henry and southern DeKalb Counties. The endellite has presumably formed by the supergene dissolution of existing clay minerals and the reprecipitation of the dissolved products at shallow depths.

ILLITE GROUP

$(K,H_3O)(Al,Mg,Fe)_2(Al,Si)_4O_{10}[(OH)_2,H_2O]$

Class Phyllosilicate

Cryst. Monoclinic

Habit Massive; extremely fine grained, often admixed with other clay minerals. Sometimes as micaceous hexagonal microflakes ranging from 200 to 2000 Å in size.

Phys. *Cleavage* {001} perfect. **H** 1-2. **G** 2.6-2.9. *Color.* colorless in thin section; usually white; also various pale colors. *Luster* dull.

Occur.

Illite group minerals are widely distributed and locally important constituents of soils and saprolite. Insufficient research has been done on the mineralogy of Georgia soils to describe specifically the significance of this mineral group; however, its presence is to be suspected in most geologic environments in which potassium-rich rocks are weathering.

MONTMORILLONITE GROUP

$(Na,Ca)_{0.33}(Al,Mg)_2Si_4O_{10}(OH)_2 \cdot nH_2O$

Class Phyllosilicate

Cryst. Monoclinic

Habit Crystals thin lamellar or vermicular; often massive or clay-like.

Phys. *Cleavage* perfect basal. **H** 1.5–2.5. **G** 2.5–2.7. *Color* white to grayish; also pink to rose-red, bluish, greenish. *Luster* dull.

Occur.

Montmorillonite group minerals may be produced by the weathering of an extremely diverse array of rock types and, as such, may be expected in varying amounts in soils and as locally important constituents of commercial clay deposits. While these minerals have been described from numerous locations for which detailed mineralogic investigation of soil profiles have been made, or for which detailed studies of clay minerals related to economic mineral deposits have been conducted, no unusual or mineralogically significant occurrences are known.

PALYGORSKITE

$(Mg,Al)_2Si_4O_{10}(OH) \cdot 4H_2O$

Class Phyllosilicate

Cryst. Monoclinic (?)

Habit Crystals lath-shaped, extremely elongated, in bundles. Usually as thin flexible sheets, composed of minute interlaced fibers, resembling leather or parchment.

Phys. *Cleavage* {110} easy; tough. **H** soft. **G** 2.217 (meas.). *Color* white, gray; dull.

Occur.

Palygorskite occurs in two distinct modes within Georgia. Unusual aggregates of palygorskite (var. mountain leather) coat large calcite crystals in cavities in Murphy Marble near Marble Hill, Pickens County. Palygorskite (attapulgite) is the chief constituent of fuller's earth produced in extreme southeastern Georgia, predominantly in those deposits lying in the southern portion of Grady and Decatur Counties. The mineral may also be a locally important constituent of fuller's earth mined in the northern portion of the Coastal Plain, particularly in Twiggs and Jefferson Counties.

Decatur County: 1. Palygorskite is abundant in fuller's earth deposits mined approximately 5 miles (8 km) east of Attapulgus, north of U.S. Highway 27 near Amsterdam; and approximately 5 miles (8 km) southwest of Attapulgus, 1.5 miles (2.4 km) west of Georgia Highway 309 on the east side of Willocoochee Creek near the county line. Both occurrences are in the Miocene Hawthorne Formation.

Grady County: 1. Similar palygorskite-rich fuller's earth deposits in the Miocene Hawthorn Formation are mined 1.5 miles (2.4 km) southeast of Calvary and 2 miles (3.2 km) east of Calvary.

Pickens County: 1. Large, white, leather-like sheets of palygorskite occur loose in large cavities within the Murphy Marble at the New York Quarry at Marble Hill. Cavities are lined with exceptionally large, well-formed calcite crystals which are locally coated with pyrite, chalcopyrite, and rutile.

Thomas County: 1. Palygorskite is a minor constituent of fuller's earth mined at numerous occurrences near Ochlocknee. Specific occurrences are discussed under sepiolite.

SEPIOLITE

$Mg_4Si_6O_{15}(OH)_2 \cdot 6H_2O$

Class Phyllosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Massive; fine fibrous. Usually compact nodular, earthy, or clay-like. Dry porous masses float on water.

Phys. *Cleavage* none. **H** 2–2½. **G** 2. *Luster* dull. *Color* white, grayish, yellowish, or tinted bluish green or reddish. Nearly opaque.

Occur.

Sepiolite has been shown to be a locally important constituent of fuller's earth mined in Thomas and Grady Counties (Weaver and Beck, 1972; Patterson and Buie, 1974). Sepiolite is particularly abundant, constituting as much as 10 percent of deposits, in the northern part of the district in the vicinity of Ochlocknee, Thomas County. Principal sepiolite occurences are the Simpson Mine, 1.25 miles (2 km) northwest of Ochlocknee city limits; the Turner Mine, 2.75 miles (4.4 km) northeast of Ochlocknee city limits; and the mine of Cherokee Industries, Ltd., 1.5 miles (2.4 km) north of Ochlocknee. All occurrences are in the Miocene Hawthorne Formation.

Sepiolite may also be a locally abundant constituent of fuller's earth deposits in other parts of the Coastal Plain such as those currently mined in Jefferson and Twiggs Counties.

VERMICULITE GROUP

$(Mg,Fe,Al)_3(Al,Si)_4O_{10}(OH)_2 \cdot 4H_2O$

Class Phyllosilicate

Cryst. Monoclinic

Habit Micaceous aggregates.

Phys. *Cleavage* {001} pefect. **H** 1.5. **G** 2-3. *Color* colorless, yellow, green, or brown. Exfoliates when heated rapidly.

Occur.

Vermiculite is no longer considered a mineral species, but rather a group of closely related phyllosilicates similar to the smectite family (Fleischer, 1975; Deer, Howie and Zussman, 1966). Due to the numerous references to vermiculite in the published literature, and the lack of research into members of the vermiculite group and their occurrence in Georgia, it will be described herein as an undivided group.

Vermiculite group minerals are widely distributed throughout the crystalline rocks of Georgia, occurring as alteration products of chlorite or biotite either by hydrothermal action or possibly weathering. It is also formed in the contact zone between mafic or ultramafic rocks and felsic country rocks. Vermiculite minerals are typically associated with corundum, apatite, serpentine, chlorite, and talc.

Columbia County: 1. Unusually coarse-grained vermiculite may be found locally near the margins of the major serpentinite bodies underlying Burt and Dixie Mountains between Pollards Corner and the Savannah River. Associated minerals are talc, asbestos, corundum, and chromite.

DeKalb County: 1. Vermiculite is locally abundant within and adjacent to the margins of aplite dikes cutting Soapstone Ridge southeast and east of Atlanta.

Jasper County: 1. Vermiculite is abundant within and adjacent to a pegmatite exposed in tract 382-F of the U.S. Department of Agriculture property, 2500 feet (762 m) S60°E of the Gladesville fire tower and about 7 miles (11 km) southwest of Monticello (Heinrich and Jahns, 1953, p. 392). Graphic granite is locally cut by 0.2 to 2.0 inch (0.5 to 5.0 cm) wide veinlets of vermiculite. The vermiculite plates tend to lie normal to the walls of the veinlets and may have been formed by alteration of biotite. 2. Vermiculite is relatively abundant along the walls of a pegmatite exposed near Georgia Highway 11, approximately 0.75 mile (1.2 km) southwest of Gladesville (Heinrich and Jahns, 1953, p. 393).

Murray County: Vermiculite is locally developed from chlorite along the contact between granite and the Cohutta Schist in the immediate vicinity of commercial talc deposits of the Chatsworth district (Furcron, Teague and Calver, 1947, p. 38).

Rabun County: Vermiculite group minerals are extremely widespread as accessory minerals of alteration zones flanking the numerous mafic and ultramafic plutons within Rabun County. An unusually large number of vermiculite occurrences have been reported in the county, due primarily to detailed work conducted during World War II by the W.P.A.

1. Vein-like bodies of vermiculite up to several feet in thickness have been prospected in numerous locations within and adjacent to the large ultramafic body formerly exploited for corundum on Laurel Creek in the southern part of lot 72, 3rd district, about one mile (1.6 km) southwest of Pine Mountain. Corundum crystals and aggregates at this occurrence are typically sheathed by vermiculite. 2. Fine-grained vermiculite is exposed in a 2-foot (0.6-m) wide vein in the old asbestos prospect on the Burrell property, approximately 8.5 miles (13.7 km) northwest of Clayton on Bettys Creek. 3. Vermiculite float occurs on the Hambridge property, lot 186, 2nd district, on the west side of Owens Branch near Dillard. 4. Vermiculite occurs in the old soapstone prospect on the Arrendale property, lot 22, 5th district, at Cannons Camp near Tiger. 5. Vermiculite schist is exposed in several places along the old road on the Williams property, approximately 3.4 miles (5.5 km) west of Dillard on the Bettys Creek Road. 6. Vermiculite in veins up to 2.5 feet (0.8 m) wide has been prospected near the old asbestos mine on lot 177, 2nd district, up Bettys Creek from Dillard and adjacent to the Burrell asbestos prospect. 7. Approximately 10 tons of vermiculite have been produced from the altered margins of a small ultramafic pluton at the Hicks Asbestos Mine, about 4 miles (6.4 km) by road northeast of Pine Mountain and one mile (1.6 km) south of the road to Glades (Teague, 1956, p. 7). 8. Vermiculite is locally abundant in veins up to 2 feet (0.6 km) thick at the Reid Asbestos Mine, approximately 1.5 miles (2.4 km) northeast of Pine Mountain (Teague, 1956, p. 7). The vermiculite occurs along the hanging wall contact of a small ultramafic pluton.

Towns County: 1. Considerable prospecting for vermiculite has been conducted on the Jethro Burrell property near the mouth of Scattaway Creek, about 5 miles (8 km) east of Hiawassee, adjacent to U.S. Highway 76. Vermiculite flakes up to 2 inches (5 cm) in diameter are relatively abundant, particularly near a pegmatite dike which cuts the host ultramafic pluton. 2. Vermiculite has been prospected on the old Cozad Estate at Lemons Gap on the ridge between Hightower and Shooting Creeks, about 7 miles (11 km) northeast of Hiawassee.

Troup County: 1. Vermiculite is locally abundant along the southeastern and western ends of an ultramafic pluton on the R. F. Floyd property, 12.85 miles (20.7 km) S25.5°E of LaGrange, about 3.5 miles (5.6 km) west of Chipley along the Troup–Harris County line (Teague, 1956, p. 4).

SERPENTINE GROUP

Chrysotile — $Mg_3Si_2O_5(OH)_4$

Antigorite — $(Mg,Fe)_3Si_2O_5(OH)_4$

Class Phyllosilicate

Cryst. Monoclinic, orthorhombic, or hexagonal

Habit Commonly massive, compact to fibrous.

Phys. *Cleavage* sometimes distinct, especially in fibrous varieties. *Fracture* conchoidal to splintery. **H** 2.5–6. **G** 2.2–2.6. *Luster* waxy, greasy, silky. *Color* various shades of green, white, gray, yellow, brownish yellow, brownish red. *Streak* white. Translucent.

Occur.

Serpentine group minerals are locally abundant within the crystalline rocks of Georgia. They are common in altered margins of mafic and ultramafic plutons and have been identified in altered rocks associated with the commercial talc deposits of Murray County. Serpentine has been mined for the production of magnesium salts in Columbia County and as a dimension stone in Cherokee County. Inadequate research has been conducted into the various serpentine species present at specific occurrences to allow proper description by species. Chrysotile and antogorite have been identified at several locations, but for the most part, descriptions in the literature simply refer to serpentine. For this reason, occurrences are discussed simply as serpentine with specific reference made to species identification when possible.

Barrow County: 1. Lustrous chrysotile in veins up to one inch (2.5 cm) thick cut the altered margin of a small dunite on the L. M. Arnold property, approximately 1.25 miles (2 km) east of Statham. Asbestos has been shipped from this property.

Carroll County: 1. Chrysotile in veins up to 0.1 inch (0.25 cm) thick occur near the margins of an altered peridotite exposed at the Foodtown Shopping Center, 0.75 mile (1.2 km) west of Villa Rica on U.S. Highway 78.

Cherokee County: 1. Perhaps the best known serpentinite body in the state is exposed in the old Verde Antique Marble Quarry in the southwest corner of lot 44, 15th district, 2 miles (3.2 km) southwest of Holly Springs. The deposit consists of a lenticular serpentine mass several hundred feet long and approximately 100 feet (30 m) wide. Exceptional specimens of pale green talc and hydroxyl-apatite occur at this location. 2. A similar serpentine body is exposed approximately 2 miles (3.2 km) to the southwest on lot 567, 15th district. Tremolite and talc are locally abundant around the margins of this pluton.

Columbia County: 1. Several relatively large masses of serpentine are exposed on and around Burt and Dixie Mountains between Pollards Corner and the Savannah River. A quarry was operated in one of the serpentine masses for the production of magnesium compounds.

Habersham County: 1. An ultramafic body extensively altered to serpentine minerals is well exposed in a road cut 0.7 mile (1.1 km) north of Wikles Store on Georgia Highway 179. 2. Dark-green serpentine cut by asbestos veins is exposed along Georgia Highway 255, approximately 1.5 miles (2.4 km) east of Georgia Highway 255 Alternate (Hurst and Crawford, 1964, p. 98). 3. Coarsely crystalline serpentine minerals are exposed in bouldery outcrops along the west side of Alec Mountain, approximately 6 miles (9.7 km) west of Clarksville. Corundum, asbestos and talc have been prospected in the immediate area.

Harris County: 1. Several small mafic and ultramafic plutons which are locally altered to serpentine minerals are exposed on the Spence property, 4.9 miles (7.9 km) N60°W of Hamilton along the steep northern banks of Mountain Creek near Beach Springs Church.

Murray County: 1. Nearly pure serpentine masses are found in most of the talc mines of the Chatsworth district. Ordinary massive or common serpentine (antigorite) appears to be the most abundant species and is found in light- to very dark-green masses associated with varying amounts of dolomite. Thin section examination indicates that serpentine has completely replaced feldspars, actinolite, and dolomite. Picrolite, the fibrous variety of antigorite, occurs with dolomite in the Cohutta mines (Furcron, Teague and Calver, 1947, p. 40). 2. Serpentine is especially abundant on lot 296, on the west slope of Fort Mountain about 4 miles (6.4 km) northeast of Chatsworth. Massive antigorite is locally cut by narrow veins of chrysotile in a well exposed outcrop. Talc is locally abundant at the contact of the serpentine body with the surrounding country rocks (Hopkins, 1914, p. 252).

Rabun County: 1. Serpentine is locally abundant within altered portions of a dunite on lot 7, 1st district, 3 miles (4.8 km) northwest of Burton on a small branch of Dicks Creek (Hopkins, 1914, p. 146). The occurrence has been prospected for asbestos and has been the source of excellent samples of anthrophyllite and talc.

Troup County: 1. Serpentine float is locally abundant over an altered ultramafic pluton on the Higginbothem Estate, 0.5 to 2 miles (0.8 to 3.2 km) northeast of West Point on both sides of U.S. Highway 29. The area includes approximately 3 square miles (Long, 1971, p. 32).

GARNIERITE GROUP
Hydrous nickel silicates
$(Ni,Mg)_6(Si_4O_{10})OH_8$

Class Phyllosilicates

Cryst. Monoclinic (?)

Habit Typically as green encrustations or waxy seams in and on weathered ultramafic rocks.

Phys. *Cleavage* {001}. **H** 2.5. **G** 2.5–2.6. *Color* green to greenish-yellow. *Luster* dull to waxy.

Occur.

Garnierite, formerly considered a mineral species, is now used as a general name for members of a poorly described group of hydrous nickel silicates related to the serpentine family (Fleischer, 1975; Deer, Howie and Zussman, 1966). Minerals of this group have been reported from laterite overlying ultramafic intrusive rocks of the Piedmont. Nickel has been prospected at one location.

Columbia County: 1. Light green garnierite may be locally observed in laterite developed at Burt and Dixie Mountains between Pollards Corner and the Savannah River.

DeKalb County: 1. Garnierite occurs locally in laterite exposed over the ultramafic intrusion at Soapstone Ridge, several miles southeast of downtown Atlanta adjacent to Interstate Highway 285.

Towns County: 1. Encrustations of light-green garnierite fill joints and fissures in partially weathered dunite near the Hogg Creek Corundum Mine on lot 92, 17th district, about 2 miles (3.2 km) west of Hiawassee on the south side of Ramey Mountain. A shaft and several pits were excavated near the creek in search of economic nickel deposits about 1890 (Ballard, 1946, p. 2).

Troup County: 1. Thin green garnierite crusts are locally conspicuous on weathered, altered peridotite at the chromite prospects near Louise, approximately 8 miles 12.8 km) north of LaGrange.

PYROPHYLLITE
$Al_2Si_4)_{10}(OH)_2$

Class Phyllosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals subhedral, tabular parallel to {010} and much elongated; often curved and distorted. Usually foliated, radiated lamellar or fibrous; also granular to compact.

Phys. *Cleavage* {001} perfect; laminae flexible, inelastic. Greasy feel. **H** 1–2. **G** 2.844 (calc.). *Color* white, grayish-white, yellowish, pale blue, greenish, grayish, or brownish green. Transparent to translucent. *Luster* pearly to dull and glistening.

Occur.

Lincoln County: 1. Pyrophyllite has been known for many years as an accessory mineral in the kyanite deposit at Graves Mountain, immediately south of U.S. Highway 378 between Lincolnton and Washington. Stellate pyrophyllite crystal aggregates up to one inch (2.5 cm) in diameter form veins up to at least one foot thick crosscutting the kyanite-quartz rock. According to Hurst (1958d, p. 18-19) nearly all of the pyrophyllite veins strike N60°–70°W and dip steeply. Coarse pyrophyllite clusters are also in and along the margins of many quartz veins. In addition, pyrophyllite is found as a fine-grained alteration product along the margins of most of the kyanite blades. 2. A low ridge on the Claude Rhodes property is littered with cobbles and boulders of kyanite, pyrophyllite, and vein quartz (Hurst, Crawford and Sandy, 1966, p. 297). This property is approximately one mile (1.6 km) southeast of the community of Kenna, adjacent to and east of Georgia Highway 220 spur, about 7 miles (11 km) southeast of Lincolnton. Pyrophyllite is quite abundant at this occurrence. 3. Kyanite altered to pyrophyllite occurs along a 1600-foot (488 m) long trend on the Dorn

property, 2 miles (3.2 km) S70°E from Metasville (Hurst, Crawford and Sandy, 1966, p. 296). A small portion of this trend extends into Wilkes County to the west. 4. Fine-grained, slaty pyrophyllite is reported by Furcron (1948a, p. 2), at the point where the nose of Graves Mountain crosses U.S. Highway 378 a short distance west of Lincolnton.

Oglethorpe County: 1. Pyrophyllite is locally abundant in metamorphic rocks exposed in and around Buffalo Mountain, about 6 miles (9.7 km) east of Lexington, south of U.S. Highway 78 (R. H. Carpenter, personal communication).

Paulding County: 1. Massive pyrophyllite rock is exposed intermittently along a low ridge between the headwaters of Turkey and Sweetwater Creeks, about 1.7 miles (2.7 km) southeast of Harmony Grove Church (Hurst and Crawford, 1970, p. 153). Outcrops and float occur over a length of about 1200 feet (366 m) and a width up to 250 feet (76 m).

Wilkes County: 1. Pyrophyllite, intimately associated with kyanite in an occurrence similar to that at Graves Mountain, is reported from the Christine Freeman property along Georgia Highway 80, about 6.2 miles (10 km) S33°E from Washington (Hurst, Crawford and Sandy, 1966, p. 295).

TALC

$Mg_3Si_4O_{10}(OH)_2$

Class Phyllosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Rarely in crystals. Usually foliated massive, granular massive, and compact.

Phys. *Cleavage* basal perfect. Can be easily cut. Flexible in thin flakes, but not elastic. Greasy feel. **H** 1. **G** 2.82. *Luster* greasy to pearly. *Color* white, greenish, gray, almost black.

Occur.

Talc is widely distributed in the Piedmont and Blue Ridge. It occurs as an alteration mineral within the Murphy Marble Belt and with asbestos around the margins of numerous ultramafic plutons. Talc is currently produced from several large mines in the Chatsworth area, Murray County.

Carroll County: 1. Talc and asbestos are relatively abundant as float over an altered ultramafic intrusion on the A. H. Walker property, lot 32, 10th district, 3.5 miles (5.6 km) south of Carrollton. 2. Chloritic soapstone and talc are relatively abundant as float over an ultramafic pluton on lot 110, 5th district, 1.5 miles (2.4 km) east of Carrollton, on the property of Gayle Burns (Hopkins, 1914, p. 285). Foliated talc and soapstone are relatively abundant in an ultramafic pluton exposed on the Lyle property, approximately 1.75 miles (2.8 km) S15°E of Carrollton.

Cherokee County: 1. A thin conformable seam of talc has been traced for approximately 1,400 feet (427 m) on the Cox property, lot 305, 4th district, 2nd section, on Sharp Mountain Creek, 2.5 miles (4 km) west of Ball Ground (Hopkins, 1914, p. 242). Extensive prospecting has been conducted on this lot with generally negative results. 2. Beautiful, light-green foliated talc occurs in thin veins and irregularly shaped masses within the serpentine body at the Verde Antique Quarry on lot 444, 15th district, 2 miles (3.2 km) southwest of Holly Springs. A small amount of commercial talc and several tons of specimen grade material have been shipped from this property. 3. Foliated talc occurs in a similar serpentinite body 2 miles (3.2 km) southwest of the Verde Antique Quarry on the Haws property, lot 567, 15th district (Hopkins, 1914, p. 278).

Columbia County: 1. Talc is locally abundant in residuum over the major serpentinite bodies on and in the vicinity of Burt and Dixie Mountains between Pollards Corner and the Savannah River. Talc may be observed intermittently along a northeast trend in this area for at least 11 miles (17.7 km). 2. Talc-rich soapstone occurs in relative abundance over a large area centering near Walnut Grove Church, a short distance south of Phinizy (Hopkins, 1914, p. 299).

Coweta County: 1. Green foliated talc occurs with chlorite and asbestos on the Hawk property, 5.5 miles (8.8 km) S28°W from Newnan (Long, 1971, p. 23). 2. A small amount of talc occurs in an asbestos prospect on the Tremmell property, approximately 2.7 miles (4.3 km) S25°E from Moreland.

Fannin County: 1. A lense of relatively high-grade talc up to 6 feet (1.8 m) thick was mined on the old J. D. Dickey property, approximately 1.5 miles (2.4 km) northeast of Mineral Bluff. The talc lens occurs between quartzite beds and may be associated with the Murphy Marble (Hopkins, 1914, p. 236). 2. Similar lenses of talc between quartzite beds have been prospected on the G. M. Dickey property immediately south of Mineral

Bluff. 3. Talc occurs locally in Murphy Marble along Cutcane Creek between 3.5 and 5 miles (5.6 and 8 km) northeast of Mineral Bluff. The talc is light gray, very dense, and micaceous. Most former prospecting has been on the Harper and Gray properties; however, talc has been reported locally for 13 miles (21 km) along this trend (Hopkins, 1914, p. 239). 4. Talc has been extensively prospected on the Wishon property, 3.5 miles (5.6 km) south of Blue Ridge along the Fannin–Gilmer County line. The property is adjacent to the Louisville and Nashville Railroad. The talc occurs in a clay matrix and is apparently derived from a dolomitic bed.

Habersham County: 1. Poor quality talc occurs with soapstone and asbestos in old prospect pits approximately 600 feet (183 m) south of the summit of Mack Mountain, immediately west of Batesville in the northwest corner of the county. 2. Small tabular masses of talc occur with asbestos in old prospect pits approximately 0.5 mile (0.8 km) north of the junction of Georgia Highways 255 and 255 Alternate in the northwestern part of the county (Hurst and Crawford, 1964, p. 98). 3. Excellent samples of light-green foliated talc may be collected in old asbestos prospects approximately 1500 feet (457 m) north of the Bethlehem Church Road, west of Clarksville (Hurst and Crawford, 1964, p. 109).

Lumpkin County: 1. A small amount of talc occurs with chloritic soapstone in exposures along the east side of the Chestatee River 4 miles (6.4 km) east of Dahlonega, particularly on lot 121, 15th district, 1st section (Hopkins, 1914, p. 274).

Meriwether County: 1. A small amount of low grade talc occurs in soil over an altered mafic pluton at the old Woodruff place, 0.5 mile (0.8 km) north of St. Marks, 6 miles (9.7 km) east of Hogansville (Hopkins, 1914, p. 292). 2. Talc and chlorite occur around several asbestos prospects in an ultramafic pluton on the R. C. Mitchell property, 2.5 miles (4 km) S12°W of the crossroads at Rocky Mountain (Long, 1971, p. 25).

Murray County: Talc is commercially produced from four major mines in the Chatsworth district. The talc deposits are apparently the result of extensive alteration and metamorphism of a dolomite-bearing sedimentary rock, possibly during the intrusion of the Fort Mountain Gneiss. The district has been studied in detail by Furcron, Teague and Calver (1947) and Needham and Hurst (1970).

1. The largest and most continuously operated mine in the district is the Georgia mine, approximately 3.5 miles (5.6 km) southeast of Chatsworth in lot 271. Talc of varying quality occurs here within the Cohutta Schist. Pockets of high-grade talc occur where there are aburpt changes in the dip of the host rock. Accessory minerals are chlorite, serpentine group minerals, and abundant dolomite. 2. Talc is produced from geologically complex lenses in the Earnest and Fort Mountain Mines, approximately 3.5 miles (5.6 km) northeast of Chatsworth on the northwest slope of Fort Mountain, lot 297. 3. A tabular talc body is currently mined at the Rock Cliff Mine on Gold Mine Branch near the old Cohutta Mine. The talc lens varies in thickness from 4 to 16 feet (1.2 to 4.9 m) and has been exposed continuously for 1005 feet (306 m). Chlorite-rich rock borders the deposit. 4. A small amount of talc is currently produced from the Judges Hole Mine adjacent to the Georgia Mine. 5. A lens of relatively good talc containing locally abundant dolomite and minor pyrite and chlorite was exploited in the Southern Mine on strike with, and north of, the Georgia Mine, approximately 3 miles (4.8 km) southeast of Chatsworth, lot 270. 6. Large quantities of talc were produced up until 1956 from the Cohutta Mine, approximately 3.5 miles (5.6 km) east of Chatsworth on the northwest slope of Cohutta Mountain, lot 294. Extensive bodies of hard dolomitic serpentine occur with talc at this location. Three large bodies of high-grade talc had been removed from this deposit through 1947. 7. A small quantity of rather poor quality talc has been produced from the King or Pickering Mine, the southernmost producer in the district, located approximately 4 miles (6.4 km) southeast of Chatsworth. 8. Lenses of high quality talc up to 20 feet (6 m) thick were mined from the relatively small Chicken Creek Mine, approximately 3.7 miles (6 km) southeast of Chatsworth along a tributary of Chicken Creek, between the King Mine and the old Cohutta Mine. 9. A large amount of talc was produced from the old Cohutta Mine adjacent to the Georgia Mine, approximately 4 miles (6.4 km) southeast of Chatsworth. Small amounts of high-grade talc have been reclaimed from the dumps of this deposit in recent years. 10. Talc has been prospected or produced in small amounts from the following additional properties: the Rock Creek Road or Sandy Gap prospect, approximately 200 yards (183 m) north of Rock Creek Road, 4.5 miles (7.2 km) southeast of Chatsworth; the Bramlett prospects on lot 292 on the southwestern slope of Cohutta Mountain; the Fields or Big Lindsey prospect on lot 293, approximately 3.4 miles (5.6 km) east of Chatsworth on the west slope of Cohutta Mountain; the Hammock prospect on lot 319, 2.6 miles (4.1 km) due east of Chatsworth on the west side of Georgia Highway 2; the Russell prospect on lot 295 on the western slope of Fort Ridge near the head of the south tributary of Rock Creek; the Latch prospects on lot 296, approximately 3.5 miles (5.6 km) northeast of Chatsworth adjacent to the Russell prospects; the Mill Creek prospects on lots 260, 261 and 245 on the eastern slope of Fort Mountain near the headwaters of Mill Creek, 7 miles (11 km) by road N50°E of Chatsworth; and the Warren Earnest prospect on lot 244, 4.7 miles (7.6 km) N50°E of Chatsworth on the east side of Mill Creek, northeast of the Mill Creek prospects.

Paulding County: 1. Poor quality talc associated with actinolite, chlorite, and anthophyllite occurs in an altered ultramafic body on lots 1171 and 1172, 3rd district, 3rd section, 3.5 miles (5.6 km) northeast of Dallas (Hopkins, 1914, p. 281). The talc-bearing body is tabular, approximately one mile (1.6 km) long, and as much as 100 yards (91 m) wide.

Rabun County: 1. Small aggregates of coarsely crystalline foliated talc occur in the altered margins of the dunite formerly exploited for corundum on Laurel Creek, lot 72, 3rd district, approximately one mile (1.6 km) from Pine Mountain. 2. Talc and asbestos occur on the north side of a ridge in lot 157, 2nd district. The minerals occur abundantly in an altered peridotite that is approximately 300 feet (91 m) in maximum dimension (King, 1894, p. 86).

Stephens County: 1. Moderately pure talc and asbestos have been prospected in chloritic soapstone on the Yearwood property, 3.5 miles (5.6 km) northeast of Toccoa (Hopkins, 1914, p. 273).

Towns County: 1. Talc is a minor constituent of altered mafic and ultramafic rock in and adjacent to the Lake Chatuge Sill north and west of Hiawassee. Small pieces of talc float may be found around Lake Chatuge during low water.

Troup County: 1. Many tons of talc are contained in dumps around shallow prospect shafts and pits at the chromite prospect near Louise. The prospects are on the Beasley property, 7.35 miles (12 km) N66°E of LaGrange and about 450 feet (137 m) S30°E of the Louise Church. Associated minerals are asbestos, chlorite, olivine and chromite. Boulders of talc are abundant in surrounding fields and woods. 2. Bright green flakes of talc up to 0.25 inch (0.6 cm) in diameter occur in anthophyllite on the dumps of an old asbestos mine on the Floyd property, 12.8 miles (20.5 km) S25°E of LaGrange, 0.75 mile (1.2 km) east of Salem Road (Long, 1971, p. 28). 3. Talc and asbestos are locally abundant in chloritic soapstone over a large area approximately 0.5 to 2 miles (0.8 to 3.2 km) northeast of West Point on both sides of U. S. Highway 29 (Long, 1971, p. 32–33). The property is locally known as the Higginbothem Estate. 4. Talc occurs along Lovelace Road, 0.4 mile (0.64 km) east of its junction with the Atlanta–West Point Railroad (Long, 1971, p. 34).

White County: 1. Pale-green and white foliated talc may be found in old asbestos prospects at Camp Ecohee, approximately 6 miles (9.7 km) northeast of Robertstown (Hurst and Otwell, 1964, p. 71). 2. Coarsely crystalline green talc may be found with asbestos in chloritic soapstone at several prospect pits south of Holiness Church, approximately 3 miles (4.8 km) north of Cleveland.

MUSCOVITE

$KAl_2(AlSi_3)O_{10}(OH)_2$

Class Phyllosilicate

Cryst. Monoclinic, pseudohexagonal

Habit Crystals usually tabular with hexagonal outline; commonly lamellar massive; also in plumose, stellate, or globular aggregates; in scales and scaly massive; also cryptocrystalline and compact massive.

Phys. *Cleavage* perfect basal yielding thin elastic laminae. **H** 2½ (on cleavage); 4 (across cleavage). **G** 2.8-2.9. *Luster* vitreous, pearly, or silky. *Color* colorless, gray, brown, various shades of green, yellow violet; rarely rose-red. *Streak* colorless. Transparent to translucent.

Occur.

Muscovite is an important and extremely common rock-forming mineral in every county of the Piedmont and Blue Ridge provinces. It is an important constituent of granites and granitic gneisses and is the dominant mineral in many schists. Its stability throughout a wide range of metamorphic conditions and its relative resistance to weathering make it one of the most well known minerals in the state.

Muscovite has been produced at intervals from pegmatites located in 5 general districts. These are the Hart–Elbert County, Rabun County, Lumpkin-Union-Towns County, Pickens–Cherokee County, and Upson–Lamar–Monroe County districts. Muscovite was mined as early as 1882 from small deposits east of Clayton and extensively at the old Dean Mine in Cherokee County in 1889. Significant production is reported from these districts during the two World Wars. Scrap mica is currently produced from several pits near Hartwell, Hart County.

Most occurrences described below are pegmatite mines which have produced exceptionally large crystals or unusual quantities of muscovite. Since more than 200 muscovite mines have been operated in

Georgia, it is impossible to describe each occurrence. The economic muscovite deposits of Georgia have been reviewed by Furcron and Teague (1943), Griffitts (1953), Heinrich, Klepper and Jahns (1953) and Heinrich and Jahns (1953).

Carroll County: 1. Nodular masses of blue-green muscovite (fuchsite) and quartz up to one foot (0.3 m) in diameter have been found approximately 1.5 miles (2.4 km) south of Bremen, east from the Carrollton Highway.

Cherokee County: Muscovite crystals exceeding 10 inches (25 cm) in diameter were produced from the Amphlett Mica Mine, 0.4 mile (0.64 km) S30°E of Conn Church, 4.3 miles (7 km) S86°E of Ball Ground. The major pegmatite body is at least 500 feet (152 mg) long and varies from a few inches to 6 feet (1.8 m) in thickness. 2. Muscovite books as large as 10 x 14 inches (25 x 35.5 cm) and weighing as much as 50 pounds (23 kg) were recovered from the J. F. Hillhouse mica prospects in lot 521, 15th district, 2nd section, about one mile (1.6 km) northeast of Toonigh. 3. Greenish muscovite books up to 7 x 14 inches (18 x 35.5 cm) and weighing 36 pounds (16 kg) were obtained from the Wacaster Mica Mine in lot 419, 15th district, 2nd section, approximately 1.2 miles (2 km) S40°W of Holly Springs. 4. Exceptional brown muscovite books up to 12 x 18 inches (30 x 46 cm) and weighing up to 75 pounds (34 kg) were mined from a zoned pegmatite exploited at the J.V. Ledford Mine on a branch of Tate Creek, about 3.2 miles (5 km) S68°W of Woodstock. 5. Schist containing very abundant fine-grained muscovite (sericite) has been produced intermittently as a talc substitute and filler from mines approximately 3 miles (4.8 km) southeast of Waleska.

Cobb County: 1. Fine-grained, chromium-bearing muscovite is locally abundant in road cuts along U.S. Highway 41 at the Cobb–Bartow County line.

Elbert County: Muscovite has been produced from numerous pegmatites within a belt 28 miles (45 km) long and 2 to 10 miles (3.2 to 16 km) wide including parts of Hart and Elbert Counties, Georgia, and adjacent Anderson County, South Carolina (Griffitts, 1953). The most extensively developed mica mine in Elbert County was the Chapman, immediately north of Coldwater Creek, approximately 0.25 mile (0.4 km) south of Rock Branch. Mines in the district are not noted for exceptionally large muscovite crystals, although a moderate amount of sheet mica has been produced.

1. Blue-green, chromium-bearing sericite has been found at the Nancy Hart Cabin.

Forsyth County: 1. A single muscovite crystal weighing approximately 150 pounds (68 kg) is reported from a prospect on the Oscar McBrayer Farm, 2 miles (3.2 km) west of Zion Hill Church, 6 miles (9.7 km) west of Coal Mountain.

Habersham County: 1. Green, chromium-bearing muscovite schist is exposed in small prospect trenches approximately 2,000 feet (610 km) north of the junction of Georgia Highways 17 and 15, 2 miles (3.2 km) west of Clarksville (Hurst and Crawford, 1964, p. 28). Chromite is locally abundant at this location.

Hall County: 1. Muscovite crystals up to 12 x 14 inches (30 x 36 cm) and weighing up to 200 pounds (91 kg) were produced intermittently from the Hope or Merck Mica Mine, approximately one mile (1.6 km) beyond the Gainesville city limits at the northwest end of Grape Street (Furcron and Teague, 1943, p. 180). The pegmatite dike varies in width up to 16 feet (5 m) and contains coarse muscovite adjacent to smoky quartz lenses.

Hart County: Muscovite has been produced intermittently from mines in eastern and central Hart County and in the Airline area for many years. Exceptionally large muscovite crystals are not common in the district, though a moderate amount of sheet muscovite has been produced. Major mines include the Bailey near Cross Roads, 5.5 miles (8.9 km) west of Hartwell; the Wood, approximately one mile (1.6 km) southwest of Cross Roads; the Waterhole on the Martin Farm, 1.4 miles (2.25 km) southwest of Cross Roads; and the Garner, approximately one mile (1.6 km) south of Airline (Griffitts, 1953).

Henry County: 1. An exceptional cleavage sheet of a single block of muscovite recovered from the Maddox Mica Mine is on exhibition in the State Capitol Museum. The sheet is irregular in outline and measures 17 x 27 inches (43 x 69 cm). This mine, located on the old Madison Maddox property 6 miles (9.7 km) north of McDonough and 5 miles (8 km) S25°E of Stockbridge, was one of the few successful mica mines outside of the 5 major districts.

Jasper County: Muscovite is locally abundant in the numerous large pegmatites exploited commerically for feldspar in a relatively small district centering near Gladesville, approximately 5 miles (8 km) south of Monticello. Small amounts of sheet and scrap muscovite were produced from this district during World War II.

Lamar County: 1. Bright yellowish-olive muscovite crystals weighing up to 75 pounds (34 kg) were produced from the J. T. Means Mica Mine, approximately 7.2 miles (12 km) S40°E of Barnsville, 0.5 mile (0.8 km) southwest of Ramah Church (Heinrich, Klepper and Jahns, 1953, p. 364). The largest muscovite crystals are associated with small, massive quartz pods which occupied the interior portion of the pegmatite dike. 2. Large amounts of sheet and punch muscovite were produced between March,1942 and June,1944 from the Early Vaughn Mica Mine, 3.9 miles (6.3 km) southeast of Barnsville. The pegmatite varies in thickness up

to 24 feet (7 m) and is locally zoned, containing a massive quartz core up to 10 feet (3m) thick. Muscovite was most abundant adjacent to the thickest portion of the quartz core between the core and the hanging wall contact.

Lincoln County: 1. Blue-green muscovite (presumably fuchsite) occurs locally in quartz-sericite schist and quartzite in and around Graves Mountain, immediately south of U.S. Highway 378 between Lincolnton and Washington.

Lumpkin County: 1. Exceptional crystals of muscovite were produced from the Williams Mica Mine, approximately 10 miles (16 km) northwest of Dahlonega and 100 feet (30 m) east of the Cooper Gap Road. Large muscovite crystals in aggregates up to 3 feet (0.9 m) in diameter are described by Galpin (1915, p. 156). 2. Individual muscovite crystals weighing more than 75 pounds (34 kg) have been removed from the Crane Mica Mine on the old Charlie Tipton place, 10 miles (16 km) west of Dahlonega, 1.7 miles (2.7 km) southwest of Ellijay Road. 3. Several tons of sheet muscovite in crystals up to 18 inches (46 cm) wide were found in pockets within a few feet of the surface at the old Sain Mica Mine about 400 feet (122 m) S10°W of the Cooper Gap Road, about 300 feet (91 m) south of the Williams Mica Mine (Furcron and Teague, 1943, p. 123).

Monroe County: 1. Irregular sheets of muscovite up to 10 x 12 inches (25 x 30 cm) were produced during or shortly after World War I at the Brooks Mine, 2.6 miles (4 km) south of Forsyth. 2. Muscovite crystals up to 11 inches (28 cm) in diameter were found adjacent to the quartz core of a zoned pegmatite exploited at the Walker Smith Mine, approximately 2 miles (3.2 km) southwest of Juliette, 0.75 mile (1.2 km) northwest of the Redding Mine (Heinrich, Klepper and Jahns, 1953, p. 375). 3. A large amount of sheet and punch muscovite was produced from numerous other mines in Monroe County including the Battles and Chatfield, 2.75 miles (4.4 km) N50°W of Culloden; the Holmes, 1.6 miles (2.6 km) N1°W of Culloden; the Rev. Thaddeus Persons, 3.65 miles (5.9 km) N1°W of Culloden; and the Peters, 7.25 miles (11.6 km) southwest of Forsyth.

Morgan County: Exceptionally large books of inferior quality muscovite up to 12 x 14 inches (30 cm x 36 cm) are reported from a prospect in a pegmatite dike on the Alliston property, 1.5 miles (2.4 km) northeast of Madison and a short distance off the Madison-Athens Highway near the old Appalachian Road (Furcron and Teague, 1943, p. 183).

Paulding County: 1. Muscovite crystals as large as 10 x 12 inches (25 x 30 cm) and weighing up to 125 pounds (57 kg) were reportedly recovered during World War I from the Cole Mica Mine, 3.5 miles (5.6 km) southeast of Roses Store, 2.5 miles (4 km) north of the Carroll-Paulding County line (Heinrich and Jahns, 1953, p. 391). 2. A moderate production of large, though heavily spotted, sheet muscovite is reported from the Dean Mine, approximately 0.4 mile (0.64 km) southwest of Hiram. Most production was prior to 1920. The pegmatite exploited at this occurrence is quite irregular and reaches widths of up to 50 feet (15 m). The body terminates in a large quartz mass approximately 100 feet (30 m) in maximum dimension. 3. Quartz-fuchsite schist is reported from the William H. Kirk property, approximately 1.5 miles (2.4 km) southwest of U.S. Highway 41.

Pickens County: 1. Light brown, inferior quality muscovite in crystals up to 14 inches (36 cm) in diameter was produced from the Howell Mine on lot 144, 4th district, 2nd section, approximately 1.5 miles (2.4 km) south of Marble Hill (Heinrich and Jahns, 1953, p. 385). 2. Blue-green, chromium-bearing muscovite is locally abundant in marble at the Silver-gray Quarry No. 8 at Tate. This is perhaps the best known fuchsite location in Georgia. 3. Schist containing abundant, very fine-grained muscovite (sericite) has been prospected for use as a talc substitute on lots 96, 120, and 122, 13th district, 2nd section.

Rabun County: 1. Unusually large muscovite crystals were mined during World War I from the Kell Mine, lot 39, 3rd district. The property is accessible by a mountain road from Warwoman Road, 8.3 miles (13 km) east of Clayton. Irregular muscovite crystals weighing up to 439 pounds (199 kg) have been removed from this property.

Towns County: 1. Muscovite in crystals exceeding 10 inches (25 cm) in diameter have been produced from the old Spanish Mountain Mine, approximately 9 miles (14.4 km) by road south of Hiawassee and one mile (1.6 km) south of the Owl Creek Road in Glassy Mine Gap.

Troup County: 1. Muscovite crystals are abundant in the zoned pegmatite eploited primarily for beryl and quartz on the old Hogg Estate, 8.6 miles (13.8 km) south of LaGrange, 1.3 miles (2 km) south of Smith Crossroads.

Union County: 1. Muscovite crystals weighing up to 100 pounds (45 kg), some as large as "cart wheels," were found during the early days of mining at the Dyer Mine on lot 150, 12 miles (19 km) southeast of Blairsville, approximately 500 feet (152 m) N60°W of the Dyer house (Furcron and Teague, 1943, p. 142). 2. Exceptional muscovite crystals reaching 18 inches (46 cm) in diameter were mined from the T. H. Saxon Mine, approximately 11 miles (17.7 km) by road due south of Blairsville on Noah Branch.

Upson County: 1. Usually large muscovite crystals were encountered in the Bell Mine, 3.2 miles (5 km) S22°W of Thompson, 0.5 mile (0.8 km) east of Bell Creek (Heinrich, Klepper and Jahns, 1953, p. 333). A single crystal weighing more than 500 pounds (227 kg) was found in 1932. 2. Muscovite crystals up to 18 inches (46 cm) in diameter have been mined from the eastern limb of the pegmatite exploited at the Corley Mica Mine, 4.25 miles (6.8 km) S70°E of Thomaston and 200 feet (61 m) south of the Triune Mills Road. The pegmatite dike is distinctly zoned and contains relatively abundant coarse muscovite in a discontinuous wall zone (Heinrich, Klepper and Jahns, 1953, p. 339). 3. Excellent well-formed crystals of muscovite occur in the extensive Mitchell Creek Mica Mine, 7.25 miles (12 km) S65°E of Thomaston and one mile (1.6 km) northeast of Waymansville on a branch of Tobler Creek. Muscovite crystals from this location are noted for unusual inclusions of euhedral biotite and apatite. 4. Crystals of muscovite up to 11 inches (28 cm) in diameter are reported from the Pennyman Mica Mine, approximately 8.5 miles (14 km) east-southeast of Thomaston (Heinrich, Klepper and Jahns, 1953, p. 350).

Wilkes County: 1. Very coarse-grained, dark-green muscovite (fuchsite) occurs on Stony Ridge, approximately 5 miles (8 km) southwest of Washington and approximately 2,000 feet (610 m) south of the Youngs Chapel copper prospect.

PARAGONITE

$NaAl_2(AlSi_3)O_{10}(OH)_2$

Class Phyllosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Massive, compact; also as fine scales.

Phys. *Cleavage* {001} perfect. **H** 2.5. **G** 2.907 (calc.) *Color* colorless or pale yellow. Transparent to translucent. *Luster* pearly.

Occur.

Paragonite, the sodium-analog of muscovite, has been reported from very few locations in Georgia. Its presence must be suspected, however, in areas underlain by mica-rich metamorphic rocks. It is essentially indistinguishable from muscovite except under controlled laboratory conditions, and it is quite likely that numerous new occurrences of this mineral will be reported as research into the petrography and mineralogy of the crystalline rocks of Georgia continues.

Lincoln County: 1. Paragonite is one of the common rock-forming minerals at Graves Mountain along U.S. Highway 378 between Lincolnton and Washington. It is very fine-grained and typically associated with fine-grained muscovite (Hurst, 1958d, p. 18).

PHLOGOPITE

$KMg_3(AlSi_3)O_{10}(F,OH)_2$

Class Phyllosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Usually six-sided prisms; often massive lamellar.

Phys. *Cleavage* perfect basal. Tough and elastic. **H** 2½–3. **G** 2.8–3.4. *Luster* pearly *Color* yellowish brown to brownish red; sometimes greenish or colorless.

Occur.

Phlogopite is a relatively rare mineral in Georgia although it was commonly described in the old literature with reference to its occurrence in the altered margins of ultramafic plutons. Most of these old descriptions are actually of vermiculite group minerals rather than phlogopite. Most accepted phlogopite occurrences are directly related to the metamorphism and alteration of carbonate-rich sediments.

Bartow County: 1. Metasiltstone containing abundant zoisite and lesser greenish-brown phlogopite crops out in the bed of Hawks Branch, 0.8 mile (1.3 km) north of Campbell Hill in the Cartersville Mining District (Kesler, 1950, p. 37).

Gwinnett County: 1. A phlogopite-bearing quartzite interlayered with biotite gneiss and amphibolite is exposed in a small stream 2,400 yards (2195 m) S32°W of Centerville (Herrmann, 1954, p. 29). The phlogopite is light brown and slightly pleochroic from light brown to yellowish-brown.

Habersham County: 1. Small crystals of phlogopite are locally abundant in dolomitic marble intersected in drill holes on the Wilbanks property. The locality is in the southwestern part of the county adjacent to Little Mud Creek, approximately 3.5 miles (5.6 km) due west from Alto (Hurst and Crawford, 1964, p. 59).

Pickens County: 1. Phlogopite associated with tremolite occurs locally in marble in and around the New York Quarry at Marble Hill. 2. Phlogopite is locally abundant in marble exposed intermittently in the bed of a small creek which enters Sharp Mountain Creek from the east, about 0.75 mile (1.2 km) north of the bridge on the Ball Ground–Hopewell Church road (Bayley, 1928, p. 95).

Rabun County: 1. King (1894, p. 50) describes well-formed, small phlogopite crystals and relatively abundant, coarsely crystalline phlogopite intimately associated with massive, asparagus-green apatite in the corundum mine on Laurel Creek, lot 72, 3rd district, approximately one mile (1.6 km) from Pine Mountain. Analyses show that the coarsely crystalline phlogopite is apparently partially altered to vermiculite.

BIOTITE

$$K(Mg,Fe)_3(Al,Fe)Si_3O_{10}(OH,F)_2$$

Class Phyllosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals tabular or short prismatic, usually in six-sided prisms. Often in disseminated scales, sometimes in massive aggregations of cleavable scales.

Phys. *Cleavage* perfect basal. Flexible in thin sheets. **H** 2.5–3. **G** 2.8–3.4. *Luster* glassy to pearly. *Color* dark green to brown to black. *Streak* colorless. Transparent to translucent.

Occur.

Biotite is an exceptionally common essential and accessory mineral in the crystalline rocks. Biotite is found in virtually every granite and granitic gneiss in Georgia and is a major constituent of many schists and other metamorphic rocks. It is typically associated with muscovite in pegmatites exploited for mica and feldspar, particularly in the Upson-Monroe-Lamar County district and in the Montevideo area of the Hart-Elbert County district.

Localities described below are those which have produced exceptional amounts of biotite or unusually large crystals. They in no way reflect the extreme abundance and wide distribution of this mineral.

Lamar County: 1. Biotite is particularly abundant in the wall zone of a pegmatite formerly exploited for mica at the Clay Creek Mine on the Harrell Farm, approximately 4.5 miles (7.2 km) S9°E of Barnsville (Heinrich, Klepper and Jahns, 1953, p. 365).

Lumpkin County: 1. Considerable biotite was found as euhedral crystals in muscovite and aggregates associated with muscovite crystals in the W. M. Gooch Mica Mine, about 10 miles (16 km) north of Dahlonega and west of the road leading to Grassy Gap (Furcron and Teague, 1943, p. 128).

Monroe County: 1. Biotite sheets exceeding 3 inches (7.6 cm) in diameter are abundant on the main dump of the Fletcher Mica Mine, 5.6 miles (9 km) southwest of Forsyth and 0.1 mile (0.16 km) southwest of Hopewell Church (Heinrich, Klepper and Jahns, 1953, p. 371). 2. Biotite crystals up to 2 x 3 inches (5 x 7.6 cm) are notable on the dumps of the Cox prospects, 4.75 miles (7.6 km) south of Forsyth. Muscovite crystals at this occurrence typically contain inclusions of euhedral biotite and green apatite. 3. Books of biotite up to 3 x 4 inches (7.6 x 10 cm) associated with brown muscovite occur in the A. T. Redding mica prospects, 1.25 miles (2 km) south of Julliett (Heinrich, Klepper and Jahns, 1953, p. 375).

Union County: 1. Biotite crystals up to 4 inches (10 cm) in diameter occur in massive quartz lenses in a pegmatite prospected for mica on lot 301, 11th district, about 0.5 mile (0.8 km) south of Suches Creek (Furcron and Teague, 1943, p. 137).

Upson County: 1. Biotite occurs in a variety of associations and sizes at the Mitchell Creek Mica Mine, 7.25 miles (11.6 km) S65°E of Thomaston, one mile (1.6 km) northeast of Waymansville on a Branch of Tobler Creek. Biotite crystals as large as 10 inches (25 cm) in diameter have been recovered here as well as smaller, extremely perfect euhedral crystals. Aggregates of muscovite books are often encased in biotite, and the outer portions of individual muscovite crystals are commonly biotite. Biotite and muscovite are typically

intergrown along planes parallel with cleavage. Euhedral biotite crystals are frequently found as inclusions in larger books of muscovite. 2. Biotite in sheets up to 7 inches (17.8 cm) in diameter is relatively abundant in the pegmatite exploited at the Mauldin Mica Mine, 3.7 miles (5.6 km) S24°E of Thomaston, adjacent to Whittle Road. 3. Biotite in books exceeding 6 inches (15 cm) in diameter is locally abundant at the Stevens or Rock Mica Mine and adjacent prospects, approximately 3.5 miles (5.6 km) west of Yatesville, 2 miles (3.2 km) west of Toblers Mill. 4. Biotite crystals are particularly abundant in the wall zone near the east end of a pegmatite exploited for muscovite at the Johnson Mica Mine, 0.8 mile (1.3 km) S8°E of Yatesville (Heinrich, Klepper and Jahns, 1953, p. 357).

MARGARITE

$CaAl_2(Al_2Si_2)O_{10}(OH)_2$

Class Phyllosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals tabular, pseudohexagonal, rare. Usually in platy aggregates or scaly masses. Twinning on {001}, twin axis {310}.

Phys. *Cleavage* {001} perfect; laminar brittle. **H** 3.5–4.5. **G** 3.077 (calc.). *Color* grayish pink, pink, pale yellow, pale green. Translucent. *Luster* pearly. *Streak* colorless.

Occur.

Carroll County: 1. Corundum, partly altered to margarite and encased in chlorite, has been described from the Pitts property, lot 110, 5th district, 1.5 miles (2.4 km) east of Carrollton (Hopkins, 1914, p. 285). 2. Corundum in margarite has been found adjacent to a small exposure of dunite on lot 118, 1.25 miles (2 km) east of Carrollton (King, 1894, p. 105).

Habersham County: 1. Exceptional crystals of bright red corundum wrapped in aggregates of green and white margarite occur on the old Piedmont Orchard property, approximately 0.5 mile (0.8 km) south of Piedmont Orchard Kyanite Mine and 500 feet (152 m) north of the old Ivy Branch Road. The occurrence is within the Chattahoochee National Forest on lot 133.

Hall County: 1. Margarite encasing bright red corundum has been known for many years from Soapstone Hill, approximately one mile (1.6 km) west of Gainesville along Georgia Highway 53. Nodular masses of margarite up to 6 inches (15 cm) in diameter were once common on the property. Margarite is zonally arranged around individual corundum grains and is grayish-white to a delicate pale-green. The zones are made up of small, pearly radiating scales with their edges tangential to the corundum nucleus (King, 1894, p. 99).

Heard County: 1. Margarite is reported by King (1894, p. 105) from the property of W. A. Hyatt, Centralhatchee, lot 44, 13th district. Margarite occurs at this location as small pink scales within black, corundum-bearing, hornblende-rich rock.

Towns County: 1. Corundum encased in margarite is described from the Hamilton Corundum Mine, lot 60, 17th district, approximately 5 miles (8 km) north of Young Harris (King, 1894, p. 91). Margarite at this location occurs either flat-lying upon corundum or in a zonal arrangement with up-turned edges. Samples of actinolite–margarite rock are also reported.

Union County: 1. Margarite-bearing material containing corundum was apparently encountered in relative abundance in the underground workings of the Track Rock Corundum Mine, lot 259, 17th district, immediately south of Track Rock Gap (King, 1894, p. 93).

GLAUCONITE

$(K,Na)(Al,Fe^{+3},Mg)_2(Al,Si)_{4\ 10}(OH)_2$

Class Phyllosilicate

Cryst. Monoclinic

Habit Usually in granules; earthy.

Phys. *Cleavage* perfect {001}. **H** 2. **G** 2.5–2.86. *Color* green to greenish black. *Streak* pale green.

Occur.

Glauconite is particularly abundant within sediments of the Coastal Plain Province. It is particularly abundant in the Eutaw and Ripley Formations of Upper Cretaceous age and the Wilcox, Jackson, and Claiborne Groups of Eocene age. Glauconite has been reported as the green coloring agent in sands of these formations at numerous exposed sections and in many well logs. Glauconitic exposures in the Georgia Coastal Plain have been described in detail by Veatch and Stephenson (1911) and glauconite occurrences in well logs are described by Herrick (1961) and Applin and Applin (1964). Potassium-argon isotope age dates have been obtained from several Coastal Plain glauconite samples at localities 44 and 45 on the Geologic Map of Georgia (1976).

CHLORITE GROUP

Clinochlore	$(Mg,Fe^{+2})_5Al(Si,Al)_4O_{10}(OH)_8$
Ripidolite	Intermediate
Chamosite	$(Fe^{+2},Mg,Fe^{+3})_5Al(Si_3Al)O_{10}(OH,O)_8$

Class Phyllosilicate

Cryst. Monoclinic—2/m (clinochlore, ripidolite, chamosite);

Habit Crystals commonly tabular, hexagonal in outline. Usually massive, foliated, scaley, or granular; oolitic (chamosite). Twinning on {001}.

Phys. *Cleavage* {001}; unknown for chamosite. Laminae flexible, inelastic. **H** 2–3. **G** 2.688 (clinocholre),2.889 (ripidolite), 3–3.4 (chamosite). *Color* green, dark green, grass green, grayish green, brownish, or almost black (chamosite). Transparent to translucent. *Luster* pearly. *Streak* colorless to pale green.

Occur.

Minerals of the chlorite group are widely distributed and exceedingly common in metamorphic rocks of the Piedmont and Blue Ridge. These minerals are extensively developed in alteration zones around mafic and ultramafic plutons, within low-grade regionally metamorphised metavolcanics and metasediments, and in extensive zones of apparent hydrothermal alteration or retrograde metamorphism in the massive sulfide district of Paulding, Haralson, Carroll and Douglas Counties.

Species identification among minerals belonging to the chlorite group is exceedingly difficult and normally requires precise chemical and structural analyses as well as the determination of optic properties. For this reason, very few reported occurrences of chlorite have been classified as to their specific chemical makeup. Clinochlore, ripidolite and chamosite have been reported with a fair degree of certainty and other species probably occur in the state. Typical, interesting, and unusual ocurrences of chlorite group minerals are given below with specific reference to species identification where warranted.

Cherokee County: 1. Chlorite schist has been quarried for various purposes at the old McAfee Soapstone Quarry, approximately 5 miles (8 km) west of Canton. The rock is predominantly chlorite schist interbedded with quartzite and local sericite schist.

Dade County: 1. Chamosite-rich ööids have been described in a thin bed of mudstone near the base of the Sequatchie Formation in Lookout Valley by Chowns (1970, p. 19).

DeKalb County: 1. Ripidolite is the typical chlorite group mineral in an altered ultramafic pluton approximately 1.4 miles (2.25 km) S27°E of Stone Mountain (Prowell, 1971, p. 40).

Douglas County: 1. Chlorite is particularly abundant in a narrow alteration zone in hornblende gneiss and amphibolite at the Villa Rica massive sulfide deposit in the northwestern corner of the county, approximately 3 miles (4.8 km) north-northeast of Villa Rica along Georgia Highway 61. Detailed examination of chlorite adjacent to massive sulfide indicates the the species present is predominantly clinochlore (Cook, 1970, p. 63).

Habersham County: Locally coarse-grained chlorite is abundant in altered rocks near the margins of numerous mafic and ultramafic plutons in this county. Exceptional specimens of very coarse-grained chlorite may be found at numerous locations.

1. Very coarse-grained chlorite associated with talc, soapstone and asbestos is locally abundant in old prospects approximately 600 feet (183 m) south of the top of Mack Mountain, approximately 0.5 mile (0.8 km) east of Batesville in the northwestern corner of the county. 2. Large books of green chlorite may be collected in the old asbestos prospects immediately south of Raper Mountain Road, approximately 2,000 feet (610m) east of

Wikles Store on Georgia Highway 197 (Hurst and Crawford, 1964, p. 88). 3. Veins of dark-green, coarse-grained chlorite occur in asbestos prospects immediately north of Crow Branch, approximately 4,000 feet (1219 m) east of Georgia Highway 255 Alternate in the extreme western part of the county (Hurst and Crawford, 1964, p. 98).

Hart County: 1. In his general discussion of rock types in Hart County, Grant (1958, p. 9) describes the local alteration of biotite to "penninite" within staurolite-mica schists. A typical occurrence is 0.8 mile (1.3 km) due south of Flat Shoals Church.

Lumpkin County: Coarse-grained chloritic soapstone is relatively abundant in small exposures over a large area in the northeast part of the county.

1. Coarse-grained, well-foliated rocks composed predominantly of chlorite are exposed in prospects on lot 21, 5th district, 1st section on the east side of the Chestatee River, approximately 4 miles (6.4 km) east of Dahlonega. 2. Similar material has been quarried at numerous locations along Soapstone Ridge, 9 miles (14.4 km) northeast of Dahlonega, 7 miles (11 km) west of Cleveland (Hopkins, 1914, p. 275).

Murray County: Chlorite is exceedingly abundant in altered rocks in and adjacent to the talc occurrences immediately east of Chatsworth. "Penninite" has been identified as an important constituent of the chlorite-rich rocks (Furcron, Teague and Calver, 1947, p. 38).

Paulding County: 1. Chlorite is very common in major alteration zones within hornblende-rich rocks outcropping sinuously throughout the county from near Draketown northeastward into Bartow County (Hurst and Crawford, 1970).

1. Ripidolite has been identified as a dominant chlorite in altered amphibolite and hornblende gneiss in the immediate vicinity of the Little Bob massive sulfide deposit, 2nd district, 3rd section, approximately 2 miles (3.2 km) northwest of Hiram (Cook, 1970, p. 14). 2. Similar ripidolite occurs in extensively altered wall and country rocks in and adjacent to the Swift massive sulfide deposit, 19th district, 3rd section, 1.5 miles (2.4 km) east of Draketown.

Rabun County: 1. Deep-green chlorite in individual books up to 2 inches (5 cm) in diameter occurs in narrow veins near the margins of the dunite body exploited for corundum at the Laurel Creek Mine, lot 72. 3rd district, one mile (1.6 km) northeast of Pine Mountain on Laurel Creek.

Towns County: 1. Coarsely crystalline, deep-green chlorite occurs with corundum in altered ultramafic rock at the old Bell Creek Corundum Mine, lot 6, 18th district, approximately 4 miles (6.4 km) north of Hiawassee, immediately west of Bell Scene Church.

Union County: 1. Coarse-grained chlorite in unusual samples may be found in old workings of the Track Rock Corundum Mine, lot 259, 17th district, immediately south of Track Rock Gap in the northeastern part of the county.

White County: 1. A narrow vein of coarsely crystalline, dark-green chlorite in books up to one inch (2.5 cm) in diameter occurs with talc and asbestos in an old prospect approximately 5.5 miles (8.9 km) northeast of Helen at Camp Echoee (Hurst and Otwell, 1964, p. 71). 2. Excellent examples of very coarse-grained, apple-green chlorite occur with asbestos in old prospects located approximately 3 miles (4.8 km) north of Cleveland, adjacent to Holiness Church (Hurst and Otwell, 1964, p. 82).

CHLORITOID

$(Fe,Mn)_2Al_4Si_2O_{10}(OH)_4$

Class Phyllosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Rarely in distinct tabular crystals, usually hexagonal in outline. Usually coarsely foliated massive; also in thin scales or small plates.

Phys. *Cleavage* perfect basal. Plates flexible but not elastic. **H** 6.5. **G** 3.26–3.57. *Luster* pearly on cleavage. *Color* dark gray, greenish gray, greenish black, or grayish black; often grass-green in very thin plates. *Streak* uncolored or grayish.

Occur.

Chloritoid has not been positively identified in the metamorphic rocks of Georgia. The mineral has, however, been reported within the Tate quadrangle by Bayley (1928, p. 70), in the staurolite-kyanite schist members of the Valleytown Formation, and in the abundant chloritic material associated with the commerical talc deposits of the Chatsworth district by Hopkins (1914, p. 210). Recent work in both of these areas has failed to recognize chloritoid.

APOPHYLLITE

$KCa_4Si_8O_{20}(F,OH) \cdot 8H_2O$

Class Phyllosilicate

Cryst. Tetragonal; ditetragonal-dipyramidal—4/m 2/m 2/m

Habit Crystals commonly pseudocubic, often modofied by {111}; also tabular, pyramidal, or long and square prismatic. Prism faces vertically striated, often brilliant; basal pinacoid dull or rough. Also massive, lamellar or granular. Twinning on {111}, rare.

Phys. *Cleavage* {001} perfect; {110} imperfect. *Fracture* uneven; brittle. **H** 4.5–5. **G** 2.3–2.4. *Color*less, white, grayish; also pale yellowish, greenish, reddish. *Luster* vitreous to pearly. Transparent to translucent. *Streak* white.

Occur.

DeKalb County: 1. Apophyllite has been reported from pegmatitic zones and fractures within several quarries on Arabia Mountain.

Fayette County: 1. Excellent apophyllite crystals and related zeolites have been found in open cavities in the Tyrone Quarry of Dixie Lime and Stone Company, 2 miles (3.2 km) south of Tyrone.

PREHNITE

$Ca_2Al_2Si_3O_{10}(OH)_2$

Class Phyllosilicate

Cryst. Orthorhombic

Habit Usually compact granular masses or in botryoidal, stalactitic, or reniform forms with columnar, radiated, or lamellar structure. Individual crystals rare, usually tabular, also prismatic or steep pyramidal.

Phys. *Cleavage* {001} distinct; {110} poor. *Fracture* uneven. Brittle. *Color* pale to dark green, yellow, gray, white, colorless. Transparent to translucent. **H** 6–6½. **G** 2.94 (calc.). *Luster* vitreous to pearly. *Streak* colorless.

Occur.

Clarke County: 1. Aggregates of white prehnite in crystals reaching 0.5 inch (1.3 cm) in maximum dimension occur in small vugs at the aggregate quarry adjacent to the Athens Airport. 2. Small vugs containing prehnite associated with chabazite, albite, quartz, pyrite and chlorite occur at the intersection of the Athens Bypass and U.S. Highway 441 (Ramspott, 1967, p. 18). The prehnite occurs in groups of tabular crystals united on {001} making broken forms, often barrel shaped.

Elbert County: 1. Ramspott (1967, p. 19) reports prehnite as massive vein-fillings up to 0.04 inch (0.1 cm) thick at the Dawn Gray quarry about 6 miles (9.7 km) south of Elberton on Georgia Highway 77.

Wilkes County: 1. Prehnite-filled amygdules up to 0.25 inch (0.6 cm) in diameter occur sparingly in a diabase dike on the west side of Hutton Fork Creek, approximately 3.5 miles (5.6 km) north of Rayle (Cook, 1967, p. 36).

CHRYSOCOLLA

$(Cu,Al)_2H_2Si_2O_5(OH)_4 \cdot nH_2O$

Class Phyllosilicate

Cryst. Monoclinic

Habit Crystals acicular, microscopic, in radiating groups or close-packed aggregates. Usually cryptocrystalline; commonly earthy or opal-like. Sometime botryoidal.

Phys. *Cleavage* none. *Fracture* uneven to conchoidal. Very brittle. **H** 2–4. **G** 2.0–2.4 (meas.). *Color* various shades of blue, blue-green, or green. Also brown to black when impure. Translucent to nearly opaque. *Luster* vitreous, earthy.

Occur.

DeKalb County: 1. Green to blue chrysocolla has been found coating foliation planes and interspersed with biotite at several quarries near Stone Mountain (Hurst, 1955, p. 65).

Fannin County: 1. Chrysocolla and scaley malachite are described as secondary minerals associated with ores of the Mobile Copper Mine on lot 59, 9th district, 2nd section by Shapard (1859).

Lumpkin County: 1. Minor chrysocolla is reported in workings of the Barlow Gold Mine, lots 746 and 747, 12th district (Pardee and Park, 1948, p. 39).

Towns County: 1. A green copper-bearing mineral, reported as "probably chrysocolla," forms thin coatings around mineral grains and fills irregular fractures in garnet crystals at the Rich Knob copper prospect on lot 91, 1st district (Shearer and Hull, 1918, p. 209). The mineral is of secondary origin and occurs in a coarse granitic "vein" consisting of quartz, biotite, garnet and feldspar.

QUARTZ
SiO_2

Class Tectosilicate

Cryst. Hexagonal—R; trigonal-trapezohedral—32

Habit Crystals usually hexagonal prisms terminated by two rhombohedrons. Sometimes appears as six-sided bipyramids made up of the two rhombohedrons. Crystals often highly modified and malformed. Also massive, coarse to fine granular, cryptocrystalline.

Phys. *Cleavage* rhombohedral (rare). *Fracture* conchoidal. Brittle to tough. **H** 7. **G** 2.65. *Luster* vitreous to greasy. *Color* colorless when pure; often various shades of yellow, red, brown, green, blue, or black. *Streak* white. Transparent to opaque.

Occur.

Quartz in its many varieties is the most widely distributed and familiar mineral in Georgia. Its extreme resistance to weathering and wide parengenetic range insure its presence in almost all rock types, soil, and sediment. It is an essential constituent of most igneous and many sedimentary and metamorphic rocks and is found in all geographic provinces and in rocks of all ages.

Quartz as sand is produced from numerous occurrences for the construction industry and as a high purity ingredient of glass. Quartzite has been prospected as a source of high-purity silica in Pike and adjacent counties. Crushed quartz for decorative building stone has been mined in Troup and Putnam Counties.

It is not possible to list all occurrences of quartz in the state. The following is a selection of the more interesting or unusual occurrences.

Euhedral and Coarse-Grained Varieties

Bartow County: 1. Interesting quartz crystal-lined geodes occur in the numerous barite mines on the south side of U.S. Highway 41, immediately opposite the Etowah River. These geodes occasionally contain transparent quartz crystals locally covered with tabular hematite crystals.

Cherokee County: 1. Large, colorless, transparent quartz crystals up to 8 inches (20 cm) in diameter were once found near Ball Ground. Excellent examples of these crystals are in the museum of the Georgia State Capitol.

Cobb County: 1. Clusters of superb, transparent quartz crystals up to 3 inches (7.6 cm) in diameter were submitted to the Georgia Geological Survey in the early 20th century from Cobb County. No specific location was given. Examples of this material are in the museum of the Georgia State Capitol. 2. Fragments of similar large rock crystal specimens occur on the W. T. White property, 3.5 miles (5.6 km) from Austel behind Orange Grove Church. 3. Amethyst crystals occur at Howell Cemetary, 300 yards (274 m) north of the Adamsville Bridge. 4. Rose quartz was once relatively abundant approximately 0.5 mile (0.8 km) east of Belmont Hills.

Elbert County: 1. Excellent doubly terminated amethyst and smoky quartz crystals were encountered in pockets at the Chapman Mica Mine. Crystals reached lengths of 3 inches (7.6 cm). Examples of this material are on display in the museum of the Georgia State Capitol. 2. Interesting, medium-purple amethyst crystals with white milky overgrowths have been found on the W. R. Perkins property, approximately 2 miles (3.2 km) west of Dewy Rose.

Fayette County: 1. Amethyst exhibiting excellent color has been found on the Homer Kelin Farm, one mile (1.6 km) north of Fayetteville on U.S. Highway 85.

Forsyth County: 1. Superb clusters of colorless quartz crystals containing hematite inclusions were submitted to the Georgia Geological Survey from the E. D. Little Farm near Sheltonville. Examples of this material are on display in the museum at the Georgia State Capitol. 2. Doubly terminated amethyst crystals up to 2.5 inches (6.4 cm) in diameter were once found on the S. H. Gilbert Farm, approximately 6 miles (9.7 km) east of Cumming. This occurrence is, in all probability, beneath the waters of Lake Lanier.

Fulton County: 1. Good crystals of smoky quartz and amethyst have been found on the Wilkins Farm, approximately 5.5 miles (8.9 km) northwest of Alpharetta. 2. Similar amethyst and smoky quartz have been collected on the adjacent farm of Durell Cook. Both locations can be reached from Alpharetta by going 6.3 miles (10 km) on Hopewell Road, then 1.1 miles (1.8 km) south on Thompson Road. 3. Light smoky quartz and amethyst have been found in both single crystals and clusters on the property of T. V. Armstrong, approximately 0.5 mile (0.8 km) N25°E of the preceeding two occurrences. 4. Perhaps the finest amethyst in this district has been found on the property of Howell Bates, approximately 7.5 miles (12 km) north of Alpharetta via Georgia Highway 2.

Hall County: 1. Excellent smoky quartz crystals up to 6 inches (15 cm) in diameter have been found on the Clyde O'Dell property on Browns Bridge Road. 2. Medium-purple amethyst, similar to that found near Buckhead in Morgan County, was submitted to the Georgia Geological Survey by Mr. Guy C. Wallace from a location near Lula. 3. Gem-quality amethyst has been found on the property of Fred Staton near Clermont.

Heard County: 1. Exceptional specimens of rock crystal up to 5 inches (12.7 cm) in diameter have been found in Heard County. Examples of this material are on display in the museum of the Georgia State Capitol. The catalog of this collection does not list the specific locations.

Henry County: 1. Rose quartz is found in the core of the pegmetite formerly exploited for mica at the Maddox Mine, approximately one mile (1.6 km) west of Millers Mill and 6 miles (9.7 km) north of McDonough (Heinrich and Jahns, 1953, p. 391).

Jackson County: 1. Interesting, etched quartz crystals up to 2.5 inches (6.4 cm) long have been found in a pegmatite approximately one mile (1.6 km) south of Hurricane Shoals on the Oconee River.

Jasper County: 1. Gem qualilty quartz varying in color from pale blue to smoky has been found in pegmatites on the Barron Fullerton property, approximately 3 miles (4.8 km) east of Hillsboro. 2. Unusual aggregates of transparent smoky quartz crystals up to 2.5 inches (6.4 cm) long and containing inclusions of orange clay have been found around the perimeter of the Gladesville Norite, about 5 miles (8 km) south of Monticello.

McDuffie County: 1. Light- to medium-purple amethyst crystals are reported from pasture land and gullies about 1,500 feet (457 m) northeast of the junction of Little Germany Creek with Germany Creek in the northeastern part of that county (Hurst, Crawford and Sandy, 1966, p. 79). 2. Pale amethyst crystals up to 4 inches (10 cm) long occurred in a quartz vein exposed in the bypass southeast on the Georgia Highway 150–Interstate 20 overpass, about 5 miles (8 km) northeast of Thompson (Hurst, Crawford and Sandy, 1966, p. 79).

Meriwether County: 1. Excellent clusters of rock crystal containing both specular hematite and chlorite inclusions were submitted to the Georgia Geolooical Survey in 1898 from an unspecified location near Woodbury.

Morgan County: 1. Amethyst has been collected for many years from diggings on the old Ben Ray property, approximately 2.8 miles (4.5 km) east of Buckhead. Numerous excellent clusters of medium purple amethyst on aggregates of small, colorless quartz crystals have been found at this location. Most crystals are less than one inch (2.5 cm) in diameter. One of the few attempts to mine amethyst in the state was conducted here.

Oconee County: 1. Rutilated rose quartz has been reported from the J. Swanton Ivey property near Watkinsville.

Oglethorpe County: 1. Pale amethyst crystals up to 4 inches (10 cm) in diameter have been found loose in the soil east of Georgia Highway 22, approximately 2 miles (3.2 km) north of Lexington. Smaller fragments of gem-grade amethyst occur at this location. 2. Interesting, transparent quartz crystals containing hematite inclusions have been found at an unspecified location one mile (1.6 km) west of Lexington along U.S. Highway 78.

Pickens County: 1. Large, transparent quartz crystals have been found in soil near the Cagle or Dunsmore Mica Mine, lot 195, 13th district, 2nd section, 4.8 miles (7.7 km) S65°W of Tate (Heinrich and Jahns, 1953, p. 385). Associated minerals are garnet, kyanite, and rutile.

Pike County: 1. The economic potential of the Hollis Quartzite as a source of silica was evaluated in 1967. The most frequently mentioned occurrence is along both sides of U.S. Highway 19, approximately 0.5 to 1.0 mile (0.8 to 1.6 km) north of the Pike–Upson County line (Long, 1971, p. 128).

Rabun County: 1. Crystals of smoky and colorless quartz have been found in soil 2 miles (3.2 km) east of Clayton behind Woodland Lodge. 2. Superb amethyst crystyals are occasionally found at an old prospect

near the Mountain City Water Works. 3. Medium-pink rose quartz as well as light smoky quartz and amethyst occur in the pegmatite exploited at the Kell Mica Mine, 9 miles (14.4 km) east of Clayton on lot 39, 3d district. 4. Excellent amethyst is reported from the W. T. Smith property in the Mocassin district. The specific location is not recorded. 5. Excellent amethyst is reported from the Ledbetter Mine, about one mile (1.6 km) north of Rabun Gap (Sinkankas, 1959, p. 337). 6. Similar amethyst occurs in the North Georgia Mine, about 4 miles (6.4 km) northwest of Clayton, and the John A. Wilson prospect 4 miles (6.4 km) southeast of Clayton (Sinkankas, 1959, p. 337).

Spaulding County: 1. Rose quartz associated with tourmaline and blue beryl occurs in pegmatites on the T. J. Allen Farm, about 2 miles (3.2 km) north and slightly east of Vaughn (Heinrich and Jahns, 1953, p. 392).

Talbot County: 1. Excellent large crystals of smoky quartz containing movable bubbles were submitted to the Georgia Geological Survey many years ago from the Rye property in this county.

Taliaferro County: 1. Amethyst is reported from the property of Fred Lundsford, Route 1, Crawfordville by Hurst, Crawford and Sandy (1966, p. 80). 2. A superb, 5-inch (12.7 cm) diameter, flawless rock crystal from an undisclosed location near Crawfordville is in the museum of the Georgia State Capitol.

Towns County: 1. Numerous superb crystals of deep purple, gem-grade amethyst have been found in pockets at the well known Charlies Creek amethyst occurrence on the east side of the creek, approximately 4 miles (6.4 km) from Titus. 2. One of the more productive gem amethyst mines in the state is the old Garrett Mine on the ridge between Shoal Branch and Jacks Branch of Hightower Creek, about 0.9 miles (1.4 km) south of Hightower Bald. Amethyst occurs here in pockets up to 3 inches (7.6 cm) wide and 3 or 4 feet (0.9 or 1.2 m) long which contain up to 100 pounds (45 kg) of amethyst. 3. High purity silica has been mined from quartzite exposures near the summit of Bell Mountain near Hiawassee (Hurst and Horton, 1964).

Troup County: 1. Medium-pink rose quartz is relatively abundant in the core of a pegmatite on the south side of the first curve in Bartlett Road, west of Smiths Crossroads, 6 miles (9.7 km) south of LaGrange (Long, 1971, p. 95). 2. Quartz crystals up to one inch (2.5 cm) in diameter and 6 inches (15 cm) in length are abundant in prospect trenches on the M. L. Mulkey property, approximately 6.35 miles (10.2 km) S9°E of the LaGrange city square (Long, 1971, p. 96). 3. Excellent rose quartz forms portions of the extensive core of the pegmatite formerly exploited for beryl at the Hogg Mine, approximately 6.9 miles (11 km) S6°E of the city square of LaGrange. The mine is immediately west of Georgia Highway 219, approximately 0.5 mile (0.8 km) south of Smiths Crossroads. Permission to collect at this site is required. 4. Medium- to dark-pink rose quartz samples from an unspecified location near Louise are on display in the Geology Museum at Emory University. 5. Numerous other quartz crystals and rose quartz occurrences are known from this county, predominantly in the vicinity of Smiths Crossroads. Most formerly reported occurrences are of residual quartz crystals found during cultivation.

Upson County: 1. Excellent colorless quartz crystals up to 6 inches (15 cm) in diameter have been found loose in soil approximately 0.5 mile (0.8 km) north of Swifton. 2. Transparent smoky quartz crystals up to 2 inches (5 cm) in length have been found on the J. O. Brasewell property near Thomaston. These crystals are particularly attractive as mineral specimens.

Walton County: 1. Excellent transparent quartz crystals up to 3 inches (7.6 cm) in diameter occur on the J. Z. Craig Farm near Blasengame, about 7 miles (11 km) from Monroe.

Warren County: 1. Pale amethyst, and white and colorless quartz crystals up to 2 inches (5 cm) in diameter are abundant in soil overlying granite saprolite on the J. B. Ivey property, 5 miles (8 km) southwest of Warrenton between Georgia Highway 16 and Mayfield Road (Hurst, Crawford and Sandy, 1966, p. 77).

White County: 1. Museum specimens of amethyst have been found in soil east of the Soseby residence near old Georgia Highway 11 at Mossy Creek Campground in the extreme south-central part of the county (Hurst and Otwell, 1964, p. 92). 2. Amethyst is reported in quartz veins exposed in cuts on the Batesville Highway, approximately 0.3 mile (0.48 km) north of Union Church (Hurst and Otwell, 1964, p. 92).

Wilkes County: 1. Small, light-colored amethyst crystals and massive, pale-purple vein material are found in residuum over a small body of coarse-grained granite, about 0.6 mile (0.97 km) south of Tyrone in the southwestern part of the county (Hurst, Crawford and Sandy, 1966, p. 79). 2. Specimen-grade amethyst crystals occur in veins a few hundred yards north of Clifford Grove Church in northwestern Wilkes County near Jacksons Crossroads (Hurst, Crawford and Sandy, 1966, p. 79). 3. Bluish-violet to deep-purple, gem quality amethyst crystals up to one inch (2.5 cm) in diameter occur in pockets in coarse-grained granite saprolite in an abandoned borrow pit, approximately 2.5 miles (4 km) northwest of Newtown in the west-central part of the county (Hurst, Crawford and Sandy, 1966, p. 80). Crystals of dark amethyst containing oriented rutile needles are found at this occurrence. Superbly faceted stones have been cut from these crystals. 4. Excellent coffee-colored quartz crystals up to 4 inches (10 cm) in diameter occur in fields near the intersection of Georgia Highways 43 and 44, approximately 6 miles (9.7 km) east of Tignall. Most crystals exhibit

phantom overgrowths. The interior portions of some crystals are dark amethyst. 5. The finest amethyst crystal yet reported from Georgia was found in a field approximately one mile (1.6 km) north of Tignall on Georgia Highway 17. The crystal was 6 inches (15 cm) in length, 4 inches (10 cm) in diameter, and was flawless gem quality material of a deep royal purple color.

Cryptocrystalline Varieties

Baldwin County: 1. Jasper has been recovered from coastal plain gravel within this county. Examples of this material are on display in the museum of the Georgia State Capitol.

Bartow COunty: 1. Geodes similar to those of the famous Keokuk, Iowa, occurrence have been recovered from the many barite pits south of U.S. Highway 41 near the Etowah River. 2. Excellent jasper can be recovered from residuum over Knox Dolomite in the vicinity of Salt Peter Cave, east of Kingston.

Ben Hill County: 1. Excellent silicified wood has been found in the Hawthorn Formation (Miocene) near Fitxgerald. Most material is white, gray, or yellow and contains well-preserved growth rings.

Bibb County: 1. Brown agate occurs near the Holten Quarry, approximately 7.5 miles (12 km) north-northwest of Macon.

Burke County: 1. Geodes containing water were once abundant on Briar Creek in Burke or Screven County. Jasper is associated with the geodes. 2. Excellent agate and bloodstone occur in the vicinity of Milhaven and Girard. One of the better known occurrences is along the old River Road leading from Augusta to Savannah paralleling the Savannah River. The occurrences are most accessible from McBean.

Catoosa County: 1. Blood-red jasper in dark olive-green chert, resembling bloodstone, occurs 400 yards (366 m) east of Ooltewah Road, 1.75 miles (2.8 km) north of Ringgold. The stone is well suited for cabochons.

Chattahoochee County: 1. One of the best known collecting sites for petrified wood is along Randall Creek south of Columbus. Excellent pastel log sections have been recovered at this location. The apparent source of the silicified wood is the Tuscaloosa Formation.

Chattooga County: 1. Red mottled and banded agate may be found at the fish hatchery, about 4 miles (6.4 km) from Summerville on Cloudland Road. 2. Agate in considerable quantity occurs in a chert quarry on the Rome–Summerville road about 2 miles (3.2 km) south of Summerville.

Columbia County: 1. Excellent examples of agatized wood from an unspecified location near Harlem are displayed in the museum at the Georgia State Capitol.

Decatur County: 1. Petrified wood is relatively abundant in residuum in low lying areas in western-most Decatur County near the Seminole County line.

Dougherty County: 1. Excellent jasper may be found on the Flint River near Albany.

Jefferson County: 1. Multi-colored banded agate from an unspecified location in Jefferson County is on display in the museum of the Georgia State Capitol.

Marion County: 1. An approximately 10-foot (3 m) long silicified log of the Pine family is on display in the museum of the Georgia State Capitol. The sample was collected from the Tuscaloosa Formation in Marion County.

Meriwether County: 1. Excellent agate occurs along the Southern Railway, approximately one mile (1.6 km) south of Warm Springs.

Muscogee County: 1. Interesting, honey-colored silicified wood occurs along Upatoi Creek where it cuts through the Tuscaloosa Formation near Columbus.

Screven County: 1. Exceptional agate containing numerous fossils may be found in extreme northeastern Screven County, approximately 6 miles (9.7 km) northeast of Millhaven near the Savannah River.

Thomas County: 1. Excellent examples of agatized coral from an unspecified location in Thomas County are on display in the museum at the Georgia State Capitol.

Upson County: 1. An unusual and attractive agate occurs at Wilmots Ravine, approximately 6 miles (9.7 km) east-northeast of Thomaston, 100 yards (91 m) north of Georgia Highway 74. The agate consists of red and white banded plates which intersect acutely enclosing open spaces which are in part filled with drusy quartz. Some cavities contain water with air bubbles.

Whitfield County: 1. Interesting oolitic red jasper may be found in railroad cuts along Tarr Creek near benchmark 710 on the outskirts of Dalton.

CRISTOBALITE

SiO_2

Class Tectosilicate

Cryst. Tetragonal; tetragonal-trapezohedral—422

Habit Crystals distinct, white. Also massive, as submicrocrystalline aggregates or with a microscopic fibrous structure.

Phys. *Cleavage* none apparent. Brittle. **H** 6½. **G** 2.2–2.3. *Color* white or milky white. *Luster* dull.

Occur.

Alpha cristobalite forms the matrix for claystone-bearing formations of the Coastal Plain, particularly the Twiggs Clay (Barnwell Formation). The dissolution of biogenous opal claystone matrix with subsequent re-precipitation of silica as disordered alpha cristobalite has been described for Georgia clays by Wise, Ciesielski, Schmidt and Weaver (1974, p. 123).

OPAL

$SiO_2 \cdot nH_2O$

Class Tectosilicate

Cryst. Noncrystalline to submicrocrystalline aggregates.

Habit Opal occurs as crusts with a botryoidal, globular, reniform, or ropy surface; small stalactitic to coralloidal; as irregularly-shaped concretionary masses. Commonly as a cavity filling and as veinlets.

Phys. *Cleavage* none. *Fracture* conchoidal. **H** 5½–6½. **G** 1.99–2.25. *Luster* vitreous to waxy. *Color*less and transparent to white, yellow, red, brown, green, gray, blue, all usually pale; also dark colors from foreign admixtures. Sometimes shows rich internal play of colors. *Streak* white. Transparent to nearly opaque.

Occur.

Opal is known to occur in two distinct modes within Georgia. Common opal infrequently replaces wood of the Tuscaloosa Formation in the northernmost counties of the Coastal Plain. Opal (variety hyalite) occurs as secondary incrustations filling joints and cavities in granite, mafic rocks, and residual masses of iron oxides. Although fire opal was reported from Washington County in the 19th century, no authentitic occurrences of this precious opal are known today.

Bartow County: 1. Thin seams and mammillary aggregates of colorless hyalite opal fill open spaces in residual iron oxide at many of the iron mines in the Cartersville District.

Brooks County: 1. Wax-like opal has been found on lot 270, 12th district. The occurrence has not been described in the literature, and it is assumed that the opal replaces wood.

Burke County: 1. Mammillary incrustations of hyalite opal coat chert and flint of Eocene age at Stony Bluff on the Savannah River.

DeKalb County: 1. Thin crusts of hyalite opal coat joint surfaces in granite quarried by the Ethyl Granite Corporation, about 2.5 miles (4 km) southwest of the crest of Stone Mountain. The material fluoresces brillant green under ultraviolet radiation and is typically associated with uranophane. 2. Similar material may be found at the Flat Rock Quarry on the north side of Stone Mountain, the quarry of Stone Mountain Granite Corporation on the south side of the mountain, at the Hayne Quarry, and elsewhere.

Floyd County: 1. Colorless, transparent hyalite opal is relatively abundant in open spaces in residual iron oxide boulders mined at numerous localities in the vicinity of Cave Springs.

Rabun County: 1. Hyalite opal occurs as thin incrustations in cracks near the margin of the peridotite body at the Laurel Creek Corundum Mine in the southern part of lot 72, 3rd district, about one mile (1.6 km) southwest of Pine Mountain on Laurel Creek. 2. Similar material has been reported from the old Miller Asbestos Mine, lot 7, 1st district, 3 miles (4.8 km) northwest of Burton on a small branch of Dicks Creek.

Richmond County: 1. Interesting opal replacing wood occurs in Richmond County. Several specimens of this material are in the museum of the Georgia State Capitol. The material exhibits interesting variations of color from red through pink to cream-white. Much of this material is fluorescent under ultraviolet light.

Washington County: 1. The occurrence of fire opal is mentioned by Dana (1892, p. 197) from a location near Chalker. The opal occurred as small masses in "silicified sandstone" of Eocene age which contained calcareous shells. The opal reportedly filled spaces left by the dissolution of the shells. An attempt by R. W. Smith to relocate this occurrence in 1926 resulted in the discovery of opal in identical matrix on the Dick Warthen property, about 2 miles (3.2 km) south of Warthen on the west side of the Sandersville highway. 2. Tan opalized wood is on display in the museum of the Georgia State Capitol from an unspecified location in Washington county.

Webster County: 1. Films and mammillary masses of colorless hyalite opal are occasionally found in cavernous masses of iron oxide in Paleocene and Oligocene sediments. Identical material is reported from Pulaski, Dooly, and Stewart Counties (S. M. Pickering, personal communication).

White County: 1. Bright green fluorescent, globular hyalite opal is found along seams and fractures in biotite gneiss exposed along a secondary road at the Tesnatee Creek Bridge off Georgia Highway 115, about 3.8 miles (6 km) west of Cleveland (Hurst and Otwell, 1964, p. 87).

FELDSPAR GROUP

The feldspars are the most widespread and abundant silicate minerals in most of the igneous and metamorphic rocks of the Piedmont, and are locally important constituents of many sedimentary deposits and some soils. Members of the feldspar group are classified primarily according to crystal structure and secondarily by chemical composition. The following classification shows the relationship of the species known to occur in Georgia:

Species and Subspecies	*Chemical Composition*
Monoclinic	
Orthoclase	$KAlSi_3O_8$
Soda-orthoclase	$(Na,K)AlSi_3O_8$
Sanidine	$(Na,K)AlSi_3O_8$
Triclinic	
Microcline	$KAlSi_3O_8$

Plagioclase Series	Albite Mole. $NaAlSi_3O_8$	Anorthite Mole. $CaAl_2Si_2O_8$
Albite	100–90	0–10
Oligoclase	90–70	10–30
Andesine	70–50	30–50
Labradorite	50–30	50–70
Bytownite	30–10	70–90
Anorthite	10– 0	90–100

Sodium commonly substitutes for potassium in both orthoclase and microcline, but as essentially no research has been conducted on the composition and symmetry of alkali feldspars from Georgia occurrences, no distinction can be made among these in the following descriptions. The plagioclase feldspars are an isomorphous series ranging from the pure sodium feldspar member (albite) to the pure calcium feldspar member (anorthite).

Members of the feldspar group are both directly and indirectly important economic minerals. Granites and granitic gneisses quarried for dimension and crushed stone typically contain up to 65 percent feldspar. Feldspar-rich rocks had been quarried in at least 96 Georgia locations by the beginning of this century. There are currently 73 major operations producing feldspar-rich rocks for dimension or crushed stone purposes. Approximately 90 individual quarries have been operated in the DeKalb–Rockdale–Gwinnett County areas alone. Feldspar for ceramics, pottery, insulators, glass, and latex fillers is quarried from several pegmatites in and near the Gladesville Norite southwest of Monticello, Jasper County.

The following descriptions of occurrences are much briefer than warranted by the abundance and petrologic importance of the feldspar minerals.

ORTHOCLASE
$KAlSi_3O_8$

Class Tectosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals often short prismatic. Carlsbad twinning common; Baveno and Manebach twinning uncommon. Often massive, coarsely cleavable to granular; sometimes lamellar.

Phys. *Cleavage* perfect {010, 001}. *Fracture* conchoidal to uneven. Brittle. **H** 6. **G** 2.56. *Luster* vitreous. *Color*less, white, pale yellow, flesh-red, gray. *Streak* uncolored.

Occur.

Orthoclase is an extremely abundant constituent of many granites and granitic gneisses and is locally abundant in metavolcanic rocks of the Little River Series and metasediments throughout the Piedmont. It is a locally important constituent of felsic pegmatites exploited for mica. Orthoclase is most obvious and easily observed in prophyritic granites and granitic gneisses locally exposed over broad areas. In such porphyritic rocks, orthoclase and other feldspars occur as large crystals in a ground mass of smaller, typically anhedral feldspar and quartz grains. Rounded, though well defined, orthoclase crystals can be found in soil and saprolite overlying such rocks. Occurrences described below are those which contain abundant orthoclase in megascopically recognizable, euhedral form.

Baldwin County: Well-formed, tabular orthoclase crystals up to 2 inches (5 cm) in maximum dimension occur in porphyritic granite exposed over a relatively wide area approximately 3 miles (4.8 km) southeast from Milledgeville. Orthoclase from this location is particularly lustrous and is commonly twinned according to the Carlsbad law.

Columbia County: 1. Orthoclase in well-formed crystals up to 1.7 inches (4.3 cm) in length is a major constituent of porphyritic granite exposed locally over a rather large area from 1 to 4 miles (1.6 to 6.4 km) east of Appling. Orthoclase at this location is typically pink or flesh colored but locally is greenish. Twinning according to the Carlsbad Law is very common. Excellent exposures are to be found at the flat, dome-shaped exposure known as Heggie Rock or Cedar Rock.

Coweta County: 1. Porphyritic granite containing abundant large orthoclase crystals is exposed locally over a large area of northeast Coweta County. This is apparently the same rock unit exposed in Campbell and Fayette Counties and is commonly termed Palmetto Granite. Excellent exposures may be seen in the old McCollum Quarry near Newnan and along the railroad near old Coweta Station (Watson, 1902, p. 91).

Fayette County: 1. Local exposures of orthoclase-rich Palmetto Granite occur in the northern half of the county. White, opaque orthoclase crystals typically exceed one inch (2.5 cm) in length and are usually twinned by the Carlsbad Law. Excellent exposures can be seen at the old McElwany property, appeoximately 10 miles (16 km) west of Fayetteville, 5 miles (8 km) east from Coweta; and at Bennetts Mill Rock, 2.25 miles (3.6 km) west from Fayetteville (Watson, 1902, p. 102).

Fulton County: Euhedral phenocrysts of orthoclase are locally abundant in the Palmetto Granite. Locations originally described by Watson (1902, p. 104–105) are approximately 2 miles (3.2 km) southwest of Palmetto on the Seed property; along the railroad several hundred yards north of the Palmetto depot; along the railroad as far south as Coweta Station; and on the Johnson property, 0.5 mile (0.8 km) east of Palmetto.

Greene County: 1. Excellent, pink to white orthoclase crystals up to 2 inches (5 cm) in length occur abundantly in porphyritic granite exposed locally over an extensive area centering approximately 10 miles (16 km) south of Greensboro near the town of Siloam. This extensive body of porphyritic granite has been named the Siloam Granite on recent geologic maps (Humphrey, 1970).

Hancock County: Locally porphyritic granite containing abundant orthoclase crystals is exposed over an extensive area east and northeast of Sparta. The orthoclase crystals are typically tabular, twinned by the Carlsbad Law, and are white and opaque. Excellent exposures are in the numerous operating and abandoned quarries between 1 and 4 miles (1.6 and 6.4 km) north and east of Sparta. Principal among these are the Granite Hill Quarry, 2 miles (3.2 km) east of Sparta, 0.5 mile (0.8 km) south of Georgia Highway 16; and the Sparta Pink Quarry, 3.5 miles (5.6 km) east of Sparta, 0.5 mile (0.8 km) south of Georgia Highway 16.

Pike County: Excellent, unweathered orthoclase crystals up to 1.5 inches (3.8 cm) long occur in porphyritic granite exposed locally over a relatively large area centering approximately 9 miles (14.4 km) west from Zebulon and 4 miles (6.4 km) west from Concord and Jolly (Watson, 1902, p. 97).

Wilkes County: 1. Large potassium feldspar crystals exhibiting a 2V between 8 and 12 degrees occur in a small pluton exposed on the east side of the paved county road 2.5 miles (4 km) north of Rayle. Optic, x-ray

and chemical examination of this mineral indicates that it is sanidine, the monoclinic disordered alkali feldspar (Cook, 1967, p. 14).

MICROCLINE
$KAlSi_3O_8$

Class Tectosilicate

Cryst. Triclinic; pinacoidal—$\bar{1}$

Habit Crystals are similar to those of orthoclase and occasionally show simple twinning of the Carlsbad, Baveno, and Manebach types. The crystals may be several inches or feet across. Also masive cleavable to granular compact.

Phys. *Cleavage* perfect {010, 001}, almost at right angles. *Fracture* uneven. Brittle. **H** 6. **G** 2.56. *Luster* vitreous, sometimes pearly. *Color* white, gray, flesh, pale cream-yellow, various shades of red and green. Transparent to translucent.

Occur.

Microcline, like orthoclase, is one of the most abundant silicate minerals in the crystalline rocks of the Piedmont. It is almost invariably an important constituent of granites, granitic gneisses and pegmatites. It is locally important in both metavolcanic and metasedimentary rocks and occurs locally within Paleozoic sedimentary rocks as detrital mineral grains. It is produced commercially from large pegmatites in the vicinity of Gladesville, Jasper County. Microcline is so widespread in Georgia that only a few typical or interesting occurrences are listed. More complete listings are given by Watson (1902), Galpin (1915), Furcron and Teague (1943), and Heinrich, Klepper and Jahns (1953).

Cherokee County: 1. Light-green to white aggregates of perthitic microcline up to 10 inches (25 cm) in diameter are common in pegmatites exploited for mica at the abandoned Amphlett Mine, approximately 0.4 mile (0.64 km) S30°E of Conn Church, 4.3 miles (6.9 km) S86°E of Ball Ground.

DeKalb County: 1. Excellent aggregates of euhedral microcline crystals with individuals reaching 6 inches (15 cm) in diameter have been found in pegmatites exposed in numerous quarries in and around Stone Mountain. Fine examples of this material are on display in the Geology Museum of Emory University.

Elbert County: 1. Perthitic microcline in anhedral crystals up to 5 feet (1.5 m) in diameter are described from the Crawford and Daniel Mica Mine on the Iva–Elberton road at a point 2.6 miles (4.1 km) southwest of the Savannah River (Griffitts, 1953, p. 303). Perthite is most abundant in a relatively wide zone flanking the discontinuous quartz core of the pegmatite. 2. Individual euhedral crystals of perthitic microcline flank and project into the quartz core of a pegmatite exploited for mica in the M. L. Gaines Mica Mine near Iva (Griffitts, 1953, p. 304).

Forsyth County: 1. Microcline (var. moonstone) has been reported from the Lowe farm near Buford. 2. Similar moonstone may be collected near Sheltonville.

Jasper County: 1. Microcline, occasionally in quite large crystals, is produced from numerous pegmatites in and around the Gladesville Norite, 4.5 to 9 miles (7.2 to 14.4 km) southwest of Monticello and southeast of Georgia Highway 83.

Monroe County: 1. Individual blocks of perthitic microcline up to 8 feet (2.4 m) across occur along the southwest margin of the quartz core of a pegmatite formerly exploited for mica in the Battles and Chatfield Mines, 2.75 miles (4.4 km) N50°W of Culloden (Heinrich and Jahns, 1953, p. 367). Some of the smaller blocks display well-developed crystal faces. 2. Perthitic microcline crystals at least 2 feet (0.6 m) across occur in the abandoned T. D. Thurman Mica Mine, 3.4 miles (5.5 km) S70°W of Forsyth.

Murray County: 1. Perthitic microcline-rich dikes up to 80 feet (24 m) thick cut Corbin "granite" and related rocks in the immediate vicinity of the Chatsworth Talc District (Furcron, Teague, and Calver, 1947, p. 15).

Rabun County: 1. An individual crystal of microcline 2.5 feet (0.7 m) long and 2 feet (0.6 m) thick, and exhibiting well-developed crystal faces is described in a pegmatite prospected for mica along the northeast side of U.S. Highway 76, 3 miles (4.8 km) west of the bridge over the Savannah River (Furcron and Teague, 1943, p. 157). 2. Euhedral microcline crystals occur locally within the pegmatite exploited for mica at the old Norton Mine, approximately 8.4 miles (13.5 km) east of Clayton on the southwest side of Earls Ford Road, 0.4 mile (0.64 km) south of the junction with Warwoman Road, lot 20, 3rd district. 3. Locally euhedral microcline crystals up to one foot (0.3 m) in diameter occur in the pegmatite exploited at the Mark Beck Mica Mine, lot 74, 4th district, 7.5 miles (12 km) southeast of Clayton on Joe Hopkins Branch (Furcron and Teague,

1943, p. 156). Beryl occurs in relative abundance at this location. 4. Blocks of microcline several feet in diameter occur in the pegmatite formerly exploited for mica at the Porter McCraken Mine, 9.7 miles (15.6 km) southeast of Clayton on lot 67, 4th district. 5. Amazonite is reported from an old mica mine on the farm of Mr. Joe Speed, about 0.5 mile (0.8 km) from the Pine Mountain Road, 7 miles (11 km) from Clayton.

Troup County: 1. Excellent microcline crystals exhibiting well-developed crystal faces occur with black tourmaline crystals in several small pegmatite dikes on the old Col. J. B. Swanson property, approximately 2 miles (3.2 km) south of LaGrange (Galpin, 1915, p. 93). 2. Euhedral microcline crystals up to 4 inches (10 cm) in diameter may be recovered from partially decomposed pegmatite in and around the LaGrange Airport. Black tourmaline crystals and beryl accompany the microcline.

Upson County: 1. Relatively large perthitic microcline crystals exhibiting well-formed faces occur in the pegmatite exploited for mica in the Reynolds Mine, 2.6 miles (4.1 km) west-southwest of Yatesville (Heinrich, Klepper and Jahns, 1953, p. 353). 2. Well-formed perthitic microcline crystals up to 8 feet (2.4 m) long are reported from the large pegmatite exploited in the Adams Mica Mine, 2.5 miles (4 km) N3°E of Yatesville. The crystals are buff-colored, unaltered, and locally seamed with late-stage sugary albite (Heinrich, Klepper, and Jahns, 1953, p. 358). 3. Well-formed, partially kaolinized microcline crystals up to 6 inches (15 cm) across occur in the W. M. Dallas mica prospects, 2.75 miles (4.4 km) S35°E of Thomaston. 4. Perthitic microcline crystals up to one foot (0.3 m) in diameter occur in the pegmatite formerly exploited for mica in the Corley Mine on the Kindrick property, 4.1 miles (6.5 km) S70°E of Thomaston and 200 feet (61 m) south of Triune Mill Road.

Warren County: 1. Porphyritic granitic gneiss containing euhedral microcline crystals up to approximately one inch (2.5 cm) in length is locally exposed over a rather extensive area centering 4 miles (6.4 km) N20°E of Warrenton, 0.75 mile (1.2 km) west of Camak. Rounded, partially altered crystals are locally abundant in soil and saprolite overlying this rock unit.

White County: 1. Well-developed microcline crystals up to 4 inches (10 cm) in diameter occur in pegmatite dikes within a general area 4 to 6 miles (6.4 to 9.7 km) south of Cleveland (Galpin, 1915, p. 167).

Wilkes County: 1. Microcline is the dominant potassium feldspar in the syenite body exposed one mile (1.6 km) north of Delhi in the northwestern part of the county. The syenite is nearly circular in outline, about 4,500 feet (1371 m) in diameter, and is bounded on the east by the porphyritic Danburg Granite (Hurst, Crawford and Sandy, 1966, p. 420). 2. Euhedral monoclinic microperthite crystals up to 2 inches (5 cm) in greatest dimention occur in great abundance in the Danburg Granite pluton which occupies approximately 50 square miles in northeastern Wilkes County and northwestern Lincoln County. Excellent exposures of this rock may be observed in the Wheless Quarry at the community of Danburg.

ALBITE

$NaAlSi_3O_8$

Class Tectosilicate

Cryst. Triclinic; pinacoidal—$\bar{1}$

Habit Crystals often tabular. Also massive, granular, lamellar (cleavelandite); laminae often curved, sometimes divergent.

Phys. *Cleavages* two perfect {010, 001} at 86°. *Fracture* uneven to conchoidal. Brittle. **H** 6–6½. **G** 2.60–2.62. *Luster* vitreous; sometimes pearly. *Color* white to colorless; occasionally bluish, gray, reddish, greenish. *Streak* white. Transparent to subtranslucent.

Occur.

Albite is widely distributed as perthitic intergrowths in microcline of granites, granitic gneisses, and pegmatites of the Piedmont. It is locally abundant in metavolcanic and metasedimentary rocks of low metamorphic grade, and in extensive alteration zones of the west-central Georgia sulfide district.

Lincoln County: 1. Short, stout albite phenocrysts, many of which are rounded by resportion, are described in a quartz-albite prophyry exposed in a small branch several hundred yards northwest of the Magruder Gold Mine in the extreme western part of the county, approximately 2.5 miles (4 km) east of Metasville (Jones, 1909, p. 55). 2. Albite is the dominant plagioclase feldspar in the syenitic body exposed approximately one mile (1.6 km) north of the community of Delhi in the northeastern part of the county (Crawford, Hurst, and Ramspott, 1956, p. 13).

Murray County: 1. Detailed petrographic examination of Fort Mountain Gneiss by Needham and Hurst (1970, p. 5) has shown this rock to contain 35 percent albite (Ab_{97}) as augen up to 0.3 inch (0.76 cm) in greatest dimension.

Paulding County: Glassy, subhedral albite crystals up to 0.3 inch (0.76 cm) in diameter occur in altered wall rock adjacent to the numerous massive sulfide prospects in Paulding and adjacent counties in the west-central Georgia sulfide district. The mineral is not obvious in outcrop but is prominent in diamond drill core and thin sections.

1. Glassy albite is abundant in drill core samples of altered wall rock adjacent to the Little Bob massive sulfide deposit within the 2nd district, 3rd section, approximately 2 miles (3.2 km) northwest of Hiram. Skeletal sphalerite crystals are locally conspicuous within this albite. Associated minerals are chlorite after hornblende and biotite, magnetite, garnet, gahnite and pyrite.

OLIGOCLASE

$Ab_{90}An_{10}$—$Ab_{70}An_{30}$

Class Tectosilicate

Cryst. Triclinic; pinacoidal—$\bar{1}$

Habit Crystals not common. Usually massive, cleavable, granular, or compact.

Phys. *Cleavages* perfect {010,001}. Brittle. **H.** 5-6. **G** 2.63-2.67. *Luster* vitreous. *Color* Colorless, white gray, greenish, yellowish, brown, reddish; occasionally shows brilliant reflections from inclusions.

Occur.

Oligoclase is the most frequently described member of the plagioclase family in granites and gneisses of the Piedmont. It is locally an important constituent of some amphibolites, hornblende gneisses, and feldspathic metasedimentary rocks. Examples described below are considered typical of the occurrence of this mineral.

Bartow County: Oligoclase-mica gneiss is locally exposed over an area of several square miles along the Bartow-Cherokee County line, approximately 2 miles (3.2 km) southeast of Stamp Creek Church (Kesler, 1950, p. 20). Oligoclase in crystals and subhedral grains up to 0.25 inch (0.5 cm) long constitutes approximately 40 percent of the rock.

DeKalb County: 1. Sodic oligoclase is the predominant plagioclase feldspar in both Stone Mountain Granite and Lithonian Gneiss. These rocks are extensively exposed throughout DeKalb and surrounding counties and may be observed in the numerous operating or abandoned quarries in the district.

Fannin County: 1. The dominant plagioclase mineral in the extensive Copperhill Formation has been shown to be oligoclase (Hurst, 1955, p. 13). It occurs in scattered, irregularly shaped grains which preserve clastic shapes. This formation underlies all of the northwest corner of the Mineral Bluff Quadrangle.

Fulton County: 1. Oligoclase is reported as the predominant plagioclase feldspar in extensive exposures of granite centering near the community of Palmetto (Watson, 1902, p. 106).

Greene County: 1. Oligoclase in equant laths not exceeding 0.1 inch (0.25 cm) in length is the dominant plagioclase in rhyolite dikes mapped by Medlin and Hurst (1967, p. 24) in the Bethesda Church area. The most accessible exposure is in a roadcut west of the South Fork of the Little River along Georgia Highway 44. The dike is approximately 12 feet (3.7 m) wide at this location.

Hart County: 1. Oligoclase is the abundant plagioclase in muscovite granodiorite and biotite granodiorite gneiss mapped by Grant (1958, p. 26–30). These rocks are well exposed in a quarry 7 miles (11 km) southeast of Shoal Creek Church, on the west bank of the Savannah River near a former fish hatchery 2.3 miles (3.7 km) east of Sardis School, 1.1 miles (1.7 km) northeast of Eagle Grove School in Coldwater Creek, roadcuts 0.6 mile (0.97 km) southeast of Goldmine, and in fords on Flat Shoals Creek approximately 0.4 mile (0.64 km) northwest of Flat Shoals Church.

Towns County: 1. Green oligoclase has been reported from lot 87 in the northwestern corner of the county.

ANDESINE

$Ab_{70}An_{30}$—$Ab_{50}An_{50}$

Class Tectosilicate

Cryst. Triclinic; pinacoidal—$\bar{1}$

Habit Euhedral crystals not common. Usually massive, cleavable, granular, or compact.

Phys. *Cleavages* two perfect {010, 001} at 86°. **H** 6. **G** 2.74–2.76. *Fracture* uneven to conchoidal. Brittle. *Luster* vitreous. *Color* white-gray, reddish. Transparent to translucent.

Occur.

Andesine is the predominant plagioclase feldspar in intermediate igneous and metamorphic rocks of the Piedmont. It is commonly identified in thin section as an important constituent of many amphibolites and other hornblende-bearing rocks. A few representative occurrences are given below.

Bartow County: Andesine crystals up to 0.45 inch (1.1 cm) long occur in small bodies of andesine-augite gneiss enclosed in porphyroblastic gneiss at several localities east of the Cartersville District, particularly north of Corbin School (Kesler, 1950, p. 21).

DeKalb County: 1. Andesine, though not easily recognized in hand specimen, is widely distributed in porphyroblastic biotite gneiss, biotite-hornblende gneiss, and amphibolite extensively exposed in the Lithonia district (Grant, 1962, p. 13-14.)

Fannin County: 1. The Brasstown Formation has been shown by Hurst (1955a, p. 51) to contain up to 12 percent andesine as fine, elongate grains exhibiting interlocking boundaries with quartz and carbonate minerals.The unit is extensively exposed in both limbs of the Murphy Syncline in the Mineral Bluff Quadrangle.

Fulton County: 1. Andesine constitutes up to 54 percent of the amphibolite and epidosite associated with the Brevard lineament in the vicinity of Atlanta in a belt extending through Vinings and Sandy Springs (Higgins, 1966, p. 7).

Greene County: 1. Andesine is the dominant plagioclase feldspar in amphibolite and hornblende gneiss in the Bethesda Church area (Medlin and Hurst, 1967, p. 16).

Paulding County: 1. Andesine is the typical plagioclase in locally thick sequences of hornblende gneiss and amphibolite which cross Paulding County in a general northeast trend. Fresh rock for which optical identifications can be made is very abundant in numerous highway and railroad cuts in Paulding and adjacent counties.

Taliaferro County: 1. Zoned andesine phenocrysts up to 0.25 inch (0.6 cm) across are abundant in gabbroic dikes exposed along Georgia Highway 22E at Lyneville in the northern part of the county (Crawford, Hurst and Ramspott, 1966, p. 20). Similar andesine is common in other gabbroic rocks within the Little River Series, particularly those intrusive into metadacite in Lincoln County.

Town County: 1. Detailed petrographic research on ultramafic and related rocks in the vicinity of Lake Chatuge by Hartley (1973) has shown andesine to be the dominant plagioclase mineral in garnet-mica schist, biotite gneiss, amphibolite, and garnet pyroxene gneiss of this area.

LABRADORITE

$Ab_{50}An_{50}$—$Ab_{30}An_{70}$

Class Tesctosilicate

Cryst. Triclinic; pinacoidal—$\bar{1}$

Habit Crystals rare. Usually massive, cleavable, granular, or compact.

Phys. *Cleavage* perfect {010, 001}. Brittle. **H** 5–6. **G** 2.69–2.71. *Luster* vitreous. *Color*-less, white, gray; occasionally shows a play of bright colors—blue, green, yellow, red, and pearl gray.

Occur.

Labradorite is the dominant plagioclase feldspar in many mafic rocks of the Piedmont and Blue Ridge. It is a major constituent of numerous noritic intrusives in Jasper, Monroe and other counties, and in numerous

scattered amphibolites and gabbroic rocks. Labradorite in small lath-like crystals is the dominant feldspar mineral in diabase dikes which cut Piedmont rocks in north and northwesterly trends. The largest dikes are up to 300 feet (91 m) wide and have been traced for more than 30 miles (48 km) along strike. One such dike may be traced from Talbot County across Meriwether County into Coweta County. Another major diabase dike is well exposed south of Gray in Jones County.

Greene County: 1. Labradorite in large tabular and prismatic crystals occurs in gabbro exposed at the old Ogeechee Brick Plant at Union Point (Hopkins, 1914, p. 31). 2. Subhedral labradorite in microlites is the dominant plagioclase in diabase dikes of the Bathesda Church area (Medlin and Hurst, 1967, p. 25). Dikes in this area are identical in all respects to other diabase bodies exposed throughout the state.

Hart County: 1. Labradorite is relatively abundant in felspathic amphibolite gneiss exposed 1.3 miles (2 km) southeast of Viola Church and in road cuts near Little Shoal Creek on Georgia Highway 77 (Grant, 1958, p. 22). 2. Labradorite occurs locally in amphibolitic quartzite exposed along U.S. Highway 29, 0.8 mile (1.2 km) east of Oak Bower Church (Grant, 1958, p. 15).

Rabun County: 1. Labradorite is the dominant feldspar in hornblende gneiss exposed at Burton (Hopkins, 1914, p. 21).

Stephens County: 1. Slightly altered, porphyritic labradorite crystals occur in hornblende gneiss exposed on the Meckline property, approximately 1.5 miles (2.4 km) north of Toccoa (Hopkins, 1914, p. 19).

BYTOWNITE

$Ab_{30}An_{70}$—$Ab_{10}An_{90}$

Class Tectosilicate

Cryst. Triclinic; pinacoidal—$\bar{1}$

Habit Euhedral crystals rare. Usually cleavable, granular, or compact masses.

Phys. *Cleavage* two perfect {010, 001} at 86°. **H** 5–6. **G** 2.72–2.75. *Luster* vitreous. *Color* Colorless, white, gray. Transparent to translucent.

Occur.

Bytownite is generally restricted in occurrence to mafic and ultramafic igneous rocks.

Elbert County: 1. Calcic plagioclase, probably bytownite, is described as an essential constituent of hornblende gabbro cropping out around Bethlehem Church, 13 miles (21 km) east of Elberton (Hopkins, 1914, p. 35).

Jasper County: 1. Bytownite is locally abundant within portions of the extensive Gladesville Norite near Gladesville, approximately 6 miles (9.7 km) south of Monticello. The norite complex is approximately 8 miles (12 km) long and one mile (1.6 km) wide, and is composed essentially of nortie and olivine gabbro (Mathews, 1967). Bytownite is described in specimens of a gabbroic phase of this intrusive collected at an unspecified location 7 miles (11 km) south of Monticello (Hopkins, 1914, p. 37).

Towns County: 1. Bytownite is a locally important constituent of coronadite troctolite and olivine gabbro exposed over relatively extensive areas in the vicinity of Lake Chatuge, both north and west of Hiawassee (Hartley, 1973).

ANORTHITE

$CaAl_2Si_2O_8$

Class Tectosilicate

Cryst. Triclinic; pinacoidal—$\bar{1}$

Habit Euhedral crystals not common. Usually massive, cleavable, granular, or compact.

Phys. *Cleavage* two perfect {010, 001} at 86°. **H** 6. **G** 2.74–2.76. *Fracture* uneven to conchoidal. Brittle. *Luster* vitreous. *Color* white-gray, reddish. Transparent to translucent.

Occur.

Plagioclase, rich in the anorthite molecule, is an important constituent of most ultramafic igneous rocks, and as such is of local importance throughout the Piedmont and Blue Ridge. No unusual occurrences have been recorded in the state, and it is usually mentioned only in the older literature.

Columbia County: Anorthite is described as a constituent of amphibole-pyroxene gneiss occurring on Hatcher Mountain, approximately 5 miles (8 km) east of Phinizy (Hopkins, 1914, p. 23).

Elbert County: 1. Anorthite as small, subhedral tabular crystals is reported in gabbro from an unspecified location approximately 8 miles (12 km) southeast of Elberton (Hopkins, 1914, p. 33).

Upson County: 1. Garnet-anorthite-quartz granulite is described from a location 1.4 miles (2.2 km) N30°W of Parker Bridge by Clarke (1952, p. 63).

SCAPOLITE GROUP

$(Na,Ca,K)_4Al_3(Al,Si)_3Si_6O_{24}(Cl,SO_4CO_3)$

Class Tectosilicate

Cryst. Tetragonal; tetragonal-dipyramidal—4/m

Habit Crystals often long prismatic, vertically striated, usually coarse, and often large. Also massive, granular, columnar.

Phys. *Cleavage* distinct {100,110}. *Fracture* subconchoidal. Brittle. **H** 5½-6. **G** 2.56-2.77. *Luster* vitreous to pearly. *Color* white, gray, bluish, greenish, lavender, and reddish, usually in pale shades. *Streak* uncolored. Transparent to faintly sub-translucent.

Occur.

Gwinnett County: 1. A mineral reported as the now invalid species pseudomeinonite was described by Hurst (1955c, p. 21) from Buford Dam, approximately 35 miles (56 km) northeast of Atlanta at the Forsyth-Gwinnett County line. The material occurs as small pod-like masses and in crude prismatic crystals up to 2 inches (5 cm) long, striated parallel to the C-axis. The mineral is colorless to pale olive green and has a poor-to-moderate basal cleavage. While a reexamination of this material is required for correct identification, the data furnished by Hurst and the properties of material previously called pseudomeinonite suggest that the material at Buford Dam may in fact be a member of the scapolite group or possibly vesuvianite.

Hart County: 1. Scapolite is mentioned as a very minor accessory mineral in amphibolitic quartzites of Hart County by Grant (1958, p. 16).

Upson County: 1. Scapolite is reported in thin sections of an unusual contact metamorphic rock from the margin of the Jeff Davis Granite, approximately 0.5 mile (0.8 km) south of Dog Crossing, 6 miles (9.7 km) N30°E of Thomaston (Clarke, 1952, p. 26). Associated minerals are diopside, garnet and vesuvianite.

STILBITE

$NaCa_2(Al_5Si_{13})O_{36} \cdot 14H_2O$

Class Tectosilicate

Cryst. Monoclinic; prismatic—2/m

Habit Crystals usually cruciform penetration twins simulating rhombic forms. Twinned crystals often in subparallel position forming sheaf-like aggregates; rarely as isolated individuals. Also divergent or radiated, massive, bladed or globular.

Phys. *Cleavage* {011} perfect, {100} indistinct. *Fracture* uneven. Brittle. **H** 3.5-4. **G** 2.184 (calc.). *Color* white, gray, yellowish, pink, reddish, orange, light to dark brown. Transparent to translucent. *Luster* vitreous; pearly on cleavage. *Streak* uncolored.

Occur.

DeKalb County: 1. Furcron (1948, p. 3) reports that stilbite occurs on the waste boulders scattered through the Stone Mountain Granite Corporation Quarry at Stone Mountain and also in other abandoned quarries on the south side of the mountain.

Elbert County: 1. Stilbite with associated chabazite and calcite is found on sub-horizontal joint surfaces in the Commolli Quarry about 3 miles (4.8 km) northwest of Elberton on Georgia Highway 17. Stilbite forms radial clusters up to 0.2 inch (0.5 cm) wide at this location (Ramspott, 1967, p. 20). 2. Stilbite occurs as thin films of colorless, radially-arranged crystals about 0.3 inch (0.7 cm) wide within the McLanahan Crushed Rock

Quarry, about one mile (1.6 km) south of Elberton between Georgia Highways 17 and 77. 3. Stilbite is reported by Ramspott (1967, p. 20) from near the bottom of the pink pit at the Blue Diamond Quarry, west of Georgia Highway 77 about 5 miles (8 km) south of Elberton. Stilbite occurs here on sub-horizontal rift surfaces as crystals exhibiting the typical sheaf structure with individual crystals ranging up to 0.1 inch (0.25 cm) in length. Other surfaces contain flat, radial stilbite clusters up to 0.8 inch (2 cm) wide.

Lamar County: 1. Sheaf-like aggregates of stilbite crystals are reported in seams and cavities in biotite gneiss near Barnesville by Hurst (1955f, p. 65). The aggregates are yellowish-orange, up to 0.2 inch (0.5 cm) long and 0.1 inch (0.25 m) thick, and are interspersed with clear, singly terminated quartz crystals of similar size.

Lincoln County: 1. Stilbite was collected in 1965 from a new road cut about 4 miles (6.4 km) north of Lincolnton. The mineral occured as white sheaf-like aggregates in a vertical seam in metadacite.

Putnam County: 1. Thin radial clusters of stilbite are reported coating fracture surfaces in hornblende gneiss drill core from an unspecified location in eastern Putnam County by Ramspott (1967, p. 22).

EPISTILBITE

$Ca(Al_2Si_6)O_{16} \cdot 5H_2)$

Class Tectosilicate

Cryst. Monoclinic; prismatic or domatic—2/m or m

Habit Crystals prismatic, always twinned; in radiated spherical aggregates; also granular. Twinning on {100} or {010} common, often as cruciform or interpenetrant twins.

Phys. *Cleavage* {010} perfect. *Fracture* uneven. Brittle. **H** 4. **G** 2.266 (meas.). *Color* pinkish, white, colorless. Transparent to translucent. *Luster* vitreous.

Occur.

Muscogee County: 1. Epistilbite has been reported as an alteration product of feldspar in drill core from the Oliver Dam site near Columbus (Hurst, 1955d, p. 150). The mineral occurs in white granular aggregates and as prismatic crystals up to 0.06 inch (0.15 cm) long. Epistilbite as well as associated laumontite, stilbite and calcite occur in veinlets up to 0.25 inch (0.6 cm) thick traversing amphibolite and biotite-plagioclase gneiss.

LAUMONTITE

$Ca(Al_2Si_4)O_{12} \cdot 4H_2O$

Class Tectosilicate

Cryst. Monoclinic

Habit Crytals usually square prisms with steep oblique terminations. Also fibrous, columnar, radiating and divergent. Twinning on {100}, sometimes as "swallow-tail" twins.

Phys. *Cleavage* {010} and {110} perfect. *Fracture* uneven. **H** 3–4. **G** 2.405 (calc.). *Color* white, gray, yellowish, pick, brownish. Transparent to translucent; becoming opaque and often powdery on exposure. *Luster* vitreous to pearly. *Streak* uncolored.

Occur.

Elbert County: Laumentite occurs with prehnite at the Dawn Gray Quarry, about 6 miles (9.7 km) south of Elberton on Georgia Highway 77 (Ramspott, 1967, p. 19). The laumentite is in clear, white, or pale pink blades arranged in radial clusters up to 1.7 inches (4.3 cm) across but less than 0.05 inch (0.13 cm) thick.

Fannin County: 1. Shephard (1859, p. 2) describes laumontite, chabazite and vivianite crystals lining cavities in rock exposed in a shaft at the Mt. Pisgah copper prospect, lot 239, about 6 miles (9.7 km) south of the Mobile Copper Mine, near Higdons Store.

Muscogee County: 1. Laumontite associated with stilbite and epistilbite is reported by Hurst (1955d, p. 149) from drill core at the Oliver Dam site at Columbus. The minerals occur in veinlets up to 0.25 inch (0.6 cm) thick traversing amphibolite and biotite-plagioclase gneiss. The laumontite is in small crystals averaging about 0.07 inch (0.17 cm) long intimately associated and intergrown with fine-grain calcite.

Paulding County: 1. Laumontite has been identified by x-ray diffraction analysis as fracture fillings in drill core obtained from the Little Bob massive sulfide deposit, 2nd district, 3rd section, approximately 2 miles (3.2 km) northwest of Hiram. The mineral occurs as radial sprays of colorless prismatic crystals coating fractures in amphibolite.

CHABAZITE

$Ca(Al_2Si_4)O_{12} \cdot 6H_2O$

Class Tectosilicate

Cryst. Hexagonal—R; hexagonal-scalenohedral—$\bar{3}$ 2/m

Habit Crystals usually simple rhombohedrons resembling a cube; also complex, or tabular {0001}. Twinning on {0001} common, as penetration twins.

Phys. *Cleavage* {10$\bar{1}$1} distinct. *Fracture* uneven; brittle. **H** 4–5. **G** 2.05–2.16. *Color* pinkish, reddish white, yellowish, greenish, white, colorless. Transparent to translucent. *Luster* vitreous. *Streak* uncolored.

Occur.

Clarke County: 1. Simple, untwinned chabazite rhombohedra up to 0.2 inch (0.5 cm) have been reported from a cavity in muscovite-chlorite-quartz-plagioclase gneiss near the intersection of the Athens Bypass and U.S. Highway 441. The mineral is dark yellowish-orange and exhibits penetration twins on {10$\bar{1}$1} (Ramspott, 1967, p. 19).

DeKalb County: 1. Chabazite is an uncommon constituent of pegmatites exposed in and around Stone Mountain (Walker, 1956, p. 32).

Elbert County: 1. Amber-colored, rhombohedral chabazite crystals up to 0.1 inch (0.25 cm) across are reported from joint surfaces in the Commolli Quarry about 3 miles (4.8 km)northwest of Elberton on Georgia Highway 17 (Ramspott, 1967, p. 20).

Fannin County: 1. Shepard (1859, p. 2) describes chabazite with laumontite and vivianite in vugs exposed at the Mt. Pisgah copper prospect, lot 239, about 6 miles (9.7 km) south of the Mobile Copper Mine, near Higdons Store.

Putnam County: 1. Chabazite occurs both as a cavity filling and as a thin coating on fracture surfaces in biotite gneiss drill core from an unspecified location in the eastern part of the county (Ramspott, 1967, p. 21).

SCOLECITE

$Ca(Al_2Si_3)O_{10} \cdot 3H_2O$

Class Tectosilicate

Cryst. Monoclinic; domatic—m

Habit Crystals slender prismatic, vertically striated. Often in fibrous radiating masses. Twinning on {100} common.

Phys. *Cleavage* {110} perfect. *Fracture* uneven; brittle. **H** 5. **G** 2.27 (meas.). *Color* white or colorless. Transparent to translucent. *Luster* vitreous, silky when fibrous.

Occur.

DeKalb County: 1. Scolecite occurs in radiating, fibrous white aggregates on joint surfaces in the Davis Quarry on the western slope of Collinsville Mountain, about 0.67 mile (1 km) south of Little Stone Mountain and just north of Georgia Highway 12 (Herrmann, 1954, p. 112). 2. A similar occurrence is reported by Herrmann (1954, p. 112) from the Reagin Quarries southwest of Little Stone Mountain, south of Tom George Creek.

CLINOPTILOLITE

$(Na,K,Ca)_{2\text{-}3}Al_3(Al,Si)_2Si_{13}O_{36} \cdot 12H_2O$

Class Tectosilicate

Cryst. Monoclinic

Habit As laths about one micron or less in size in the groundmass of altered pyroclastic sediments.

Phys. Standard mineralogical constants such as specific gravity or hardness have not been determined with any degree of certainty. Can be clearly distinguished from heulandite by optical, x-ray, thermal and chemical means.

Occur.

Clinoptilolite is reported to be a constituent of clays of the Coastal Plain, particularly those associated with phosphate-rich formations.

BIBLIOGRAPHY

Anderson, C. S., 1934, Gold mining in Georgia: *Am. Inst. Min. Met. Engrs. Trans.*, v. 109, p. 61–68.

Applin, E. R., and Applin, P. L., 1964, Logs of selected wells in the coastal plain of Georgia: *Ga. Geol. Survey Bull. 74,* 229 p.

Ballard, T. J., 1946, Exploration of the Hog Creek Corundum Mine, Towns County, Ga.: *U.S. Bur. Mines Rept. Inv. 3855,* 3 p.

____ 1948, Investigation of Louise chromite deposits, Troup County, Ga.: *U.S. Bur. Mines Rept. 4311,* 24 p.

Ballard, T. J., and McIntosh, F. K., 1948, Diamond drilling at the Tallapoosa Copper Mine, Haralson County, Ga.: *U.S. Bur. Mines Rept. Inv. 4316,* 8 p.

Bayley, W. S., 1928, Geology of the Tate Quardrangle, Georgia: *Ga. Geol. Survey Bull. 43,* 170 p.

Blake, W. P., 1874, Wood tin in Georgia: *abs.* in *Amer. Jour. Science,* 3rd ser. v. 8, 392 p.

Brantly, J. E., 1916, Report on the limestones and marls of the Coastal Plain of Georgia: *Ga. Geol. Survey Bull. 21,* 300 p.

Broadhurst, S. D., and Teague, K. H., 1954, Halloysite in Chattooga County, Georgia: *Ga. Mineral Newsletter,* v. 7, p. 56–61.

Brown, W. R., Gates, D. W., Rowlands, C. E., and Straley, H. W., 1953, Magnetic reconnaissance, Dahlonega Special Quadrangle, Lumpkin County, Georgia, *in* Short contributions to the geology, geography and archaeology of Georgia: *Ga. Geol. Survey Bull 60,* p. 136–141.

Carpenter, R. H., 1965, A study of the ore minerals in cupriferous pyrrhotite deposits in the southern Appalachians: Ph.D. Dissertation, Univ. of Wisc., 70 p.

Chowns, T. M., 1970, A chamosite-hematite oolite from the Sequatchie Formation in northwest Georgia, (Abs.): *Bull. Ga. Acad. Sci.*, v. 28, no. 2, p. 519.

Clarke, J. W., 1952, Geology and mineral resources of the Thomaston Quadrangle, Georgia: *Ga. Geol. Survey Bull. 59,* 99 p.

Cofer, H. E., 1953, Gahnite occurrence and association at Magruder Mine, Lincoln County, Georgia, *in* Short contributions to the geology, geography and archaeology of Georgia: *Ga. Geol. Survey Bull 60,* p. 309–312.

Cofer, H. E., and Renshaw, E. W., 1953, Luminescent properties of some of the minerals of Arabia Mountain, DeKalb County, Georgia, *in* Short contributions to the geology, geography, and archaeology of Georgia: *Ga. Geol. Survey Bull. 60,* p. 312–315.

Cook, R. B., 1967, The geology of a part of west-central Wilkes County, Georgia: M.S. Thesis, Univ. of Ga., 53 p.

____, 1970, The geologic history of massive sulfide bodies in west-central Georgia: Ph.D. Dissertation, Univ. of Georgia, 162 p.

____, 1973, Tetradymite in the southeastern United States: *Abs., Jour. Ala. Acad. Sci.*, v. 44, no. 3, p. 185–186.

Cook, R. B., and Hughes, T. C., 1973, Langite, linarite and brochantite in the Chestatee massive sulfide deposit, Lumpkin County, Georgia: *Abs., Bull. Ga. Acad. Sci.*, v. 31, no. 2, p. 84.

Crawford, T. J., Hurst, V. J., and Ramspott, L. D., 1966, Extrusive volcanics and associated dike swarms in central-east Georgia: Geol. Soc. America, Southeastern Section Field Trip Guidebook 2, 53 p.

Dana, E. S., 1892, *Descriptive Mineralogy,* 6th ed.: John Wiley and Sons, Inc., New York, p. 1081.

____, 1893, *Catalogue of American localities of minerals:* John Wiley and Sons, Inc., New York, 51 p.

____, 1912, *A text-book of Mineralogy:* John Wiley and Sons, Inc., New York, p. 339.

Deer, W. A., Howie, R. A., and Zussman, J., 1966, *An introduction to the rock-forming minerals:* John Wiley and Sons, Inc., New York, 528 p.

Espenshade, G. H., 1950, Occurrences of tungsten minerals in the southeastern United States: *in* Symposium on mineral resources of the southeastern United States (F. G. Snyder, ed.), p. 56–66.

____, 1964, Geology of some copper deposits in North Carolina, Virginia, and Georgia: *U.S. Geol. Survey Bull. 1142-I,* 50 p.

Fairley, W. M., 1965, The Murphy Syncline in the Tate Quadrangle, Georgia: *Ga. Geol. Survey Bull 75,* p. 47.

Fleischer, M., 1975, 1975 Glossary of mineral species: Mineralogical Record, Inc., Bowie, Maryland, 145 p.

Fluker, W. H., 1903, Gold Mining in McDuffie County, Georgia: *Amer. Inst. Mining Engineers Trans., v. 33,* p. 119–125.

Fortson, C. W., and Navarre, A. T., 1959, Monazite-bearing pegmatites in the south Georgia Piedmont: *Econ. Geol.*, v. 54, p. 1309–1311.

Furcron, A. S., 1942, Dolomites and magnesium limestones in Georgia: *Ga. Geol. Survey Inf. Circ. 14,* 29 p.

____, 1948a, Diamonds in Georgia: *Ga. Mineral Society Newsletter,* v. 1, no. 2, p. 3.

____ (ed.), 1948b, Magruder Mine — near Washington, Georgia: *Ga. Mineral Society Newsletter, v. 1, no. 1, p. 3.*

____ (ed)., 1948c, Gem apatite near Dunwoody: *Ga. Mineral Society Newsletter,* v. 1, no. 10, p. 7.

____ (ed.), 1948d, Stone Mountain: *Ga. Mineral Society Newsletter,* v. 1, no. 1, p. 3.

____, 1949, Neomineralization in granite near Hogansville, Troup County, Georgia: *Ga. Mineral Society Newsletter,* v. 2, no. 3, p. 3.

____, 1951, Radioactive garnet from Towns County, Georgia: *Ga. Mineral Society Newsletter,* v. 4, no. 4, p. 130.

____ (ed.), 1952, Society events, field trip, January 20, 1952: *Ga. Mineral Society Newsletter,* v. 5, no. 2, p. 59.

____, 1955, Prospecting for uranium in Georgia: *Ga. Mineral Society Newsletter,* v. 8, no. 2, p. 38–46.

____, 1956, Iron ores of the Clayton Formation in Stewart and Quitman Counties, Georgia: *Ga. Mineral Newsletter,* v. 9, no. 4, p. 116–124.

____, 1958, Mineral resource survey of Floyd County, Georgia: *Ga. Mineral Newsletter, v. 11, no. 1, p. 1–15.*

____, 1959, Beryl in Georgia: *Ga. Mineral Newsletter,* v. 12, no. 3, p. 91–95.

____, 1960a, Corundum in Georgia: *Ga. Mineral Newsletter,* v. 13, no. 4, p. 167–177.

____, 1960b, Some lost mineral localities in Georgia: *Ga. Mineral Newsletter,* v. 13, no. 3, p. 124–129.

____, 1960c, Kyanite, sillimanite, and andalusite in Georgia: *Ga. Mineral Newsletter,* v. 13, no. 1, p. 9–21.

Furcron, A. S., and Teague, K. H., 1943, Mica-bearing pegmatites of Georgia: *Ga. Geol. Survey Bull. 48,* 192 p.

____, 1945, Sillimanite and kyanite in Georgia (a preliminary report): *Ga. Geol. Survey Bull. 51,* 76 p.

____, and Calver, J. L., 1947, Talc deposits of Murray County, Georgia: *Ga. Geol. Survey Bull. 53,* 75 p.

Galpin, S. L., 1915, A preliminary report on the feldspar and mica deposits of Georgia: *Ga. Geol. Survey Bull. 30,* 190 p.

Genth, F. A., 1860, Re-examination of tetradymite from Dahlonega: *Mining Mag.,* 2d ser., v. 1, p. 358–359.

Goff, J. H., 1959a, Saltpeter production among the Georgia Cherokees: *Ga. Mineral Newsletter,* v. 12, no. 3, p. 128.

____, 1959b, Some salt licks in the old Cherokee Country of Georgia: *Ga. Mineral Newsletter,* v. 12, no. 3, p. 128.

Grant, W. H., 1949a, Alums from Rabun County: *Ga. Mineral Society Newsletter,* v. 2, no. 6, p. 8–9.

____, 1949b, A new hornblende locality in Towns County: *Ga. Mineral Society Newsletter,* v. 2, no. 5, p. 6.

____, 1955, Secondary calcite from Mitchell Creek Mica Mine *in* Mineralogical notes: *Ga. Mineral Newsletter,* v. 8, p. 150.

____, 1958, Geology of Hart County, Georgia: *Ga. Geol. Survey Bull. 67,* 75 p.

____, 1962, Field excursion, Stone Mountain—Lithonia district: Geol. Soc. America Southeastern Sec. Ann. Mtg., Guidebook 2, 21 p.

____, 1975, Chemical weathering of Panola adamellite with special reference to apatite: *Southeastern Geol.,* v. 17, no. 1, p. 15–27.

Griffitts, W. R., 1953, Hartwell District, Georgia and South Carolina, Part 7 of Mica deposits of the southeastern Piedmont: U. S. Geol. Survey Prof. Paper 248-E, p. iv, 293–315.

Guinn, S. A., 1973, Molybdenite, Siloam Granite Quarry, Greene County, Georgia: *Abs., Bull. Ga. Acad. Sci.,* v. 31, no. 2, p. 81.

Hartley, M. E., III, 1973, Ultramafic and related rocks in the vicinity of Lake Chatuge: *Ga. Geol. Survey Bull 85, 61 p.*

Hartley, M. E., and Penley, H. M., 1974, The Lake Chatuge Sill outlining the Brasstown Antiform: *Ga. Geol. Soc.,* Guidebook 13, Ga. Dept. Nat. Res., 27 p.

Haseltine, R. H., 1924, Iron ore deposits of Georgia: *Ga. Geol. Survey Bull. 41,* 222 p.

Hatcher, R. D., 1971, The geology of Rabun and Habersham Counties, Georgia: *Ga. Geol. Survey Bull. 83,* 48 p.

Hayes, C. W., and Phalen, W. C., 1908, Graphite deposits near Cartersville, Georgia *in* Contributions to economic geology, 1907: *U.S. Geol. Survey Bull. 340,* p. 464-465.

Heinrich, E. W., and Jahns, R. H., 1953, Outlying deposits in Georgia, Part 10 *of* Mica deposits of the southeastern Piedmont: U.S. Geol. Survey Prof. Paper 248-F, p. 377–400.

Heinrich, E. W., Klepper, M. R., and Jahns, R. H., 1953, Thomaston–Barnesville District, Georgia, Part 9 *of* Mica deposits of the southeastern Piedmont: U.S. Geol. Survey Prof. Paper 248–F, p. v, 327–376.

Henderson, E. P., and Furcron, A. S., 1957, Meteorites in Georgia, Part 2, Description of falls: *Ga. Mineral Newsletter,* v. 10. no. 4, p. 113–142.

Henderson, J. T., 1885, *The commonwealth of Georgia:* J. P. Harrison and Co., 379 p.

Herrick, S. M., 1961, Well logs of the Coastal Plain of Georgia: *Ga. Geol. Survey Bull. 70,* 468 p.

Herrmann, L. A., 1954, Geology of the Stone Mountain—Lithonia District, Georgia: *Ga. Geol. Survey Bull. 61,* 139 p.

Hess, F. L., and Graton, L. C., 1904, The occurrence and distribution of tin: U.S. Geol. Survey Bull. 260-C, p. 164.

Higgins, M. W., 1966, The Geology of the Brevard Lineament near Atlanta: *Ga. Geol. Survey Bull. 77,* 49 p.

Hopkins, O. B., 1914, A report on the asbestos, talc, and soapstone deposits of Georgia: *Ga. Geol. Survey Bull. 29,* 319 p.

Hughes, T. C., 1970, Magnetite-rich quartzite, Jackson County, Georgia: (Abs.), *Bull. Ga. Acad. Sci.* v. 28. no. 2, p. s21.

Hull, J. P. D., 1920, Report on the barytes deposits of Georgia: *Ga. Geol. Survey Bull. 36,* 146 p.

Hull, J. P. D., LaForge, L., and Crane, W. R., 1919, Report on the manganese deposits of Georgia: *Ga. Geol. Survey Bull. 35,* 295 p.

Humphrey, R. C., 1970, The geology of the crystalline rocks of Green and Hancock Counties, Georgia: M.S. Thesis, Univ. of Ga.

Hunter, C. E., and Rankin, H. S., 1941, Forsterite olivine deposits of North Carolina and Georgia: *Ga. Geol. Survey Bull. 47,* 117 p.

Hurst, V. J., 1951, Tourmaline from Cobb and Clarke Counties: *Ga. Mineral Society Newsletter,* v. 4, no. 6, p. 206.

———, 1953, Heavy minerals in saprolite differentiation, *in* Short contributions to the geology, geography, and archaeology of Georgia: *Ga. Geol. Survey Bull. 60,* p. 244–264.

———, 1955a, Stratigraphy, structure, and mineral resources of the Mineral Bluff Quadrangle: *Ga. Geol. Survey Bull. 63,* 137 p.

———, 1955b, Chrysocolla, *in* Mineralogical notes: *Ga. Mineral Newsletter,* v. 8, no. 2, p. 65.

———, 1955c, Pseudomeinonite from Buford Dam *in* Mineraological notes: *Ga. Mineral Newsletter,* v. 8, no. 1, p. 21.

———, 1955d, Epistilbite and laumontite near Columbus, Georgia, *in* Mineralogical notes: *Ga. Mineral Newsletter,* v. 8, no. 4, p. 149–150.

———, 1955e, Spinel, *in* Mineralogical notes: *Ga. Mineral Newsletter,* v. 8, no. 3, p. 98.

———, 1955f, Stilbite, *in* Mineralogical notes: *Ga. Mineral Newsletter,* v. 8, no. 2, p. 65.

———, 1956a, Mineralogical notes: *Ga. Mineral Newsletter,* v. 9, no. 1, p. 19.

———, 1956b, Cordierite, *in* Mineralogical notes: *Ga. Mineral Newsletter,* v. 9, no. 2, p. 73.

———, 1956c, Anatase pseudomorphs after titanite, *in* Mineralogical notes: *Ga. Mineral Newsletter, v. 9, no. 2, p. 73.*

———, 1956d, Andalusite, *in* Mineralogical notes: *Ga. Mineral Newsletter,* v. 9, no. 3, p. 125.

———, 1956e, Apatite, *in* Mineralogical notes: *Ga. Mineral Newsletter,* v. 9, no. 2, p. 90.

———, 1957a, Mineralogical notes: *Ga. Mineral Newsletter,* v. 10, no. 2, p. 95.

———, 1957b, Uraninite, *in* Mineralogical notes: *Ga. Mineral Newsletter,* v. 10, no. 1, p. 55.

———, 1957c, Rare sillimanite crystals, *in* Mineralogical notes: *Ga. Mineral Newsletter,* v. 10, no. 2, p. 55.

———, 1958a, Chatoyant tourmaline, garnet, hornblende, calcite, zeolite, and alum, *in* Mineralogical notes: *Ga. Mineral Newsletter, v. 11, no. 2, p. 48.*

____, 1958b, Rare earth-bearing apatite, *in* Mineralogical notes: *Ga. Mineral Newsletter,* v. 11, no. 1, p. 31.

____, 1958c, Stibnite and beryl in Consolidated Quarries, *in* Mineralogical notes: *Ga. Mineral Newsletter,* v. 11, no. 2, p. 48.

____, 1958d, Geology and mineralogy of Graves Mountain, Georgia: *Ga. Geol. Survey Bull. 68,* 33 p.

____, 1966, *Mineral Resources of the Central Savannah River Area:* Washington D.C., U.S. Dept. of Commerce Econ. Dev. Admin., v. 2, 231 p.

Hurst, V. J., and Crawford, T. J., 1964, *Exploration of mineral deposits in Habersham County, Georgia:* Washington, D.C., U.S. Dept. Commerce Area Redevel. Adm., 180 p.

Hurst, V. J., and Crawford, T. J., 1970, *Sulfide Deposits in the Coosa Valley Area, Georgia:* Washington, D.C., U.S. Dept. Commerce Econ. Dev. Admin., 190 p.

Hurst, V. J., Crawford, T. J., and Sandy, J., 1966, *Mineral Resources of the Central Savannah River Area:* Washington, D. C., U.S. Dept. Commerce Econ. Dev. Admin., v. 1, 467 p.

Hurst, V. J., and Horton, G. R., 1964, *The Bell Mountain silica deposit, Towns County, Georgia:* Washington, D.C., U.S. Dept. Commerce Area Redevel. Adm., 42 p.

Hurst, V. J., and Otwell, W. L., 1964, *Exploration of mineral deposits in White County, Georgia:* Washington, D.C., U.S. Dept. Commerce Area Redevel. Adm., 166 p.

Hurst, V. J., and Porter, K. E., 1963, 1963, Lithiophorite from Hall County, Georgia (Abs.): *Ga. Acad. Sci. Bull.,* v. 21, no. 1-2, p. 12.

Ingram, W. F., 1950, The kyanite, staurolite, and garnet association in Upson County, Georgia, *in* Short contributions to the geology, geography, and archaeology of Georgia: *Ga. Geol. Survey Bull. 56, p. 85-91.*

Jackson, C. T., 1859, *On bornite from Dahlonega, Georgia: Amer. Jour. Science,* 2nd ser. v. 27, p. 366-367.

Janes, T. P., 1878, *A manual of Georgia, for the use of immigrants and capitalists:* Ga. Dept. Agriculture, J. P. Harrison printer, 110 p.

Jones, S. P., 1909, Second report on the gold deposits of Georgia: *Ga. Geol. Survey Bull 19,* 283 p.

Kesler, T. L., 1950, Geology and mineral resources of the Cartersville District, Georgia: U.S. Geol. Survey Prof. Paper. 224, 97 p.

King, F. P., 1894, A preliminary report on the corundum deposits of Georgia: *Ga. Geol. Survey Bull. 2,* 133 p.

Kline, M. H., and Beck, W. A., 1949, Investigation of the Chestatee copper and pyrite prospect, Lumpkin Co., Georgia: U.S. Bur. Mines Rept. Inv. 4397, 12 p.

Lester, J. G., 1939, Garnet segregations in granite gneiss of DeKalb County, Georgia: *Jour. Geology,* v. 47, p. 841-847.

____, 1959, Gem minerals of Georgia: Emory Univ. Quarterly, v. 15, p. 160-167.

Lesure, F. G., 1962, Geology of the Taylor mica mine, Hart County, Georgia: *Ga. Mineral Newsletter,* v. 15, nos. 1-2, p. 9-14.

Lindgren, W., 1906, The gold deposits of Dahlonega, Georgia: *U.S. Geol. Survey Bull. 293, p. 119-128.*

Long. S., 1971, *Mines and prospects of the Chattahoochee-Flint Area, Georgia:* Univ. of Georgia Inst. Community and Area Development, 143 p.

McCallie, S. W., 1894, A preliminary report on the marbles of Georgia: *Ga. Geol. Survey Bull. 1,* 87 p.

____, 1900, A preliminary report on a part of the iron ores of Georgia—Polk, Bartow, and Floyd Counties: *Ga. Geol. Survey Bull. 10-A,* 190 p.

____, 1908, Report on the fossil iron ores of Georgia: *Ga. Geol. Survey Bull. 17,* 199 p.

____, 1909, The Pickens County meteorite: *Science,* new ser. vol. 30, p. 772-773.

____, 1910, A preliminary report on the mineral resources of Georgia: *Ga. Geol. Survey Bull. 23,* 208 p.

McLemore, W. H., and Hurst, V. J., 1970, *The carbonate rocks in the Coose Valley Area, Georgia:* Washington, D.C., U.S. Dept. Commerce Econ. Dev. Admin., 170 p.

Martin, A. C., and Stafford, L. P., 1972, *Mining Directory of Georgia,* 17th edition: Ga. Dept. Natural Resources, Earth and Water Div., 87 p.

Mason, B., and Berry, L. G., 1968, *Elements of Mineralogy:* W. H. Freeman and Co., San Francisco, 550 p.

Mathews, V., 1967, Geology and petrology of the pegmatite district in southwestern Jasper County, Georgia: M. S. Thesis, Univ. Of Georgia.

Maynard, T. P., 1912, A report of the limestones and cement materials of Georgia: *Ga. Geol. Survey Bull. 27,* 293 pp.

Medlin, J. H., and Hurst, V. J., 1967, Geology and mineral resources of the Bethesda Church area, Greene County, Georgia: Ga. Geol. Survey Inf. Circ. 35, 29 p.

Mertie, J. B., 1953, Monazite deposits of the southeastern Atlantic states: U.S. Geol. Survey Circ. 237, 31 p.

Mitchell, L., Faust, G. T., Hendricks, S. B., and Reynolds, D. S., 1943, The mineralogy and genesis of hydroxlapatite: *Amer. Mineralogist,* v. 28, p. 356–371.

Needham, R. E., and Hurst, V. J.,. *Talc deposits of the Coosa Valley area, Georgia:* Washington, D.C., U.S. Dept. Econ. Dev. Admin., 58 p.

Oslon, J. C., and Adams, J. W., 1962, Thorium and rare earth in the United States, exlusive of Alaska and Hawaii: U. S. Geol. Survey Mineral Invs. Resources Map MR-28.

Palache, C., Berman, H., and Frondel, C., 1944, *Dana's system of Mineralogy,* vols. 1 and 2: John Wiley and Sons, Inc., New York, 834 p., 1624 p.

Pardee, J. T., and Park, C. F., 1948, Gold deposits of the southern Piedmont: U.S. Geol. Survey Prof. Paper 213, 156 p.

Park, C. F., 1953, Gold deposits of Georgia: *Ga. Mineral Newsletter, v. 6, no. 4, p. 107–113.*

Park, C. F., and Wilson, R. A., 1936, *The Battle Branch Gold Mine, Auraria, Georgia: Econ. Geol.,* v. 31, p. 73–92.

Patterson, S. H., and Buie, B. F., 1974, Field conference on kaolin and fuller's earth, November 14–16, 1974: Soc. Econ. Geologists, Guidebook 14, Ga. Geol. Survey, 53 p.

Peyton, A. L., and Cofer, H. E., 1950, Magruder and Chambers copper deposits, Lincoln and Wilkes Counties, Georgia: U.S. Bur. Mines Rept. Inv. 4665, 23. p.

Pickering, S. M., 1961, Geology of iron ore deposits of the Perry Quadrangle, Georgia: *Ga. Mineral Newsletter,* v. 14, no. 4, p. 83–90.

Pierce, W. G., 1944, Cobalt-bearing manganese deposits of Alabama, Georgia, and Tennessee: *U.S. Geol. Survey Bull. 940,* p. 271–275.

Prindle, L. M., Johnson, W. D., Crickmay, G. W., Grandrud, B. W., and Smith, R. W., 1935, Kyanite and vermiculite deposits of Georgia: *Ga. Geol. Survey Bull. 46,* 50 p.

Prowell, D. C., 1971, Ultramafic Plutons in the central Piedmont of Georgia: M.S. Thesis, Emory University, 83 p.

Ramdohr, P., 1960, *Die erzmineralien und ihre verwachsungen:* Berlin, Akademie—Berlag, 1089 p.

Ramspott, L. D., 1967, Zeolites in the Georgia Piedmont: *Ga. Acad. Sci. Bull., v. 25, no. 1, p. 18–25.*

Richard L. M., 1911, *Garnet deposits of Georgia: Mining World,* v. 34, p. 1135.

Salotti, C. A., and Fouts, J. A., 1967, An occurrence of cordierite-garnet gneiss in Georgia: *Am. Min.,* v. 52, p. 1240–1243.

Shearer, H. K., and Hull, J. P. D., 1918, A preliminary report on the pyrite deposits of Georgia: *Ga. Geol. Survey Bull. 33,* 229 p.

Shephard, C. U., 1859, Report on the Mount Pisgah Copper Mine in Fannin County, Georgia: New Haven, printed by E. Hayes, 8 p.

Silliman, B., 1830, Georgia meteor and aerolite: *Amer. Jour. Science,* v. 18, p. 388–392.

Silver, L. T., and Grunenfelder, M. H., 1957, Alteration of accessory allanite in granites of the Elberton area, Georgia: (Abs.), *Geology Soc. America Bull.,* v. 68, no. 12. p. 1796.

Sinkankas, J., 1959, *Gemstones of North America:* Princeton, New Jersey, Van Nostrand Co., 675 p.

Smith, J. L., 1854, Xenotime in Georgia, no. 41 *of* Part 4 *of* Re-examination of American Minerals: *Amer. Jour. Science,* 2nd ser. v. 18, p. 377–378.

———, 1877, Two new meteoric irons: *Amer. Jour. Science,* 3rd ser., v. 14, p. 24b,

Smith, R. W., 1929, Sedimentary kaolins of the Coastal Plain of Georgia: *Ga. Geol. Survey Bull. 44,* 482 p.

Spencer, J. W. W., 1893, The Paleozoic Group, The geology of ten counties in northwestern Georgia: *Ga. Geol. Survey,* 406 p.

Stephenson, M. F., 1871, *Geology and mineralogy of Georgia, with a particular description of her rich diamond district:* Atlanta, Globe Pub. Co., 244 p.

____, 1878, Diamonds and precious stones of Georgia: Gainesville, Georgia, Eagle Job Office, 32. p.

Teague, K. H., 1956, Georgia occurrences described, *in* Asbestos in Georgia: *Ga. Mineral Newsletter,* v. 9, no. 1, p. 4–7.

Veatch, O. J., and Stephenson, L. W., 1911, Preliminary report on the geology of the Coastal Plain of Georgia: *Ga. Geol. Survey Bull. 26,* 466 p.

____, 1911, Graphite in vein quartz: *Science,* new ser. v. 33, p. 38.

Walter, K. G., 1956, A study of the pegmatites of the Stone Mountain–Lithonia–Panola Shoals area: M.S. Thesis, Emory Univ.

Watson, T. L., 1902, A preliminary report on a part of the granites and gneisses of Georgia: *Ga. Geol. Survey Bull. 9-A,* 367 p.

____, 1904, A preliminary report on the bauxite deposits of Georgia: *Ga. Geol. Survey Bull. 11,* 169 p.

____, 1904b, Seminole copper deposit of Georgia: *U.S. Geol. Survey Bull. 255,* p. 182–186.

____, 1906, A preliminary report on the ocher deposits of Georgia: *Ga. Geol. Survey Bull. 13,* 81 p.

____, 1908, A preliminary report on the manganese deposits of Georgia: *Ga. Geol. Survey Bull. 14,* 195 p.

____, 1912, Association of native gold with sillimanite: *Amer. Jour. Science,* 4th ser., v. 33, p. 241-244.

Weaver, C. E., and Beck, K. C., 1972, Vertical variability in the attapulgite mining area, *in* Puri, H. S., ed., Proceedings 7th Forum on Geology of Industrial Minerals, Tampa, Fla., April 28–30, 1971: Florida Bur. Geology Spec. Pub. 17, p. 51–90.

Wells, R. K., 1937, Analyses of rocks and minerals from the laboratory of the United States Geological Survey; 1914, 1936: *U.S. Geol. Survey Bull. 878,* 134 p.

Willet, J. E., 1870, Account of the fall of a meteoric stone in Stewart County, Georgia: *Amer. Jour. Science,* 2d ser., v. 50, p. 335–338.

Wise, S. W., Ciesielski, P. F., Schmidt, W., and Weaver, F. M., 1974, Opaline claystones of the Alabama-Georgia–South Carolina Coastal Plain: Environmental interpretation: (Abs.), Symposium on the petroleum geology of the Georgia Coastal Plain, Georgia Department of Natural Resources, Earth and Water Division, p. 123.

Yeates, W. S., McCallie, S. W., and King, F. P., 1896, A preliminary report on part of the gold deposits of Georgia: *Ga. Geol. Survey Bull. 4-A, 542 p.*

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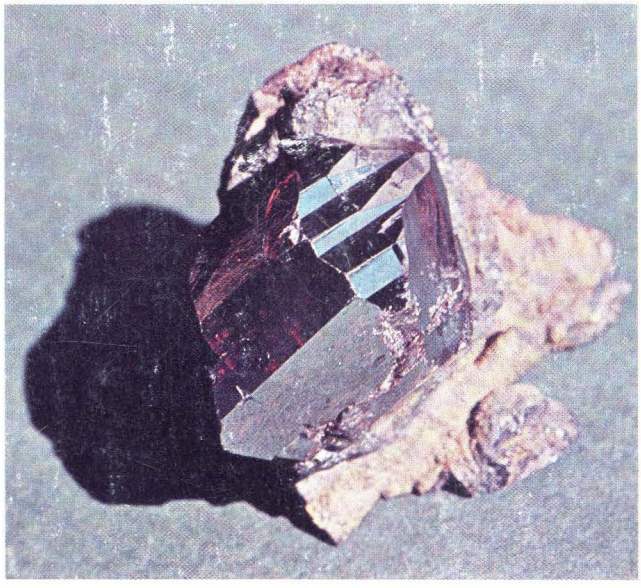
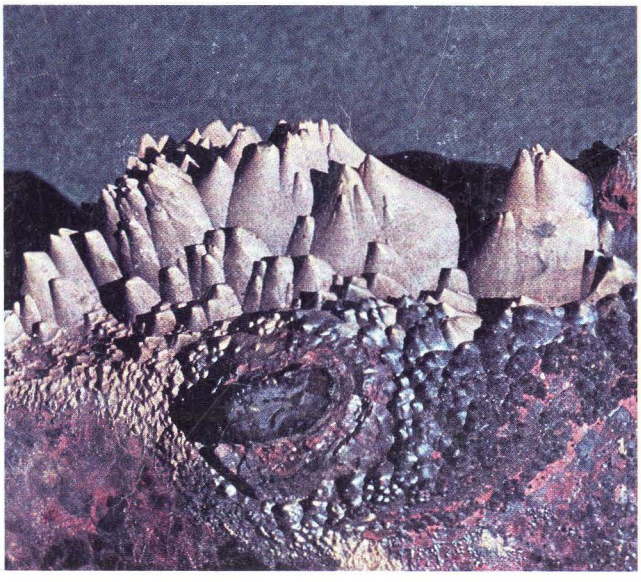
MINERAL INDEX





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