Geology and Ground-Water Resources of Bartow County Georgia

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1619-FF

Prepared in cooperation with the Georgia Department of Mines, Mining, and Geology

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By M. G. CROFT

CONTRIBUTIONS TO THE HYDROLOGY OF THE UNITED STATES

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CONTENTS

ILLUSTRATIONS

TABLES

CONTRIBUTIONS TO THE HYDROLOGY OF THE UNITED STATES

GEOLOGY AND GROUND-WATER RESOURCES OF BARTOW COUNTY, GEORGIA

By M. G. Croft

ABSTRACT

Bartow County is in northwestern Georgia and includes about 463 square miles. Cartersville, the county seat and largest town, is about 40 miles north of Atlanta. The county lies in two geomorphic provinces; the southeastern quarter in the Piedmont and the remainder in the Paleozoic area. Land-surface altitude ranges from about 700 to 1,800 feet above sea level. The area receives about 46 inches of precipitation annually. The ores of iron, manganese, and barite are mined in the Cartersville mining district, one of the oldest continuously mined districts in the southeast.

The Paleozoic rocks include the Weisner formation, the Shady dolomite, the Rome formation, the Conasauga formation, the Knox dolomite, the Newala limestone, and the Rockmart slate of Hayes (1891). These rocks are intensely folded and locally faulted. They are bounded on the south and east by porphyritic granite gneiss and by the Cartersville fault, which separate them from the Precambrian Great Smoky group of schist, slate, metasiltsone, and metagraywacke. Amphibolite, schist, and granite gneiss are separated from the Great Smoky group in the southeast corner of the county by faults.

Bartow County has water supplies available for development of its many natural resources. Ground water has been developed in the county for industrial, municipal, farm, and domestic use. The carbonate rocks west of the Cartersville fault contain joints, fractures, and well-developed solution channels, which yield large quantities of water. Industrial wells in the Shady dolomite yield up to 300 gpm of water which is of good quality and ranges from moderately hard to hard. Water from the limestone and dolomite of the Conasauga, Knox, and Newala formations is generally hard. If properly located, wells in the porphyritic granite gneiss and granite gneiss will yield up to 80 gpm of soft to moderately hard water.

INTRODUCTION

LOCATION

Bartow County is in northwestern Georgia and includes about 463 square miles (fig. 1). Cartersville, the county seat and largest town, is about 40 miles north of Atlanta. It is connected with Atlanta and Chattanooga by U.S. Highway 41 (pl. 1), much of which is a four-

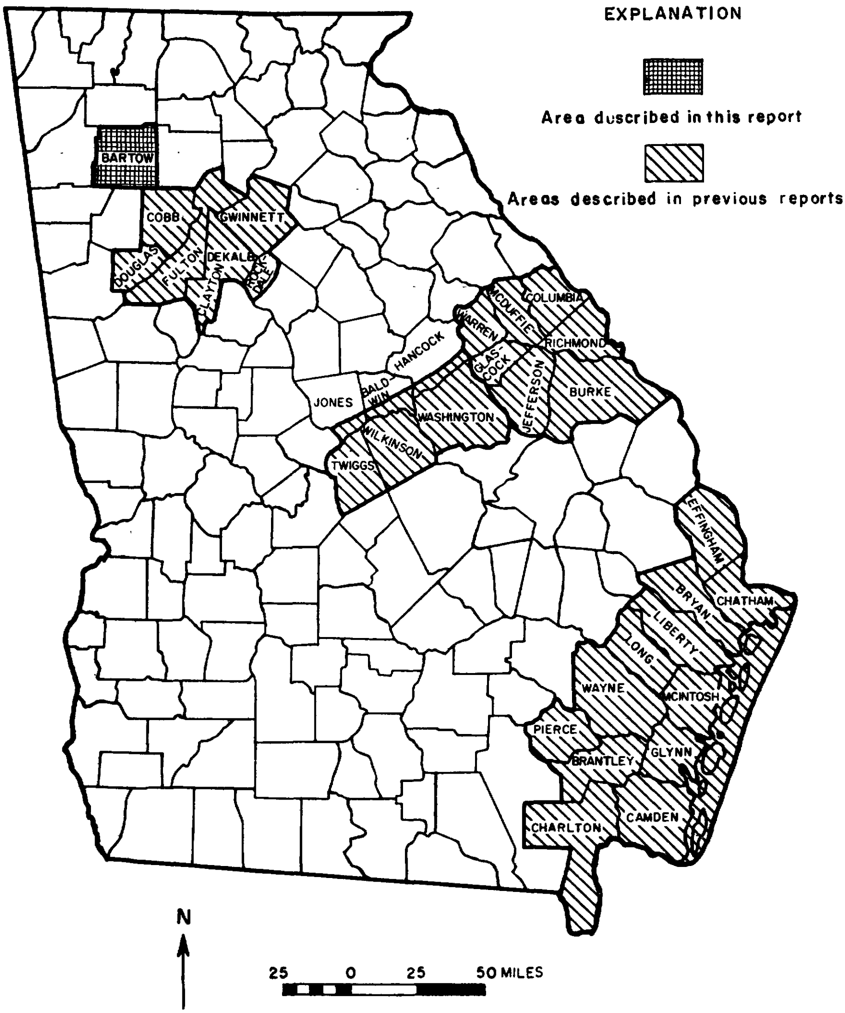

FIGURE 1.—Map of Georgia showing Bartow County and areas described in previous reports.

lane expressway. U.S. Highway 411 connects Cartersville with Rome and Chatsworth, Ga. Roughly paralleling the main highways are the Nashville, Chattanooga and St. Louis Railroad, the Louisville and Nashville Railroad, and the Seaboard Air Line Railroad, all of which converge at Cartersville. Topographic quadrangle maps are available for all but the western 10 percent of the county.

Bartow County is in two geomorphic provinces. The Paleozoic province includes about three-fourths of the county—the northwestern and central parts. The Paleozoic rocks consist of limestone, dolomite, sandstone, and shale. The remaining one-fourth of the county—the southeastern part—is in the Piedmont province. The rocks of the Piedmont area are metamorphosed and consist of granite gneiss, schist, slate, amphibolite, and quartzite.

Recreational facilities include Red Top Mountain and George Washington Carver State Parks at Allatoona Lake, about 6 miles east of Cartersville. The highly publicized Etowah Indian Mounds are about 3 miles south of Cartersville.

The principal industries are mining and smelting of iron, barite, and manganese ores. The ores are mined mainly in the southeastern part of the county, which is known as the Cartersville mining district. Mining began about 1840, and the district is one of the oldest in the southeast with continuous activity. Bauxite is mined in some parts of the county, and there are also several large limestone and dolomite quarries. Agricultural products include cotton, corn, livestock, and timber.

TOPOGRAPHY

The Paleozoic rocks of Bartow County are part of the Appalachian Valley and Ridge physiographic province. The Paleozoic rocks, composed mainly of shale, limestone, and dolomite, are intensely folded, and erosion has produced low rounded ridges, hills, and broad valleys. The altitude ranges from 700 to 1,800 feet.

The topography of the Piedmont area of Bartow County generally is that of a dissected plateau whose upland surface is about 1,000 feet in altitude. The streams are long and sinuous and commonly have eroded 100 to 200 feet below the crest of the ridges. Also included in the Piedmont are the series of high rugged ridges of low-rank metamorphosed shale and quartzite east of Cartersville. The maximum altitude of these ridges is about 1,800 feet.

CLIMATE

The climate of Bartow County is relatively mild and humid with long warm summers and short cool winters. The mean annual temperature recorded by the U.S. Weather Bureau at Cartersville is about 62°F. The temperature of the water recorded at springs and wells closely approximated this mean. Figure 2*A* shows the average monthly temperature recorded at Cartersville. The average growing season is about 200 days.

The average annual precipitation recorded at Cartersville for the period 1951–59 was 46.4 inches (fig. 2*B*). This amount probably was general throughout the area. Most of the precipitation occurs as rain, although snow is common in the winter. The greatest amount of precipitation falls in the winter and spring and the least in the

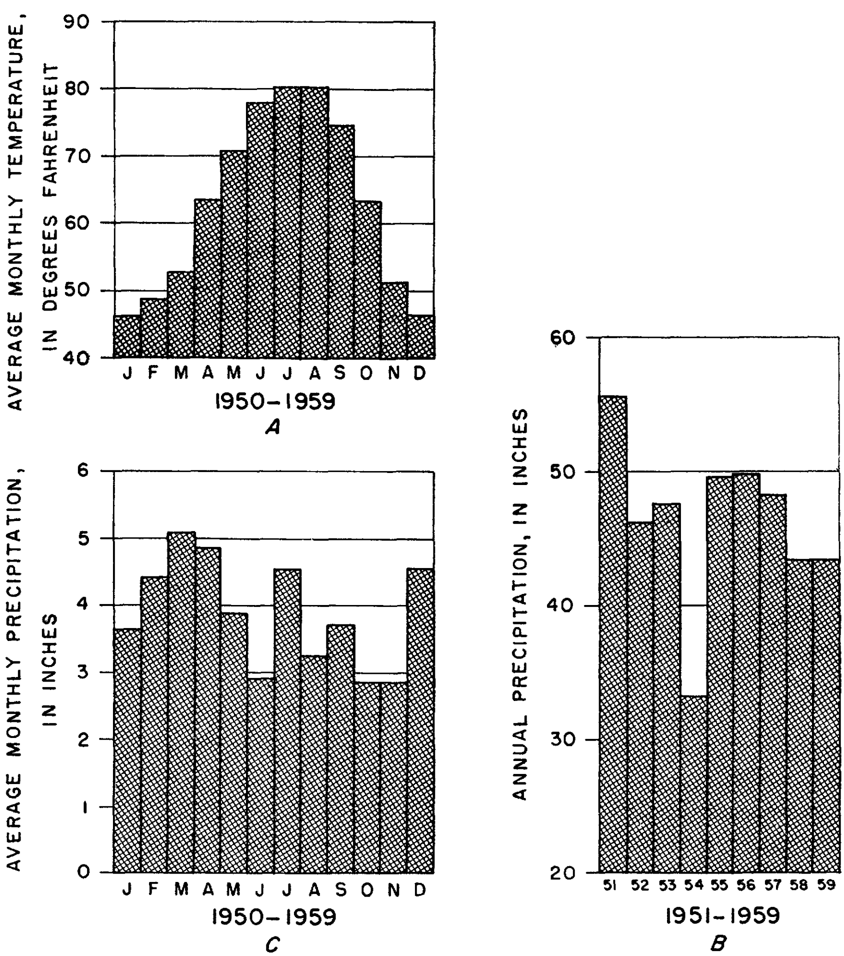

FIGURE 2.—Precipitation and temperature at Cartersville, Bartow County.

summer and fall. July, August, and September are characterized by heavy showers (fig. 2*C*).

DRAINAGE

About three-fourths of Bartow County is drained by the Etowah River and its tributaries. The Etowah River, a major tributary of the Coosa River, begins in the highlands of northern Georgia and flows westward through the southern part of Bartow County. Allatoona Lake was formed by the construction of Allatoona Dam on the Etowah River about 4 miles east of Cartersville. The flow of the river west of the lake is controlled at the dam. The streams in the northern part of Bartow County flow northward into Gordon County, where they meet the Coosawattee River, also a major tributary of the Coosa River.

PURPOSE AND SCOPE OF INVESTIGATION

Fieldwork for this report was begun in August 1959 to determine the location, extent, and thickness of the aquifers and the chemical quality of the ground water. This information is needed for the development of industries and the growth of communities. An investigation was made of the ground-water development in the county. About 8 months was devoted to geologic mapping, and about 3 months was devoted to gathering water samples, canvassing wells, and collecting other hydrologic data. Fieldwork was completed in July 1960.

ACKNOWLEDGMENTS

This investigation is a part of the statewide studies of water resources being made by the U.S. Geological Survey in cooperation with the Georgia Department of Mines, Mining, and Geology. The study of the ground-water resources of the Palezoic rocks of Georgia has continued intermittently since 1943. This investigation was under the immediate supervision of J. T. Callahan, district geologist of the Ground Water Branch. The State Cooperator was Garland Peyton, Director, Georgia Department of Mines, Mining, and Geology.

Acknowledgment is made to the citizens and industrial concerns of the county, who were helpful in supplying information on ground-water withdrawals and records of wells. Vernon J. Hurst, A. S. Furcron, and other members of the staff of the Georgia Department of Mines, Mining, and Geology, made many valuable suggestions and discussed stratigraphic problems with the author.

GEOLOGY

PREVIOUS GEOLOGIC WORK

Since 1870 many geologists and mining engineers have visited Bartow County to study the mineral deposits in the Cartersville mining district. Kesler (1950, p. 5) lists 41 publications on the geology and mineral deposits of the county. One of the pioneer geologists was C. W. Hayes of the U.S. Geological Survey, who mapped the geology of the region and outlined the stratigraphy and geologic structures. However, many of his maps, which were prepared about 1890, were never published because of uncertainty in the interpretations and correlations presented. Hayes' manuscript material and notes are on file with the U.S. Geological Survey, and copies of his maps are on file with the Georgia Department of Mines, Mining, and Geology.

Many of Hayes' conclusions and findings were later published in other reports that dealt with the mineral deposits of the area but these publications have unfortunately tended to obscure the fundamental uncertainties in the original work. Laurence LaForge mapped the geology of the district in greater detail from 1903 to 1905, but his maps and reports were never published.

Kesler (1950) made one of the most recent and intensive studies of the mining district, including the geology and a detailed description of the mineral deposits and mines. A description of the stratigraphy and the structure of Paleozoic rocks also was made by Butts and Gildersleeve (1948). Reports also of interest include a compilation of the geology of east Tennessee by Rodgers (1953) and a study of the Paleozoic rocks of Alabama by Butts (1926).

Reports concerning nearby crystalline rocks have been made by Bayley (1928), Hurst (1955, 1956), and Smith (1960).

METAMORPHIC ROCKS

Amphibolite and mica schist, injected with granite gneiss, occur in the southeast corner of Bartow County. Mapping by Hurst (1956) indicates that the sequence forms a broad belt, which includes most of Cobb County to the south. Only a small part of the belt occurs in the southeast corner of Barrow County. The age of these rocks is uncertain, as they are separated from the Ocoee series by faults. Hurst (1960, p. 14) stated that the amphibolites represent a series of metavolcanic rocks (metamorphosed lavas and pyroclastics).

Porphyritic granite gneiss occurs in the area of the Allatoona Reservoir in southeastern Bartow County.

AMPHIBOLITE

Amphibolite beds were mapped in two southwest- and northeast-trending belts in the southeast corner of Bartow County. The rock is composed mainly of dark greenish-gray to black, slaty to massive beds of hornblende gneiss. Coarse-grained rock, much of which is saussuritized gabbro, crops out along the contact with the granite gneiss. The saussuritized gabbro forms massive greenish-gray rocks. In some areas beds of light-colored siliceous rocks contain large crystals of hornblende. Quartz stringers occur throughout and generally are parallel to the foliation. The amphibolite weathers to form a deep reddish-orange saprolite, and the soil is strewn with boulders and cobbles of quartz. Good exposures were found along U.S. Highway 41.

Ground water of good chemical quality occurs in joints, fractures, and along foliation planes in this very dense rock. The yield of wells is small, generally less than 30 gpm, but it is sufficient for most domestic and farm purposes. Farm and domestic wells are about 100 to 200 feet deep.

MICA SCHIST

Mica schist forms a unit several hundred feet thick between two massive units of amphibolite. The schist is composed mainly of large curved sheets of light- to dark-gray and black mica. Quartz stringers, which are about 3 inches thick, occur throughout and are generally parallel to the foliation. The schist weathers to form a reddish-brown soil, and the quartz stringers form cobbles and boulders which are strewn over the surface.

Ground water occurs in the schist along joints, fractures, and foliation planes in the rock and in the saprolite. As the rock is not very permeable, the yield of wells is small, generally less than 30 gpm (gallons per minute), but it generally is sufficient for farm and domestic use.

PORPHYRITIC GRANITE GNEISS

The rock mapped as porphyritic granite gneiss (pl. 1) was first described and named by Hayes (1901, p. 406–410) and is shown on his unpublished maps as Corbin granite. This name has since persisted even though the location and lithology of the original type section are uncertain. The name has been used so extensively, without precise meaning, that its use should be discontinued.

Metamorphism has produced a strongly foliated or fluted structure that in many areas contains much schist. The rock is composed of large porphyritic crystals of feldspar in a ground mass of bluish-gray quartz and mica. The feldspar crystals, which are generally about ½ to 2 inches long, take a sodium cobaltinitrite stain. Most of the feldspar is microcline and shows polysynthetic twinning in thin section. Plagioclase was rare in the thin sections examined. In many areas the rock weathers rapidly to a thick light-red soil.

Hayes (1901, p. 406–408) suggested that the lower unit of the Weisner formation unconformably overlies the porphyritic granite gneiss. However, the trace of the contact suggests that the porphyritic granite gneiss is intrusive into the Weisner formation, and is therefore post-Weisner in age. Many granitic rocks in the Appalachian region have been shown to be of middle to late Paleozoic age, and it is the author's opinion that the porphyritic granite gneiss probably was formed contemporaneously with them. Although the eastern border of the porphyritic granite gneiss is shown as a fault, it is conceivable also that the rock intrudes the Great Smoky group, indicating that intrusion followed the thrusting. Exposures are poor in this area, and the relationship of the granite and the Great Smoky rocks is uncertain.

Ground water occurs in the rock along joints, fractures, and exfoliation planes and in the thick overlying saprolite. Information regarding the yield from wells is scanty, but the yield from wells that are less than 200 feet deep ranges from 5 to 60 gpm. Wells drilled in low-lying areas of the porphyritic granite gneiss should have the largest yields. Herrick and LeGrand (1949) found this to be true in the Atlanta area where many wells in granitic and gneissic rocks yield 60 gpm or more. Water from the porphyritic granite gneiss is soft to moderately hard.

GRANITE GNEISS

The rock mapped as granite gneiss was named by Hayes (1901, p. 408) and is shown on his unpublished map as the Acworth gneiss. It is strongly foliated, showing augen and fluted structure, and is composed of gray quartz, feldspar, and biotite. Most of the feldspar is microcline, as it takes a sodium cobaltinitrite stain and shows polysynthetic twinning in thin section. Antiperthitic intergrowths occur in the plagioclase. In some samples quartz appears to be the most abundant mineral. During the investigation no evidence was found to indicate the age of the rock, but the granite gneiss is tentatively dated as middle to late Paleozoic for the same reason that the porphyritic granite gneiss (p. FF7) is dated.

Ground-water conditions in the granite gneiss are similar to those in the porphyritic granite gneiss.

PRECAMBRIAN ROCKS

OCOEE SERIES

GREAT SMOKY GROUP

Rocks of the Great Smoky group are present in the northeast and southeast corners of Bartow County. The Great Smoky group is separated from the Paleozoic rocks by a major thrust fault. In the Great Smoky Mountains (King and others, 1958) and in the Mineral Bluff quadrangle (Hurst, 1955), the Great Smoky group is divided into formations. Because the region south of the Mineral Bluff quadrangle and Great Smoky Mountains is considered to be inadequately mapped, formational names have not been extended. However, Bayley (1928, map 2) mapped the Great Smoky, Nantahala, and Murphy formations a few miles eastward in Cherokee County. There may be rocks included with the Great Smoky group that belong to younger, overlying Cambrian formations. The subdivisions of the Great Smoky group that were mapped are shown as zones on plate 1.

Zone A.—Zone A is predominantly low-grade metamorphosed graywacke interbedded with mica schist, slate, and metaconglomerate. Graded bedding is abundant, and particularly good examples were observed along Georgia Highway 53 northeast of Fairmount in Gordon County. This locality is about 3 miles north of Johnson Mountain. The metagraywacke, which is resistant to weathering and forms low rugged hills, constitutes about half the zone. A few thick beds of schist probably could be traced for many miles. Zone A is probably equivalent, in part at least, to the Copperhill formation and the lower part of the Hughes Gap formation, as mapped by Hurst (1955, p. 9–35) in the Mineral Bluff quadrangle.

Zone B.—In general, the rocks of zone B are finer grained than the rocks of zone A. The zone consists of thin-bedded, platy metasiltstone and metaarenite interbedded with mica schist. Metagraywacke is present in some areas, but it generally is rare. Many of the gray and black schists throughout the zone are graphitic. The rocks weather to a sandy reddish soil.

Zone C.—The rocks of zone C are several hundred feet thick and consist mainly of gray slate and a few thin beds of amphibolite which weather to form a reddish-yellow soil. On the basis of a small amount of fieldwork in Cherokee County, Bayley (1928, p. 61–65) suggested that this zone was equivalent to the Nantahala slate. However, there are several beds of dark-colored slate in the upper part of the Great Smoky group, and whether Bayley was justified in correlating the slate with the Nantahala is questionable. Hayes, in his unpublished Cartersville folio, mapped much of the zone in Cherokee County as the Wilhite slate. For the present it appears logical to include the zone with the Great Smoky group until further mapping can be done in the Murphy belt of northern Georgia.

Zone D.—The rocks of zone D are poorly exposed and were observed only in the southeast corner of the county. The zone appears to be similar lithologically to zone B.

Ground water in the Great Smoky group.—Domestic and farm wells, about 200 feet deep, generally yield less than 30 gpm from the rocks of the Great Smoky group. Water occurs in fractures, joints, and bedding planes in the rock and in the saprolite. The water is generally of good quality.

CAMBRIAN SYSTEM

WEISNER FORMATION

The Weisner formation of Early Cambrian age includes three distinctive lithologic units, which are referred to as lower, middle, and upper. The formation was named by Hayes (1901) for Weisner Mountain in Cherokee County, Ala.

The lower unit, which consists of interbedded quartzite, sericite schist, and conglomerate, has been called the Pinelog conglomerate in a few previous reports of the area (Hayes, 1901; Kesler, 1950). The name presumably was given to it by Hayes for exposures on Pine Log Mountain. Graded bedding, abundant throughout the unit, was observed in exposures of overturned beds just west of Allatoona Dam. Many individual beds grade from sand and conglomerate into shale and schist. The contact with the middle unit is gradational.

The middle unit consists mainly of sericite schist. Rarely do thin beds of sandstone occur. The outcrop pattern narrows and widens along the strike, due probably to abrupt changes in the dip of the beds. Where the outcrop pattern is narrowest, the unit is about 100 to 200 feet thick. On his unpublished maps Hayes labeled this unit the Wilhite slate.

The upper unit consists of thin- to thick-bedded, fine- to coarse-grained sandstone and orthoquartzite, interbedded with shale and schist. Thick and massive beds of quartzite form ridges, and thick shale units form intervening strike valleys. Most of these shale units appear to be traceable for only a few miles. Graded bedding is difficult to find in the upper unit. Individual beds of sandstone generally are separated by thin partings of shale. The sediments which comprise the rocks are much better sorted than in the lower unit. It is probable that the upper unit contains thin beds of carbonate rocks, as derivatives of weathering—chert, jasper, and deep reddish soil—were observed in some areas. These derivatives are characteristic of weathering of the Knox dolomite and other carbonate rocks in this region.

Fossils found by McCallie (1900, p. 124) have been erroneously identified with the Shady dolomite by Kesler (1950, p. 11). No further fossils were found in the area where McCallie made his find. The Chilhowee group in Tennessee, to which the Weisner formation is probably equivalent in part, is classified as Early Cambrian and Early Cambrian(?). The Weisner formation is classified as Early Cambrian.

Water occurs in the Weisner only along joints, bedding planes, and other fractures in the rock, as the rock is dense and well indurated, and the shale is not permeable. The yield, except in highly fractured zones, is small—probably less than 30 gpm in wells less than 200 feet in depth.

SHADY DOLOMITE

The Shady dolomite of Early Cambrian age is named from Shady Valley in Tennessee. The formation, which is everywhere deeply weathered, is divided into three units—a lower unit and an upper unit of carbonate rocks and a middle unit of sandstone and shale.

The lower unit of the Shady dolomite is about 300 feet thick and is composed of gray siliceous dolomite, which weathers to a deep reddish soil. The unit forms a longitudinal strike valley between the ridges composed of Weisner formation on the east and the middle unit of the Shady dolomite on the west, and it is exposed in several barite and iron pits located along its strike.

The middle unit of the formation consists of about 50 to 100 feet of sandstone, shale, and sericite schist. The unit forms a prominent ridge south of Cartersville. A good exposure was observed where U.S. Highway 41 crosses the Etowah River. The sandstone ridge could not be traced north of Cartersville, the lower and middle units of the formation having been faulted out.

The upper unit of the Shady dolomite consists of gray sandy dolomite and limestone. Much of the dolomite contains partings of shale, which weather out and remain in the soil. In some areas, the weathering of carbonate rock containing siliceous material leaves large rounded boulders of chert or jasper, which closely resemble quartzite. Good exposures of the dolomite were observed in the Paga barite pits northwest of Emerson. Fossils were reported by Hull (1920, p. 26) and by Kesler (1950, p. 11) that indicate an Early Cambrian age.

Water occurs in joints, fractures, and solution channels in the carbonate rock. Industrial wells in the formation generally will yield 200 to 300 gpm. Most wells will yield larger amounts of water, but at greater pumping rates the water generally contains fine silt and clay. The water is of good chemical quality and is classified as moderately hard to hard.

ROME FORMATION

The Rome formation of Early Cambrian age consists of shale, sandstone, quartzite, and limestone. It is lithologically similar to the rocks at Rome, Ga., the type locality for the formation (Hayes, 1902, p. 2). The formation is divided into three units—lower and upper units of sandstone and shale and a thin middle unit of limestone and dolomite—and it is probably more than 1,500 feet thick.

The lower and upper units are very similar. They consist mainly of interbedded shale and sandstone. In some areas there may be a few beds of limestone or dolomite, but no good exposures were found. The base of the formation is faulted out. The upper few hundred feet of the upper unit consists of quartzite and shale, which form a prominent ridge. Graded bedding was observed in the sandstone, and good examples occur where the rocks are overturned at Aubrey Lake and along U.S. Highway 411, just north of the city limits of White. The middle unit of the formation consists of about 100 feet of limestone and dolomite. Pettit Creek closely follows the belt of limestone and dolomite along part of its length.

Water occurs in joints and fractures in the shale and sandstone and in solution channels in the carbonate rocks. The yield from wells in the lower and upper units generally is less than 30 gpm, but it is sufficient for farm and domestic use and is of good chemical quality. Wells in the carbonate rocks of the Rome formation probably will yield 200 gpm, but the water is hard.

CONASAUGA FORMATION

The rocks of the Conasauga formation of Middle and Late Cambrian age are exposed in about 25 percent of the county. Three prominent units of the formation, totaling at least 4,000 feet in thickness, were mapped. An exact thickness of the formation would be difficult to obtain because of intense folding and shearing.

The lower unit consists mainly of gray thin- and thick-bedded dolomite and a few beds of limestone. Good exposures were observed in a quarry about a mile north of White. The carbonate rocks weather to form a broad strike valley, which extends from the Etowah River to Flexatile. In some areas of the valley, low hills are composed of shale and green slate, but these rocks are traceable for only short distances. The slate quarried at Flexatile is from this unit. Fossils listed by Kesler (1950, p. 13–14) are from the dolomite rock.

The middle unit consists of a considerable thickness of shale and slate and forms a prominent ridge. In fresh exposures the shale is dark green, but on weathering it becomes reddish orange.

The upper unit consists of interbedded gray limestone and shale. Much of the limestone is argillaceous, and units range in thickness from a few to several hundred feet. Many units of the limestone appear to wedge out toward the north. The shale is similar to the shale in the middle unit. This unit probably could be further subdivided, but it would require much detailed work.

Ground water occurs in joints and fractures in the shale and in solution channels in the carbonate rocks. The shale generally yields less than 30 gpm of soft to moderately hard water to wells that are less than 200 feet deep. The yield from wells in the carbonate rocks generally is much greater, but the water is hard. Wells from 200 to 500 feet deep in the carbonate rocks commonly yield 200 gpm.

CAMBRIAN AND ORDOVICIAN SYSTEMS

KNOX DOLOMITE

The deeply weathered residuum of the Knox dolomite, which occurs only in the western part of the county, forms about 30 percent of the exposures in Bartow County. Fresh rock is observed only in quarries and along streams. The formation consists mainly of thin- to thick-bedded dolomite and a few beds of limestone. The Knox dolomite, upon weathering, develops a thick residuum of cherty nodules and boulders and a reddish soil. The formation generally forms ridges and high knolls. The first occurrence of chert in the residuum was mapped as the base of the formation.

In adjacent states, the Knox dolomite forms a group composed of the Copper Ridge dolomite, the Chepultepec dolomite, and the Longview limestone. These formations are present in Bartow County (Butts and Gildersleeve, 1948, p. 17–18). Southwest of Adairsville, White and Denson (1952, p. 4) traced a sandstone zone in the formation which probably separates the Copper Ridge and Chepultepec formations. An excellent exposure of ripple-marked sandstone was observed about 3 miles southwest of Kingston, just east of the bridge over the Etowah River in the roadcuts for the four-lane highway which was under construction in 1960. This zone probably could be mapped and the remainder of the Knox dolomite divided throughout the county. The formation is about 4,500 feet thick.

Ground water occurs in joints, fractures, bedding planes, and solution channels in the dolomite. In most areas wells that are less than 150 feet deep yield ample water for domestic and farm supplies. Residents generally report that the wells yield from 5 to 100 gpm. Wells of greater depth probably could obtain supplies of ground water sufficient for small towns and industries because the deeper wells could penetrate more solution channels and fractures in the rock. Springs were observed in many areas and were most abundant at the base of the formation. Water from the Knox dolomite is classified as hard to very hard.

ORDOVICIAN SYSTEM

NEWALA LIMESTONE

The Newala limestone of Early Ordovician age occurs in three isolated areas in the southwestern part of the county. The rock consists of thick-bedded, light-gray limestone and is exposed only along the larger streams. The Newala limestone is very soluble and weathers rapidly. Because of the poor exposures, the area mapped as Newala limestone was inferred and encloses all the low-lying flat land in the vicinity of observable outcrops. Sinkholes and ponds are common in

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areas underlain by the formation. Butts and Gildersleeve (1948, geol. map) mapped a much larger area, but there are ridges of the Knox dolomite in some areas that were mapped as Newala limestone. In contrast to the residuum of much of the Knox dolomite, the residuum of the Newala limestone is a thick clay with only a thin layer of chert. The formation is probably 200 feet thick.

Ground water occurs along joints, fractures, and solution channels in the rock. Little information about the yield of wells that tap the Newala limestone is available, but, because of its susceptibility to solution, the formation should be productive. Wells with yields of several hundred gallons per minute probably could be developed. Water from the Newala limestone is characteristically hard.

MISSISSIPPIAN SYSTEM

ROCKMART SLATE OF HAYES (1891)

Two infolded outliers of the Rockmart slate of Hayes (1891) crop out in the southwestern part of the county. The formation consists of buff, reddish-brown, and tan shale; siltstone; sandstone; and gray slate. Butts and Gildersleeve (1948, p. 53–54) report the presence of *Platycrinus* sp. and *Spirifer* sp. in the formation. On this basis a Mississippian age was assigned to the rocks by Butts. The Rockmart slate therefore unconformably overlies the Ordovician rocks. The slate generally forms low ridges and hills. The thickness of the formation is not known.

Ground water occurs along bedding planes, fractures, and joints in the rock. The slate and shale are not permeable, and wells probably yield less than 30 gpm.

QUATERNARY SYSTEM

ALLUVIUM

Unconsolidated boulders, pebbles, sand, silt, and clay occur in flood plains and terrace deposits along the Etowah River and other major streams in the county. The deposits are mainly in the eastern part of the county where the streams descend through gorges from the highlands of the Piedmont. Stratification of the deposits can be observed in roadcuts. Owing to the irregularity in outline and the difficulty in distinguishing the deposits from colluvium, they were not mapped. The thickness of the deposits probably does not exceed 25 feet, and their value as sources of ground water is not known.

STRUCTURE

The rocks of Bartow County were intensely deformed by compression during the Appalachian orogeny, and tight folds and overthrust faults were formed. Prominent structural features are the northeast- and southwest-trending anticlines and synclines. The thrust faults in some areas closely parallel the folds, but in other areas the thrusts are clearly transverse to the faults and folds in the Paleozoic rocks (pl. 1).

FOLDS

Rocks of the Weisner, Shady, and Rome formations from Emerson to Pine Log Creek form the west limb of a major fold (pl. 1). The rocks of this belt are steeply overturned and dip to the southeast at angles which generally range from 22 to 46 degrees. In some areas, as may be seen in exposures along the paved highway between Johnson Mountain and Pine Log Mountain, the beds are completely overturned. Kesler (1950, p. 33) called this belt the Weisner anticlinorium. Westward, the Conasauga and Knox formations form a series of tightly folded anticlines and synclines. Many geologists have favored this interpretation in the past. The location of the fold axes is inferred as deep weathering generally obscures the bedding in the area underlain by the Knox dolomite.

Where the Conasauga formation is exposed at Adairsville and Kingston, there appears to be a culmination of the folds, and the occurrence of Newala limestone south of Sproull Mountain indicates a depression of the folds. The western limbs of the anticlinal structures east of Adairsville and Kingston are overturned in many areas. However, more detailed work needs to be done in the vast expanse of Knox dolomite and Conasauga formation exposed in the western parts of the county, as the structure of this area probably is more complexly folded and faulted than is shown on the accompanying geologic map (pl. 1).

FAULTS

The Paleozoic rocks are sheared by a group of thrust faults which closely parallel the folds. The Knox dolomite was observed in the western part of the quarry at Quarry Mountain to dip to the west at a low angle, but in the eastern part of the quarry the dolomite is highly brecciated, vertical, and is probably the lower dolomite member of the Conasauga formation. The quarry is cut by a fault which extends to Cass, where it is shown as branching (pl. 1). East of White, the Weisner and Shady formations have been thrust over the Rome formation. The faults of this group appear to have been formed during the folding.

Kesler (1950, p. 30–33) doubted the existence of the Cartersville fault, but many geologists still recognize a major fault separating the Paleozoic and the Ocoee rocks from Tennessee to Alabama. However, the position of the fault in the Cartersville mining district is debatable. Hayes (1901) drew the fault along the escarpment at the western end of Johnson Mountain, at the contact of the middle and upper units of the Weisner formation, and along the escarpment southwest of Emerson. This interpretation is the most widely accepted. LaForge (Hull, LaForge, and Crane, 1919, p. 52–53) concluded (1) that a fault extends from the escarpment at Johnson Mountain and eastward along the valley of Pine Log Creek; (2) another fault occurs along the east side of the area underlain by the porphyritic granite gneiss and along the escarpment southwest of Emerson; and (3) the two faults possibly come together at the north end of Pine Log Mountain east of the Bartow County line. The interpretation given in this report is similar to that of LaForge and is shown in plate 1.

The crystalline rocks east of the Cartersville fault have overridden the folds and faults of the Paleozoic rocks. Brecciation was observed at many places along the trace of the fault from Johnson Mountain northward to Fairmount in Gordon County. Elsewhere, weathering is too deep to observe the brecciation. The magnitude of the fault in Bartow County can be estimated only roughly. Assuming that the position of the fault around Pine Log Mountain has been correctly interpreted, the crystalline rocks appear to have moved at least 12 and perhaps 15 miles westward over the Cambrian rocks, as the Weisner formation of Pine Log Mountain, which is surrounded on three sides by the Great Smoky group, was observed to extend that distance into Cherokee and Pickens Counties. The vertical displacement of the fault south of Stilesboro, where Precambrian rocks are superposed upon Mississippian rocks, is at least 20,000 feet. The total thickness of the Cambrian, Ordovician, and Mississippian systems in the southern part of the county is about 10,000 feet, and a thickness of 10,000 feet does not seem to be unreasonable for the Great Smoky group. Hurst (1955, p. 9) described a much thicker sequence of the Great Smoky group in northern Georgia.

GROUND WATER

USE OF WATER IN BARTOW COUNTY

An estimated 5,613,000 gallons of water was pumped daily in Bartow County from January 1959 to March 1960. About 73 percent of the water was obtained from the ground-water reservoir, and about 27 percent was obtained from the Etowah River near Cartersville (fig. 3). During 1959 the city of Cartersville processed an average of 1,505,000 gpd (gallons per day) from the Etowah River for municipal purposes and for a few industries in the area. An estimated 10,000

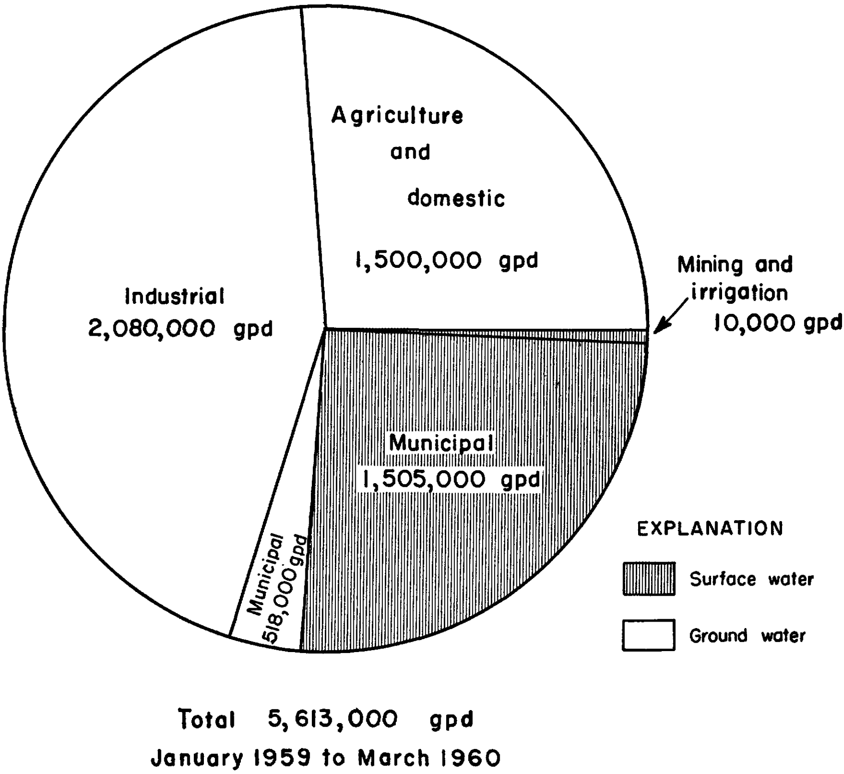


FIGURE 3.—Estimated daily use of water from the ground-water reservoir and the Etowah River, Bartow County.

gpd was taken from the Etowah River and other streams for irrigation and mining operations.

An estimated 4,098,000 gpd was taken from the aquifers for municipal, industrial, agricultural, and domestic use. About 518,000 gpd was obtained from the aquifers for municipal supplies, and about 2,080,000 gpd was used by industry. The municipal and industrial users of ground water are given in table 1. An estimated 1,500,000 gpd was obtained from springs and wells throughout the county for agriculture and domestic supplies.

A record of selected springs in the county is given in table 2, and a record of wells in the county may be examined in the Atlanta office of the Geological Survey. The location of wells and springs is shown on plate 1. In general, springs and wells are numbered consecutively within the area covered by the designated quadrangle or topographic map. Wells in the area of the county not covered by topographic maps also are listed consecutively. Where the topographic map of the Cartersville mining district overlaps part of the Stilesboro quadrangle, wells are included with those in the Cartersville mining district, as the map of the Cartersville mining district is more recent. Wells in the area where the 7½-minute Acworth quadrangle overlaps the Cartersville mining district are listed with the Acworth quadrangle for the same reason.

HYDROLOGY

The water that is obtained from wells and springs throughout the county is primarily rainwater and occurs in joints, fractures, and bedding planes in the rocks. These openings are enlarged by slightly acidic water to form extensive water-filled solution channels in limestone and dolomite. Wells that penetrate large solution channels commonly yield several hundred gallons per minute. Wells in the crystalline and quartzite rocks of the Piedmont area have much smaller yields.

Because of the difference in the yield to wells of the Paleozoic and Piedmont rocks, the hydrology of the Paleozoic rocks is discussed under the heading "Aquifers of the Paleozoic area," and the hydrology of the Piedmont area is discussed under the heading "Aquifers of the Piedmont area."

AQUIFERS OF THE PALEOZOIC AREA

The limestone and dolomite, which are interbedded with shale and sandstone in the Paleozoic rocks of Bartow County, are excellent aqui-

TABLE 1.—*Estimated daily municipal and industrial use of ground water, Bartow County (January 1959–March 1960)*

Source	Owner	Gallons per day
	Municipal	
1 spring	City of Adairsville	188,000
1 well	City of Emerson	20,000
1 well	City of Kingston	265,000
1 well	City of White	45,000
Total		518,000
	Industrial	
2 wells	Chemical Products Corp	510,000
1 well	Goodyear Clearwater Mill	104,000
1 well and 1 spring	Rubberoid Co	[1] 288,000
1 well	Southland Ice Co	[2] 86,000
1 well	Tompson-Weinman Co	504,000
2 wells	Visking Corp	[3] 345,000
1 well	Marquette Cement Manufacturing Co	3,000
Total		2,080,000

[1] Combined industrial and community supply from well and spring.
[2] Well is used about 8 months of the year.
[3] Visking Corp. began using ground water about February 1960.

TABLE 2.—*Record of selected springs, Bartow County*

Spring No.	Quadrangle	Distance from corner of quadrangle	Owner or name of spring	Aquifer	Hydrologic data: Yield (gpm): Rate	Hydrologic data: Yield (gpm): Date of measurement	Temperature (°F)	Remarks
1	Adairsville	10.1 miles E., 9.0 miles N. of SW. corner	P. W. Head (Hayes Spring).	Upper unit of Conasauga formation.	[1] 50	September 1959	61	
2	do	11.4 miles E., 6.3 miles N. of SW. corner	Harvey Lewis	Knox dolomite	[1] 50	do	61	
3	do	9.3 miles E., 4.7 miles N. of SW. corner	C. L. Pratt	do	241	Sept. 28, 1950	62	
4	do	8.5 miles E., 9.2 miles N. of SW. corner	George Gaines (Mosteller Spring).	do	2,100	do	59+	
5	do	2.8 miles E., 8.5 miles N. of SW. corner	City of Adairsville	do	4,100	Sept. 27, 1950	60	Chemical analysis available.
6	do	2.5 miles E., 2.3 miles N. of SW. corner	Connesena Spring	do	1,050	do	60	
7	do	10.5 miles E., 3.6 miles N. of SW. corner	Crowe Spring Church.	do	1,000	Sept. 28, 1950	59	
8	do	10.9 miles E., 3.5 miles N. of SW. corner	Vernon Rutledge (Crowe Spring).	do	517	do	61	
9	do	13.8 miles E., 3.8 miles N. of SW. corner	H. H. Lipscomb	Upper unit of Conasauga formation.	[1] 60	August 1959	62+	
10	do	2.8 miles E., 3.5 miles N. of SW. corner	Kerr Spring	Knox dolomite	[1] 200	December 1959	61	
11	do	10.9 miles E., 8.0 miles N. of SW. corner	Orma Adcock	do	[1] 200	do	59	Do.
1	Cartersville mining district.	1.5 miles E., 1.3 miles N. of SW. corner	Mrs. W. B. Moss	Alluvium(?) Upper unit of Shady dolomite.	[1] 200		63	
2	do	1.4 miles E., 1.3 miles N. of SW. corner	do	do	[1] 200		61	
3	do	1.1 miles E., 3.6 miles N. of SW. corner	Cartersville Spring	do				Do.
1	Stilesboro	2.5 miles E., 9.5 miles S. of NW. corner	Wallace Moore	Newala limestone	174	Sept. 26, 1950	63	
2	do	1.1 miles E., 8.7 miles S. of NW. corner	C. C. Cox	Knox dolomite	967	do	62	
3	do	4.5 miles E., 4.2 miles S. of NW. corner	Gillam Spring	do	754	Sept. 27, 1950	60	
4	do	5.0 miles E., 4.9 miles S. of NW. corner	Ted Dunken (Boiling Spring).	do	584	do	61	Do.
5	do	2.2 miles E., 8.1 miles S. of NW. corner	W. W. Nelson (Blue Spring).	do	3,290	Sept. 26, 1950	62	
6	do	5.0 miles E., 0.2 miles S. of NW. corner	Roger Gordon	do	2,090	Sept. 27, 1950	59	
1	Waleska	2.2 miles E., 9.8 miles N. of SW. corner	Funkhouser Spring	Lower unit of Conasauga formation.	220	Sept. 29, 1950	61	
2	do	1.1 miles E., 5.1 miles N. of SW. corner	W. M. Vaughan	do	[1] 50	August 1959	60+	
3	do	1.2 miles E., 5.4 miles N. of SW. corner	Wiley Vaughan	do	[1] 50	do	61	
4	do	3.6 miles E., 6.6 miles N. of SW. corner	Copper Hill Mining Co.	Upper unit of Rome formation.	[1] 700	do	62	Do.
1	None		Davis Estate	Knox dolomite	1,200	Sept. 26, 1950	61+	2.2 miles E., 1.1 miles N. of SW. corner Bartow County.

[1] Estimated flow of spring.

fers. Extensive solution channels in the rock act as conduits for water. The Shady, Knox, and Newala formations and the limestone and dolomite members of the Rome and Conasauga formations are excellent aquifers. Water occurs along fractures, bedding planes, and solution channels in the rock and also in the overlying residuum. The yield to wells is variable, depending on the size and number of joints and solution channels penetrated by a well. Fortunately, solution channels are so abundant that rarely is a dry well drilled (fig. 4). Generally, farm and domestic wells are less than 200 feet deep, and it is customary to select a new site if a well furnishes inadequate water at a depth of 250 feet. Yields of several hundred gallons per minute for domestic, municipal, industrial, and farm use can be obtained from most areas of the county underlain by carbonate rocks.

Information concerning the yield from several industrial wells and from one pumping test is available for wells tapping the Shady dolomite in the Cartersville mining district. Thompson Weinman well 2, 140 feet deep and 21 inches in diameter, was pumped at about 3,200 gpm during a test of the well in October 1958. The coefficient of transmissibility was computed by the nonequilibrium method (Wenzel, 1942, p. 87–92) to be about 150,000 gpd per ft (J. W. Stewart, 1960, oral communication). Well 1 at Visking Co. had a drawdown of 9 feet when pumped at 300 gpm during a 3- to 4-hour pump test, and

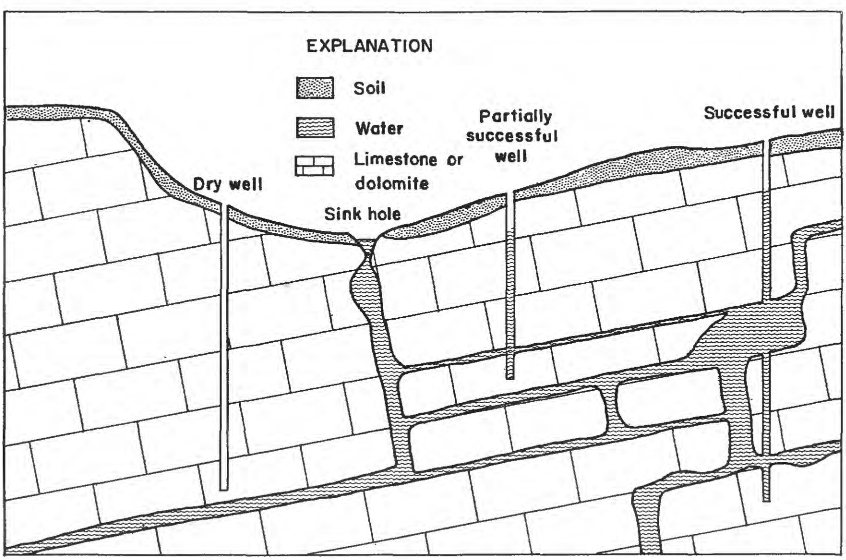


FIGURE 4.—Diagram showing the occurrence of ground water in solution channels in limestone or dolomite.

well 1–a had a drawdown of 18 feet when pumped at 500 gpm during a 3- to 4-hour pump test. The wells at Visking Co. are 108 feet and 113 feet deep, respectively. Wells 3 and 3–a at the Chemical Products Corp. are reported to yield 200 to 300 gpm when pumped continuously. Well 4 at the New Riverside Ochre Co. is reported to yield 200 gpm when pumped continuously. Most wells in the Shady dolomite are less than 150 feet deep.

Wells in the Shady dolomite obtain water from solution channels in the rock, the deeply weathered residuum, and voids in the partly weathered rock. When first drilled, most wells yield water containing much clay and silt, but, with development, they will produce 200 to 300 gpm of water nearly free from suspended matter. The water from several wells pumped at less than 200 gpm was observed to be free of suspended matter. During development, wells should be pumped and surged with caution to prevent the too rapid removal of clay and silt particles adjacent to the well. If material is removed too rapidly, the earth may collapse around the casing.

Pumping tests have not been made in the Rome, Conasauga, Knox, and Newala formations, but two industrial wells at the Goodyear Clearwater Mill (wells 1 and 1–a in the Stilesboro quadrangle) are reported to yield 150 to 200 gpm. These wells penetrate carbonate rocks in the Conasauga formation and are reported to have been pumped at 350 gpm. However, when pumped at 350 gpm the water contains silt and fine sand. Owners of domestic wells in the Knox dolomite report that wells generally yield 5 to 100 gpm. Most of these wells are about 150 feet deep. The Knox dolomite, which is relatively slow weathering, is not as soluble as the carbonate rocks of the Shady, Rome, Conasauga, and Newala formations. This suggests that solution channels in the Knox dolomite may not be as large or as well developed as those in the carbonate rocks of the Shady, Rome, and Conasauga formations. Information on the yield from wells in the Newala formation is not available, but the rock is very soluble and solution channels probably are large and well developed. Wells less than 200 feet deep probably will yield 200 gpm. Wells of similar yield probably can be developed in the carbonate rocks of the Rome formation.

Information is scanty about the yields from the shale and sandstone of the Weisner, Rome, Conasauga formations, and the Rockmart formation of Hayes (1891); however, indications are that the yield is small, generally less than 30 gpm in wells less than 200 feet in depth. Larger yields for small industrial and municipal supplies probably could be obtained from wells as deep as 400 feet, which would penetrate more waterfilled fractures and joints and provide larger reservoirs for storage.

AQUIFERS OF THE PIEDMONT AREA

Very little information is available about the yield from drilled wells in the Piedmont rocks of Bartow County. However, indications are that the yield from wells in the rocks of the Great Smoky group and the amphibolite and mica schist units ranges from ½ to 30 gpm, and the average is probably 15 gpm. Wells dug in these rocks probably yield less than 5 gpm. In the Atlanta area Herrick and LeGrand (1949) reported that many industrial and municipal wells in granitic rocks yield 60 gpm or more. Wells with yields of 60 gpm probably could be obtained in the granitic and gneissic rocks of Bartow County if they are properly located and as deep as 400 feet. Below 400 feet, open joints and fractures are rare in crystalline rocks. Wells in the Weisner formation, the Great Smoky group, and the amphibolite and mica schist rocks probably yield less water than wells in granitic rocks.

Criteria for locating wells in crystalline rocks are discussed by Herrick and LeGrand (1949, p. 18–23). Streams and canyons, which trend at acute angles to the bedding or regional foliation, are developed along major joint systems in the rocks, and wells drilled into these fracture systems or in fault zones probably will have larger yields than wells located randomly.

SPRINGS

Springs are a major source of ground water in many parts of the county. Adairsville spring (table 2) flows about 4,100 gpm and furnishes water for the city of Adairsville. The flow of water from this spring is only partly used. The water from Funkhouser spring is used at Flexatile for municipal and industrial purposses. Elsewhere in the county are many large springs which yield 100 to 3,000 gpm. The water from most of these springs is not used, although small quantities of water are taken from several for domestic and farm use. Cartersville spring, which formerly furnished water for the city of Cartersville, is now abandoned. The spring is reported to have ceased flowing when heavy pumping began in the vicinity. The location of springs in the county is shown on plate 1.

The largest springs in Bartow County occur in the Paleozoic rocks. In general, they are centers of discharge from solution channels in the carbonate rocks. About one-third of the springs, including the

Adairsville and Mosteller springs, are near the contact of the Conasauga and Knox formations. The relatively impermeable shale in the Conasauga formation appears to prevent the lateral or downward movement of water at the contact of the formation with the Knox dolomite; consequently, water rises as a spring where fractures intersect the land surface (fig. 5). These springs are classified as contact

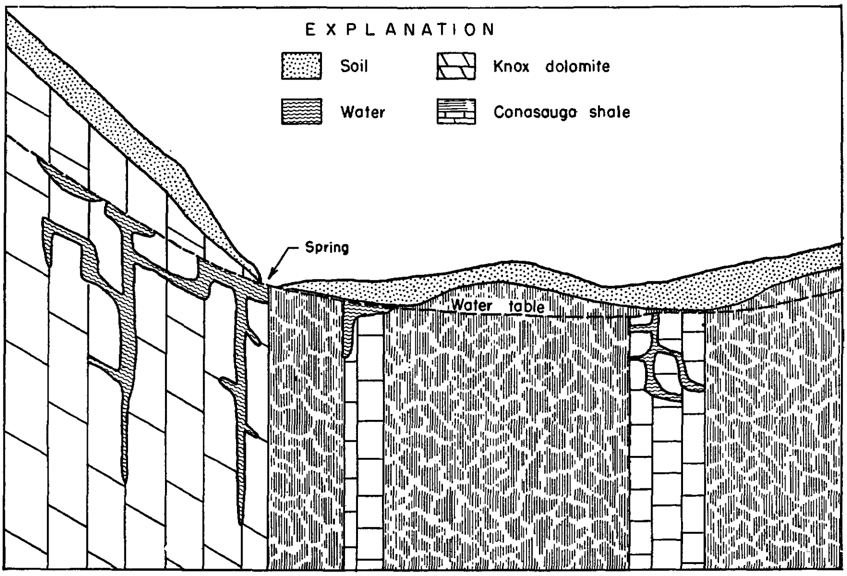


FIGURE 5.—Occurrence of springs at the contact of the Conasauga formation and the Knox dolomite.

springs. Water from several other large springs, such as Connesena and Crowe springs at Crowe Spring Church, flows from large fractures and solution channels in the rock. These fractures probably extend for considerable distances into the rock and act as conduits for draining many other openings. This type of spring is classified as a tubular or fracture spring.

WELL CONSTRUCTION

Bartow County has about 1,500 drilled and dug wells. About 80 percent of the wells are drilled and 20 percent are dug. In some areas one domestic well may furnish water for several houses. In most parts of the county drilling is the only practical way of obtaining a sufficient supply of water. However, in some areas where the Shady, Rome, and Conasauga formations occur and in some areas of the Piedmont where the saprolite is of sufficient depth, dug wells can be constructed to furnish sufficient water for domestic and farm use.

Most domestic and municipal wells are 6 inches in diameter. Industrial wells range from 6 to 21 inches in diameter. Wells are generally cased from the surface to the first hard rock, the depth depending on the thickness of the residuum or the saprolite. The casing is then tightly sealed into the rock by driving and cementing, after which drilling is continued deeper into the rock to penetrate fractures and other water-filled openings. Farm and domestic wells generally are less than 300 feet deep, and industrial wells are less than 500 feet deep.

CHEMICAL QUALITY OF GROUND WATER

Precipitation is the source of water in the rocks of Bartow County. Rain and snow contain only minute quantities of dissolved carbon dioxide, but, upon contact with soil and rock, water immediately begins to dissolve mineral and organic substances. The quantity and type of solutes in ground water is dependent upon the type of rocks dissolved, the amount and kind of organic compounds contained in the soil through which precipitation infiltrates, the temperature of the ground water, and the length of time that the water is in contact with the soil and rocks. The salts of sodium, calcium, magnesium, iron, and aluminum are the most commonly dissolved constituents.

The dissolved constituents in water limit its use for various purposes. According to the U.S. Public Health Service (1946), municipal and domestic supplies generally should contain less than 500 ppm (parts per million) dissolved solids, 250 ppm chloride, 250 ppm sulfate, and 125 ppm magnesium. To prevent mottling of teeth, fluoride should not exceed 1.5 ppm. The hardness of water as $CaCO_3$, in parts per million, is classified as follows: less than 60, soft; 61 to 120, moderately hard; 121 to 180, hard; more than 180, very hard. Water should be low in silica and have less than 150 ppm total hardness to prevent boiler scale and excessive use of soap. Water should not contain dissolved oxygen, carbon dioxide, free acid, suspended matter, or more than 0.3 ppm iron. Water that contains more than 0.3 ppm of iron stains objects with which it comes in contact and deposits a sediment of reddish-brown oxide. The temperature of ground water is important to many industries because of cooling requirements. Chemical analyses of water from wells and springs are listed in table 3.

Two analyses of water from amphibolite rocks show that the water is of good quality. The hardness as $CaCO_3$ of two samples was 60.2 and 66 ppm. The dissolved solids content was 104 and 136 ppm, the silica, 6.0 and 42 ppm, and the iron, 0.04 and 0.28 ppm. Water from zone B of the Great Smoky group is similar in quality. In two analyses the water contained 136 and 205 ppm of dissolved solids, and the hardness of the water was 106 and 158 ppm. Silica content was 22 and 30 ppm and iron, 0.04 and 0.1 ppm.

Water from the porphyritic granite gneiss and the granite gneiss is soft to moderately hard. In four analyses the hardness ranged from 11 to 62 ppm, the dissolved solids content ranged from 65 to 103 ppm, and the iron ranged from 0.0 to 0.45 ppm.

The hydrogen ion concentration of water is expressed as the pH. Water having a pH of 7.0 is neutral on the pH scale, whereas values less than 7.0 indicate acidity and values greater than 7.0 indicate alkalinity. The pH values of water from the porphyritic granite gneiss and the granite gneiss ranged from 6.2 to 7.1.

Water from the Shady dolomite is generally of better chemical quality than water from the other carbonate rocks. The hardness as $CaCO_3$ in five analyses ranged from 83 to 134 ppm. The dissolved solids content ranged from 126 to 225 ppm, the silica from 6.0 to 10 ppm, and the iron from 0.01 to 0.25 ppm.

Water from wells that penetrate shale and sandstone of the Conasauga and Rome formations ranges in hardness from 125 to 152 ppm. Water from the limestone and dolomite of these formations is hard. The hardness of 10 water samples from the 2 formations ranged from 42 to 229 ppm. The dissolved solids content ranged from 63 to 252 ppm, and the iron content was less than 0.05 ppm.

Water from the Knox dolomite and the Newala limestone is similar, and 10 water samples showed hardness ranging from 110 to 262 ppm. Dissolved solids content ranged from 112 to 337 ppm, and the silica ranged from 6 to 18 ppm. In all samples except that for the city of Taylorsville, the iron content was less than 0.15 ppm. The groundwater samples from the city of Taylorsville well showed an iron content of 1.6 ppm, which was probably due to contamination.

FUTURE DEVELOPMENT OF WATER RESOURCES

Bartow County has water supplies available for the development of its many natural resources and for the expected growth of its population. In the future, additional supplies of water can be obtained from wells and springs and from the Etowah River and other streams throughout the county. Water from the river and other streams requires treatment for the removal of suspended matter and other undesirable constituents, but the water from wells and springs generally requires little or no treatment except for removal of excess calcium and magnesium that contribute to the hardness of water.

The development of the ground-water supplies offers the most economical and practical means of obtaining future supplies of water. Water for industries and cities can be obtained in most parts of the

TABLE 3.—*Chemical analyses, in parts per million, of ground water, Bartow County*

[Analysed by U.S. Geological Survey unless indicated]

Well or spring No.	Quadrangle	Aquifer	Date of collection	Owner	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180° C)	Hardness as $CaCO_3$ (calcium, magnesium)	pH
1	Acworth	Acworth gneiss of Hayes (1901).	12-30-59	Frank McEver	58	39	0.09	6.4	1.0	7.8	2.0	38	0.4	1.0	0.1	13	103	20	6.6
2	do	Amphibolite	12-30-59	Effie White	58	42	.04	13	8.1	6.1	.3	78	9.2	5.5	.2	4.9	136	66	7.1
3	do	Great Smoky group; zone B.	12-30-59	Hoyt Green	63	30	.04	30	7.5	9.2	1.6	144	7.6	5.0	.2	.8	167	106	7.1
1	Adairsville	Upper unit of Conasauga formation.	1-4-60	J. E. King		13	.04	54	4.3	1.9	2.6	174	5.6	3.0	.1	6.8	180	152	7.8
2	do	Lower unit of Conasauga formation.	12-31-59	Buford Kay	58	8.3	.04	41	20	2.6	.6	212	8.0	5.0	.2	2.4	201	184	7.6
1	Cartersville Mining District.	Upper unit of Shady dolomite.	12-22-59	Visking Co	63	8.9	.07	26	12	6.6	.7	128	2.4	11	.0	8.9	146	114	8.0
[1] 1a	do	do		do		10.4	.07	22.3	16				.0	14.5	.1		151	121.5	8.3
2	do	do	12-30-59	Thompson Weinman Co.	63	8.8	.05	27	16	2.9	.7	148	3.2	4.0	.1	7.4	153	134	7.7
[2] 5	do	do(?)	9-22-52	City of Emerson		6	.25	30	2.0	Tr.	Tr.	127	.0	3	.0	.0	225	83	7.7
6	do	Corbin granite	12-30-59	T. A. Jenkins	61	48	.05	3.2	.7	8.1	4.0	39	.4	1.0	.2	.0	94	11	6.2
[2] 7	do	do	3-2-50	L. N. Jenkins		20	.45	15	6.0	Tr.	Tr.	60	14	3	.0	.0	83	62	7.1
[3] 8	do	Amphibolite	5- -54	Butler Street YMCA.		6.0	.28	15.7	5.1				1.0	5.4			104	60.2	8.0
SP-9	do	Lower unit of Rome formation.	1-4-60	Minnie Rodgers		12	.05	32	18	3.6	2.4	180	.8	4.0	.1	1.9		154	7.9
10	do	Corbin granite	9-30-58	Red Top Mountain State Park.		26	.00	6.8	1.2	3.3	2.4	36	.4	1.0	.1	.7	65	22	6.4
[2] 1	Stilesboro	Lower unit of Conasauga formation.	9-22-52	Goodyear Clearwater Mill.	62	6.0	.00	43	25	.2	.1	178	10	4	.0	1	163	210	7.4
[2] 1a	do	do	9-22-52	do		7.0	.00	44	29	Tr.	Tr.	210	8.0	3	.0	.5	182	229	7.8
[2] 2	do	Newala limestone	3-21-47	Bartow Consolidated School (Taylorsville).								172	3.0	2	.2	3			
[2] 3	do	Upper unit of Conasauga formation.	9-22-52	City of Kingston		6.0	.00	50	Tr.	1		117	1.0	Tr.	.01		252	125	7.0
4	do	Knox dolomite	1-4-60	Dolph Nelson		12	.07	34	19	3.5	1.9	204	2.0	4.5	.1	2.0	188	163	7.4

5	do	Newala limestone	1- 4-60	City of Taylorsville	------	7.2	1.6	96	5.5	9.4	2.4	301	14	16	.2	3.3	337	262	7.0
6	do	do	1- 5-60	C. C. Strain	57	7.9	.01	41	12	1.4	.4	172	3.2	2.0	.2	6.2	166	152	7.5
[2] 7	do	Knox dolomite	3-27-48	J. W. Pickelsimer	------	10	.05	33	26	2.0		153	2.0	1.5	.0	.0	203	180	8.4
[2] 8	do	do	3-21-47	Joe Brandon	------	------	------	------	------	------	------	233	7.0	4	.2	7.2	------	------	------
[3] 1	Waleska	Lower unit of Conasauga formation.	3-19-47	Rubberoid Co	60	------	------	------	------	------	------	118	9.0	4	.2	1.6	------	------	------
2	do	Great Smoky group; Zone B.	12-31-59	Otto Townsend	58	22	.10	53	6.3	5.5	3.6	188	11	2.5	.1	1.8	205	158	7.6
3	do	Lower unit of Conasauga formation	12-31-59	M. C. Watts	60+	8.6	.04	10	4.1	.5	.3	52	4.4	2.0	.2	.2	63	42	6.9
[2] 5	do	Upper unit of Conasauga formation.	3-19-47	Bartow Consolidated School (Pine Log).	------	------	------	------	------	------	------	149	2.0	3	.2	.6	------	------	------
[2] SP-5	Adairsville	Knox dolomite	9-22-52	City of Adairsville	------	6.0	Tr.	31	14	.1		142	4.0	2	.0	.5	112	134	7.7
[2] SP-5	do	do	3-12-59	do	60	8.8	.04	24	12	.6	.0	133	2.4	1.0	.0	1.4	124	110	8.2
[2] SP-11	do	do	10-16-44	Orma Adock	59	14	.15	58	13	Tr.	Tr.	------	9.0	3	------	------	207	------	7.1
SP-3	Cartersville Mining District	Shady dolomite (Alluvium?)	5- 3-38	Cartersville Spring	62	9.1	.01	24	14	1.7	1.7	136	2.5	2.6	.0	6	126	117	------
SP-4	Stilesboro	Knox dolomite	7-26-43	Ted Dunken	------	18	.1	31	14	<1	<1	------	4.0	6	------	------	150	------	8.0
SP-4	Waleska	Upper unit of Rome formation.	12-31-59	Copper Hill Mining Co.	60	17	.04	33	12	1.8	2.6	152	6.4	1.0	.3	.5	150	132	7.7

[1] Analysis by Visking Co., Cartersville, Ga.
[2] Analyses by Georgia Dept. Mines, Mining & Geology.
[3] Analysis by Law & Co., Atlanta, Ga.

county from wells less than 500 feet deep. The most heavily pumped formation is the Shady dolomite, which yields several hundred gallons per minute of moderately hard to hard water. The eastern part of the city of Cartersville overlies this formation (fig. 6). South of Cartersville, several industrial wells yield 200 to 300 gpm from the formation. The Shady dolomite also is present near Emerson and White. Much of the northern and western parts of the county are underlain by the carbonate rocks of the Rome, Conasauga, Knox, and Newala formations, which also will yield several hundred gallons per minute of water to wells. The water from these formations is generally of good quality, but for some uses it may need treatment because of its hardness. Soft to moderately hard water can be obtained from the areas underlain by the granitic and gneissic rocks in the southeastern part of the county. Wells as deep as 400 feet in the porphyritic granite gneiss and granite gneiss will yield as much as 60 gpm if properly located.

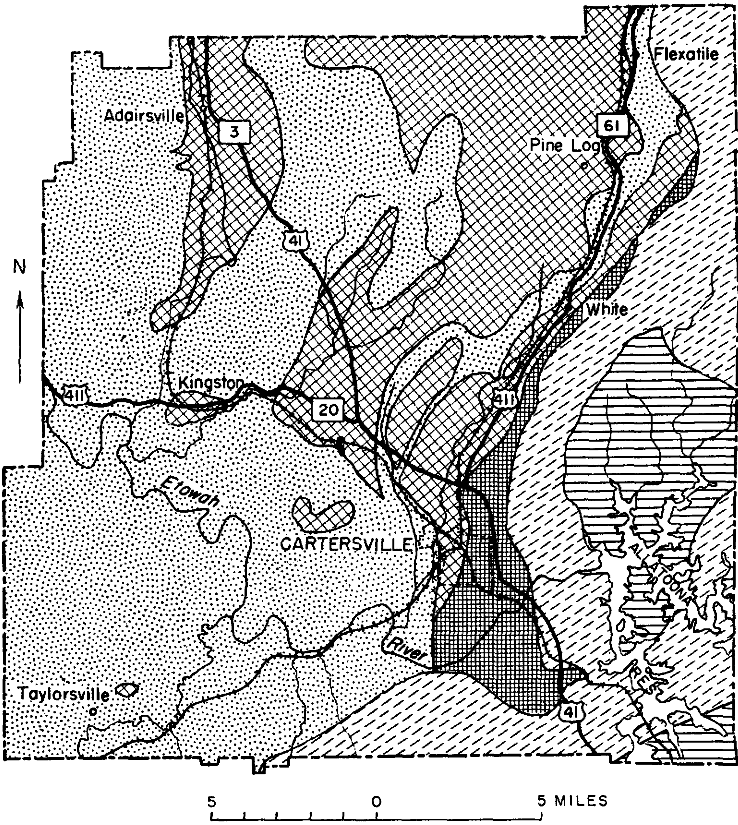
Springs offer an economical means of obtaining water of generally good chemical quality. Many springs discharge as much as 100 gpm, but the water from only a few springs is used to any extent.

NONMETALLIC AND METALLIC ORE DEPOSITS

Because detailed descriptions have been published concerning the occurrence, methods of mining, and the location of most of the commercially important mineral deposits in the county, only a brief description will be given here. Kesler (1950, pl. 1) has made the most recent study of the mineral deposits in the Cartersville mining district, and he shows the location of prospect pits and mines for barite, copper, gold, manganese, iron, and ocher. Butts and Gildersleeve (1948, mine, quarry, and prospect map) show the location of quarries and mines for flagstone, limestone, barite, bauxite, iron, manganese, and slate. White and Denson (1952, pls. 1–3) studied the bauxite deposits, which are mainly in the western part of the county, and their maps show the major mines and areas where prospecting and drilling may reveal additional deposits. These reports contain extensive bibliographies.

BARITE

Barite is used mainly as a heavy medium in drilling muds, but it is also used in paints, chemicals, and fillers. Barite occurs as large irregular residual deposits in the Shady dolomite and is mined only in the Cartersville mining district. In some of the larger pits, the barite appears to form about half the residuum. The barite may occur as granular opaque masses or in clusters of elongated prismatic



EXPLANATION

Excellent aquifer; wells yield 300 gpm; water moderately hard

Excellent aquifer; wells yield 5 to 300 gpm; water hard

Where aquifer is shale, wells yield about 10 gpm, and the water is of good quality; where aquifer is limestone, wells yield about 200 gpm, and the water is hard

Wells probably will yield as much as 80 gpm; water soft to moderately hard

Average yield of wells about 15 gpm; water of good quality and moderately hard

FIGURE 6.—Map of Bartow County showing expected yield of wells and the quality of ground water.

crystals. Barite deposits in Bartow County are best located by drilling. Barite is mined with large power shovels in open pits, many of which are about 100 feet deep and several hundred feet across.

BROWN IRON ORE

The brown iron ores of Bartow County consist of massive limonite and acicular and botryoidal crusts of goethite. Most of the deposits probably were formed by weathering. In general, the ore occurs as irregular masses in pockets and lenses of variable size and is associated with residual clays of the Weisner, Shady, and Knox formations. The ore is mined in open pits. Ore reserves are large, but development of the mining industry has been slow because of high freight rates to furnaces outside the State.

MANGANESE

Manganese is used mainly as an alloy in the manufacture of steel. It is also a pigment in paint, glass, and pottery, and is used in the manufacture of chlorine, bromine, and disinfectants. The manganese minerals of primary importance in Bartow County are psilomelane and pyrolusite. The ore occurs in residual clays as irregular bodies and pockets and in concretions and nodules of varying sizes. The manganese ore generally is associated with the ores of limonite, barite, and ocher. The main deposits and mines are in the Weisner and Shady formations.

BAUXITE

The first material identified as bauxite in the United States was found near the Bartow-Floyd County line southwest of Snow Springs Mountain about 1883. Bauxite, which is hydrated alumina formed by weathering, is the principal ore of aluminum. The ore may contain many rounded concentric and spherical bodies of bauxite in a claylike matrix. Deposits of bauxite generally occur as pods and pockets in the residuum of the Knox dolomite. Deposits may be several hundred feet across and about 100 feet in depth. White and Denson (1952, p. 1) report that most ore bodies are shaped like vertical cylinders or inverted cones. Most of the bauxite ore in the county has been obtained from the Adairsville area.

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