

flow. This was the case at nearly every river station in Georgia, as well as at many stations in other States. For example, at Alaga, Ala., on the Chattahoochee River, the normal stage for November is 3.9 feet, mean for the current month 1.5 feet; at Eufaula the normal stage is 2.5 feet, mean for November, 1910, 0.5 foot. Under these conditions all the rivers maintained a very uniform flow, the differences between the highest and lowest stages rarely reaching as much as 1 foot. At many points the water did not flow over the dams of the various hydroelectric companies, and in some cases auxiliary steam power had to be used.

MISCELLANEOUS PHENOMENA.

The prevailing winds during the month were from the northwest, and the wind movement not as large as usual for November. The average hourly movement exceeded 10 miles an hour only at Hatteras, average hourly movement 15.7 miles; at Atlanta, 14.2 miles; at Savannah, 12.6 miles; and at Pensacola, 11.9 miles. Wind velocities exceeding 40 miles an hour occurred at but two points, Hatteras reporting 42 miles from the north on the 4th, and Pensacola 58 miles from the south on the 28th. The average number of clear days was 18, ranging from 13 in Mississippi to 21 in Florida and North Carolina; the average number of partly cloudy days was 6, and of cloudy days 6.

*Local storms.*—A severe thunderstorm occurred at Roanoke Rapids, near Weldon, N. C., on November 14 at about 6 p. m. A single brilliant flash of lightning from a sky only partly cloudy struck the Baptist Church, demolishing the entire front, and was conducted into twelve residences by telephone and electric-light wires, doing more or less damage to each house. A boy in the church was killed, and several people on the streets were stunned by the flash.

THE WATERPOWER RESOURCES OF GEORGIA.

By CHARLES F. VON HERRMANN, District Editor.

The utilization of the force of gravity through the medium of falling water and its conversion into electric energy for convenient distribution over adjacent territory furnishes the cheapest form of energy known to man. It is not surprising then that hydroelectric power is supplanting steam in many portions of the country and that the rapid industrial development of a community is becoming more and more dependent upon the available waterpower.

Although the use of waterpower in Georgia on a somewhat large scale began with the building of the dam at the head of the Augusta Canal in 1845, it is probable that at present but a tenth part of the possible power at the minimum flow of its rivers is utilized. Mr. George M. Chapin, of Atlanta, in an article in *The World's Work* for September, 1910, estimated the possible waterpower of Georgia at almost 500,000 horsepower. His table is reproduced here:

*The horsepower of the six great basins of Georgia.*

Name of basin.	Minimum horsepower.	Minimum horsepower for 6 high-water months.
Savannah.....	175,462	269,184
Ogeechee.....	3,895	9,730
Altamaha.....	47,088	78,272
Apalachicola.....	173,786	281,550
Mobile.....	57,524	95,804
Tennessee.....	33,895	65,333
Total.....	491,650	799,873

The rivers of Georgia can be depended on to supply easily nearly 500,000 horsepower at normal river stages, while

during the six months of greatest average flow this rises to nearly 800,000 horsepower. The construction of water-storage reservoirs and the use of auxiliary steampower during periods of drought increases the possibilities considerably.

The rivers of Georgia nearly all rise within or close to the boundaries of the State, and the most important have their sources near the northeast corner; they form nine distinct drainage basins, which discharge into the Atlantic Ocean and the Gulf of Mexico. Five of these basins have that portion of their territory containing the chief available water powers between the "fall lines," the southern of which extends from Augusta through Milledgeville and Macon to Columbus, and the western, which passes through Polk, Bartow, Gordon, and Murray Counties in the northwestern part of the State.

The dividing line between the waters entering the Atlantic Ocean and those flowing into the Gulf of Mexico is formed by the Chattahoochee Ridge, which enters the State from North Carolina at the boundary between Rabun and Townes Counties, passes southwest to Atlanta, thence south to Culloden and Fort Valley, Houston County, then in a southeasterly direction through Okefenoke Swamp between St. Marys and Suwannee Basins into Florida. The largest rivers east of this "backbone" of Georgia are the Savannah, with its most important tributaries, the Tugaloo, Chattooga, Tallulah, and Broad, and the Altamaha, which is formed by the union of the Oconee and Ocmulgee Rivers. West of the divide are the Flint and the Chattahoochee, which join to form the Apalachicola, the Mobile, and the Tennessee Basins. The greatest development of waterpowers is found at Augusta on the Savannah River and at Columbus on the Chattahoochee. The falls of the Chattahoochee are said to be the most numerous in the entire eastern Appalachian Mountain region and are capable of supplying an enormous amount of power. Figure 1 shows some of the most important waterpower sites, as well as the drainage basins of that part of the State.

THE SAVANNAH RIVER.

The Savannah River marks throughout its entire length the boundary line between South Carolina and Georgia, and is formed by the union of the Tugaloo and Seneca Rivers, which have their ultimate sources in the Blue Ridge Mountains of western North Carolina. The river is 355 miles long but only about half of that length in a straight line. Above Augusta the width of the basin is from 40 to 50 miles, comprising a total area of about 7,294 square miles. The river is navigable to Augusta, and from that point to the head of the river, a distance of about 180 miles, there are 19 important shoals. The longest is Trotters Shoal, 64 miles above Augusta, which is 7 miles long with a fall of 75 feet, and the shortest is Bowmans Ledge, 83 miles above Augusta, which is 120 feet long with a fall of 3 feet. The total fall of the river from the top of McDaniels Shoal to the foot of Augusta Shoal is 448 feet. An important feature is the great height of the shoals on some of the larger tributaries, as, for example, Tallulah Falls, in Rabun County, which has a total fall of 525 feet in a distance of 2½ miles, and Anthony Shoals on the Broad River, in Elbert and Lincoln Counties, which has a fall of 90 feet.

The river valley below Augusta has an average width of 30 miles and a total drainage area of 3,211 square miles. The banks are at first quite high, averaging 25 feet above low-water level at Augusta, but decrease to a few feet at Cross Tides. For 30 miles below Augusta the width of the river varies from 500 to 900 feet, but for the remainder of the distance to Savannah the average low-water width is 300 feet.

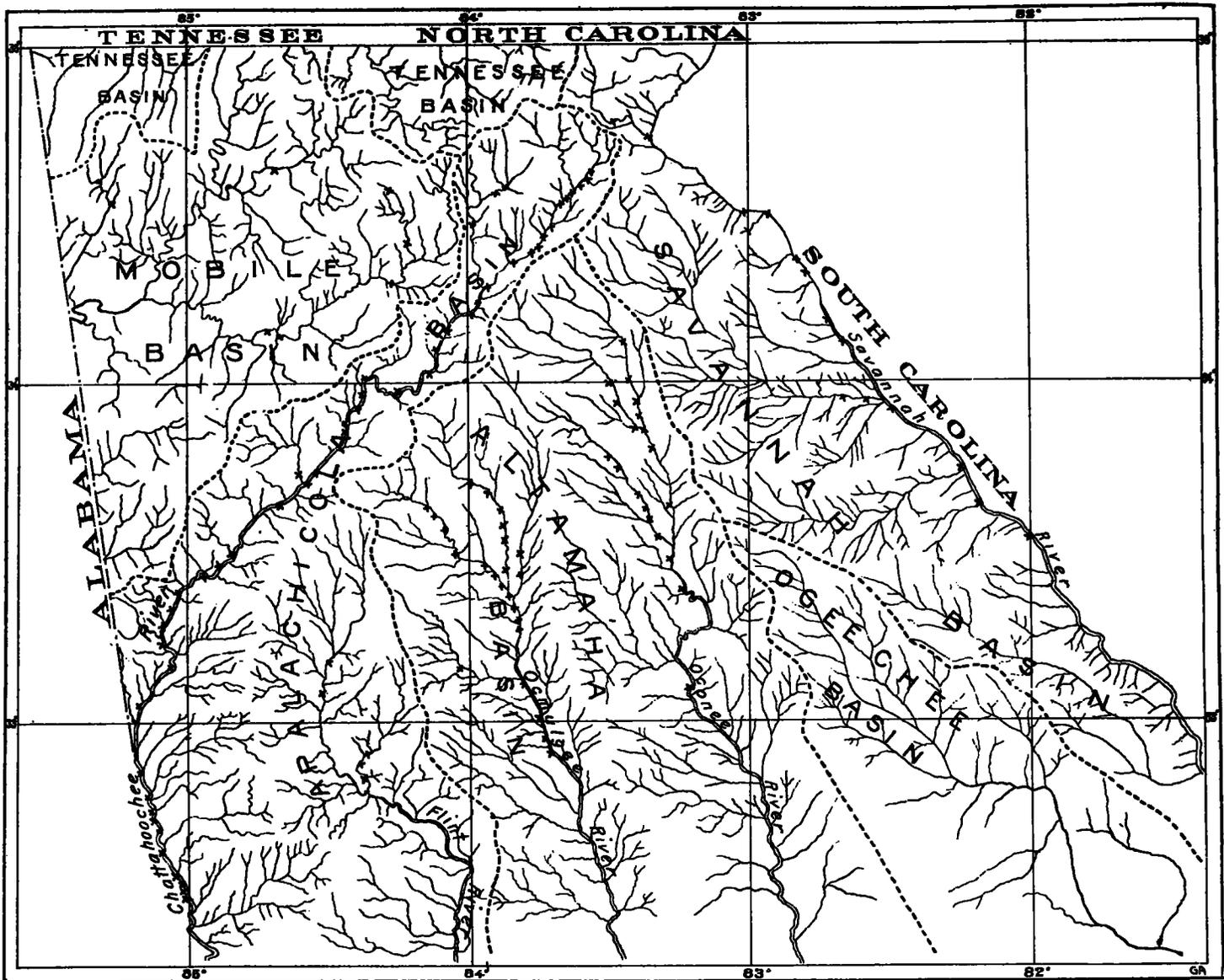


FIG. 1.—Hydrographic map of Georgia, showing the drainage basins of Georgia and the location of some of the waterpower sites. By B. M. Hall, 1896. Waterpower sites.

*Principal shoals on the Savannah River and its main tributaries.*

Stream and location.	Name of fall or shoal.	Distance from Augusta.	Length of shoal.	Fall.	Width of river.
		Miles.	Feet.	Feet.	Feet.
<i>Savannah River.</i>					
Richmond County	Augusta		37,000	50	560
Columbia County	Blue Jacket Shoal		600	10	
Lincoln County	Long Shoal	29½	26,000	35	1,800
Elbert County	Trotters Shoal	64	37,000	75	570
Do.	Cherokee Shoal	75	2,640	9	1,800
Do.	Bowmans Ledge	83	120	3	600
Do.	Greggs Shoal	85½	5,280	14	1,300
Do.	Middletons Shoal	88½	5,280	18	2,100
Do.	Ferrells Ledge	89	390	3	960
Hart County	Watts Ledge	91½	900	25	900
Do.	McDaniels Shoal	95	26,000	30	1,500
<i>Tugalo River.</i>					
Habersham County	Mouth of Tallulah River		13,000	75	
Franklin County	Eastonny Shoals	131	2,640	4	750
Do.	Stribling Shoals	130	2,640	2	300
Hart County	Guest Shoal	113½	5,280	17	1,200
Do.	Hatton Shoal	110	8,000	39	1,500
<i>Tallulah River.</i>					
Rabun County	Tallulah Falls		4,000	335	
<i>Broad River.</i>					
Elbert County	Bakers Ferry		600	3	
Do.	Anthony's Shoals		6,600	70	
Do.	Smiths Shoals		2,640	10	

The average rainfall for the Savannah River Basin, together with the mean river stages at three points, Carlton on the Broad and Calhoun Falls and Augusta on the Savannah, are given in the table at the end of this article.

The first shoals above Augusta, having a fall of 75 feet in 2½ miles, supplies water for the Augusta Canal, which is 8 miles long, with a capacity of about 3,000 cubic feet of water per second. The dam is 1,720 feet long, 10.63 feet high on the average, and is built of solid stone in cement on a foundation of solid rock. It is located about 7 miles above Augusta. The fall at Augusta between the level of the canal and low water in the river is about 50 feet, but all of it can not be utilized economically. The available power is estimated at 12,000 horsepower. The city of Augusta owns this power and the water is leased to mills at \$5.50 per horsepower.

Further extensive developments of power on the Savannah River are under way. The Twin City Company will develop a 32,000-horsepower plant at Prices Island, 22 miles north of Augusta, and other developments are contemplated at Anthony's Shoals and Calhoun Falls. The Piedmont Power

Company of Atlanta will develop power from the Tugaloo, Chattooga, and Tallulah Rivers, which will be transmitted to Atlanta.

THE CHATTAHOOCHEE AND FLINT RIVERS.

Attention may now be invited to the position and form of the Chattahoochee River Basin, which is very narrow in proportion to its length. The river has its sources in Habersham and White Counties, whence its course is southwesterly to West Point, Ga., where it bends southward and forms the boundary between Georgia and Alabama to its point of junction with the Flint River south of Bainbridge. As far south as Columbus the stream flows upon crystalline rocks and is frequently obstructed by shoals, rapids, and low falls. From Thompsons Bridge in Hall County to West Point, a distance of about 180 miles, the fall is 386 feet, while from West Point to Columbus, a distance of only 34 miles, the fall is 362 feet. The combination of great fall and large volume of water make at Columbus a waterpower which is the largest in the State and is well utilized. Thompsons Bridge, near Gainesville, is 615 miles from the mouth of the river, and Columbus, which is at the head of navigation, is 400 miles from the Gulf by the river. The drainage area above Columbus is 4,561 square miles. There are at least 50 shoals on the Chattahoochee River. The most important are Hargett Island Shoals, capable of furnishing about 22,000 horsepower, and Mulberry Creek Shoals, 12,000 horsepower. The shoals near Columbus from a point 4½ miles upstream down to navigable water at Columbus furnishes an available force of nearly 48,000 horsepower.

Principal shoals on the Chattahoochee River.<sup>1</sup>

Stream and location.	Name of fall or shoal.	Distance from Columbus.		Length of shoal.	Fall.	Width of river.
		Miles.	Feet.			
Muscookee County.....	Columbus.....	44	22,440		120	( <sup>2</sup> )
Harris County.....	Mulberry Creek Shoals.....	10	10,560		30	1,000
Do.....	Tate Shoals.....	12	5,280		22	650
Do.....	Mountain Shoal.....	18	5,174		30	1,100
Do.....	Hargett Island.....	22	15,840		60	1,300
Do.....	Jack Todds Shoals.....	27	39,600		51	( <sup>2</sup> )
Troup County.....	Potts Shoal.....	36	3,600		5	
Heard County.....	Jackson Mill Shoals.....	52	475		5	830
Do.....	Bush Head Shoal.....	60	2,112		5	1,000
Carroll County.....	McIntosh Shoals.....	68	3,900		7	1,200
Campbell County.....	Meders Shoal.....	82	7,392		8	600
Cobb County.....	Paces Ferry.....	100	4,250		6	300
Do.....	Devils Race Course.....	102	10,560		20	450
Fulton County.....	Bull Sluice.....	111	10,560		40	( <sup>2</sup> )
Do.....	Roswell Shoal.....	113	10,260		13	600
Milton County.....	Island Ford.....	110	5,016		9	800
Forsyth County.....	Garners Shoal.....	128	11,880		17	( <sup>2</sup> )
Hall County.....	Shallow Ford.....	145	2,300		7	300

<sup>1</sup> For a complete list of the shoals on the Chattahoochee and its tributaries, see Twentieth Annual Report of the United States Geological Survey, Part IV—Hydrography, pp. 175, 176.  
<sup>2</sup> The river varies in width from 300 to 1,600 feet with channel divided by islands.

Columbus is the most important center of waterpower development in the State of Georgia. The largest dam in active use is the North Highland Dam of the Columbus Power Company, which was built in 1900 across the river at Lovers Leap, just beyond the city limits. The dam is 42 feet high and 732 feet wide, giving a head of 40 feet. The North Highlands plant has an installed capacity of 9,300 horsepower. An auxiliary steam plant of 3,000 horsepower is also in use. In addition to the hydroelectric development at this point, 1,300 horsepower in water is used by the Bibb Manufacturing Company as direct drive to the mill on the bluff over the power station. The street railway service and retail light and power business conducted by the Columbus Railroad Company is supplied by the Columbus Power Company as well as a number of large and important

manufacturing industries and nine large cotton mills. The textile mills of Columbus have 251,000 spindles and the necessary complement of looms and use approximately 9,000 horsepower; the street railway system requires approximately 2,000 horsepower.

The Columbus Power Company is extending its sphere of operations by the erection of another dam at Goat Rock, from which point electric power will be distributed to adjacent cities and ultimately to West Point. The contractor now engaged in building the new dam operates all of his machinery with about 700 electric horsepower, a unique instance of the power of a river being utilized to harness itself. The development under construction at Goat Rock will be capable of generating 24,000 primary horsepower and 16,000 secondary horsepower. The head at this dam will be 73 feet.

There are also two other dams across the Chattahoochee River at Columbus that were built in 1853 and are still doing good service. These are the Eagle and Phenix Dam and the City Mills Dam, having effective heads of 27 and 9 feet, respectively. The development at the Eagle and Phenix Mills is used both as a direct water drive and for generating electric power, which is partially transmitted to other mills across the river in Alabama. The installed capacity is 6,000 horsepower. The City Mills Company utilizes 600 horsepower direct water drive to operate its gristmills, and in addition has an installed hydroelectric development of 1,000 horsepower.

The West Point Manufacturing Company at West Point, Ga., has established a hydroelectric development of about 3,000 horsepower, which is used to operate two cotton mills of about 20,000 spindles each.

A water-power development of considerable importance on the Chattahoochee River is the plant of the Atlanta Water and Electric Power Company, which is located at Morgan Falls (Bull Sluice), about 5 miles below Roswell. The dam is a massive concrete structure 48 feet high and 900 feet long. The power house is equipped with seven 1,500-kilowatt generators and the power is transmitted to Atlanta, where it is utilized by the Georgia Railway and Electric Company to operate the street cars.

Three miles north of the city of Gainesville is located the plant of the North Georgia Electric Company, built in 1901. There is a small development on the Chestatee River, 8 miles north of the main one. At the main power house four 550-kilowatt generators are used and at the smaller plant two 450-kilowatt generators. This plant supplies power and light to Gainesville, Norcross, Buford, and smaller places and transmits 3,000 horsepower to Atlanta, a distance of 50 miles.

Incidentally it may be mentioned that extensive use of the waters of the upper tributaries of the Chattahoochee River is made in mining operations. The following description is taken from the Twentieth Annual Report of the United States Geological Survey, Part IV, page 173:

This river drains a large area of the Dahlonega gold belt in the north-eastern part of the State, in which hydraulic mining of the saprolite ores is an important industry. These veins or belts of auriferous decomposed schists vary in thickness from 50 to 150 feet, and are decomposed to the level of the adjacent large streams, giving a breast or heading in the open cut of from 100 to 150 feet in depth above sluice grade. The mining is done by hydraulic giant or nozzle under pressure from reservoirs on the hilltop, in the same manner that the great gravel deposits of the Pacific slope are worked. \* \* \* The supply for these mining operations is taken from the mountain streams at high level and brought by gravity in deep, narrow, swiftly running ditches or canals along the hillsides, and finally on the hilltops over the mines, at which point it has an elevation of from 200 to 300 feet above the streams. \* \* \* These canals vary in length from 6 to 25 miles.

## THE FLINT RIVER.

The Flint River rises about 12 miles southwest of Atlanta, takes a southerly course, and joins the Chattahoochee to form the Apalachicola River at the southwestern corner of the State. The length of the river is about 230 miles and its drainage area about 8,420 square miles. The river crosses the "fall line" near Knoxville, Ga., on a direct line between

Macon and Columbus. Above the fall line the river is swift and has numerous shoals. Between Montezuma and Albany, a distance of 70 miles, the fall is 125 feet. The river has several tributaries with unimproved power sites, among which may be mentioned Kinahatoochee Creek, 2 miles north of Albany, with power enough for 100,000 spindles.

(To be continued.)

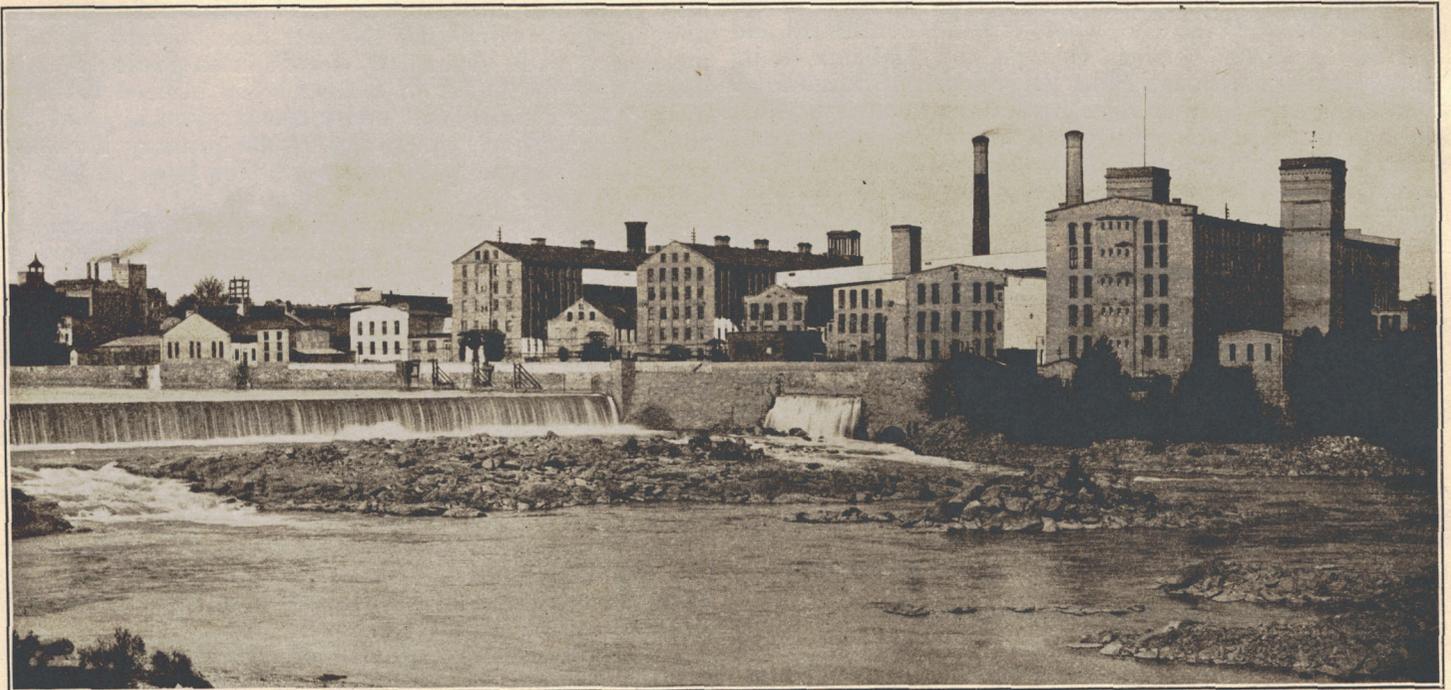


FIG. 2.—Eagle and Phoenix Dams and Mills, Columbus, Ga.