

White Oak Island is reported to have grown 200 yards on its upper end in the last five years; a bar on its upper end is crowding the main current to the left, and the right-hand chute is shoaling.

The channel between the two Hurricane Islands is filling and also narrowing by the growth of a bar that will soon unite them into one.

On Leatherwood Shoals the bar on the right side is said to be growing and the chute on the left closing. The channel across the bar has recently required dredging.

Panther Creek Island is reported to have grown considerably since it was patented in 1870. In 1904 the bar gave much trouble and required extensive dredging.

Blood River Island is growing on both its upper and lower ends, and the channel to the left has shoaled so rapidly that it is now completely dry in low water.

Pentecost Towhead is slowly growing on its upper end.

Birmingham Island has not changed in the last 40 years, but a bar just below it has grown from 2 to 10 acres at low-water stages during this time.

Threemile Island has extensive gravel bars at both its head and its foot, and the channels dredged through them have refilled and required redredging. Over 140,000 cubic yards of sand and gravel have been removed.

Sevenmile Island is said by an old resident not to have changed in the last 40 years, and its entire outline seemed to be in stable condition.

The towhead just above Tennessee Island at the mouth of the river seems to be growing slightly, though Tennessee Island itself has not materially changed within recent years.

COOSA-ALABAMA RIVER SYSTEM.

The headwaters of the Coosa-Alabama River system—Oostanaula and Etowah rivers—rise in the mountains of northern Georgia and northeastern Alabama and unite at Rome, Ga., to form the Coosa, which in its lower course becomes the Alabama and flows southward and westward into the Gulf of Mexico near Mobile. A detailed examination was made of the headwaters of this system in northern Georgia, and the Coosa was traversed by steamer from Rome, Ga., 165 miles, to Gadsden, Ala. Below Gadsden conditions along the river were studied at several points, the lowest of which was Selma, Ala.

OOSTANAULA BASIN.

COHUTTA MOUNTAIN REGION.

The main mass of the Cohutta Mountains is in northwestern Georgia, some miles southwest of Ducktown, Tenn., but the mountains extend northward into Tennessee, where they are deeply trenched by the gorge of Ocoee River. Most of this mountain area, however, drains into the Coosa system. The rocks are ancient granites, gneisses, schists, and slates, which have been greatly weathered and eroded. The mountain mass is deeply cut by numerous streams, which flow from it in a somewhat radial fashion. The ridges are sharp topped and steep sided; the intervening valleys are narrow and most of them contain only the merest traces of a flood plain. The highest parts of the mountains are between 4,000 and 4,500 feet in elevation. The land is poor as a rule, and very little of it is cleared for agriculture. Most of the timber has been purchased by lumbermen and is being cut wherever transportation is possible.

The entire basin of Jacks River is wooded, with the exception of its upper 2 miles. It was being actively lumbered when examined, but showed no material erosion as a result of lumbering. At its very head the slopes have been cleared to a considerable extent and some of the fields are old and have become badly gullied. The total cleared area in the basin, however, is less than 2 per cent. The west side of the basin has been logged down to Cowpen Mountains, but the country farther down is in original forest. The soil is so poor that in some places it is reported that lumbermen have abandoned their holdings after they have cut them over.

South of Sasfras Gap, at the head of Mountaintown Creek, the entire country is wooded for several miles; then a flood plain begins to appear along the small creek and soon becomes a third of a mile wide. It is cultivated in places, as are also the lower slopes on either side. These lands do not show erosion or damage by floods.

The small headwater tributaries of Mountaintown Creek are bordered by narrow flood plains of moderate fertility, most of which are cleared and in good condition, and some of the lower slopes are also cultivated. There seems to be no marked erosion in this basin.

The basin of Holly Creek is wooded from its head to the point where the stream leaves the mountains, some 5 miles downstream. Below this point the creek has formed a flood plain which is at first beveled or sloping and is almost entirely above the reach of floods, but within a few miles becomes more nearly level and extends continuously down to the mouth of the creek. During floods the upper 10 miles of this flood plain receives deposits that enrich it; the lower 10 miles is not so fertile, lies lower, and is in places swampy. It is not damaged anywhere by floods.

CONASAUGA RIVER.

Above Treadwell, Ga., Conasauga River has a fertile flood plain that ranges in width from half a mile to $1\frac{1}{2}$ miles. The grade of the river is low and its velocity during floods is not great enough to seriously injure the lands by erosion.

The bottoms below Treadwell are neither so broad nor so fertile as those above, but both are uninjured. The flow of the stream seems rather constant. The owner of the mill at Treadwell reports that only a few times during the last 20 years has it been necessary to shut down for want of water. This freedom from flood damages and regularity of flow are undoubtedly due to the forest protection on its headwaters.

Conasauga River unites just above Resaca with the Coosawatee to form the Oostanaula. The Oostanaula meanders irregularly across a flood plain that is perhaps half a mile in average width and on either side is bordered alternately by bluffs and flood-plain areas. Its bottoms are not greatly damaged by floods, it is navigable throughout its entire course, and it contains no bars or islands that seem to be growing.

COOSAWATTEE RIVER.

The Coosawatee is navigable to Carters, at the foot of the mountains. The width of its flood plain varies greatly, but averages from one-fourth to one-half mile, though in a few places it is a mile or more. The ordinary flood plain of the stream is bordered in many places by an extraordinary one, 10 to 20 feet higher, and rounded stream gravels are found on the valley sides 50 to 60 feet above present flood-plain level. The highest flood recorded occurred in 1866, when some places were so badly washed that they have only just about made back again. In some localities to-day ordinary floods erode the bottoms and do considerable damage, but the farmers along the river generally regard floods as beneficial, rather than harmful, because of the sediment they deposit. This deposition of rich sediment is especially marked at Carters, where the mountain stretch of the stream, which has a high gradient, runs out upon a broad plain and assumes a low gradient and at once begins to build a flood plain.

From Carters southeastward to Silver only the lower slopes of the bordering uplands are cleared and along the streams there are narrow bottoms, most of which are also in cultivation. Some of the older hillside clearings have become badly washed.

On Talking Rock Creek, west of Blaine, 50 or 60 per cent of the uplands have been cleared and some 10 per cent of them show extensive erosion. East of Blaine about 30 per cent of the uplands are cleared and there is but little erosion. At Talking Rock Station there is a broad flood plain bordered by a fossil one 15 feet higher, whose back part rises gently upward to the tops of the low hills. These hill slopes are in places largely cleared, but the cleared areas, upland and bottom alike, are generally in good condition. Farther east, at the heads of Fishing and Price creeks, the lands are very poor and the clearings are confined to the very lowest slopes of the valley sides and the narrow bottoms along the streams. Perhaps not more than 10 per cent of the entire area of these stream basins is cleared.

In and just west of the gap at the head of Clear Creek there are numerous old fields, most of which have been worn thin and abandoned, but only here and there are there signs of marked erosion. Northeast, east, and southeast of the gap the entire region is forested except in two small areas, one covering a few acres, the other a few score acres.

ETOWAH RIVER BASIN.

Etowah River heads on the southern slopes of the Blue Ridge northwest of Dahlenega and after flowing southward 25 miles turns to the southwest and unites with the Oostanaula at Rome to form the Coosa. Its headwater region is largely uncleared except for narrow flood-plain areas and an occasional low valley slope.

No clearings were seen west of Amicalola Creek, but along that stream some bottoms 200 or 300 yards wide have been cleared and are in good condition.

From Amicalola Creek eastward to Etowah River the soil of the rolling to hilly uplands is generally poor and practically all the land is wooded. Along the many small streams in this region there are some narrow flood plains, most of which have been cleared and are uninjured by floods. Some small areas of the bordering slopes have also been cleared, but much the larger part of the region is in forest and is not eroding.

Etowah River is shallow and swift, with steep banks 12 to 15 feet high. It has a level sandy flood plain of moderate fertility, bordered by a flat-topped terrace 15 feet high. East of the river is an old, flat, cobble-strewn terrace that stands 80 feet above the present flood plain.

In some parts of its course the rocks are more resistant and it flows in a narrow gorge without a flood plain. Throughout the greater part of its length, however, it winds irregularly, and on one side or the other has developed a flood plain that in places may be half a mile or more in width. During floods it carries a large quantity of sand and gravel, a considerable part of which is due to hydraulic mining on the uplands, but a part of which is due to dredging operations which are carried on extensively along the river near Auraria and Landrum.

In many places the Etowah has a very narrow ordinary flood plain, 6 or 8 feet above water level and 1 or 2 rods wide; above this there is an extraordinary flood plain with undulating surface 12 or 15 feet higher and of varying width, but in places as much as 200 to 400 yards wide, especially on the concave side of incised meander curves. In a few places this extraordinary flood plain is half a mile or more wide. Both the ordinary and extraordinary flood plains are generally formed of a sandy loam and rarely show great damage by floods. In many places there is also a well-developed fossil flood plain or terrace 20 or 30 feet above the present extraordinary flood-plain level.

From Landrum down to Canton flood-plain areas have not been seriously injured by floods. At Canton the ordinary flood plain is 300 yards wide, stands about 15 feet above stream level, and is quite flat. It shows slight erosion from floods. The extraordinary flood plain is not well developed just at this point, but may be seen both above and below.

Just west of Field's bridge, on the north side of the river, there is a good example of the flood-plain topography found in so many places along this river. From the northern valley wall an old beveled fossil flood plain, produced while the river was cutting down and swinging southward, slopes to the south with a very gentle grade. It is about half a mile wide and at its lower edge there is a descent of 8 to 12 feet by a well-defined scarp to the present flood plain, which is much more nearly level and also about a half mile wide.

This last or living flood plain has a somewhat undulating surface, produced by the scouring action of the higher floods, which have cut occasional runways, so that it has been necessary to build dikes or low walls to prevent serious erosion. The highest floods cover this bottom to a depth of 12 to 16 feet; the lower or ordinary ones cover it but a few feet. On the south side of the river there is a similar living flood plain at the same height but of less width.

The soil on both the fossil and the living flood plains is fertile and, though the river occasionally injures the lower one by washing, the farmers regard floods as beneficial in

their general results rather than injurious. The greatest injury done by them consists of the destruction of a crop when high water happens during the growing season.

From Canton to Cartersville much of the upland on either side of the river is poor and the larger part is uncleared. In some places the cleared lands have a porous soil and do not erode badly; in others the soil is a more compact clay, and steep slopes that have been long cleared show gullying.

The Etowah for some distance below Canton has an average fall of 2 to $2\frac{1}{2}$ feet a mile—a slope that tends to produce broad flood plains, such as those at Field's bridge.

Two miles below Galt's ferry the river enters a narrow, rock-bound gorge and for 6 miles descends in rapids at the rate of $14\frac{2}{3}$ feet a mile. Below these rapids the gradient again decreases to about $2\frac{1}{2}$ feet a mile, and this, which may be called the normal slope of the Etowah, continues for 45 miles, to its mouth at Rome, Ga. Throughout this distance the stream has formed a flood plain that is in many places 200 to 400 yards wide, especially in the upper part of this 45-mile stretch. On concave sides of bends, where the stream cuts across limestone belts, the width may increase to a mile or more; where more resistant rocks occur the hills may close in and practically shut off the flood plain. Width of flood plain is a function of both river gradient and rock resistance.

Immediately below the rapids, where the gradient decreases to the normal again, flood velocities are checked and much sand is deposited, so that for about a mile the bottoms are poor and sandy and show some gouging by floods. Below this they are, as a rule, composed of fertile loam.

Just south of Cartersville broad bottom lands—now very largely fossil—have been developed on a limestone belt. The living flood plain is very narrow here and is fertile and in good condition. Below this limestone belt the hills close in at several places on the river, but at others the valley opens again and there is the usual development of an old, undulating, sloping fossil flood plain, as a rule somewhat irregular, but distinct, and from 8 to 12 feet high. The upper limit of the old beveled flood plain is generally about 60 feet above the present one. This fossil flood plain is above the reach of all floods and its slope is too gentle for serious sub-aerial erosion. The present flood plain, as a rule, receives deposits of silt during floods and is being built higher and enriched. At bends or where rafts lodge—as at bridges and other obstructions—some holes and flood channels were observed, but these may soon be filled by succeeding floods of less height and velocity of current. The flood of 1886 is the highest reported. It cut across and scoured many bends and in a number of places washed out flood channels that have not yet been filled.

Below Kingston the banks of the river are 20 to 25 feet high and the present flood plain is narrower. In most places it is distinctly separated from the fossil flood plain by an 8 to 12 foot scarp, but locally this scarp is absent and the boundary between the two is indefinite. The surface of the old higher flood plain is very undulating and in many places slopes irregularly upward to an indefinite union with the old high valley wall. On the valley sides are many cultivated tracts. Where the soil is composed of a cherty clay the clearings do not erode greatly, but where the clay is more compact erosion generally begins within 5 or 10 years after clearing and in a few more years the fields are abandoned.

COOSA RIVER FROM ROME, GA., TO GADSDEN, ALA.

The 165 miles of river between Rome and Gadsden were examined from a steamboat that ran only during the day, so that an opportunity was had of examining the Coosa for its entire length. Many landings were made along the way and the passengers and officers on the boat furnished information concerning the condition of the river and the changes that have occurred in recent years.

The banks of the river are generally covered down to the water's edge with trees which effectively protect them from erosion. At only a few places was any undercutting of banks

and caving noted, and at these it was so insignificant in amount and extent as to be negligible. The banks are everywhere very stable.

At and just below Rome the banks are 20 to 25 feet high and very steep, and the flood plain was either narrow or absent. About 30 miles farther down their average height had decreased to 15 or 18 feet and they were still steep and wooded. Still farther downstream the river widened and deepened and the average height of the banks was yet lower, until at Greensport, below Gadsden, they were reported to be only 4 or 5 feet high. There is a corresponding decrease in the height of floods down the river. A stage of 30 feet at Rome, which covers the flood plain, at Greensport makes a stage of only 5 feet, which barely suffices to cover the flood plain. This concomitant decrease in height of flood crest and of flood plain surface down the river is normal and necessary. The flood wave tends to lengthen or flatten out as it advances downstream and thus lowers the height of the flood crest, and since the flood plain is built by the flood it is necessarily limited in elevation by the height of the crest of the floods that produce it.

There are comparatively few gravel bars in this 165 miles of river, and those known are reported by the pilots to be stationary in position and height. Some of them have been dredged in recent years by the Federal Government. The material thrown out on the banks is chiefly well rounded chert gravels and cobbles, most of which are less than 3 inches in diameter, though the large cobbles have a diameter of 12 inches. In some places pieces of blue shale or slate are mixed with the chert. In only a few localities are there any visible gravel accumulations below the mouth of tributary streams, and where such gravel beds occur they seem to have reached points of equilibrium between the forces that built and the forces that destroy them.

The islands in the river are small and most of them are the ordinary midstream islets, but a few others of unusual type were observed, 100 or 200 yards long, 6 or 8 feet high, and only 20 or 30 feet wide. Such islands lie very close to one bank or the other and were covered with trees. Inquiries and personal examination failed to discover that any changes are in progress on such islands. They would seem to have originated by the undercutting of a portion of root-matted river bank until it broke loose, slipped into the river, and became a long, narrow islet, parallel and very close to the bank from which it was derived. If this be the mode of origin the time was remote enough for all trees that may have been tilted when the island was formed to have disappeared, as all now standing are perfectly erect.

At many places the bed of the river contains rock ledges that lie as a rule at sufficient depth to be no serious menace to navigation. In many other places the rock in the bed of the river is covered by a very few feet of loose gravel. The river seems to be eroding its channel.

At 9½ miles and again at 10 miles below Rome there are two gravel bars that have been dredged within the past few years. This dredged channel has not since shown any tendency to fill. The material removed was chert gravel. There is little or no sand on any of the bars or islands. The river meanders in long, irregular curves, but during floods shows little tendency to cut across these meander bends, for the stream does not generally rise high enough above the bottoms or flood plain within the bends to carry a strong current across them. Foster Bend was the only place where cutting across a meander curve was observed. A runway formed here in 1886 badly damaged some of the land. Later floods have not been high enough to reoccupy this runway, so that it has not yet been filled by later deposits.

Just above Poole's ferry a gravel bar has recently been dredged and the channel would seem to be able to maintain itself without the aid of further dredging.

Just below the mouth of the Chattooga there are two gravel bars whose material has evidently been furnished by the Chattooga. This material seems to be carried away to-day by the river as fast as the tributary stream brings it in, so that the bars have reached a stable size and form and are reported not to have changed in the last 40 years.

At Center Landing there are two small islets, each about 150 or 200 yards long and 25 yards wide. These islets have not changed materially within the last 40 years.

Just below the mouth of Terrapin Creek there is a gravel island about 2 acres in area, which rises 3 or 4 feet above ordinary water level and is scored longitudinally by the river floods. Just below it is a shallow gravel shoal. Both of these have been built of material furnished by the creek and, like the bars below the mouth of the Chattooga, have been in equilibrium for at least the last 40 years.

Just below Wood's ferry there is an island, between 5 and 10 acres in area, whose upper end is kept scoured by floods, but whose size and form are reported as unchanged during the last 40 years.

At Gadsden the river is 150 yards wide and its banks are somewhat higher than usual so far down the river; they are 22 to 26 feet in height. The ordinary flood plain is 150 to 200 yards wide and is bordered on the east by an extraordinary one 10 or 12 feet higher, which rises eastward by imperceptible gradations until it becomes fossil and ultimately merges with the general country level. On the west side a bluff rises from the ordinary flood-plain level to an old high-terrace level, whose surface at the west end of the railway bridge is about 71 feet above ordinary water level. Gadsden is situated on this old high terrace. Its surface is composed of a clay stratum, 10 or 12 feet thick, beneath which there is a bed of 8 or 10 feet of well-rounded river gravel, whose average maximum diameter is 2 inches or less, though some pieces reach 6 inches.

This gravel is a rusty, brownish yellow and very much resembles the gravels seen on the lower Tennessee and on the bluffs along the Mississippi above Memphis and may be of the same age. Very few floods are high enough to cover the ordinary flood plain, and the extraordinary one has been covered within recent years only by the flood of 1886, when the stage reached was 36 feet, and even this stage lacked 2 feet of covering the highest parts of this old extraordinary flood plain. The ordinary flood plain is not much injured by the floods that occasionally cover it.

COOSA RIVER BELOW GADSDEN, ALA.

The river was examined some 50 miles below Gadsden, at Riverside, where it is 150 yards wide and its banks are 8 or 10 feet high. The present flood plain on either side of the stream has an aggregate width of some 100 yards, and above it, at a height of 10 or 12 feet, there is an older flood plain, perhaps never reached by floods of to-day, which rises slowly until it merges along its outer edges into the general country level. There were no signs of flood damages and inquiry failed to elicit any information of such damages. Some 40 miles below Riverside the river was examined at Childersburg. At the railway bridge north of the town it is 180 yards wide and has banks 15 feet high, which are covered with trees and quite stable. At this point there seems to be no ordinary flood plain. On the south side is an undulating extraordinary flood plain that slopes gradually upward for a half mile until it merges into the general upland surface. Floods reach its edge or occasionally cover some unusually low runway on its surface. The flood of 1886 is the only one recorded that might be said to have covered any considerable part of this flood plain.

At Chancellor Ferry, 2 miles farther downstream, there is on the north side of the river a fossil flood plain with very gentle slope, separated on its riverward margin by a 10 to 15 foot scarp from an extraordinary flood plain, 50 or 60 yards wide, whose surface is slightly undulating and has been covered only by the very highest floods, such as the one of 1886. It is 15 feet above water level. Immediately above the ferry there is a small island whose outline has not perceptibly changed in the last 40 years. On the south side of the river there is an ordinary flood plain 10 feet above water level, forming a very narrow shelf, and 5 or 6 feet higher an extraordinary one, which is 150 yards wide and rises gradually in this distance some 12 feet, merging into an old fossil flood plain, remarkably level and broad, which extends southward and eastward several miles beyond Childersburg.

Below Childersburg the river was again examined at Montgomery and at Selma, but the conditions at these places, both of which are on the Coastal Plain, where the whole country is

made of soft sands and clays or partly indurated marl, were so extremely different from the conditions on the middle and upper part of the river system that no fair comparison could be made. Changes in the position of the navigable channel by the formation and growth of bars and islands and by the undercutting of the banks made it an entirely different kind of river from that exhibited in its middle and upper courses.

The middle and upper portions of the river are evidently not much clogged by material eroded from its steep headwater slopes; bars and islands are not growing; the position of the steamboat channel and of the river itself is unchanged. All this is undoubtedly due to the fact that there is comparatively little active erosion in the mountains in northern Georgia, where this stream system heads. Most of the region there is still in forest, and the Coosa presents the best observed example of a stream system on which conditions are still satisfactory. These conditions can, however, be maintained only by adopting preventive measures before lumbering and clearing have started serious erosion and begun to establish the same unsatisfactory conditions that are found on the Tennessee and other streams flowing from the more largely cleared portions of these southern mountains. The accumulation of sand bars and the changes in the stream channel in the coastal-plain portion of Alabama are due to local causes or conditions that are commonly characteristic of large streams flowing with low gradient on broad alluvial plains and can not be attributed to abnormal erosion on their headwaters. If they were they would undoubtedly be producing changes in the low-grade portions of the stream both above and below Rome, Ga. An examination of this stretch of the river showed that no great changes are in progress and that present conditions have been maintained for many years.

CHATTAHOOCHEE DRAINAGE BASIN.

GENERAL CONDITIONS.

The headwaters of the Chattahoochee basin, on the eastern slope of the Blue Ridge, were examined and the river itself was followed across the Piedmont Plateau as far as Atlanta.

The headwater tributaries of the Chattahoochee rise on the southeastern slope of the Blue Ridge and flow for several miles southeastward as if to enter the Atlantic, but are then gathered into a master stream that flows to the southwest and enters the Gulf of Mexico.

The tributaries descend from the crest of the Blue Ridge 2,000 or 3,000 feet in a few miles, and reach the inner edge of the Piedmont Plateau at an elevation of about 1,500 feet above sea level, below which their descent, until they join the Chattahoochee, is probably not more than 20 feet to the mile. Along the eastern face of the Blue Ridge headwater erosion is exceedingly active, and the scarp has been intricately carved into narrow gorge-like valleys, separated by sharp-crested, sloping spurs. This minutely dissected Blue Ridge scarp is in some places rough and rocky, but in others is covered with a residual soil layer. Except along the stream channels themselves it is almost everywhere wooded, though the soil is dry and thin and the forest growth is open and of poorer quality than that at similar elevations on the same range 100 miles to the north. On shaded northern slopes, where there is more moisture, there is a greater accumulation of humus and the forest growth is denser and larger. Most of these headwater streams are bordered by no flood plains until they have descended almost to the level of the plateau, where, at some distance from the base of the hills, a narrow flood plain appears, which rapidly grows broader until it may exceptionally attain a width of a quarter of a mile, a half mile, or even a mile. Some miles farther down, however, these streams begin to incise their channels beneath the plateau level and soon flow in narrow gorges whose depth increases until in many places it reaches 100 to 200 feet. Few of these gorges have flood plains and their sides are generally too steep and rugged for cultivation. Such, for example, is the character of the Chestatee near Dahlonga, of the lower part of the Soque, and of the Chattahoochee itself for a number of miles both above and below the mouth of the Soque.

The general upland surface of the Chattahoochee basin is an old plateau, whose elevation near the head of the river is about 1,500 feet above sea level. It is bounded on the north and northwest by the scarp of the Blue Ridge, which overlooks it, and on the southeast by a somewhat similar but lower scarp, well seen from Mount Airy and other points in its vicinity that overlook the Atlantic portions of the Piedmont Plateau. The Chattahoochee Plateau thus forms an intermediate step, as it were, between the Piedmont Plateau and the crest of the Blue Ridge.

This lower scarp, between the upper part of the Chattahoochee basin and the streams flowing southeastward to the Atlantic, decreases in height southwestward until it disappears in the region northeast of Atlanta, where the Chattahoochee Plateau and the Piedmont Plateau merge into one. The surface of this Chattahoochee Plateau is broken by streams that have incised their channels beneath it and by isolated residual peaks and broken ridges that rise above it. In other words, its topographic relations are exactly similar to those that are characteristic of the Asheville Plateau, or to those of the remaining part of the Piedmont Plateau to the southeast.

These three plateaus are undoubtedly of the same age and were formed by long-continued erosion that reduced each to a low plain, usually called a peneplain, that has since been uplifted, their difference in height being due to difference in distance along their drainageways to the sea. They have undergone the same amount of atmospheric weathering, and where the rainfall, slope, and soil are similar, show the same effects of erosion. The rocks of this Chattahoochee Plateau are like those of much of the Asheville Plateau—deeply decomposed schists, gneisses, and granites. Much of the soil is a red clay and on steep slopes erodes rapidly.

The most serious injury noted in this basin is the filling of the Chattahoochee channel with sand, which is destroying the ferries and threatening to fill several dams recently built to utilize the large water power furnished by this stream. This sand deposit has not yet greatly injured the bottom lands, but with further increase in its accumulation, which is inevitable under present conditions of clean culture on steep slopes and their subsequent rapid erosion, the bottom lands will soon be so covered with sand that in a few years their fertility will be destroyed. With the filling of the dams at power plants and the burying of the rich bottom lands beneath barren sand the river will have practically completed the destructive processes which it is only too evident have already been well begun.

DETAILS OF CONDITIONS.

For a few miles above Nacoochee Valley the Chattahoochee has a narrow flood plain, which is commonly bordered by a terrace 30 feet higher, beyond which runs another one 20 feet higher still, though in some places these two merge into one, forming one old flood plain 50 feet above the present flood plain. Higher up the river there is practically no flood plain, and there is very little clearing along its upper 10 miles, either on the stream itself or on the adjacent mountain slope. Much of this region is rough and practically all of it is wooded.

In the Nacoochee Valley there is a flood plain half a mile to a mile wide, through which the stream flows in a broad, shallow channel 2 to 5 feet below flood-plain level. Along its course there are many gravel bars, which alternate with deep, quiet pools. In most places the channel is bordered by a narrow cobble zone, produced in time of floods. The river sometimes destroys the crops in this valley, but has not greatly injured the lands. At its eastern end Nacoochee Valley is joined by the valley of Sautee Creek. This valley is very similar to Nacoochee Valley, and conditions in it are similar to those just described.

A few miles below the junction of these two valleys the Chattahoochee begins cutting its way beneath the plateau level and forms a narrow gorge that contains little or no flood plain almost down to Gainesville. Here and there in this distance, inside of bends or at the mouths of tributary streams, there are small flood-plain areas, but the aggregate amount of such land is small.

In the Chestatee basin about Dahlonega the upland is an old, well-dissected plateau, whose topographic form is very similar to that of the Asheville Plateau in western North Carolina, and its age and origin are doubtless also the same. Around Dahlonega the soil is a poor mica schist, worth but little for agriculture. In many places it carries considerable quantities of gold, and for years more or less hydraulic mining has been done in this region. The great quantities of material washed in this way to the streams have not caused the complaint from farmers that might be expected, since the swift currents of these streams remove all this material during periods of high water. The streams are actively eroding their channels and have high banks and velocity enough, it would seem, to remove more material than is being furnished them even by the hydraulic mining.

For 7 miles east of Dahlonega, on the road to Cleveland, the numerous small streams have narrow flood plains that are farmed, but the uplands are practically uncleared. Where the road crosses the Chestatee there are some bottoms. On the Little Tesnatee and again at Pleasant Retreat there are excellent bottoms. The uplands about Pleasant Retreat and farther east, toward Cleveland, have much better soil than that around Dahlonega and are much more largely cleared. This soil is a deep clay and erodes in many places much as it does about Asheville, N. C. The small streams show the influence of this hillside erosion and are depositing sand and clay on their flood plains and cutting channels across the meander curves that have begun to form.

North of Cleveland the same conditions—largely cleared uplands, erosion, stream aggradation, and flood damage—also prevail, until the divide separating the Chestatee from the Chattahoochee is reached.

In the upper part of Soque River basin much of the upland is poor and comparatively little of it has been cleared. Along most of its small tributaries there are narrow flood plains, and on some streams the lower 50 yards of adjacent hillsides are cleared, although the aggregate of such clearings is less than 10 per cent of the area. In places two-thirds of the cleared land has been worn out and abandoned. In some localities it is gullying, in others it seems to be growing up again in forest.

The Soque is bordered by a flood plain from a point near the mouth of Shoal Creek down to a point some distance below Clarksville, where it begins to cut sharply beneath the plateau level and develops a gorge, just as the Chattahoochee does below Nacoochee Valley.

Less than 15 per cent of the uplands along the Soque above Clarksville is cleared, and on the steep southern slope of the Blue Ridge there is practically an unbroken forest cover, though this cover here, as elsewhere in this region in similar situations, is thin and the timber is inclined to be scrubby.

From a point below Clarksville toward Mount Airy and down the Chattahoochee, more than half of the plateau surface is cleared. Much of it has been farmed for years, and in many places it is eroding badly, especially where the rocks are granitic or gneissose. Where they are micaceous schists the soil is usually full of small rock fragments and is more porous, and erosion is less rapid.

Deep Creek enters the Soque from the northeast about 2 miles above Clarksville. A large part of its basin is comparatively level and 50 to 75 per cent of it has been cleared. Much of its area is a sandy clay that erodes readily, and from this basin great quantities of sand have been carried into the Soque and have almost filled its bed, so that ordinary water level is now but little below flood-plain level. During floods immense quantities of this sand are spread over the bottoms and have greatly injured them. About Clarksville much of the river bottom has been set in Bermuda grass, which seems to prevent erosion better than anything else and at the same time stands being covered by floods better than other grass.

The basins of Flat Creek, White Creek, and Mossy Creek are generally fertile and have been largely cleared. In these basins rainfall gathers quickly and floods are usually high and do much damage. Three weeks before the region was visited in 1905, floods on these streams had swept away a number of bridges and damaged growing crops 25 to 50 per cent, besides severely damaging the lands themselves in many places.

Mud Creek basin has been cleared to much the same extent and is eroding in the same way. The uplands between it and the river are 60 to 70 per cent cleared, and much of this cleared area has been badly gullied and is now abandoned.

At Bolton Ridge the channel of the river is reported to have filled greatly with sand within the last few years, so that floods now occur much more frequently than formerly. There is a well-preserved old terrace at 60 feet and another 20 feet higher. The higher slopes are 80 per cent cleared and 10 per cent of this area is eroded and abandoned.

At Seven Island Ford the injuries and benefits from floods are said to about balance each other; crops are damaged to a considerable extent every five or six years, and at somewhat longer intervals a crop is entirely lost. Intermediate floods enrich the lands.

At and below Clark's bridge the ordinary flood plain is 15 feet above the water level and shows considerable flood scour. About 60 feet above it is another fossil flood plain with a red, loamy, fertile soil that overlies a cobble zone, and 40 feet higher are poorly preserved remnants of another still older flood plain. The edges of this older flood plain are steep enough to erode badly when not terraced. More than a third of the uplands has been cleared, and when old these fields erode unless terracing is practiced. Farmers in this region have lately begun terracing their lands as the only means of preventing erosion under the cultural conditions that prevail where cotton is the principal crop, and where, as a consequence, the land must be kept clean.

From Gainesville down to Atlanta 60 per cent of the uplands on either side of the river are cleared. On some of the poorer soils the clearing is not more than 40 per cent, but in others the proportion rises to 80 or 90 per cent. Much of the soil in this area is a deeply rotted granite, and everywhere the old plateau surface has been carved by erosive agencies into forms that are as a rule sharply rounded. These uplands are practically all kept in cotton, and where they are not terraced erosion is rapid. Practically all of the small tributary streams on both sides of the river carry enormous quantities of sand into the river. The channels of many of these streams had filled so that it was impossible to drain their flood plains, and the lands along them had become practically worthless. The flood plains of others had been covered by sand or cut to pieces during floods and rendered useless. The sand brought down by these streams has accumulated in low-gradient reaches of the river so as to practically fill the channel.

At Stringer's ford the North Georgia Electric Co. has developed power by a dam 36 feet high, which backs up the water 8 miles, to a point beyond Clark's bridge. This dam was completed July 4, 1904, and signs of filling with sand and silt were apparent a year later. This filling must steadily increase and will ultimately destroy the storage value of the dam and force the company to depend on the capacity of the stream alone.

At Shallow Ford there is an ordinary flood plain 6 to 8 feet above the water level, and an extraordinary one 12 feet higher, which in 1905 had recently been cut to pieces in places by unusually high floods. About 40 feet above the extraordinary flood plain is an old, well-preserved terrace, and 40 feet higher is still another terrace, which is, however, poorly preserved. In the bed of the river sand has lodged on bars, behind piers and projecting rocks, and wherever opportunity has offered. The stream is evidently overloaded with such waste.

At Brown's bridge the river is 150 yards wide. The ordinary flood plain is 10 to 12 feet above water level and aggregates on both sides 75 yards in width. Floods had recently destroyed about 10 per cent of the crops, but had not injured the land. There are two terraces, one 15 and the other 60 feet above the flood plain.

At Shadburn's ferry the river channel has been greatly filled with sand, so that the running of the ferry during the summer and fall has become exceedingly difficult. Late in the winter the sand is swept out by floods, but it begins to accumulate again early in the spring. Floods are reported to be more frequent than formerly, and the annual damage to crops averages 15 to 20 per cent. Forty years ago the river was deep at this point and accumulations of sand were unknown.

At Pirkle's ferry it was reported that sand has been filling the channel for the last six or eight years, and that it had prevented ferrying for more than half of the time during the last four years. The conditions here have steadily grown worse, and the owners of the ferry have petitioned the county court to be allowed to discontinue it as a public thoroughfare. Ten or fifteen years ago horses frequently swam the river at this point; now sand has accumulated in quantities so great that a flatboat drawing 6 or 8 inches can not cross during more than half of the year. The river is now muddy most of the time, whereas it was formerly clear.

Baldridge, Twomile, Fourmile, and Sixmile creeks have basins that are very largely cleared and farmed in cotton. They furnish immense quantities of sand to the river.

At Strickland's ferry the channel began filling with sand 8 or 10 years ago, and conditions became so bad 2 years ago that the ferry was discontinued and a bridge was erected instead. The bottoms here are good and are several hundred yards wide; they are injured by some floods and are benefited by others, since floods of one stage erode and those of another stage deposit fertile sediment. The flood plain is bordered by a 60-foot terrace, the steep edge of which is eroding in places. The small creeks on the west side of the river, like those farther up, are filled with sand and have greatly injured or entirely destroyed their bottom lands.

At Terry's ferry the river banks are 8 to 10 feet high and floods frequently destroy crops, but rarely cut the land to pieces. In the last six years the channel has so filled with sand that the ferry has practically been abandoned.

At Hutchin's, Maynard's, Roger's, Abbot's, and Warsaw ferries the same difficulties from the channel filling with sand were found to exist, and at some times of urgent need for ferriage temporary ferryboat channels through the sand had been made with horses and scrapers. These ferries are now being abandoned, and in the place of some of them bridges will be built, though the cost of bridges prohibits their immediate erection by the county at each of the ferries, and much inconvenience to the people on either side of the river is occasioned by this forced abandonment of long-established crossing places. Bottom lands near these ferries are in places a half mile wide. They are not generally hurt by the floods, but crops are frequently seriously damaged or totally lost, and the frequency and severity of this loss has become much greater since the river channel has filled with sand.

An examination of the profile of Chattahoochee River shows that the gradient along this part is in many places less than 1 foot per mile, so that the stream at ordinary stages is not able to remove the amount of sand furnished by its tributaries. The excess, therefore, accumulates in the channel and fills it until continued or repeated high waters in late winter and early spring scour it out.

At Jetts and Johnsons ferries there is no serious inconvenience from the accumulation of sand, since the river gradient has increased to nearly 9 feet per mile and the sand is kept moving.

At Bull Sluice the Atlanta Water Power & Electric Co. had recently completed a dam that gives a head of 50 feet and backs the water up to the highway bridge at Roswell. It will be interesting to watch the gradual accumulation of sand above this dam and the decrease of storage capacity, which is bound to occur unless erosion in the upper Chattahoochee basin is checked. The water wheels installed have a larger capacity than is warranted by the normal flow of the river, so that they are designed to take advantage of the flood discharge as well as the storage capacity of the dam.

At Powers Ferry the stream gradient again decreases and sand accumulates. Floods have injured the lands somewhat by spreading sand over them, but the chief damage is done to the crops. On the east side is a 60 or 70 foot terrace; on the west side a considerable area is covered with sand or cut into holes.

At Paces Bridge an old terrace 70 or 80 feet high, on the west side of the stream, has long been cultivated, but its steep sides are now eroding. The present flood plain is cut by numerous flood runways and is covered here and there with barren white sand.