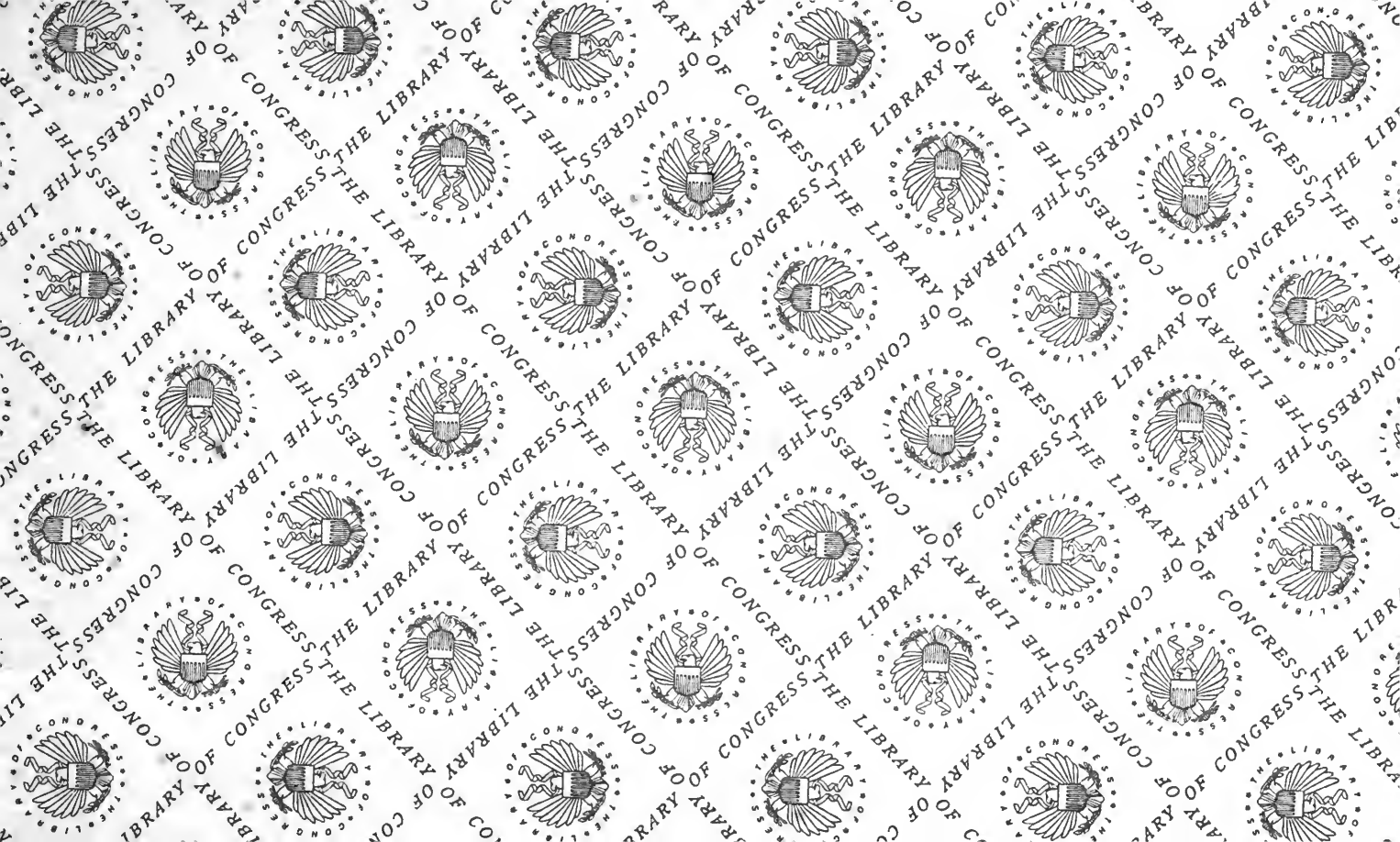
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CHATTANOOGA
THE MOUNTAIN CITY

COMPILED FOR THE SPRING MEETING

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

CHATTANOOGA, MAY 1 to 4, 1906

THE READ HOUSE—SITE OF THE HISTORIC CRUTCHFIELD HOUSE.

CHATTANOOGA

The Mountain City

A Souvenir Volume

COMPILED FOR THE SPRING MEETING OF THE
AMERICAN SOCIETY OF
MECHANICAL ENGINEERS

Chattanooga, May 1-4, 1906

: : : BY : : :

THOMAS E. MURRAY

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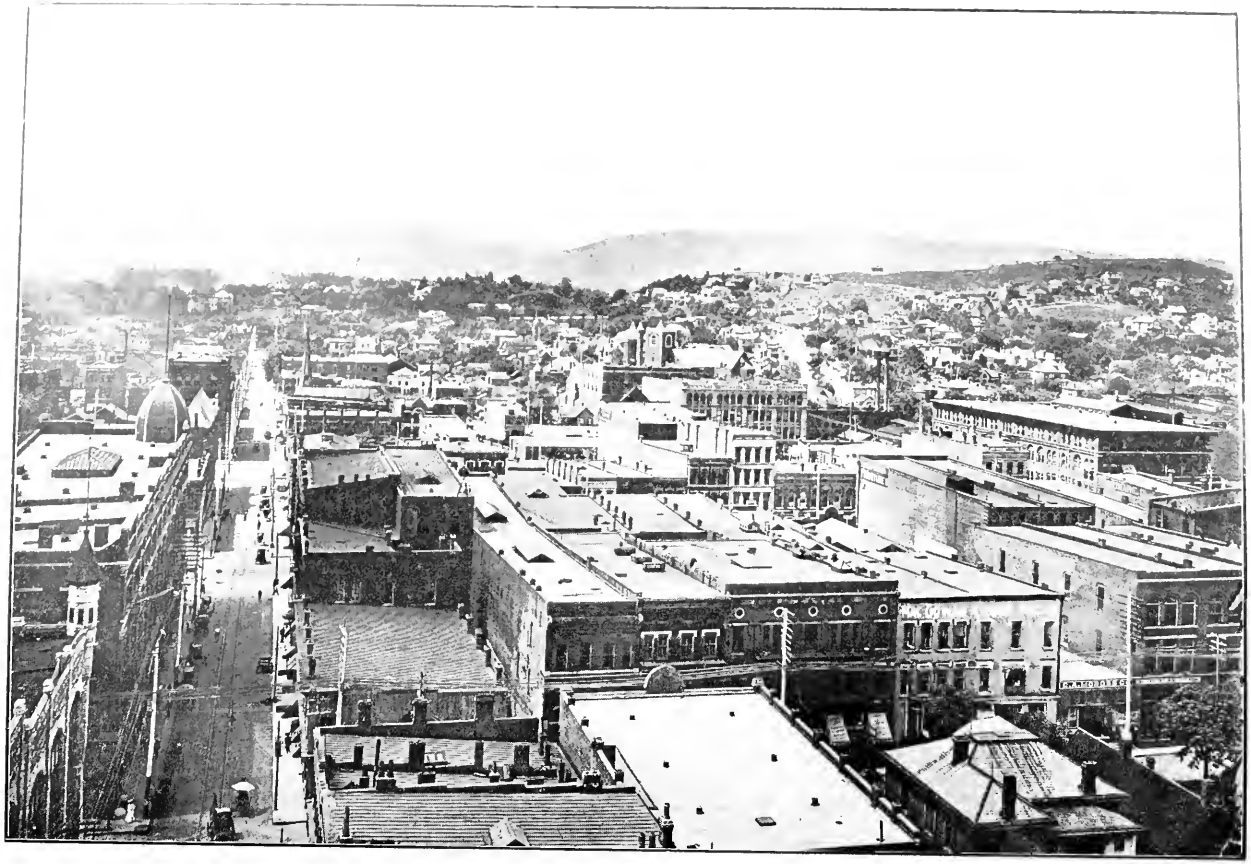

FROM TIMES DOME, LOOKING WEST.

This volume has been compiled as a guide for the visiting members of the American Society of Mechanical Engineers and their friends to the many attractions and places of interest in and about Chattanooga. It is hoped that it may be both useful for the present as a guide and in the future as a souvenir of a pleasant and enjoyable sojourn in the "Mountain City."

I wish to thank Geo. W. Ochs and the Chattanooga Chamber of Commerce for permission to use copyright matter, and the *Manufacturer* and its business manager, G. E. Hatcher, for material and other assistance in the preparation of the volume.

THOMAS E. MURRAY.

New York, April, 1906.

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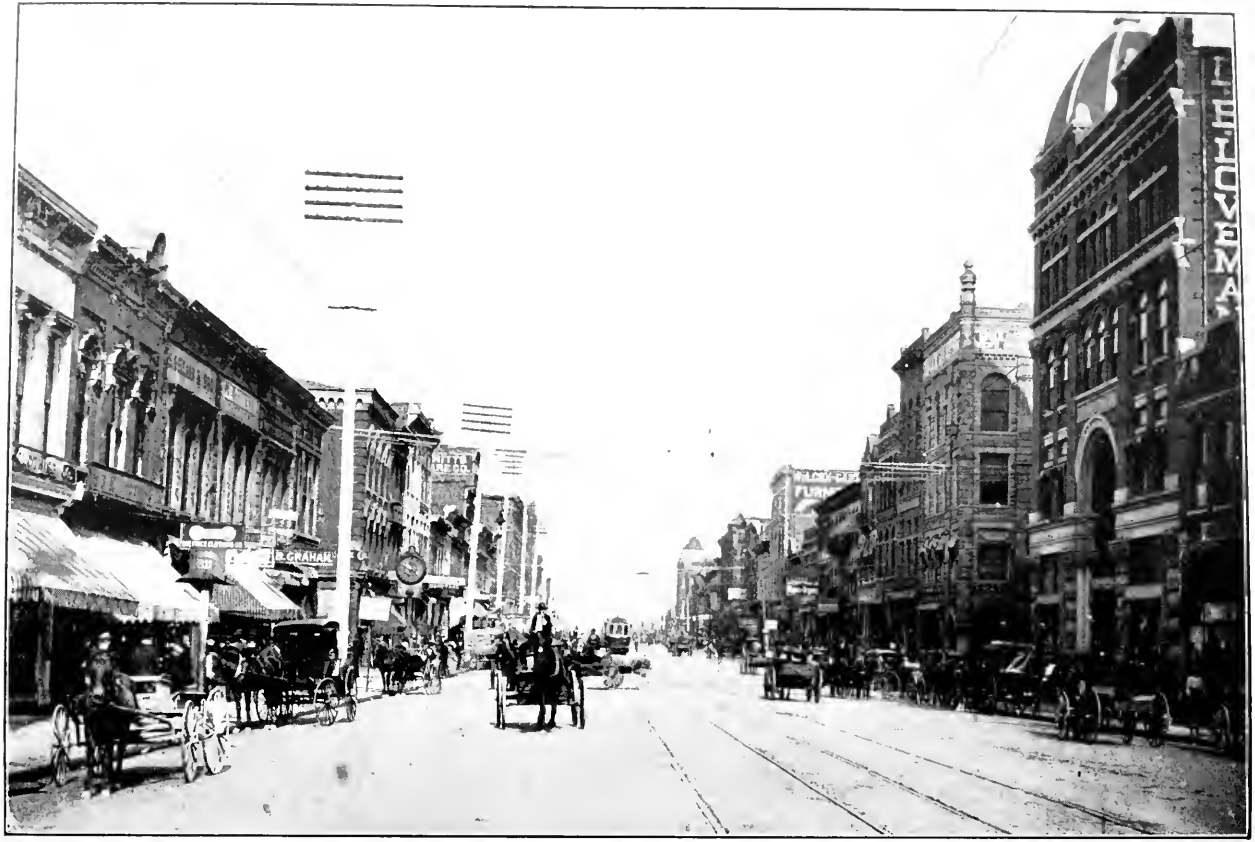


MARKET STREET, CHATTANOOGA'S MAIN BUSINESS THOROUGHFARE.

CHATTANOOGA

The Mountain City

Chattanooga, the Mountain City, situated on the left bank of the Tennessee River, on the borders of three states, has been greatly favored by nature, as well as by man. Struggled for in war by contending armies, sought for in peace by the great highways of commerce, she has a glorious history to commemorate and a wonderful development of the arts of peace to maintain her supremacy in the mountain regions of the south.

The citizens of Chattanooga live in the midst of natural scenic attractions, which may be said to be unsurpassed, a climate removed from the heat of the south and the cold of the north, with health-giving hills and mountains close at hand, stores of coal, iron and timber at their very doors, busy industry surrounding them on all sides and a population gathered from all points of the globe, living in peace and harmony and striving to build up the community with a substantial and solid progress.

The scope of country which is known as the Chattanooga District, comprises the surrounding counties of Tennessee, Georgia and Alabama, lying within a radius of from seventy-five to one hundred and fifty miles, whose commercial, mining and manufacturing interests are centered at this point.

The wonderful progress and development of this section since the Civil War has been unparalleled in history, clearly indicating the ultimate pre-eminence of a country most favored by the bounteous hand of nature. It is a well known fact that previous to the war no section of the Union excelled this, either in the production of material wealth or in the civilization, culture and refinement of its citizenship. Many of the foremost men which America has produced were born and raised in these states, and the energy, zeal and patriotism of this people have been the admiration of the world.

From the fact that this immediate vicinity was the scene of vast operations, including many fierce conflicts and decisive battles, all the destructiveness of war was exemplified here, and at its close general industrial conditions were far worse than they could possibly have been in an entirely new country. Thousands of people were thrown upon their own resources, without homes, property or credit. With mills and factories destroyed, farms and plantations abandoned, all lines of transportation obstructed, and political conditions unsettled, menacing even life and property, these people, with a fortitude and courage unexampled in the history of nations, set about to recover their fallen fortunes. Encouraged by their example and impressed with the boundless natural resources of this section and its advantages, people from other states, both North and South, came here to establish homes and assist in the regeneration of the country.

The results which have been accomplished, briefly outlined in these pages, will stand as a living monument to the energy and enterprise of the American people, and an eloquent testimonial to the favorable natural conditions which have made it possible within the life of one generation to accomplish so much.

It is not the purpose of this sketch to trace in detail the transformation of a devastated land and a little, ruined, straggling Southern village of, perhaps, 2,000 population into a district of happy homes, in touch with all the elements of modern progress and a bustling, thriving, progressive city of over 70,000 people. But we may briefly review the causes which have contributed to this astonishing result, and find therein a reasonable and logical basis for our faith in the future greatness of this city and the further development and prosperity of the district of which it is the metropolis.

Perhaps the first and most important question in this connection is that of physical health as based on favorable climatic conditions. The whole district is a natural sanitarium, and Chattanooga is one of the healthiest cities in the world. The mountain breezes temper the heat of summer, while the lofty Cumberland ranges to the northwest protect the valleys from the fierce blasts of winter. It is no unusual thing for the people in this district to enjoy the most beautiful sunny days, while those in localities far south of us are struggling with frost and fog, ice and snow. In summer the highest daily temperature at Chattanooga rarely equals that of cities in the northwestern states.

A SECOND VIEW OF MARKET STREET.

As shown by the records of the Weather Bureau at Chattanooga, the average annual temperature is 60 degrees; average annual rainfall, 54 inches. The isothermal line which passes through Chattanooga runs just south of St. Louis and San Francisco, through Lisbon, Madrid, Marseilles, Rome, Naples and a little south of Constantinople. The climate of this district is not subject to violent or sudden changes. The average temperature for the summer months is 76 degrees; for winter, 44 degrees; spring and autumn, 60 degrees; average of clear, sunshiny days out of the 91 included in each season is, summer, 78; autumn, 68; winter, 53, and spring, 62. A comparison of this record with other sections will be a revelation to many, and it proves the assertion that this climate rivals that of Italy.

The elevation of the city above sea level averages about 700 feet, and the surrounding mountain plateaus from 2,000 to 3,000 feet.

It is stated that no case of pulmonary consumption was ever known to develop among the residents of these mountain table lands, but of course it is impossible to absolutely verify this as a fact. It is certain, however, that these mountain districts are remarkably free from this dreaded disease, notwithstanding the fact that thousands of people resort here for the benefit of their health, many of whom are suffering from its ravages when they come.

The supply of drinking water is obtained throughout the rural districts almost entirely from mountain springs, many of which furnish mineral waters of great medicinal value. The supply for the city is obtained from the Tennessee river, pumped into the mains after going through an elaborate system of filters and settling basins. From a sanitary standpoint, the city supply is almost absolutely pure, and will compare favorably with that of any city in the United States.

The annual death rate for the white population in the city for the last year was 13.4 per thousand, which is the highest for many years, the average being about 10 per thousand. This in itself tells the story of a healthy country and needs no comment.

The city has an excellent drainage system, including forty miles of brick, tile and cast iron sewers, and there is no such things as marshes, stagnant pools or filthy mud holes in the vicinity.

The streets are well paved and first class gravel roadways reach out to all the suburbs and surrounding country.

The mortality among children, in all communities alike, is a

most unerring sanitary monitor, for where the little ones perish there exists also danger to the health of the adult population.

Strikingly in contrast with the experience in other cities, north, east and west, is the infrequency in Chattanooga of scarlet fever, diphtheria and typhoid fever. These insatiable angels of death and destroyers of the happiness and hopes of families have never prevailed in epidemic form in this community.

The careful examination of a map showing the river courses and mountain ranges in this region will help to explain what has been said about climate, and it will also show the reason why Chattanooga has come to have the best transportation facilities of any city in the south. It has been remarked that it would puzzle an engineer to run a line of railroad anywhere in this neighborhood without going through Chattanooga. The railroads stretch out from this city like the lines of a spider's web, to all points of the compass, following the valleys which converge at this point and the course of the river, which breaks through the Cumberland Mountains a few miles below the city. Being about equidistant between the larger cities of the North and South, East and West, makes this the natural crossing and division point for all lines, and the principal interior terminal point of the South.

Railroads are, of course, a necessity, but do not answer all the purposes of transportation required by great cities, and it has been remarked as a peculiar coincidence that large rivers run near the great cities right where they are the most needed. The Tennessee is one of the great rivers of North America, draining an immense territory in six great states. The National Government has done much to better the navigation of the Tennessee, and more improvement is to come enlarging the opportunities for river commerce, while the electric power plant of the Chattanooga and Tennessee River Power Company about to be established in connection with the work of river improvement gives hope of a great impetus to the industries.

Chattanooga is at the head of what is called the mountain section of this great river, and thus has water transportation to all western river points and the Gulf of Mexico, besides all points on the 1,300 miles of navigable waters above the city.

The Chattanooga District is not what might be called a rich agricultural country, for the reason that a large percentage of its area is rough, broken and mountainous; but in the valleys the conditions for successful farming are ideal. In addition to this,

NINTH STREET—A BUSY MART OF TRADE.

the mountain lands make splendid ranges for stock, and the high plateaus and ridges are unexcelled for grape culture and fruits. The favorable climate makes successful farming possible on lands which in other states would be barren and useless. There is no better country in the world for the raising of vegetables and small fruits, and the accessible markets make this line of agriculture extremely profitable, so that, taken as a whole, probably no locality offers greater inducements to the careful, industrious and practical farmer.

Chattanooga is the commercial metropolis of a district containing about 2,500,000 people. While the development of the city's wholesale trade has been wonderful during the last ten years, it has not yet begun to fill the measure of its possibilities.

Probably no district of equal area on the face of the earth can boast of greater variety or abundance of its developed and undeveloped timber and mineral resources. To these sources of wealth must be attributed a large part of the prosperity with which this locality has been blessed in the past, and to them we look for an immense industrial expansion in the future. The possibilities along these lines of industrial activity, and the manufacturing interests which naturally grow out of them, are practically unlimited in the Chattanooga District.

There is no better location in the South for the establishment of textile industries, and a number of large mills are now in successful operation in and about Chattanooga.

In other lines the manufacturing interests of Chattanooga exceed those of any other Southern city in value and diversity of products, taken together. There are over three hundred manufacturing plants in and near the city, a number of them the largest of their kind in the South. The aggregate capital interest is over $36,000,000. Chattanooga-made goods are sold in nearly every country in the world. Chattanooga is already a great manufacturing center, and is destined to become one of the greatest.

It is not often the case that the vicinity of an important commercial and manufacturing city is at the same time a desirable pleasure and health resort. In this respect Chattanooga is unique. Thousands of tourists visit the city every year to breathe the pure air, view the mountain scenery, visit the many points of historic interest, and enjoy life generally in a climate unexcelled by that of Switzerland and Italy.

The city has become so popular as a visiting and meeting place

that during the last few years several great national and international conventions have been held here, and in order to properly entertain and accommodate such gatherings in the future the city has erected a magnificent Auditorium, which will comfortably seat 5,000 people.

The population of Chattanooga is cosmopolitan, nearly every state in the Union being represented among its leading citizens, and no city can boast of a more enlightened, progressive and enterprising class of people.

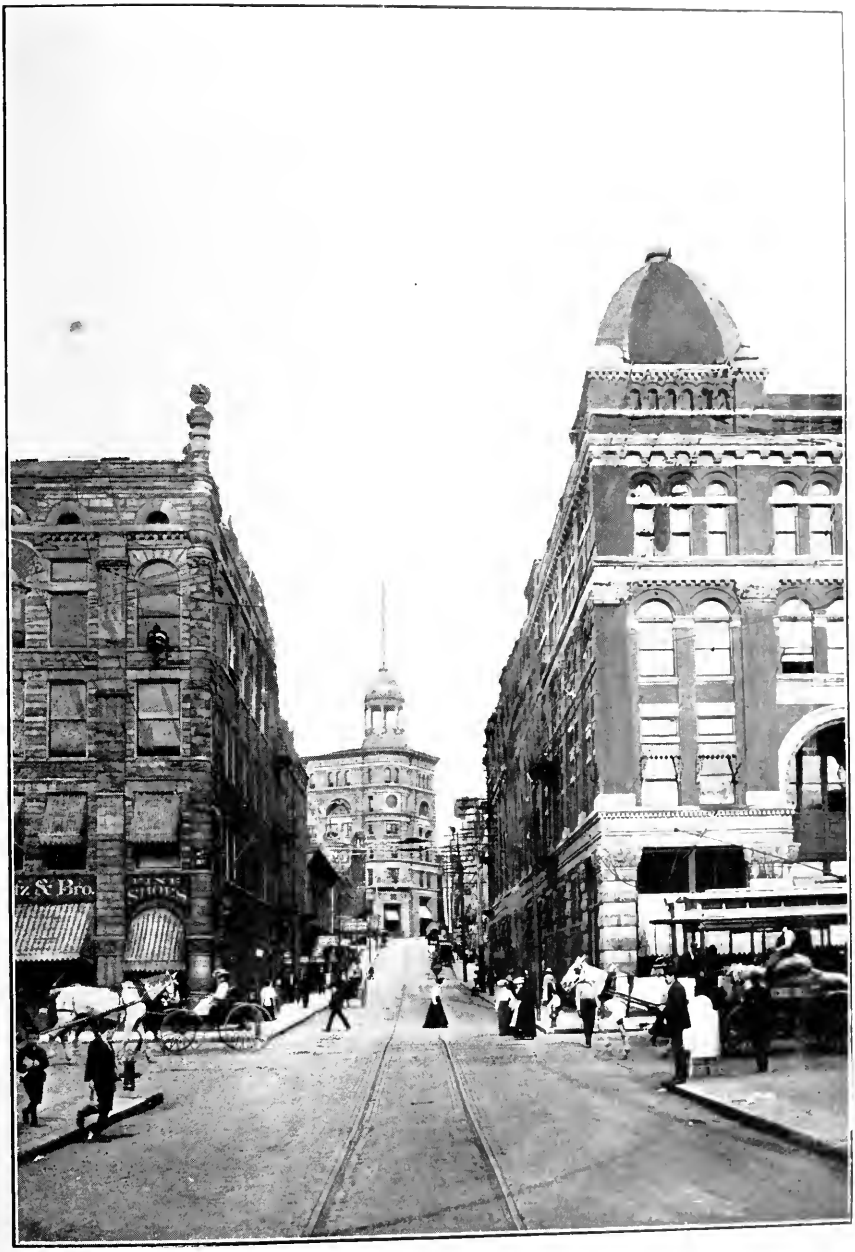
The Chattanooga of today is made up of people from all sections of the Union. After the Civil War many soldiers of both armies settled here to enter again into the pursuits of peaceful life, and as they were about equally divided between North and South, and most of them real soldiers from the ranks, no time was lost in obliterating all traces of sectional feeling in a common effort for the public welfare. Right here on this spot was first completely bridged that bloody chasm which has been the regret of the century to real patriots in both sections of our beloved land, and Chattanooga led the van in a practical policy of reconciliation and fraternal regard on both sides, which has happily relegated sectional prejudice to the past and brought about an era of good feeling among our own people to be no more disturbed, we trust, forever.

In Chattanooga the Confederate Veterans and the Grand Army of the Republic march in procession together to drop a tear over the grave of a comrade and to plant flowers in the cemetery on Memorial Day. The old soldiers set an example which has become the spirit of the community, and it matters not where people come from or what their political or religious opinions are, Chattanooga welcomes all good men and women to the full privileges of citizenship. The sentiment thus encouraged finds expression in our motto, "All for Chattanooga." The best brain and brawn of the North and the South has been contributed to give distinctive character to the inhabitants of the Mountain City.

While a large percentage of our people are American born, the different races and nationalities are well represented. Everybody gets a fair show in Chattanooga.

The city is about equally divided between political parties, and such things as political prejudice and religious intolerance are unknown in the business and social life of the community.

Chattanooga is distinctly a city of homes, and the almost com-



EIGHTH STREET—LOOKING EAST FROM MARKET.

plete absence of the proverbial tenement row is noticeable. Most of the larger factories are located in the suburbs, and the workers employed therein live in the neighborhood and own the residence property which they occupy. Above all things else, Chattanooga is desirable as a place of residence; the people who live here intend to stay, and from this results the natural ambition of every person to own a home. The location of the city is such and the lines of local transportation so numerous that a large area of desirable suburban property is available at reasonable prices, suitable for residences, having all the advantages of city conveniences, but away from and above the noise, heat, dust and traffic of the busy streets. Good wages are paid as a rule, the cost of living is moderate, and desirable residence property can be had on very reasonable terms; therefore, the wage-earner and the small trader in this favored city of the South can afford the luxury of a home and seek repose after the labors of the day under his own vine and fig tree.

These suburban towns are typical American communities, having city water, gas, electric lights and telephones, and their own churches, schools, societies and government.

One of the finest residence streets in the metropolitan district is on the crest of Mission Ridge, fully four miles from the business center, on the ridge electric line. The street just mentioned, as well as a majority of the principal residence streets of the city, is laid with a first-class macadamized roadway, practically free of mud or dust at all seasons of the year.

Many wealthy people doing business in other cities have their residences at or near Chattanooga.

On the terraces in the city and suburbs, and upon the surrounding heights are residences that cost fortunes—residences of stone, of brick, and residences of every material that houses can be built of, surrounded with vines and shade trees, which the gentle climate causes to grow almost without cultivation or any assistance beyond that of nature; and the interior of these homes is even more striking than the exterior, containing as they do all the evidences of culture and refinement.

Chattanooga a Place of Historic Interest—A Great Battlefield of the Civil War

The territory in which Chattanooga is located was a part of the old Cherokee Indian Reservation. In 1834, John Ross, a half-

breed Cherokee chief, established a ferry and steamboat landing at the foot of what is now Market street, just below the Walnut street bridge, and the place was known as Ross' Landing. In 1838 the name of the little settlement which had been established at the landing was changed to Chattanooga, so-called after Chat-a-nuga creek, an Indian name. A town government was established in 1840. The Western and Atlantic Railway was completed in 1849 and the Nashville and Chattanooga the following year, making this point the junction of those lines of communication, destined later to become the line of the advance of great armies into the heart of the South.

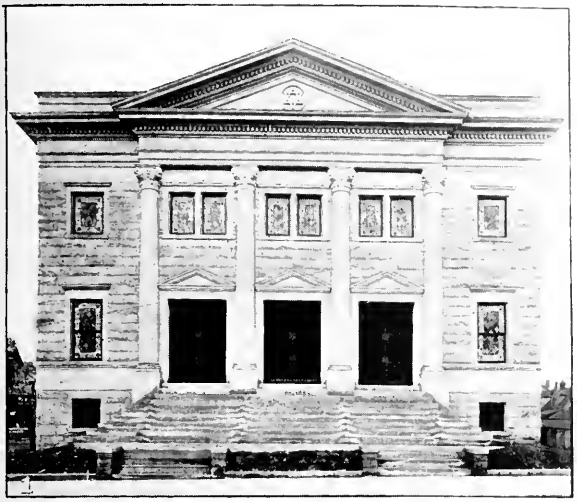
The strategic importance of Chattanooga, from a military point of view, was recognized by both sides early in the Civil War, and it became the objective point of one of the greatest campaigns in that sanguinary struggle. Nearly every great general which the war produced, on the Federal side at least, saw service within the shadow of old Lookout Mountain, which stood as a grim sentinel overlooking this, the military key of the Confederacy. In their ultimate results the Chattanooga campaign and the following Atlanta campaign must be classed as the most important operations of the war, making possible as they did Sherman's march to the sea and a movement from the rear which accomplished the discomfiture of that army, which for four years had successfully resisted and repelled all attacks from the front.

The Chattanooga campaign was the turning point of the war, and the battlefields in this neighborhood include the most stubbornly contested, the deadliest, according to numbers engaged, and certainly the most notable spectacular engagements of modern times. These battlefields, the names of which are familiar to all old soldiers, as well as to students of history, are within easy reach of the city, either by electric cars or carriages. Chickamauga, Wauhatchie, Lookout Mountain, Missionary Ridge and Ringgold are distinct and separate battlefields. Brown's Ferry, Orchard Knob, Sherman's earthworks, Fort Wood, Point Lookout, Cameron Hill and Rossville are points made famous by historical associations. The National and Confederate Cemeteries are the resting places of a vast army of those who died for principles held dearer than life, and whose deeds will shed luster on the fame of American manhood forever.

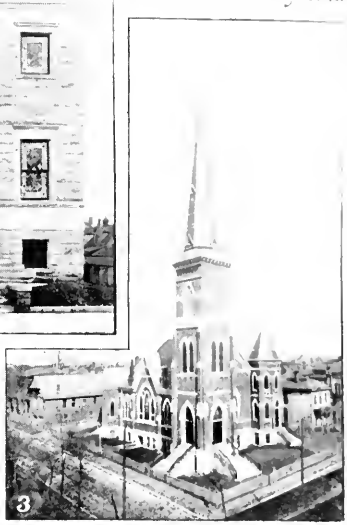
In and about the city the various forts and lines of military works are marked with bronze tablets, as are also the location of

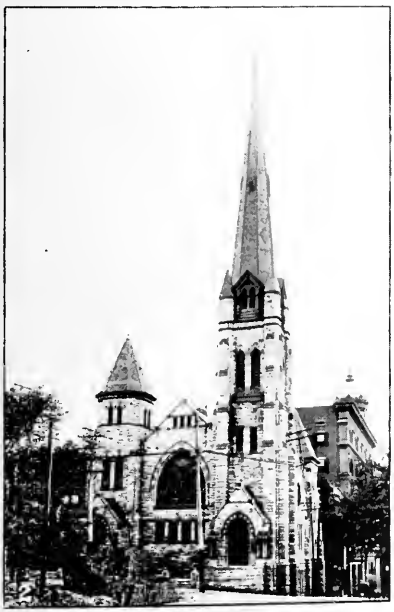
"OAK"—A RESIDENCE STREET IN CHATTANOOGA.

U. S. GOVERNMENT BUILDING.

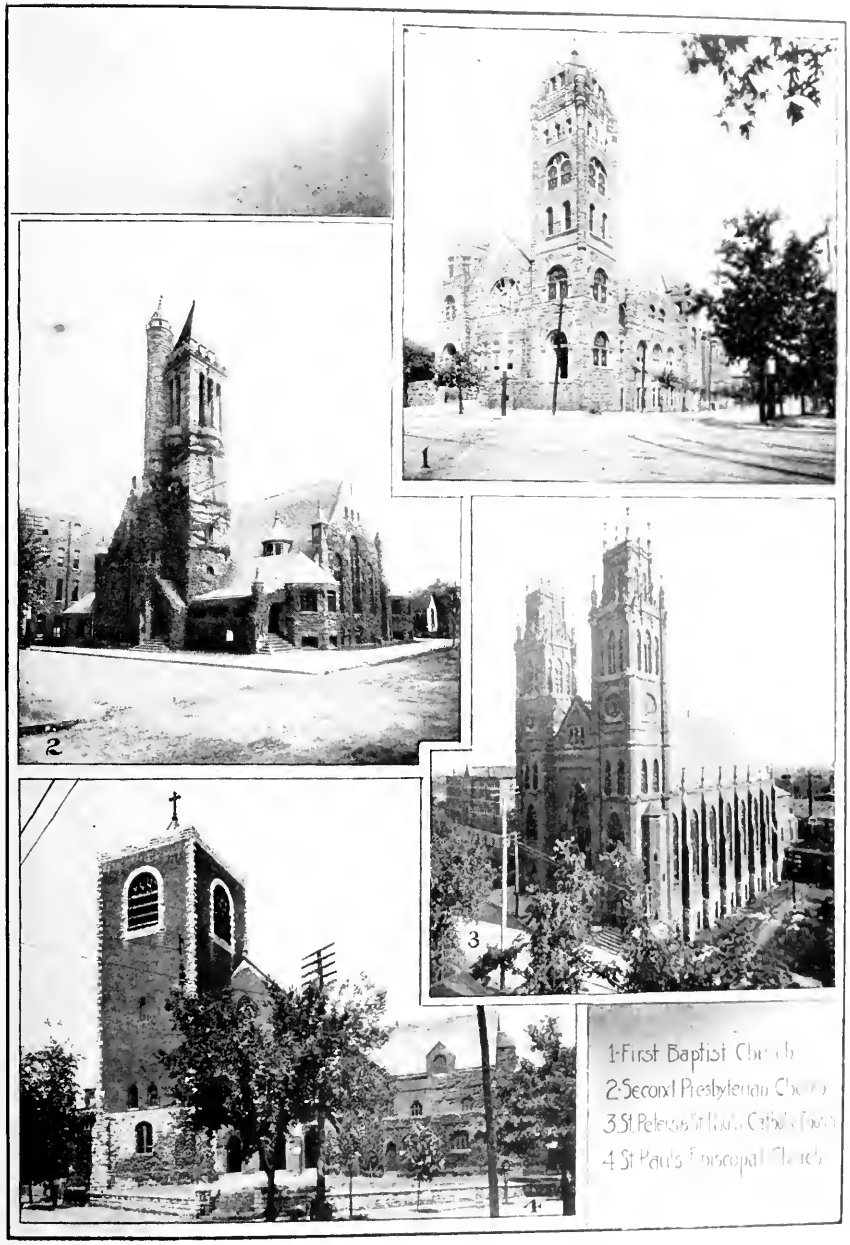


1. Jewish Synagogue
2. First M. E. Church
3 Centenary Methodist
4 Cumberland Presbyterian





HOUSES OF WORSHIP.



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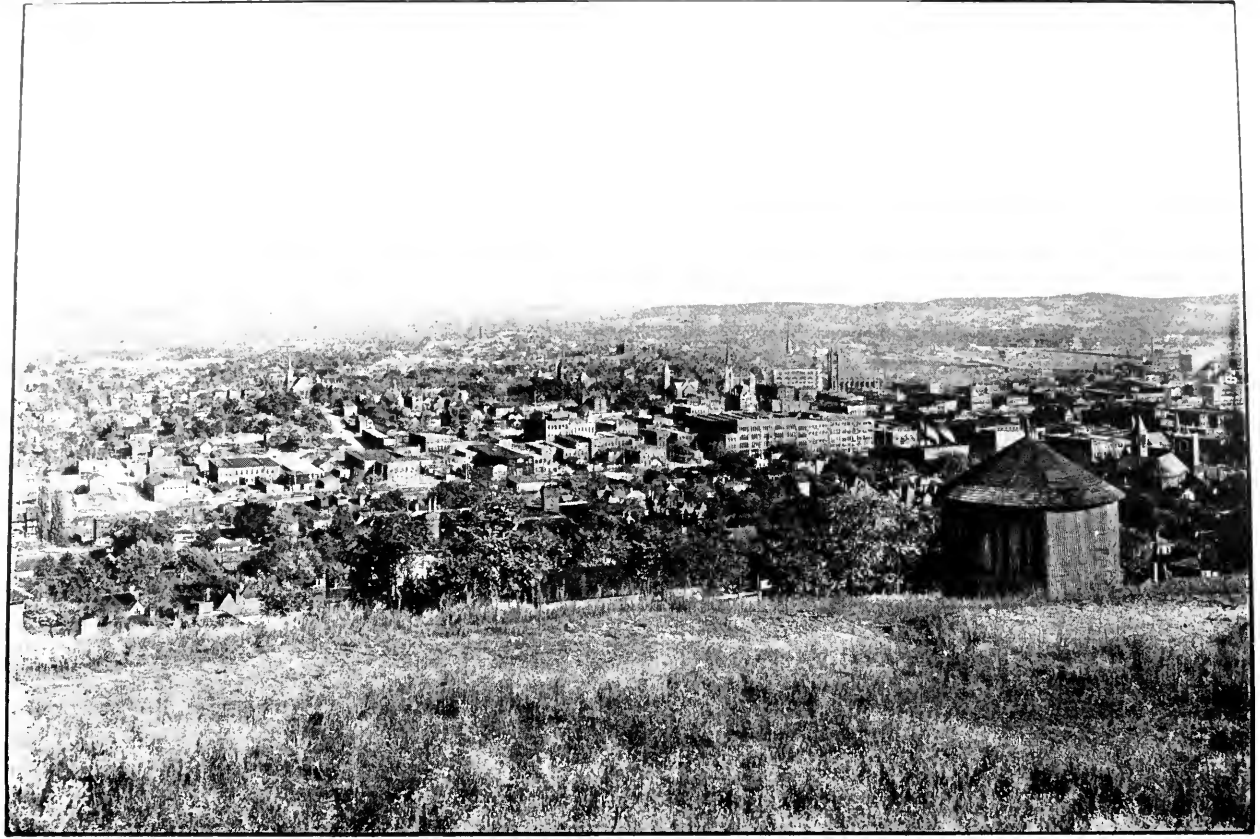
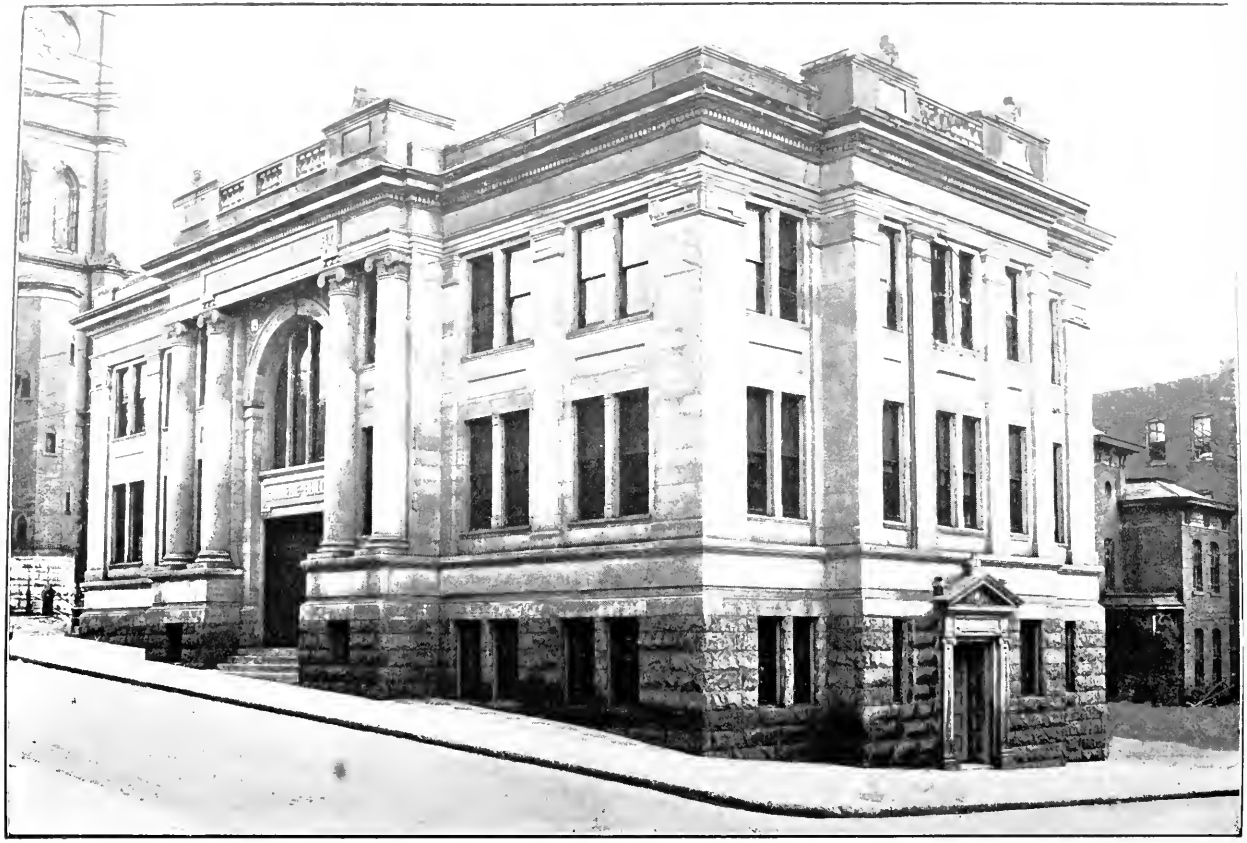
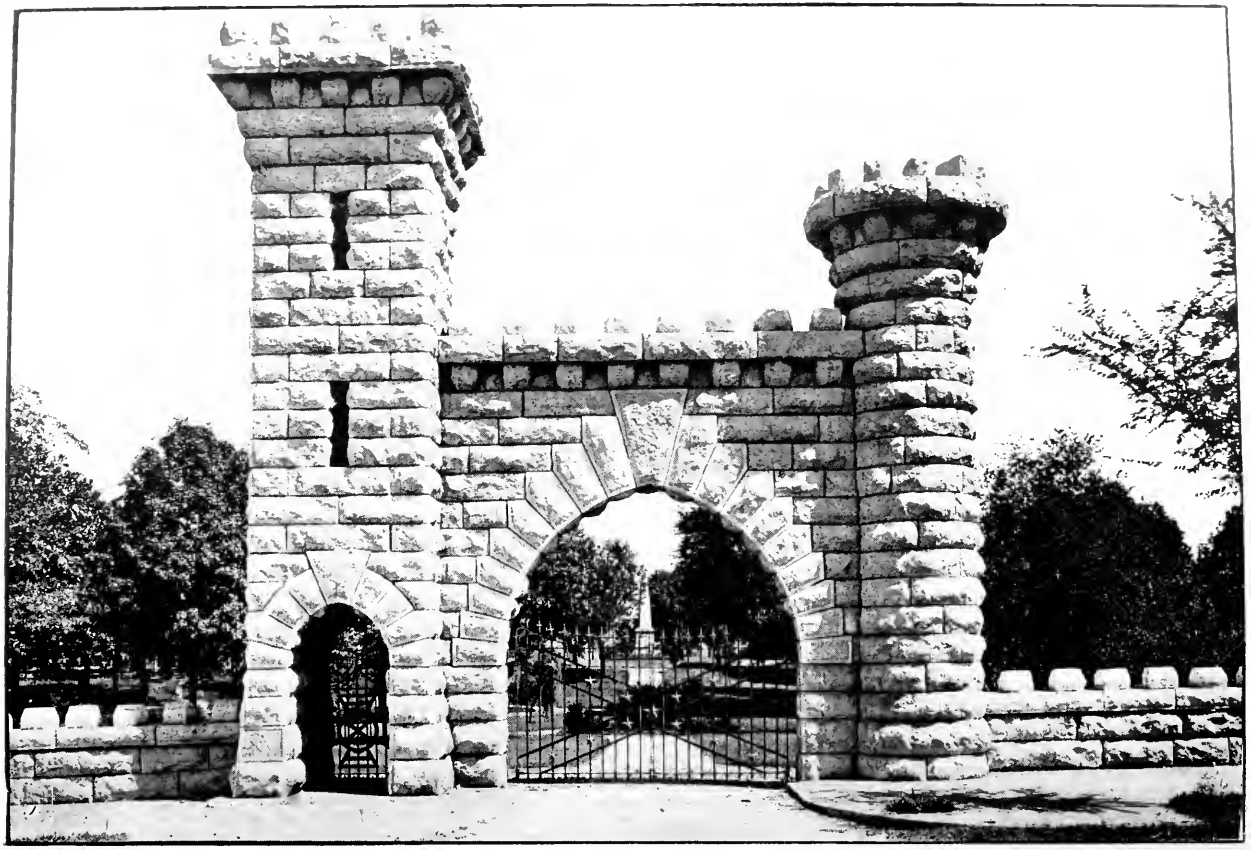


VIEW OF BOYNTON PARK.



CHATTANOOGA PUBLIC LIBRARY, CARNEGIE BUILDING.

FOUNTAIN SQUARE—CHATTANOOGA.



GATEWAY TO THE CONFEDERATE CEMETERY.

hospitals, prisons, batteries and headquarters of the commanding generals.

Among the more noted generals whose names are associated with the operations around Chattanooga are Grant, Sherman, Thomas, Rosecrans, Garfield, Hooker, Logan, Sheridan, Bragg, Polk, Johnston, Hood, Wheeler and Longstreet.

The vicinity of Chattanooga has been selected by the United States Government as the most appropriate location for a great National Military Park to preserve the history of these battles, memorialize the heroes whose lives were lost therein, and to perpetuate the glory won by American soldiers. This park, the greatest of its kind in the world, will be described in the following chapter.

The National Military Park

By General H. V. Boynton

The Chickamauga and Chattanooga National Military Park consists of two distinct parts, the park proper, which embraces the entire battlefield of Chickamauga and the approaches. The area within the legal limits of the park is about fifteen square miles. The approaches in the vicinity of Chickamauga are mainly roads over which the armies reached and left the field. Those about Chattanooga lie mainly along lines of battle. Those over Lookout cross Hooker's battlefield and run near Walthall's, while the Crest road along Missionary Ridge follows Bragg's line of battle in front of General Thomas' Army of the Cumberland and General Sherman's Army of the Tennessee.

All these approaches, as well as the roads within the park, have been rebuilt by the Government in the most solid manner. The Crest road and the Lafayette or State road, from Rossville to Lee & Gordon's mill, are both constructed on a 50-foot right of way. The drive over this magnificent boulevard from Sherman Heights to Glass' Mill, which was the Confederate left flank in the battle of Chickamauga, is twenty miles. The scenery alone, over eight miles of its extent, from the northern extremity of Missionary Ridge to Rossville, is such as will give the drive a national reputation. When to these remarkable charms of valleys, city, river and bold mountains we add a comprehensive and distinct view of the battlefields of Lookout Mountain, Orchard Knob and Missionary Ridge, this drive becomes one that is without parallel. The remaining twelve miles of the boulevard run through the center and touch both flanks of the Chickamauga field, and the whole passes through or in plain sight of the hot fighting ground of the five days' battle between the great armies. The boulevard, like the other roads and approaches of the park, has historical tablets and monuments to illustrate every important point of action on each side in these battles.

The government owns as a part of the park the site of Bragg's headquarters on Missionary Ridge, which juts out toward Chattanooga, opposite the left of the line of assault of the Army of

IN MEMORY OF

the Cumberland. This tract contains five and a half acres, and from it the face of the ridge to a point within a division front of the right of the line of assault can be seen. Upon each of these tracts stands one of the five observation towers which have been erected in the park. The whole of Orchard Knob, which is an isolated knoll about six acres in extent and about sixty feet above the plain, has been made a part of the park. This was the headquarters of Generals Grant, Thomas, Gordon and Granger during the battle of Missionary Ridge, the Knob being located about half way between Chattanooga and the Ridge. The Confederate works, and those erected after the Union forces captured it, are still well defined, and the general appearance of the knoll remains unchanged.

At the north end of Missionary Ridge, including the Tunnel Hill position defended by General Hardee, and the points assaulted by the Army of the Tennessee under General Sherman, is the northern terminus of the park system, being a tract forty-four acres in extent, generally designated with the pretty little suburban town located there as Sherman Heights.

There are also several small tracts and monument locations at Wauhatchie and various other points in and around Chattanooga.

Perhaps the most interesting section of the park is that located on Lookout Mountain, including the Point, as from this spot the whole series of battlefields, roads, river and notable points of interest can be seen, thus giving one a very clear idea of the military operations which resulted in the events which the park is designed to memorialize.

The plan of establishing the park contemplates a restoration of the whole Chickamauga field, as nearly as can be, to its condition at the time of the battle. Except in the growth of timber, its features have changed but little since that time. The old roads, which were those of the battle, have been reopened and improved, and roads opened since the battle have been closed and abandoned. The only natural feature existing at the time of the fight which has been changed is the cutting out of the underbrush. This was absolutely necessary in order to bring the lines of battle into view and to show the topography of the field. As a result of this work, carriages can now drive in all directions through the great forests and along the various lines of battle. Five steel observation towers, each seventy feet to the upper platform, have been erected at prominent points in the park.

Three of these are on Chickamauga field and two on Missionary Ridge. Of the former, one is near Hall's Ford, on the ground where Bragg's army first formed for battle, one is near Jay's saw mill, where the battle actually began, and the third is on Snodgrass Hill. All the towers are in sight of each other, and they thus serve to indicate the relative positions of the various points of the fields of Chickamauga and Chattanooga. The strategy of the campaigns and the movements of the battles are readily understood by the views afforded from them.

The plan of marking the lines of battle is to designate them both by monuments and historical tablets. The Government erects the monuments to the regular regiments and batteries, and the tablets. The erection of monuments to mark the positions of volunteer organizations is left to the states.

The historical tablets are of iron with the lettering cast as part of the plates. They are each four feet by three. They are of several classes—as those for army headquarters, corps, divisions and brigades. The historical tablets each present from 200 to 300 words of test, setting forth in condensed yet comprehensive form the movements at the points where they are erected. Both sides have equal attention in the erection of these tablets. The only distinctive mark is the letter "U" for Union, in the upper right hand corner, and the letter "C" for Confederate.

Besides the large historical tablets, there are guide tablets at every cross road, giving distances and direction to the prominent points of the field, and many locality tablets marking the sites of houses and fields which were land-marks in the battle, points where prominent officers were wounded, and where notable captures of prisoners or guns occurred.

The fighting position of all batteries are marked by guns of the same kind used in battle, mounted upon cast iron carriages, painted so as to be an exact representation of the carriage of 1861.

The spots where general officers, or those exercising the command of a general officer, were killed or mortally wounded, are marked by triangular pyramids of eight-inch shells, ten feet in height. A tablet on each gives name, rank and army of the officer killed.

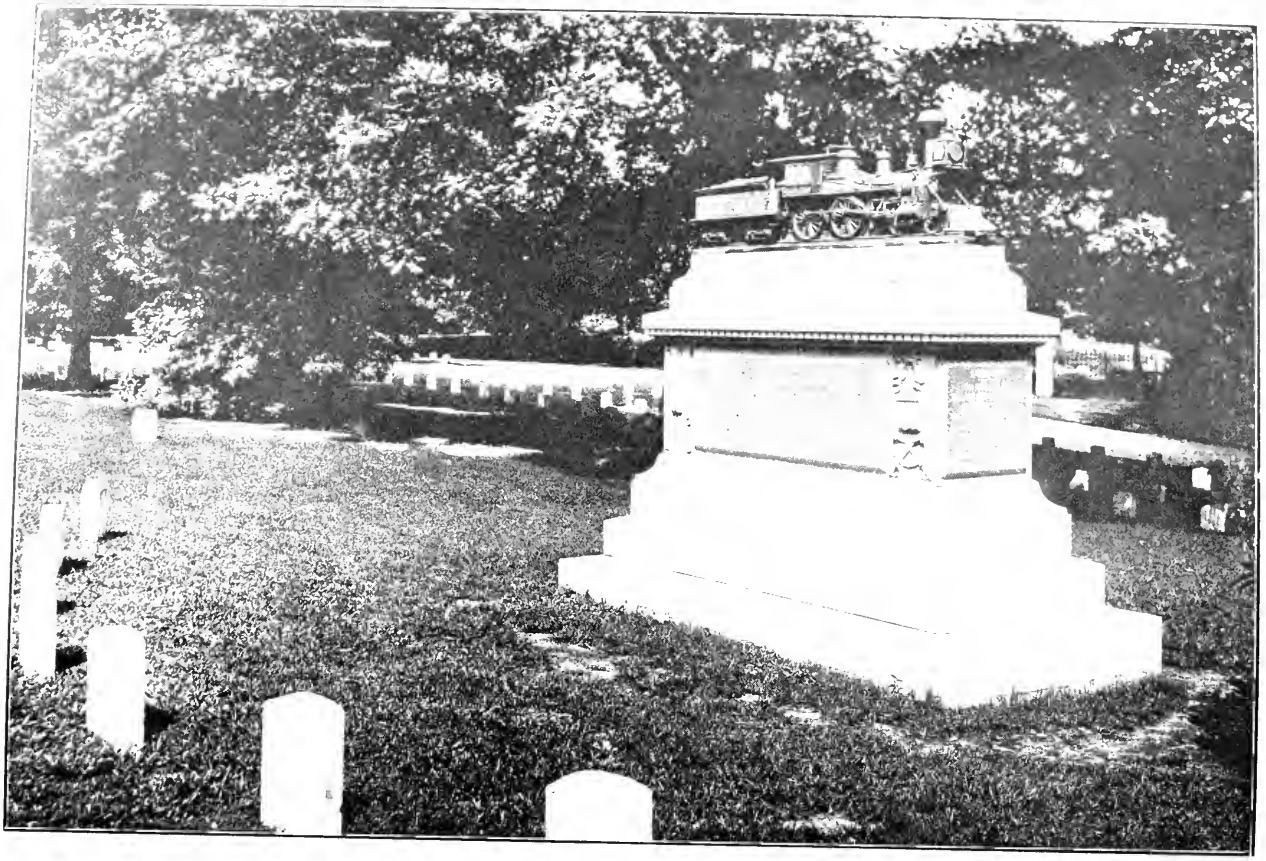
The lines of the rude works used by each side in various parts of the field have been restored. All the lines of each day's battle are marked. As a rule the regimental monuments are erected where the representatives of the regiments think the organizations made

WHERE THE BROTHERHOOD HONOR CHIOZZA AVENUE

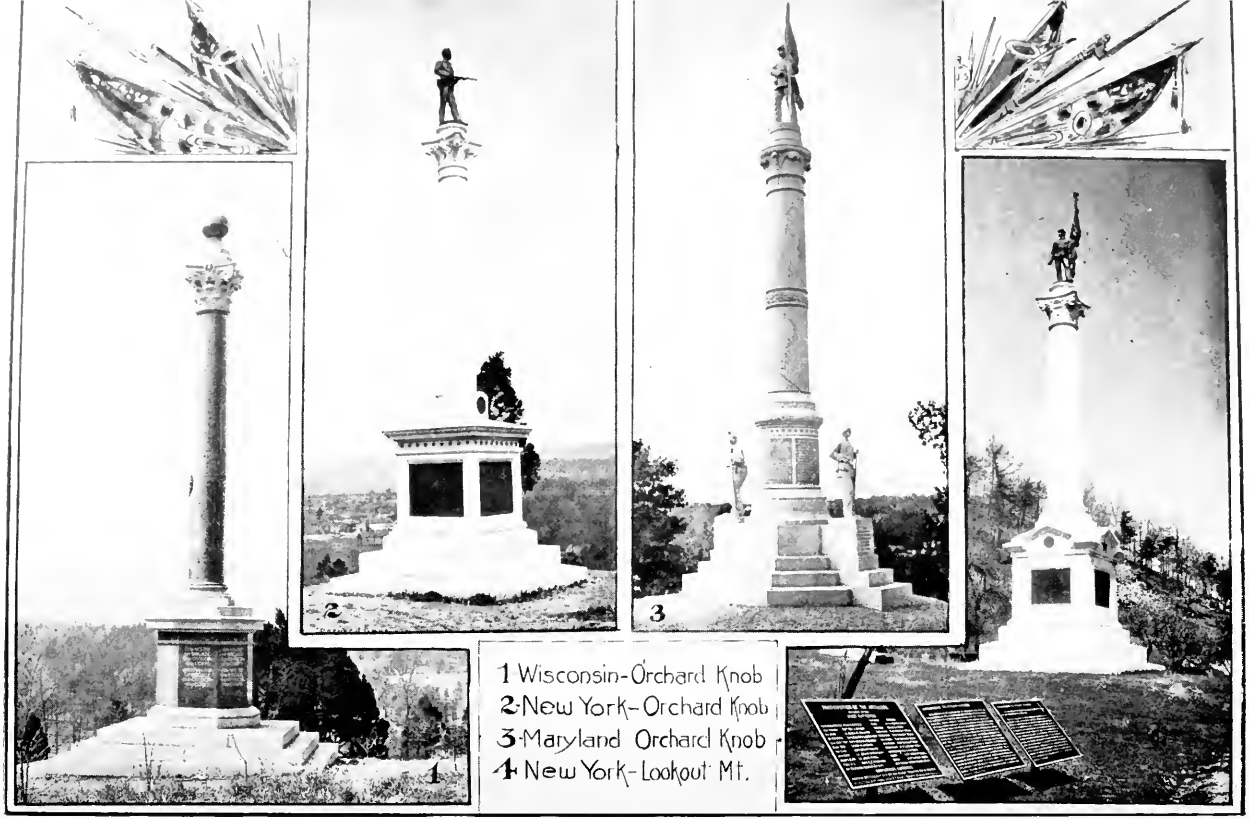
SNODGRASS HOUSE, CHICKAMAUGA PARK.

THE POE FIELD, CHICKAMAUGA PARK.

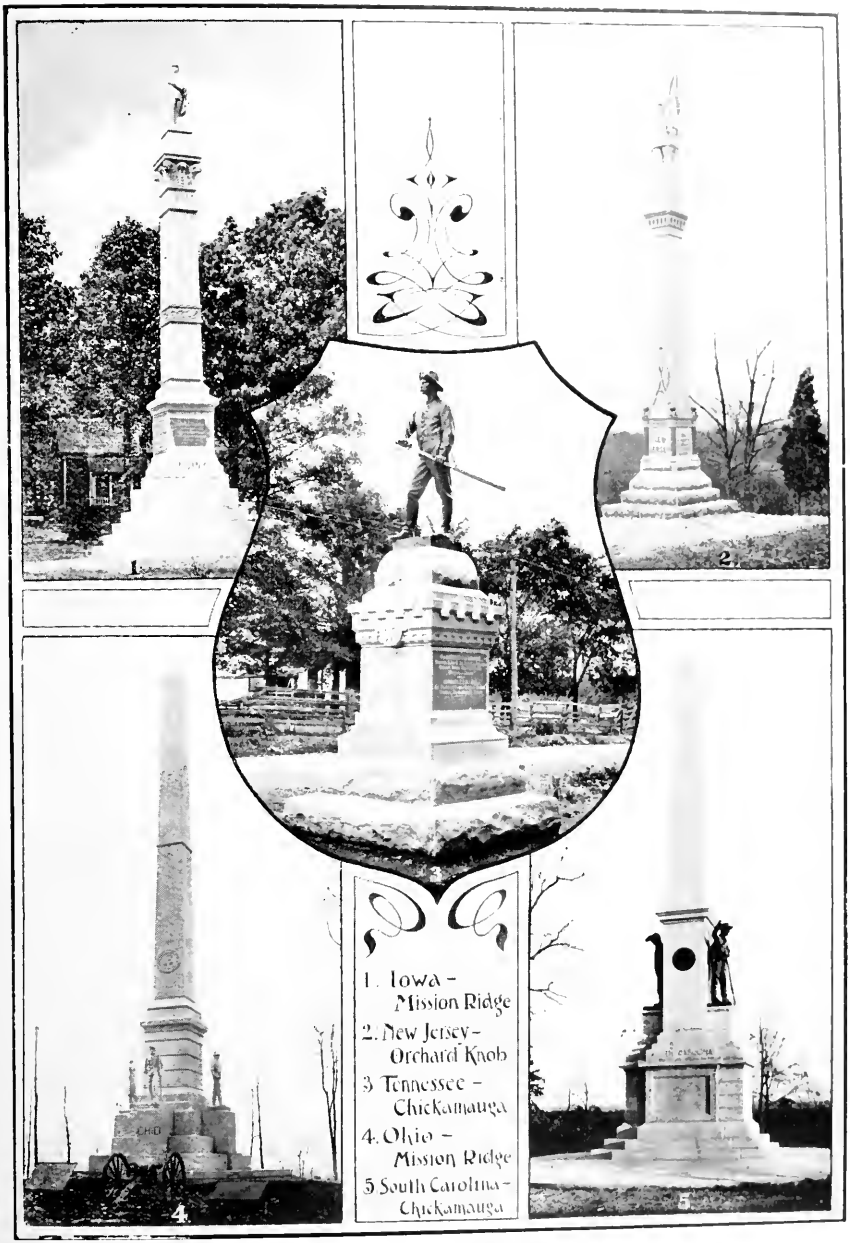
ORCHARD KNOB—GRANT'S HEADQUARTERS.



ANDREWS RAIDERS' MONUMENT—NATIONAL CEMETERY.



MONUMENTS OF STONE AND BRONZE.



TRIBUTES IN BRONZE AND STONE.

OBSERVATION TOWER—BRAGG'S HEADQUARTERS.

the most notable record, and other positions are designated by granite markers.

It will thus be seen that the field is thoroughly marked, and that not only general movements, but those of every regiment and battery can be followed through the battle, and that the park is a most complete object lesson in war.

The battle of Chickamauga was one of the best illustrations of pluck, endurance and prowess of the American soldier which the war afforded. Measured by the percentages of losses, and the duration of the fighting for the various portions of each army, it was the deadliest battle of modern times. Its strategy will always be notable in the history of wars. So far as the occupation of the field is concerned, it was a Confederate victory. Considering the objects of the campaign, it was a Union triumph.

The battle of Chattanooga was the grandest spectacular engagement of the war. Its features appear in as bold relief as do Lookout Mountain and Missionary Ridge upon the fields which they dominate.

Twenty-nine of the thirty-three states east of the Rocky Mountain, which comprised the Union at the outbreak of the war, had troops engaged in these campaigns, and five of them were represented on both sides. It was this universal interest of the country and its armies in these battles, the brilliancy of the strategy, the unsurpassed pluck of the fighting, and the wonderful natural features of the fields of battle, which made it possible to secure the unanimous support of Congress for the project of establishing the Chickamauga and Chattanooga National Military Park. It was the pioneer project in giving impartial representation to both sides in preserving the history of the fields and marking the lines of battle. The veterans and the great army societies, North and South, have taken an active interest in the park, and the several states have erected and are erecting monuments to their organizations in various portions of it which are unsurpassed for beauty and magnificence. These monuments and other improvements at the park must be seen to be appreciated.

Chattanooga lies at the center of this extended theatre which the Government is covering with historical work. Twenty minutes by train takes the visitor to Wauhatchie, Chickamauga or Sherman Heights, and the same time by Rapid Transit electric cars, while the city electric lines reach Orchard Knob, Missionary Ridge. Bragg's Headquarters and Lookout Mountain.

Lookout Mountain

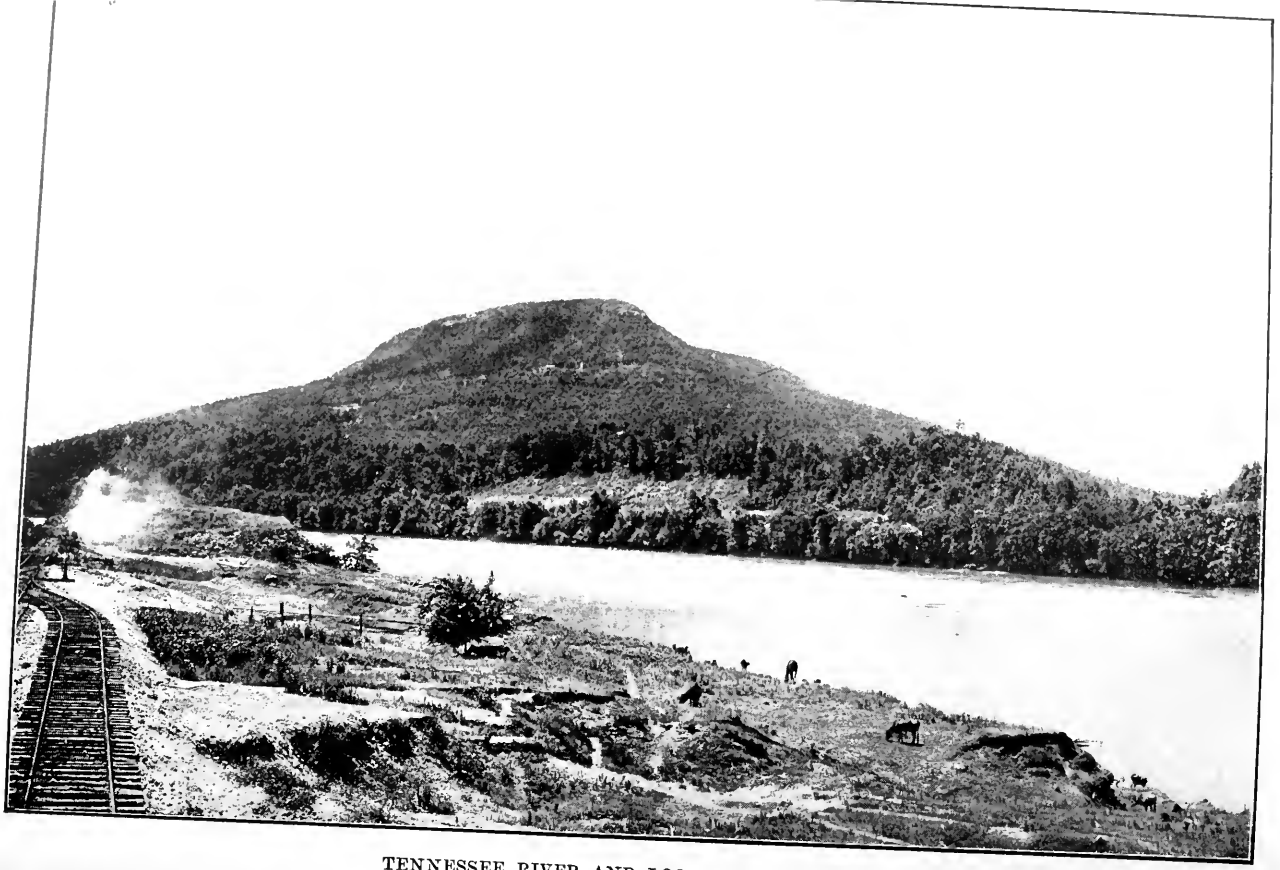
Lookout Mountain stands 2,000 feet above Chattanooga, almost overhanging its corporate limits, with its foothills forming the city's nearest suburb. Its summit is reached within thirty minutes from the business center of the city by two incline railways and electric cars, connecting with all passenger depots in the city, by which means the trip to the mountain can be made in forty-five minutes.

The mountain has been greatly improved, and is today one of the most desirable resorts for the enfeebled, the overworked or the pleasure seeker upon this continent. Lookout Inn is perhaps the most magnificent hotel upon a mountain in this country; it was erected at a cost of $250,000, contains nearly 500 guest chambers; it is elaborately and richly furnished throughout; equipped with all modern conveniences, heated by steam, lighted by electricity and gas, supplied with running water and is furnished with every comfort and attraction that modern ingenuity and generous hospitality can devise.

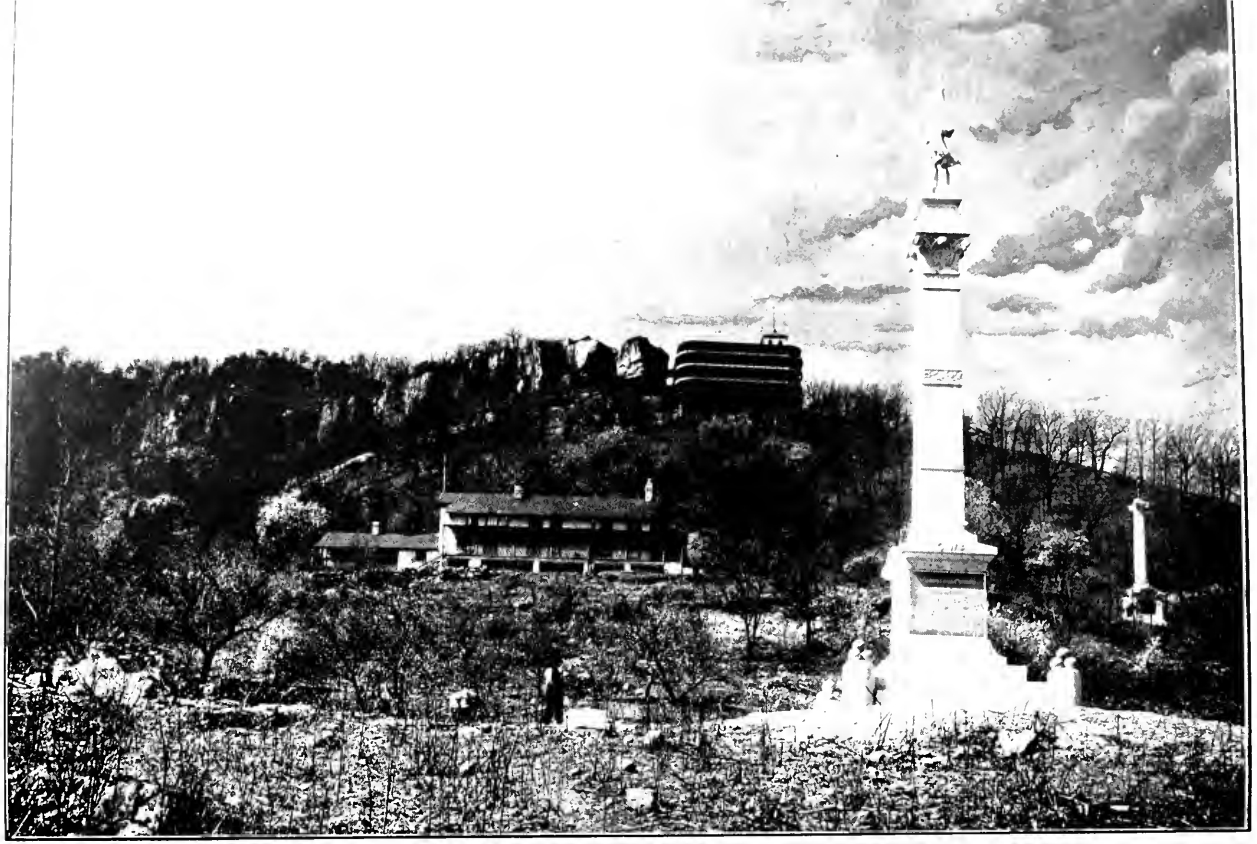
Broad, well built boulevards traverse the mountain plateau for miles; the streets are underlaid with water and gas mains; telephone and electric wires are strung to the scores of ornate cottages that line the shaded streets and roadways, and everywhere there are all the comforts and conveniences of city life.

The most beautiful spots upon the brow of the mountain have been preserved for parks; it is quite likely that the United States Government will purchase the chief reservation at "The Point" of Lookout Mountain to make it a fitting completion of the magnificent plan of the Chickamauga-Chattanooga National Military Park.

Among the mountains called of battle, Lookout deserves the first place in any history of the Southern Appalachians. Before the first Anglo-Saxon saw its wooded talus and gray-green cliffs from the opposite crest of Walden's Ridge, it was the battle-ground of the red men. The warlike Cherokees and their kinsmen, the Chickamaugas, dwelt in the valleys 'round about, and on its slopes their war parties made good against their tribal enemies their claim to the ownership of the "Far-Look" mountain. The precipitous cliff



TENNESSEE RIVER AND LOOKOUT MOUNTAIN.



"BATTLE ABOVE THE CLOUDS," CRAVENS HOUSE, LOOKOUT MOUNTAIN.

at its northern extremity was their signal height. The smoke of the alarm fire rising from its summit was the warriors' call to arms.

In the early settlement of Tennessee the cliff-crowned mountain at the toe of the moccasin became the battlefield of the races. Defeated in the great valley of East Tennessee, the Indians retreated to their fastness on Lookout; and on the western slope of the mountain within sight of a greater future battlefield, was fought the last decisive conflict with the allied tribes. John Sevier won it and broke the organized strength of the red men, but for many years afterward the pioneers, drifting down the Tennessee from the older settlements on its headwaters, to the fertile valleys beyond the Cumberlands, watched furtively for the first glimpse of the sentinel mountain standing grim and silent at the portal of the ninety-mile gauntlet through the gorges. If the sky line was clear, all went well, but if a column of smoke was hanging above the signal height, the hardy adventurers looked to their arms, refilled the priming pans of their rifles, and made bulwarks of the cargo to protect the women and children during the running fight which would begin at the overhanging bluffs of the great mountain.

A peaceful half century followed the dying out of the last Indian signal fire on the Point Rock, and then the distant murmur of a fiercer tide of conflict echoed from the cliffs of Lookout. One lambent autumn day the tide of civil war poured over the passes of the Raccoon to submerge the fields in Will's Valley and to rise in billows of blue on the slopes of the historic mountain until the marching thousands of Rosecrans' left wing caught their first glimpse of Chattanooga and Missionary Ridge from its wooded summit.

The tide flowed onward, and a few days afterward the eastern pallisades of Lookout flung back the thunders of Chickamauga to Chattanooga Valley. Then the tide surged backward, and when the lines of circumvallation had been drawn about the beleaguered city in the great bend of the river, the bosom of the old mountain was scarred and furrowed with the intrenchments of the besieging army, and from summit and half-way height the batteries hurled their messengers of death down upon the armed hosts in the valley.

The final act in the historic mountain's tragic drama was played on that November day when the mists of the valley thickened into sweating clouds on the wooded slopes, and Lookout hid its face as if to shut out the sight of carnage. All the world knows how

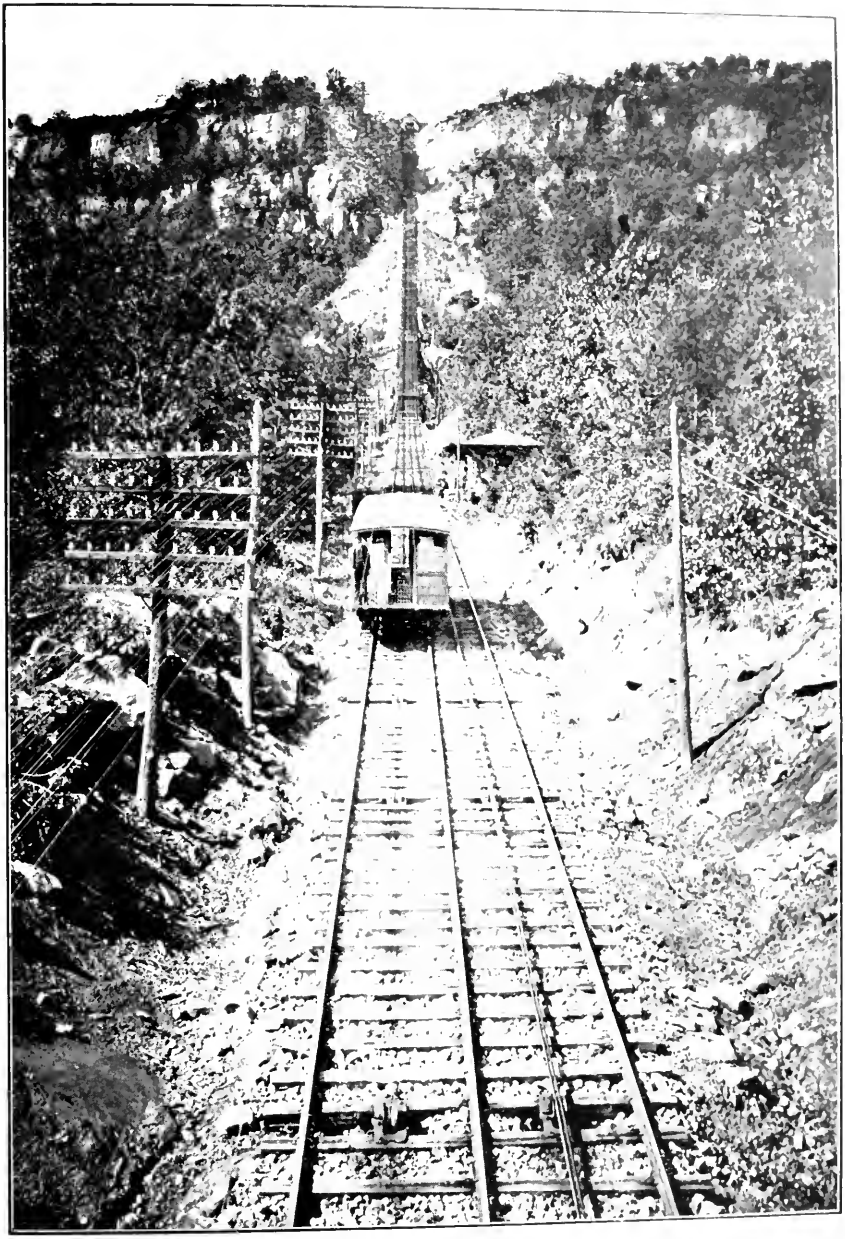
"the battle above the clouds" was lost and won, what deeds of heroism and brilliant courage were there enacted, and many a curious pilgrim has since stood upon the time-worn signal cliff to gaze down upon the scene of the mountain's final conflict.

The scars are healed now. The breastworks have become grassy mounds, and the sightseer has to be guided to the redoubts from which the bellowing cannon played upon the city, spread out in the valley below. But after the spring rains have washed away the litter of the year, the children, gathering arbutus and the fragile wind flowers on the slopes of the ancient mountain, find broken arrow-heads bedded in the mellow earth side by side with battered minie-balls and fragments of shattered shells; relics of the earlier and later struggles whose din has been re-echoed by the gray cliffs of old Lookout.

What pen can portray the matchless beauties that are unfolded from the mountain heights? At every spot upon the brow, a bewildering panorama of landscape stretches forth. There are loftier mountains, more sublime stretches of precipice and beetling cliffs, taller peaks and deeper gorges, but there is no spot on this western world where beauty is so charmingly united to sublimity, or where one's soul is so thrilled without being awed by appalling surroundings; where the limpid lyrics of nature are so interwoven with her epics, where the melting hazes of purpling landscape dissolve into majestic stretches of towering peaks; where nature frowns and smiles, and wooes the enchanted beholder, thrilled by the glories and the majesty of God's handiwork.

MOCCASIN BEND FROM POINT PARK.

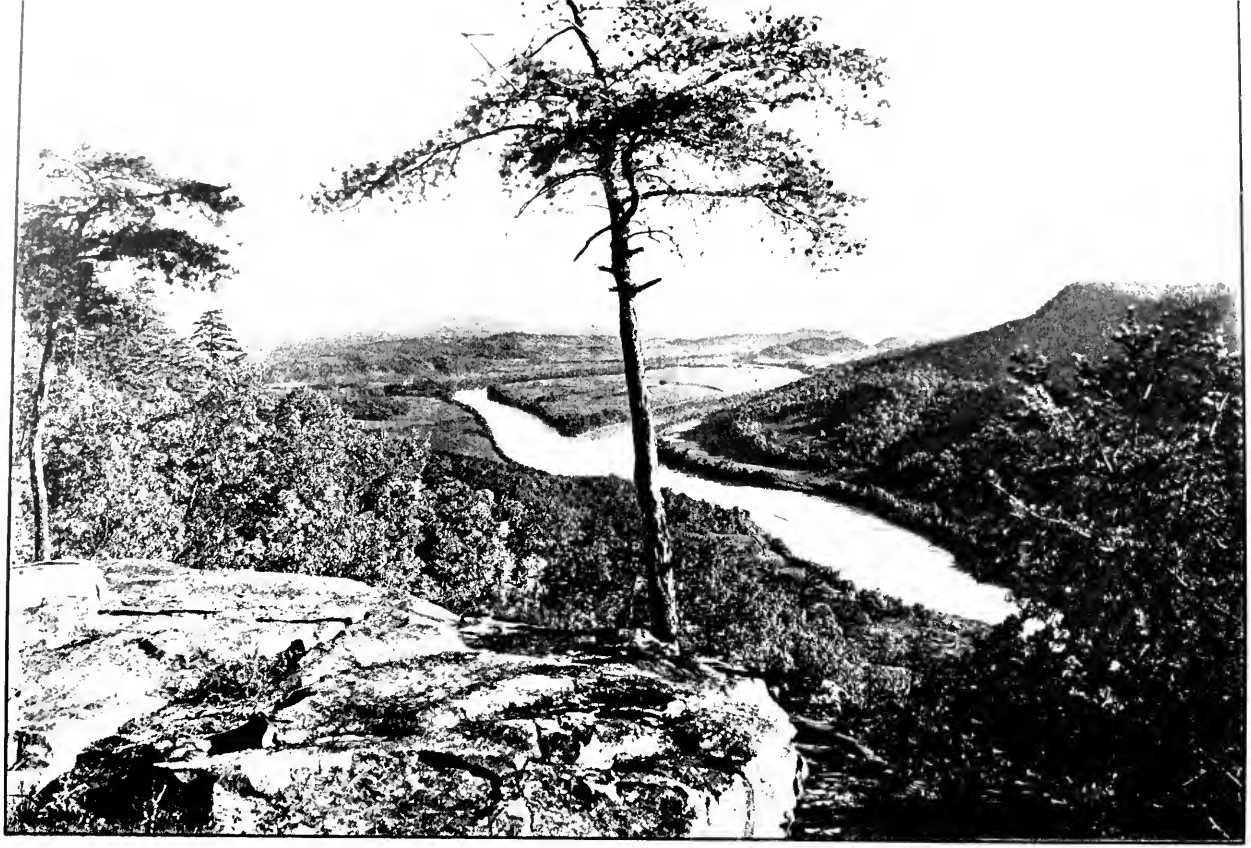
CHATTANOOGA'S THERMOPYLAE.



LOOKOUT MOUNTAIN INCLINE RAILWAY.

SUNSET ROCK—LOOKOUT MOUNTAIN.

ENTRANCE TO POINT PARK—LOOKOUT MOUNTAIN.



VIEW FROM SIGNAL POINT, WALDEN'S RIDGE.

SLOPE OF MISSIONARY RIDGE—DE LONG'S POINT.

The Chattanooga Campaign

Chattanooga early heard the tread of feet hurrying to war, and in the spring of 1862 the city was occupied by the Confederates. But its inhabitants did not foresee the magnificent battle-play which was to be staged in the woods, valleys and heights nearby in 1863 when Rosecrans followed Bragg from Middle Tennessee.

Like the impatient clamor of a waiting audience came the sound of Wilder's shells from Stringer's Ridge into the city on the 21st of August, leading up to that 9th of September when the last trooper in gray rode out and the men in blue came in, and the stars and stripes went up on the old Crutchfield House.

On Saturday and Sunday, September 19th and 20th, 1863, the opening scenes of the first act were played on the field of Chickamauga, nine miles away, beyond Missionary Ridge, in Georgia.

From the lines of Rosecrans and Bragg, extending some three miles north and south to struggle for the LaFayette Road, and engaged through so much of their length, came at intervals the swelling and subsiding roar as the battle shifted, waxed and waned, through Saturday, the scene opening with the first clash of arms in the morning as Croxton's brigade and Forrest's cavalry met in the woods, the curtain falling with the firing in the dusk at the flashes of each others' guns when Cleburne dashed at the breastworks in his attack on Baird and Johnson.

Then came the sad intermission through the night, unlit by camp fires, so close were the lines, but broken by the sound of Rosecrans' axes busy on defenses for the morrow, while the wounded groaned near the bodies of the dead, and soldiers of both armies felt how great was their chance of soon joining their mangled comrades.

Sunday morning Breckinridge opened the second scene of the act on the Confederate right at the north, and as the command "forward" went down the line Bragg's divisions moved in swift succession to the attack, grappling and struggling as on the former day, till before noon came the breaking of the Union center, the forcing back of the Union right and that tide of disaster which swept so much of the Federal army in the wreck before it, till

Thomas at Snodgrass Hill saved defeat from becoming utter rout. Longstreet's veterans in overwhelming numbers charged the men in blue, only to be beaten back in that bloody, stubborn fighting which has passed into history. Thomas' men were at last about to be driven before the crushing weight of superior numbers, when unexpected aid from Granger and Steedman and reinforcements from the hard-fought region of the Kelly Field came to help them make good the defense. Then, the coming of night, the withdrawal of the last of the Union troops, and the curtain descends on the last scene of the first act, closing a two days' struggle whose ghastly record of killed and wounded throws into shade some of the bloodiest battles of the old world.

And now came the long and anxious intermission between the acts, the Union army remaining shut up in Chattanooga, while from Lookout Mountain and Missionary Ridge the besieging Confederates watched the beleaguered Federals hemmed in by hostile cannon and a prey to threatened famine.

Two months of waiting, and the curtain is ready to rise on the first of the three-day scenes of the second act, staged so grandly before Chattanooga. Bragg's army holds its strong positions, but its brave ranks are weakened by sending some of its men elsewhere. The Union army, Grant now in command, is rested, reinforced, confident and eager. The first scene closes with the men in gray driven from Orchard Knob. The second, on the next day, that famous struggle so often called the "Battle above the Clouds," sees Hooker on rugged Lookout Mountain pushing Walthall up the side and over the slope at the Cravens House. The third scene comes on the following day, that memorable Wednesday, 25 November, 1863, opening with Sherman thundering at the north end of Missionary Ridge, but held back by Cleburne's stubborn defense. Later Hooker reaches Rossville Gap and sweeps northward, driving before him this weak part of Bragg's Missionary Ridge line, and Grant on Orchard Knob gives the order for Thomas' troops to take the foot of the Ridge, and then comes that historic charge where the men in blue after storming the foot of the Ridge swept on to the crest, breaking the line in six places and taking the Ridge in an hour from the order to take the foot. The valor of the American soldier is the glory of the American people, be the uniform what it may. The same pride we feel in Thomas, Granger and Steedman, Brannan and Van Derveer, and all the brave men, whether bearing swords or bayonets, who saved the day from utter

GOVERNMENT BOULEVARD—MISSIONARY RIDGE.

PART OF 13,398 SOLDIERS' GRAVES, NATIONAL CEMETERY.

disaster at Snodgrass Hill, is ours at thought of Bate rallying the retreating fragments of the beaten army and sternly standing at bay, grappling with Sheridan; of Stewart fighting front, left and rear, and only retreating before being entirely surrounded as darkness was coming on; of Walthall, the day hopelessly lost, still struggling on the crest till night stopped the battle.

But despite all valor the retreat streamed into Georgia; by bedtime Bragg's army was beyond the Chickamauga, and the curtain had run down on Chattanooga's great battle-drama.

Hamilton County

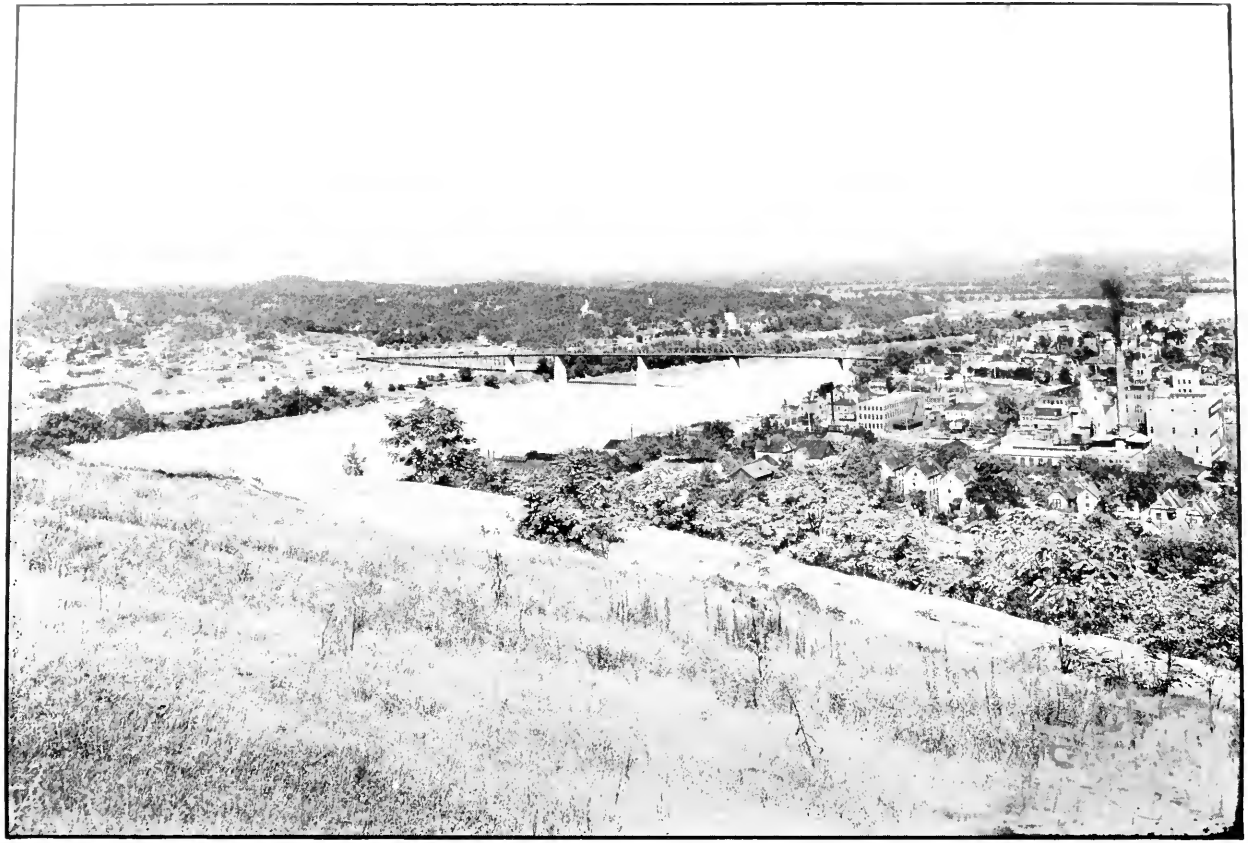
Products of the County

Hamlton county contains an area of about five hundred square miles, and is almost bisected by the Tennessee river; it is well watered by innumerable creeks that flow toward the river at every point in the county. The difference in altitude between the table lands of Walden's Ridge and the alluvial river bottoms is about one thousand five hundred feet; this is equivalent to four degrees of latitude, giving to the elevated ground the climate of Southern Ohio, along the hillsides that of Kentucky.

The soil formations are of very great variety, beginning at the river bottoms, changing into the various alluvial formations, the chocolate and red clay soils, and these again joined and mixed with another variety of flinty gravel or magnesium limestone soil. The soil holds moisture to a surprising degree, and is uniformly valuable for tillage, though varying materially in appearance and character. As a whole it may be classed as undulating land, hilly land, mountain land and bottom. Much of it is well timbered, but may be easily and profitably cleared.

The ridges and hills about Chattanooga are peculiarly well adapted to the growth of strawberries and other small fruits, as well as vegetables. The mountain lands are well adapted to the growth of apples, pears and also potatoes, especially for winter use. Pears, plums, cherries, apricots and quinces all grow successfully and bear well. Clover, timothy and herd grass are produced on the river bottoms very successfully and a considerable amount is marketed. Millet, red top, timothy and clover are successfully raised in the county. Sugar cane, sowed thickly yields largely, and three crops may be cut from one season's sowing, making an excellent feed. Another excellent feed article known as keifer corn, grows very successfully; it has a slender stalk and leaf, but resembles corn, with top seeds, and is exceptionally fine for poultry.

Stock raising is becoming more general than formerly in the county. Mules, horses and cattle average well. Good results are being had in sheep raising, especially on the high and hilly land.



THE COUNTY BRIDGE FROM BOYNTON PARK.

The county is well adapted to poultry raising, and the business has been very successfully prosecuted. Chickens, turkeys, guineas, peafowls, geese and ducks thrive, are free from disease, yielding a large egg product.

Roads and Bridges of Hamilton County

That part of Hamilton county lying north of the Tennessee river is divided by a natural topographical division into two nearly equal parts. This dividing line does not trend exactly north and south, but about twenty degrees east of north, and is the eastern escarpment of Walden's Ridge, that magnificent table land of the East Cumberland, which rises grandly between the valleys of the Sequatchie and the Tennessee. That part of Hamilton county lying south of the Tennessee, having the same general characteristics as the north, is especially distinguished by Lookout Mountain, standing like a mighty sentinel over the fertile Lookout Valley on its left and Chattanooga Valley on its right.

To the east, across the broad and open Chattanooga Valley, cradling its busy city of over seventy thousand people, we have the historic Missionary Ridge. To the east of Missionary Ridge we have the undulating plain of the South Chickamauga. Thus we do not only have on the north side of the Tennessee the Cumberland tableland, with its peculiar adaptability to the raising of orchard fruits, but the alluvial river bottoms as well, stretching along thirty miles of river front and yielding its immense harvests of corn, oats and wheat.

On the south side of the river we have all the varieties of soil, from the rich limestone wheat producing soil of the Lookout Valley, to the mulatto soil of the chert formation (which is pronounced the best anywhere for the production of strawberries and small fruits), to the red lands east of Missionary Ridge, which for general farming purposes cannot be excelled.

Hamilton county, Tennessee, being endowed with this generous variety of arable soils, capable of supporting the great city which Chattanooga, by reason of her geographical situation is destined to become, the question of accessibility—of roads making accessible this territory for the diversified interests of a people and enabling capital and enterprise to develop the natural wealth lying within our borders, becomes one of paramount importance.

The subject of better roads for Hamilton county was first effectively agitated in 1876, at which time the present system of mac-

adamized roadways, which now radiate from the county seat, was begun. Today one hundred and fifty miles of macadamized and graveled thoroughfares stand as a monument to the enterprise of the citizens of Hamilton county, costing in the neighborhood of $375,000. The Rossville Pike, the first essay in permanent road building attempted by the county, extends south from Chattanooga to Rossville, just beyond the Georgia state line. This road, connecting with the principal thoroughfare to the Chickamauga and Chattanooga National Military Park at Rossville, Ga., is a favorite with cyclists, the destination being the above mentioned park, where the National Government has already spent a million of dollars laying the foundation of the greatest military park on the continent.

To the east, two broad thoroughfares, Montgomery and McCallie avenues, connect the city with the Government Boulevard, eight miles in length, on the crest of Missionary Ridge, and continue on by easy grades to the southeastern and eastern limits of the county, respectively, about ten miles distant.

Thirteen miles northeast is situated the town of Harrison, noted as having been the county seat from 1840 to 1870. The Harrison Pike was one of the earliest of permanent roadways, and renders accessible an immense section of fine farming lands, skirting the east side of the Tennessee river. To the north, crossing the Tennessee river is Washington road, which has been completed to the town of Sale Creek, a distance of twenty-eight miles. This thoroughfare, connecting the thrifty towns of Daisy, Soddy, Retro and Sale Creek, represents, including the subsidiary roads built in connection with it, an expenditure of about $42,000. Leaving this road to the east soon after crossing the river, we have the Dallas road, which has been completed to a point beyond Hixson, and will ultimately connect with Dallas. To the left we have the Anderson Pike, leaving the Washington road at Mountain Creek. The Anderson Pike ascends Walden's Ridge by easy grades, amid scenery of ever increasing grandeur until, surmounting the cliffs at the summit, one beholds the broad Tennessee Valley below him with its tracery of stream and road and checker work of cultivated fields. Should the beholder possess a practical mind he cannot help remarking the wisdom and liberality of a policy which has thus rendered accessible the many acres of mountain land to the seeker of healthful homes, as well as to the far seeing investor of capital.

Still further north another road leaves the Washington road at

CHEERFULNESS WITHOUT CASH.

Daisy. This road ascends by the side of the ridge at a grade of seven feet in one hundred, taking the place of the old road at this place, which ascends by the most prohibitory grades of eighteen to twenty-seven feet per hundred, and hence constitutes an object lesson, illustrating the old and new systems of road construction. To the west and southwest of the county seat we have a network of roadways that are the admiration of the visitor to our picturesque environment.

Lookout Mountain offers its graveled boulevard, rivaling the famous shell roads of Mobile and New Orleans, to the tourist who would explore the wonders of Rock City, or visit the sylvan shades of Lula Lake.

Missionary Ridge with its magnificent boulevard, built by the United States government, traverses the crest of the ridge from Rossville Gap on the south (where it connects with LaFayette road, also built by the government) to Sherman Heights on the north. The views from along this boulevard, taking in as it does both sides of Missionary Ridge, cannot be excelled for historical interest of national importance. Two observation towers, seventy feet in height, occupy commanding situations, and permit a study of the fields of the great struggle of November, 1863.

The Minerals

The coal, iron ore and limestones of the Southern mineral region lie close together, intermixed and co-terminous, in an area of approximately twenty-four thousand square miles; ten thousand five hundred square miles of this area is in commercial reach of Chattanooga.

Her furnaces have profitably used coke from the Pocahontas mines and ovens in Southwest Virginia. The ores in this neighborhood have been used for mixing by the furnacemen in the Birmingham district of Alabama. In the region penetrated by Chattanooga railroads and the Tennessee river, there is a supply of coal greater than Great Britain had before her measures were touched by a miner's pick, and more iron ore, limestone and marble than was ever in the United Kingdom, and three times as much as the German supply. There are now mined in the area that is tributary to the city of Chattanooga, annually about two million long tons of coal, and six hundred thousand to one million tons of iron ore. In one-third this area Germany mines sixty-five million tons annually; Pennsylvania with an area not one-fourth

larger, produced one hundred million tons of bituminous and anthracite last year. These figures will convey an idea of the possiblities of this district in the production of coal.

The coal is bituminous of every grade, chiefly of good quality, most of it excellent. High quality gas coals are in great abundance. In Scott, Roane and other counties, one hundred miles or so north of Chattanooga, and convenient to the Cincinnati Southern Railway, there is an abundance of coking coal and a very fine quality of coke is being made at the different mines in Hamilton county; there is some cannel coal in upper East Tennessee.

In the Chattanooga district there are ten coke blast furnaces, which produce annually nearly three hundred thousand tons of pig iron. The annual amount of coal mined in Hamilton county is about three hundred thousand tons; in Marion county, two hundred and twenty-five thousand tons; in Rhea county, two hundred and twenty-five thousand tons; the total amount in the state, three million tons.

The Chattanooga district produces about two hundred thousand tons of coke per annum. The coals in Walden's Ridge, which is the main spur of the Cumberland Mountains, underlie that elevation for an average of ten miles wide and one hundred and twenty miles long. These coals vary in kind and quality from the free-burning and lighter varieties found in the Coal Creek region, to the heavy and hard coals found in the Sale Creek, Soddy and North Chickamauga. There is enough fuel in that one mountain to supply a million people with fuel, for all possible uses, for several thousand years, and the poorest of it is better than the best German coal. Great beds of this coal are within four miles of Chattanooga.

The fixed carbon in coals in this immediate locality varies from 84 to 94 per cent., and sulphur from 1 per cent., to as low as 1-10 of 1 per cent.

The iron ore of this region covers a great stretch of territory, and is of two varieties, red and brown hematite. The brown ores lie in immense beds in the western part of McMinn and Monroe counties; some of them are of high quality, but mostly high in phosphorus and metallic iron. There are also large beds of this ore in upper East Tennessee, and great quantities about Cartersville, Georgia. The Georgia ore has served to make excellent open hearth or bessemer steel.

FALLS OF LULA LAKE—LOOKOUT MOUNTAIN.

The red ores are everywhere in the Tennessee Valley; in the foot ridges of the Cumberland range, in Lookout and Chattanooga Valleys, south of the city of Chattanooga, across the Tennessee, within two miles of the city, and several hundred tons were dug out some years ago in the city limits. Down the Chattanooga Southern Railway in Walker and Catoosa counties, Georgia, are millions of tons of high quality of red ore that are being very cheaply mined. At Inman, Marion county, near the furnace plant of South Pittsburg, Tennessee, are large ore operations, whence many hundred thousand tons have been taken. These red ores are at many points along the river or railroads, can be put on cars or in barges at a cost ranging from 25 to 30 cents a ton. The ore supply of the district has barely been scratched here and there, not developed by any means.

A fine grade of manganese ore is abundant in this locality, and it is very extensively mined within seventy miles of the city.

The limestones and marbles of this district are among the most valuable of its resources. There are millions of yards of pure dolamite, other millions of beautiful blue limestones, that make very handsome trimmings and walls, and wear like iron when crushed and used for road finish. Limestones are found in unlimited quantity up the Tennessee river, which are pronounced by the highest authorities to be the best quality of stones for bridges, abutments and other structures requiring high crushing and resisting strength. The marbles extend from Pickens county, Georgia, sixty miles below the city, to the upper counties of East Tennessee. They are of every quality of the variegated grades, gray, red, amber, brown, black and white. Some very beautiful monumental stones have been developed. The capacity of the East Tennessee quarries alone is in excess of twenty-five thousand cubic yards per month. Great quantities of the variegated marble are shipped to all parts of the world for furniture and other interior uses, from all parts of East Tennessee and other points tributary to Chattanooga. This interest has only been slightly developed.

The occurrence of mica is quite frequent in this section; a total of seven hundred and fifty-six thousand pounds was produced in North Carolina in 1896, most of which was produced within one hundred miles of Chattanooga.

Slate of a very high quality has been developed on the Little Tennessee river in Blount county, East Tennessee, and other points

in this region. The bed is one of the largest and best in the world; the slate can be barged to Chattanooga at a nominal cost of freight.

There are eight copper mines in Polk county, within sixty miles of Chattanooga, all of which are now producing ore, with several smelters in operation. These ores are copper pyrites and carry about 5 per cent. of copper.

At different points in East Tennessee zinc and lead operations are being carried on. At Clinton, in East Tennessee, there is a smelter with a capacity of one hundred and six pounds metallic zinc per day. Two thousand pounds of lead are daily produced in Bradley county, within forty miles of the city.

Oil has long been known to exist in commercial quantities in Fentress, Morgan, Overton and other counties, within one hundred to one hundred and fifty miles of Chattanooga. It is now being developed rapidly, and the district promises to become highly profitable, the oil being in large supply and of high quality.

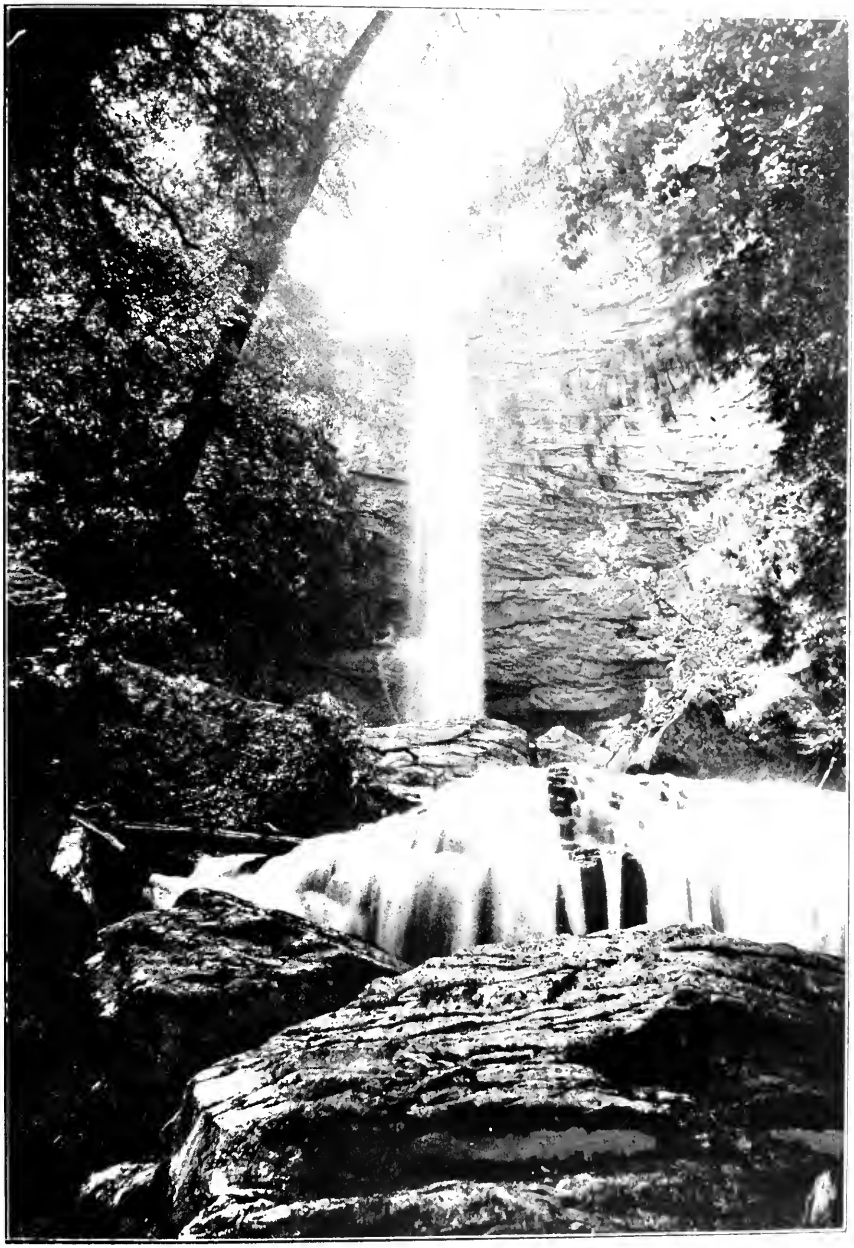
The clay and kaolin deposits in this immediate section are of very great importance. Besides the coarser sorts there are fine stoneware clays which burn to a hard body of a good color, and there is a deposit of good ball clay; fire clays of high quality are very abundant.

There are in the city of Chattanooga two very large sewer pipe works, which use the clay of this immediate section very extensively and produce probably a larger amount of sewer pipe than any other city south of the Ohio river; the product is shipped to all parts of the country. Stoneware clays are also being utilized in this county, and several potteries are in successful operation, turning out a very large product.

Silica sand is very abundant, and large glass works are in operation here. The sands of this section possess a very high grade of silica and the glass industry is very successfully prosecuted.

The production of mineral paint is a large industry at Chattanooga. Ochre is mined extensively near Cartersville, Georgia, and a fine quality of red and brown oxide exists in practically unlimited quantities in this region and makes a very superior paint.

The extensive deposits of asbestos, fibrous talc and soapstone which are found in our neighboring state of North Carolina, within seventy-five miles of Chattanooga, are utilized in two large local industries making gas tips and the other various articles into which those minerals are manufactured.



FALLING WATER—WALDEN'S RIDGE.

The Iron Industry

The iron industry of Chattanooga is more varied and extensive than that of any other city in the South, and it is steadily growing in importance.

There are in the city and suburbs thirteen iron foundries, two cast iron pipe foundries (one of which is, perhaps, the largest iron pipe foundry in the world), two blast furnaces, besides other important iron making industries which embrace everything in the line of foundry job work, specialties in the way of cast iron pipe, malleable iron castings, stoves and hollowware, stationary engines, saw mills, cars, agricultural implements, cane mills, evaporators, architectural material, mantels and grates, boilers, tanks, stand-pipes, builders' hardware, etc., etc.

The Chattanooga foundries consumed during the year 1905, in the manufacture of their product, over 100,000 tons of pig iron, besides a large variety of other forms of iron and steel, representing a larger consumption of raw material for conversion into finished product than is reported from any other city in the Southern States. The foundries of Chattanooga are prepared to pour the largest castings and produce the heaviest forgings that can be manufactured in the South.

Chattanooga, by reason of its location on the Tennessee river, which is navigable almost the year round to connections with the Ohio and Mississippi ports, having rival railway lines in every direction, is an ideal place for the assembling and distribution of materials. Beds of coal and iron ore are found along the lines of all these railways and also on the river, within easy reach of Chattanooga, the iron ore cropping out within the city limits and coal of a very high grade existing in abundant quantities within six miles; an abundant supply of limestone of excellent quality also lies about the city. The juxtaposition of these raw materials within such close reach of the city gives unsurpassed facilities for the manufacture of pig iron of almost any required analysis, at an exceedingly moderate cost. The product of the Chattanooga iron furnaces commands a high price in all the markets of the country, and one of the Chattanooga furnaces sells most of its material to the higher grade of hardware manufacturers in the East, on account of its superior quality.

The cast iron pipe works of the U. S. Cast Iron Pipe and Foundry Company, which was erected a few years ago at a cost of nearly one-third of a million dollars, is one of the most elaborately equipped pipe works in the world, being furnished throughout with

the most improved electric appliances, the pits, cranes, and, in fact, all the manipulation in the manufacture of cast iron pipe being entirely new and having been erected in the light of modern electrical achievements. The capacity of this plan is nearly 300 tons of cast iron pipe per day.

Chattanooga's iron industries are destined to become of great importance for emphatic and obvious reasons, which briefly are:

1st. Abundance, excellence and cheapness of raw materials for the production of both iron and steel.

2nd. Exceptionally good transportation facilities by rail and river.

3rd. Central location in a large territory which she can reasonably hope to supply against all competition.

4th. Physical, climatic and artificial attractions that make the place inviting both to the citizen and to the visitor, insuring an enlightened and reliable class of labor.

The Timbers of this Section

The annual cut of timber in Chattanooga from the log is over twenty million feet, and the total amount of timber annually handled in this city for manufacturing purposes is over fifty million feet. This is exclusive of the lumber sold from this city in an unmanufactured state.

The chief wood in this locality is oak—white, red, spanish, overcup and chestnut, or tan bark. This wood in some localities runs fifteen thousand feet to the acre, the trees varying from twelve inches to four feet in diameter. About five million feet come annually to the city by water, in logs. It is used very extensively here in the manufacture of furniture and for building material.

Chattanooga is a large buyer of tanbark, and nearly fifteen thousand cords are annually sold, a considerable portion coming by wagon.

Poplar also grows very extensively throughout the country, and is a strictly first-class wood, the trees varying from twelve inches to two feet in diameter, often running as high as thirty thousand feet to the acre. It is very accessible, and from twelve to fourteen million feet annually come to this city in logs. It is used largely for building purposes, and also used in wood products.

Pine, yellow and white, is found extensively throughout this locality, on the ridges and mountains; the trees run from eight to thirty inches in diameter, grow in clusters, and vary from four

"W" (OR ZIG ZAG), AT HEAD OF WALDEN'S RIDGE.

to five thousand feet in each clump. About a million feet of yellow pine comes to the city annually in logs.

Sweet gum is largely used in this city for furniture, butter dishes and baskets, about three-fourths of a million feet annually arriving here in rafts.

Maple is used in the manufacture of furniture and pulleys, about one-fourth of a million feet per annum coming to the city, the trees varying from twelve to twenty-four inches in diameter, and in some localities there are from ten to twelve thousand feet to the acre.

From one-third to one-half a million feet of basswood are annually brought to the city by river; it is used in the manufacture of coffins and furniture. A good quality of ash grows in this locality, the annual receipts by river being in the neighborhood of one hundred thousand feet.

Beech is very abundant and also chestnut; cherry and cedar or juniper are found in many localities in this immediate section.

Among the hard woods that are procurable in this locality are boxwood, hickory, laurel, hackberry and black locust. The forests of oak, pine and poplar are very extensive and show scarcely any appreciable diminution in supply.

County Government

The total assessed valuation of all property in Hamilton county for years 1903, 1904 and 1905 is, in round numbers, $67,000,000.00, on a basis of about 70 per cent., making the actual valuation $87,000,000.00, not including railroads. The tax rate in the years named was as follows: $1.55 on the hundred dollars, $1.65 on the hundred dollars, $1.50 on the hundred dollars.

The expenses of the county for the years 1903 and 1904 were as follows:

	1903.	1904.
Work House	$ 32,292 87	$ 31,154 77
Poor House	28,332 25	17,375 35
Interest on bonds	22,000 00	22,000 00
Schools	113,000 00	131,000 00
Roads	24,000 00	20,000 00
Other expenses	34,000 00	18,000 00
Total	253,625 12	$239,530 12

Industrial Chattanooga

Modest beginnings by plucky pioneers show growth for three decades, followed by rapid recent advance, proximity to best raw materials, exceptionable transportation facilities, favorable climate, good labor conditions, general co-operation among manufacturers, with a determination to build a modern industrial city, remarkable diversity of products, nearness to great growing markets, a prosperous present and brilliant future prospects, in some measure epitomize "Industrial Chattanooga."

In 1860 there were twenty-two industries in Chattanooga, with $209,300 capital. The 1870 census showed $850,000 invested in fifty-eight concerns. The following figures, compiled in the office of the Chattanooga Manufacturers' Association, give an idea of the growth since 1880:

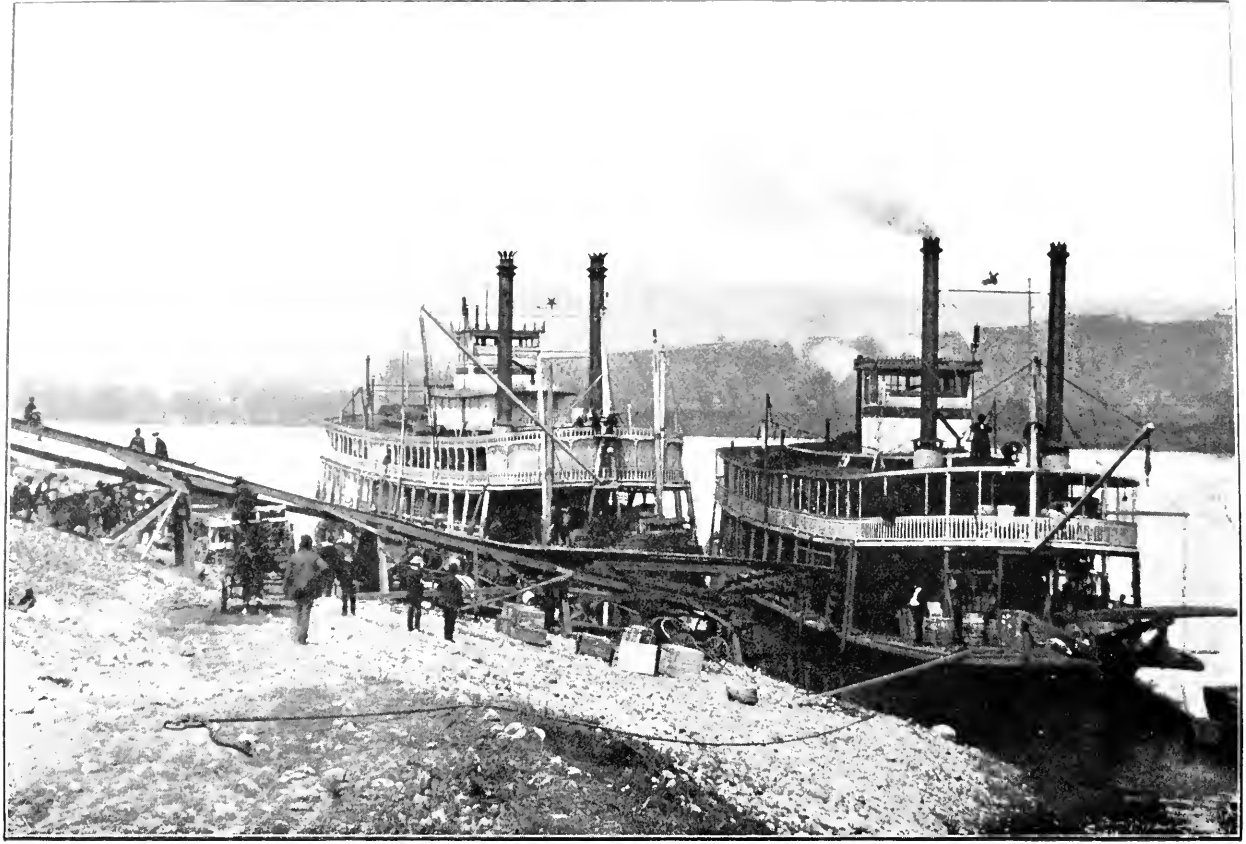
1880—Number of industries, 77; hands employed, 2,123; capital, $2,000,000; wages, $568,508; value of product, $5,975,500.

1890—Number of industries, 110; hands employed, 4,800; capital, $6,000,000; wages, $2.019,446; value of product, $8,975,500.

1897—Number of factories, 161; number of hands employed, 6,182; capital, $7,546,300; wages, $2,497,100; value of product, $11,802,600.

1905—Number of factories, 278; number of hands employed, 10,980; capital, $21,680,500; wages, $5,476,500; value of product, $30,995,000.

An analysis of the plants shows great diversity in character, iron and steel taken together leading. This class has sixty-five active concerns, $4,980,000 capital and 3,500 men employed. Here are blast furnaces, foundries, boiler works, machine shops, engine, saw and bridge plants, tool steel, mill and other iron and steel working establishments. There are forty cast and wrought iron foundries making 200 articles, ranging from the crudest builders' castings to the finest finished enameled bath tubs and lavatories, and including sewer and drain pipes, cars and car wheels, stoves and ranges, cane and saw mills, store fronts, grates, mantels, stairs, pumps, beds, brake-shoes, frogs, switches, tanks, etc. Five concerns make high grade boilers, Chattanooga ranking as one of the great



CHATTANOOGA WHARF—TENNESSEE RIVER.

boiler markets of the country, similar rank being maintained on foundry products. The machine shops make many specialties, notable examples being cross arm, insulating, shingle, key-setting, dyeing and acetylene gas machines. A second large babbit metal concern has just come here from Richmond, Va. Iron, steel and galvanized roofing, siding and ceiling is made by two leading concerns.

Furniture and other wood working plants employ over $2,000,000 capital and show very rapid development. Thirty kinds of furniture are produced, supplying especially complete equipment for the kitchen, bed room and dining room. Coffins and caskets, curtain poles, barrels, packing cases, sash, doors and blinds, hardwood floors and finish, bowls, pulleys and plumbers' wood supplies are also made in quantities.

For the combination of iron and lumber into plows, wagons, buggies, carriages, refrigerators, coffins, beds and bed springs, elevators, wheelbarrows, show cases, hay presses, etc., Chattanooga's nearness to iron ore and valuable timber gives special advantages. Thirty-five such concerns have $1,500,000 cash capital. Of these plants ten are capitalized at over $50,000 and three at over $200,000.

The hosiery mills lead in the textile class. The consolidated Richmond Mills have begun the erection of a spinning mill to supply their own yarn. Besides a complete line of hosiery, yarns of different kinds, twines, bags, wool and merino shoddies, batting, skeins, underwear and clothing are produced, $1,500,000 capital being required in these lines.

Chattanooga's flouring mills have long had an enviable reputation. They have recently been supplemented by a large cracker factory, which has quickly developed an extensive business. Baking powder, confections, flavoring extracts and grocers' sundries are also made by leading firms.

Proprietary remedies and pharmaceuticals rank as leaders here in volume of business, sixteen laboratories being required for their production. The statistics show about $1,500,000 capital in this business, and the extent of their territory is very large. This figure does not include soaps or toilet articles or such specialties as Coca-Cola or Stainoff.

The United States Leather Company has some of its largest tanneries and extract works in the Chattanooga district, and the Scholze interests are also very extensive, including harness and

saddle making. Trunks, sample cases and other leather products are made largely.

Clay pipe, terra cotta, pressed brick, glass bottles, pottery, lime, cement, concrete, tile, crayons and slate pencils are among the numerous products of the clays, sands and rocks of the Chattanooga territory. Marble is cut here in quantity.

For ice making, cold storage, cotton oil mills, packing houses, fertilizer factories, engraving and electrotyping, cigars, paper boxes, breweries and distilleries, large additions have recently been built.

These facts suggest the extent of Chattanooga's present manufacturing interests and show the trend of her industrial development. There are certain indications that this will continue at a still more rapid rate in the future. Chattanooga made goods have obtained a wide reputation. Chattanoogans themselves are coming to recognize that equal opportunities for profitable manufacturing exist here as in Pittsburg twenty-five years ago. The critical experimental stage has passed with our leading lines, and we have entered as a real contestant in the great race for commercial supremacy.

Among Chattanooga's superior advantages which have made her development possible, and will make her industrial future secure, is perhaps most important of all, her location. Few places have such proximity to both raw materials and markets for their finished products as this mountain city, situated so nearly in the center of the broad territory bounded by the Atlantic ocean, the Gulf of Mexico, the Mississippi and the Ohio and Potomac rivers.

Ten railroads center here. The great Southern system, with its more than 7,000 miles of track, has four lines to Chattanooga, and is now engaged in a series of improvements, extensions and betterments which are attracting wide attention and will result favorably for Chattanooga manufacturers. The Queen and Crescent system gives us a direct line to Cincinnati, where our goods may be entered into the northern markets, and to New Orleans, the traffic center of the southwestern states, and the port through which is handled most of the business with South America.

The Nashville, Chattanooga and St. Louis, and the Louisville and Nashville system of nearly 5,000 miles offers competitive service for southern and western business, while the Central of Georgia and the Chattanooga Southern are independent lines running through rich agricultural and mineral lands. For export business the manufacturer finds the ports of Norfolk, Charleston, Savannah,

HOMES OF THE CLIFF-DWELLERS.

Brunswick, Pensacola, Mobile and New Orleans about equi-distant, so that with excellent transportation facilities to all of these cities, he has a most inviting field in which to operate. The Chattanooga Union, or "Belt" Railway, connects with all lines entering the city and reaches nearly all the factories with its direct lines. We find all of these railroads greatly interested in manufacturing in Chattanooga, co-operating with generally equitable commodity rates to secure a widening of our markets. The Chattanooga Manufacturers' Association maintains a well equipped freight bureau under the management of an experienced railroad official, which is of great practical service to manufacturers and their customers.

But Chattanooga's favored location gives her one other means of transportation for her products. She is situated on a river of like length, depth and volume of water with the Ohio, and in some essentials the superior of that waterway. The banks and bottom of the Tennessee are more permanent, its supply of water is more uniform and less affected by droughts or floods. The Tennessee never freezes and seldom has it had a destructive overflow. The length of the main river from Knoxville to Paducah is about 675 miles, with a fall of 518 feet. The period of successful navigation is being steadily lengthened by government improvements in the channel, the lock and dam in the mountain section below Chattanooga and the nearly completed work at Colbert Shoals, near Florence, promising a nearly all the year river.

Chattanooga business men have recently incorporated the Chattanooga Packet Company to secure the continued operation of the independent Chattanooga-Paducah line of boats. A loaded boat recently made the through trip from Chattanooga to St. Louis in four days.

In few places on the American continent can such a combination of valuable ore deposits be found as in the Chattanooga district. To this wealth of coal, iron and limestone, the great timber supply of her forests and the proximity of the cotton fields Chattanooga is largely indebted for her industrial position. The late Col. J. E. MacGowan, for many years editor-in-chief of the Chattanooga Times, once said: "The greatest natural advantage Chattanooga enjoys, in a material sense, is the proximity of the city to coal and iron ore, and the resulting cheapness of the production of iron in all forms in the city and vicinity. There are unlimited quantities of these materials on all sides of the town; within five miles of the corporate limits enough ore and coal are hid by the ridges

and mountains to supply a score of furnaces for a century, and furnish fuel for a quarter of a million people."

Both steam and domestic coal are bought in Chattanooga cheaper than in any competing city. The nearest coal to Chattanooga that is being mined on an extensive scale is the Etna mine, twelve miles away, near Whiteside, Tenn., where superior blacksmith coal is found.

The Durham mines, seventeen miles east of the city, are now turning out a daily output of nearly 900 tons. Other large nearby mines are at Soddy, Graysville, Retro and Sale Creek, at Dade, near Shellmound, and other points in the Sequatchie valley and North Georgia coal fields. No combination of mine operators could ever prevent Chattanooga manufacturers from securing the cheap coal so abundant at their very doors. It is confidently predicted that the present low coal rate into the city will be materially reduced at an early day.

The iron ore in this district is found mainly in the Cumberland plateau, passing entirely through the state of Tennessee and extending into northern Georgia and Alabama. The deposits are of three varieties—hematite or red iron ore; limonite, or brown ore; magnetite, or magnetic iron ore. The red and brown ores are of a high grade, and are found in exhaustless quantities. A vein of red ore is found inside our city limits, in Cameron hill, and mines have been opened up across the river, in Hill City. Large quantities of ore are being mined along the Chattanooga Southern Railway. Some of the principal mines not far distant from the city are located at Estelle, Broncho, Cedartown, Prior's Station, Rising Fawn, Sulphur Springs, Eureka, Fort Payne, Crudup, Attalla, Cartersville and other nearby points.

Bauxite, copper, zinc, barytes, marble, gold, clay, talc, phosphate rock and other minerals and valuable soil materials are also found in quantities in the Chattanooga district.

Proximity to cheap raw material opens two other profitable fields of industry for Chattanooga—lumber and textile interests. It is on the northern border of the pine belt and is favorably located by both rail and water to reach the best oak and poplar sections east of the Mississippi and south of the Ohio. Nearly 30,000,000 feet of logs are floated down the Tennessee river and sawed by local mills annually. As a furniture making city Chattanooga is making rapid headway, and goods made here are being sold throughout the country. New planing mills are being started up con-

stantly, and the comparative cheapness and good quality of lumber is enabling local wagon and plow companies, as well as carriage and car factories, to compete with the established centers in those lines of industry. The rapidly failing forests of Michigan has alarmed northern manufacturers, and as a result hundreds of thousands of dollars were spent for timber lands in this section last year.

The best authorities insist there is no more favorable location than Chattanooga for large textile plants. They say that the necessary advantages of a good textile city are location near the cotton crop and near the market, climate, labor, cheap fuel and power, good water and where living is cheap. Perhaps the most important is the nearness to the cotton fields. Chattanooga's location in this respect is worth $5 per bale to her over New England mills, and with labor, fuel and living all cheaper here than in the northeastern states, it would appear that textile manufacturing will certainly attain to a very large proportion.

The City Government

The municipality of Chattanooga is administered by the Board of Mayor and Aldermen, consisting of the Mayor and sixteen Aldermen, two from each ward; the Board of Public Works, a body of three (elected by the Board of Aldermen), which has control of the streets; the Board of Public Safety, also a body of three (elected by the Board of Aldermen), which has control of the police department. All other legislative and executive functions are within the control of the Board of Mayor and Aldermen. The Mayor is the president of the Board of Aldermen, appoints the standing committees and has general supervision of the city affairs. The present city officials are:

Mayor—Wm. L. Frierson.
City Judge—William Cummings.
Attorney—G. W. Chamlee.
Auditor—Jack O'Donohue.
Physician—Dr. P. D. Sims.
Collector and Treasurer—T. J. Gillespie.
Clerk to City Judge—Wm. Stafford.

The city of Chattanooga is at present very economically governed. Basing the population within the restricted corporate limits at 50,000, the net cost of conducting the city during the current year, including the annual interest charge on bonds, will

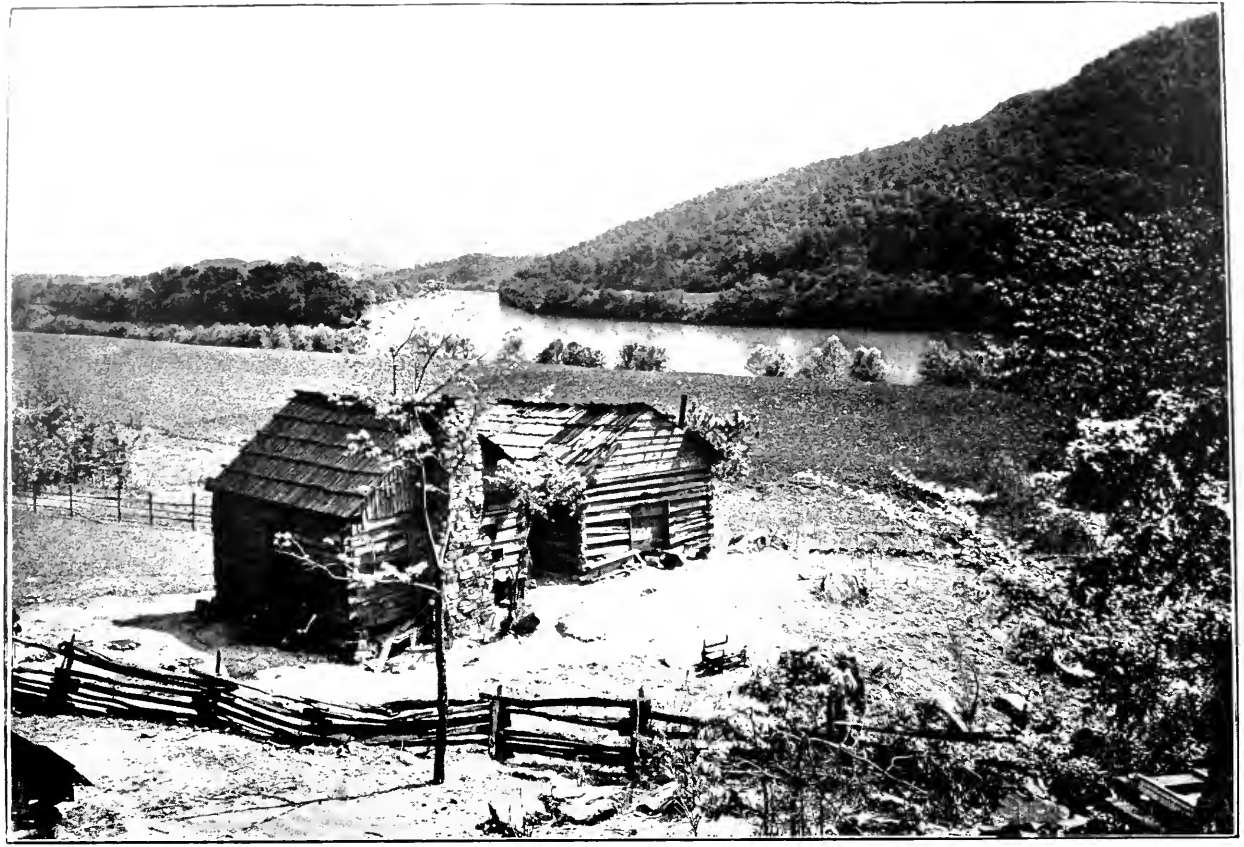
be about $9.38 per capita. The average expense of American cities per capita, including interest charges, is in excess of $15. The following table shows the aggregate city expenses in the past six years, including the annual interest charges:

1891	$354,237 55
1892	334,953 23
1893	322,435 11
1894	275,595 48
1895	282,102 84
1896	256,179 34
1897	331,356 28
1898	301,809 60
1899	320,386 08
1900	382,504 21
1901	334,455 77
1902	306,288 88
1903	352,489 28
1904	467,307 69

The following table shows the actual expense of each department of the past year, and from this an idea is conveyed of the general management and expense of the city government:

	Actual 1904 Expenses.
Schools	$ 53,264 66
Health and Hospitals	11,429 83
General Miscellany	5,600 00
School Buildings	95,707 73
Board of Public Works	87,041 93
Police and Prisons	48,544 75
Fire Department	48,535 81
Claims	38,727 10
Water	7,701 23
Salaries	14,402 76
Judgments and Costs	6,845 55
Interest	49,506 34
Total	$467,307 69

The financial condition of the city at present is very healthy. The city has no floating debt, and it has a sufficient cash balance in the treasury to meet all obligations during the current fiscal



ON THE BANKS OF THE TENNESSEE.

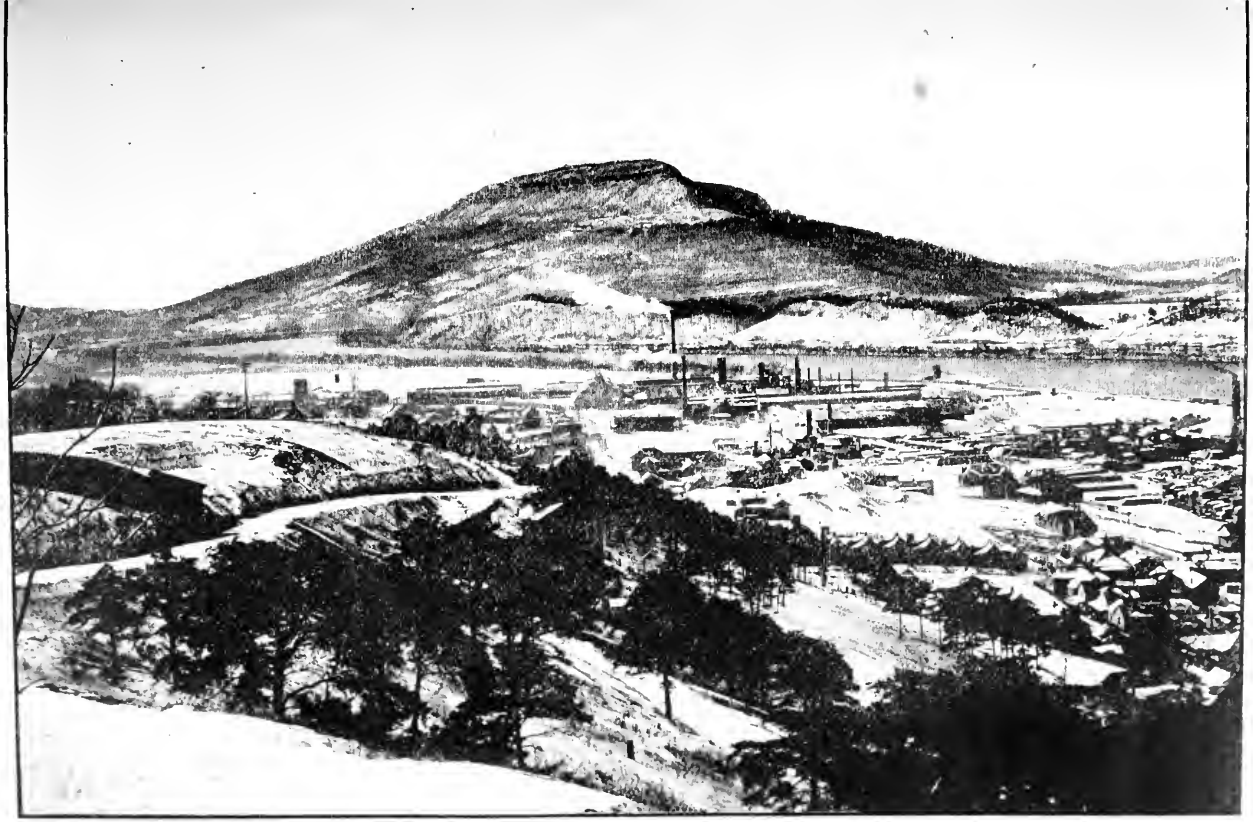
year and has no bills payable. The valuation on all property aggregates $8,700,000; on a basis of about 60 per cent., the actual value of real estate and personality within the corporate limits being $14,500,000. The net bonded indebtedness of the city, less the sinking fund, is $1,200,000.

Tax levy of the city in the past seventeen years has been as follows:

Tax levy, 1889	$1.80	on	$100
Tax levy, 1890	1.75	on	100
Tax levy, 1891	1.80	on	100
Tax levy, 1892	1.60	on	100
Tax levy, 1893	1.30	on	100
Tax levy, 1894	1.30	on	100
Tax levy, 1895	1.25	on	100
Tax levy, 1896	1.65	on	100
Tax levy, 1897	1.50	on	100
Tax levy, 1898	1.40	on	100
Tax levy, 1899	1.65	on	100
Tax levy, 1900	1.65	on	100
Tax levy, 1901	1.45	on	100
Tax levy, 1902	1.45	on	100
Tax levy, 1903	1.45	on	100
Tax levy, 1904	1.45	on	100
Tax levy, 1905	1.65	on	100

The Power Plant

While now enjoying comparatively cheap fuel for the generation of power, Chattanooga is to see a further reduction in this charge. The following pages contain a description of the great power plant being erected at Hale's Bar, in the Tennessee river, for the purpose of supplying electric power to Chattanooga industries. No event has ever made such a contribution to Chattanooga's industrial supremacy as the inauguration of this feasible project in which the United States government and two enterprising Chattanooga business men, Messrs. C. E. James and J. C. Guild, are mutually interested. The Chattanooga and Tennessee River Power Company, who are the successors of Messrs. James and Guild, have contracted with the Oliver-Stewart Contracting Company, of Knoxville, Tenn., for the construction of the dam, lock and power house, and work is now progressing rapidly. The officers of the Chattanooga and Tennessee River Power Company are R. H. Williams, president; N. F. Brady, vice-president; George B. Lancaster, secretary; John Bogart, C. E., consulting engineer; J. C. Guild, C. E., chief engineer.



"Lookout Mountain"

No. 097.*

THE IMPROVEMENT OF THE TENNESSEE RIVER AND POWER INSTALLATION OF THE CHATTANOOGA AND TENNESSEE RIVER POWER COMPANY AT HALE'S BAR, TENN.

BY THOMAS E. MURRAY

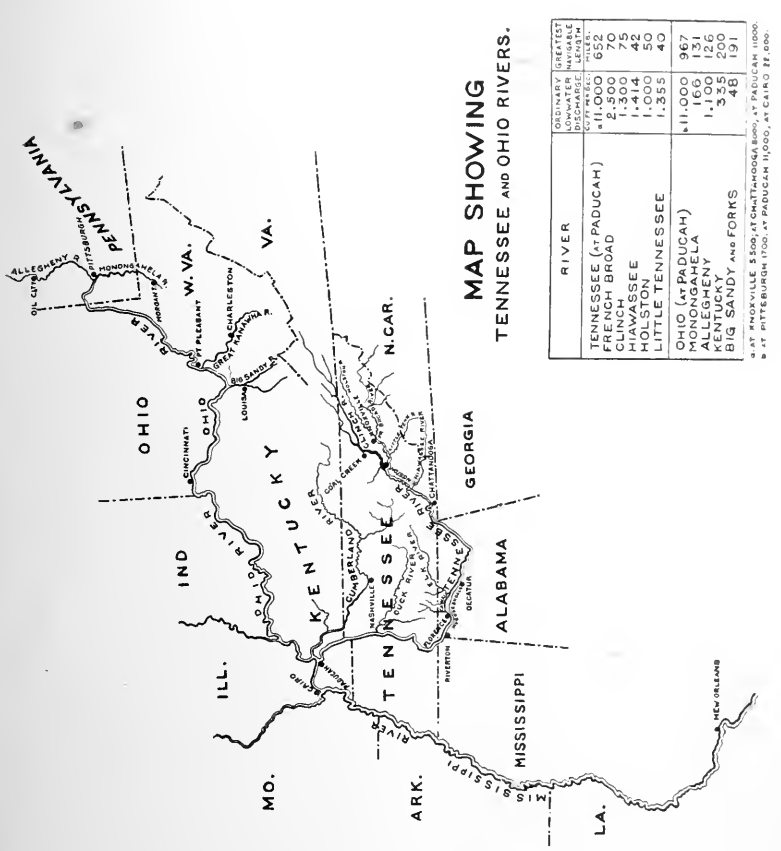
(Member of the Society.)

The Tennessee River is six hundred and fifty-two (652) miles long. It is formed by the junction, four and one-half ($4\frac{1}{2}$) miles above Knoxville and one hundred and eighty-eight (188) miles above Chattanooga, of the French Broad River which rises in the western part of North Carolina and the Holston River which rises in the southwestern part of the State of Tennessee.

Thus formed, the Tennessee River flows in a southwesterly direction across the State of Tennessee and through the City of Chattanooga. Its general course is parallel to the eastern slope of the Cumberland plateau, and it receives on the way a number of important tributaries. At Chattanooga the river inclines more to the westward and breaks through the range of the Cumberland Mountains. After passing the mountains it crosses the northern part of the State of Alabama, flows past the northeast corner of Mississippi, and turning to the north crosses the States of Tennessee and Kentucky, finally emptying into the Ohio River at Paducah, a course of 464 miles. Together with its principal tributaries, it forms a system of internal waterways capable of being navigated by steamboats more than thirteen hundred (1,300)

* Presented at the Chattanooga meeting (May, 1906) of the American Society of Mechanical Engineers, and forming part of Volume XXVII. of the *Transactions*.

miles. In addition to this, its tributaries are still further navigable by rafts and flatboats, for a distance of more than one thousand (1,000) miles, making a system of navigable waters of about two thousand three hundred (2,300) miles in length, with a drainage area of about forty-four thousand (44,000) square miles. The



RIVER	ORDINARY LOW-WATER DISCHARGE. CU. FT. PER SEC.	GREATEST NAVIGABLE LENGTH. MILES.
TENNESSEE (AT PADUCAH)	a 11,000	652
FRENCH BROAD	2,500	70
CLINCH	1,300	75
HIAWASSEE	1,414	42
HOLSTON	1,000	50
LITTLE TENNESSEE	1,355	40
OHIO (AT PADUCAH)	a 11,000	967
MONONGAHELA	1,166	131
ALLEGHENY	1,100	126
KENTUCKY	335	200
BIG SANDY AND FORKS	48	191

a AT KNOXVILLE 3,500; AT CHATTANOOGA 8,000; AT PADUCAH 11000.
a AT PITTSBURGH 1700; AT PADUCAH 11,000; AT CAIRO 11,000.

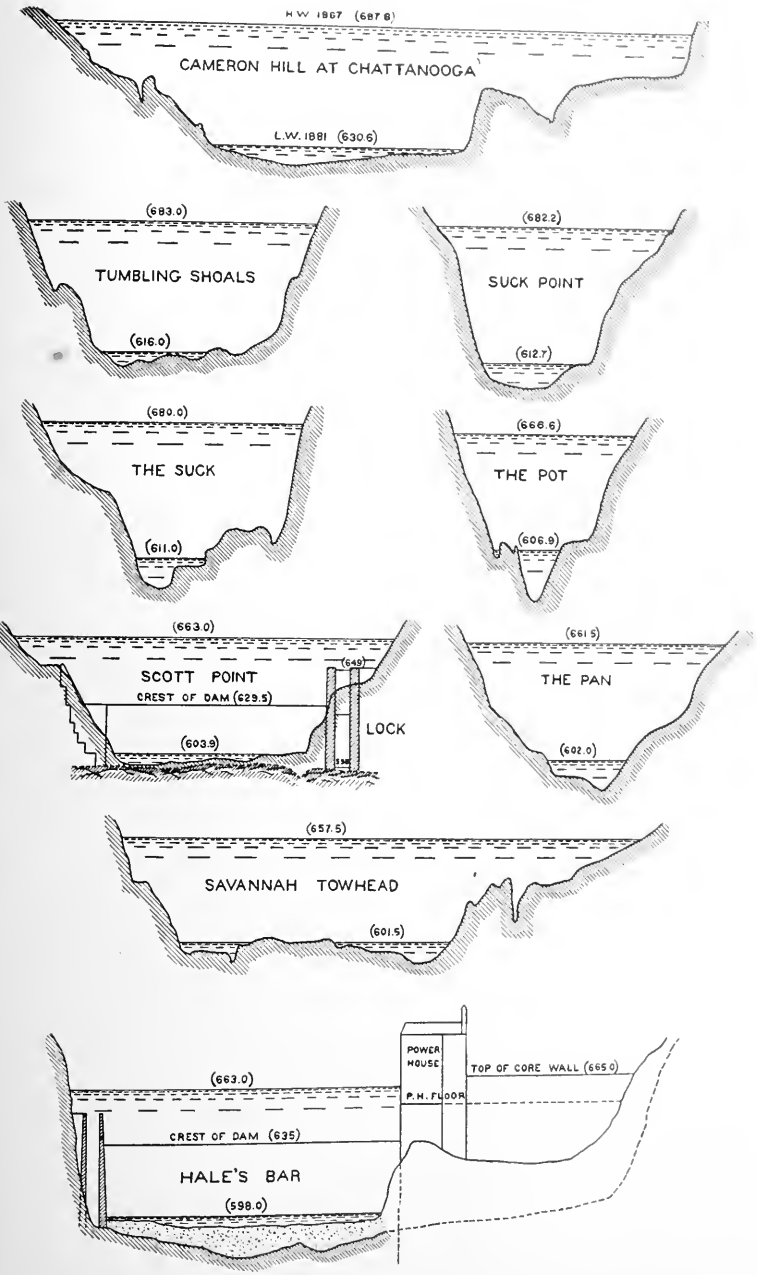
river is navigable the entire year from its mouth to Riverton, Alabama, a distance of two hundred and twenty-six (226) miles. Between Riverton and Muscle Shoals—a distance of sixty-two and one-half ($62\frac{1}{2}$) miles—the obstructions to navigation have been surmounted by means of canals with locks, so that a low-water channel of five (5) feet depth is available the entire year. From

Muscle Shoals to Chattanooga—a distance of one hundred seventy-five and one-half (175½) miles, the low-water navigation is limited to a draught of water not exceeding two (2) feet, and for long periods during high-water navigation must be entirely suspended.

The chief steamboat commerce of the river consists of local boat lines having headquarters at the principal towns along the river, and there is no through traffic covering the entire system, the longest regular boat service is between Chattanooga and Paducah when the stage of water permits.

The total commerce of the Tennessee River amounted in the calendar year of 1904 to nearly 1,500,000 tons, valued at approximately thirty million ($30,000,000) dollars. Of this traffic less than ten (10) per cent. was carried over four hundred and fifty (450) miles; about fifty (50) per cent. between two hundred (200) miles, and 450 miles and about twenty (20) per cent. between fifty (50) and 200 miles. The commerce on the portion of the river above Chattanooga, in the same year, amounted to over 500,000 tons, valued at about four million five hundred thousand ($4,500,000) dollars. The commerce carried on the river between Chattanooga and Florence—a few miles above Riverton— in the same year amounted to about 170,000 tons, valued at seven million ($7,000,000) dollars; and the commerce between Florence and Paducah, in the same year, amounted to 870,000 tons, valued at over eighteen million ($18,000,000) dollars.

The general characteristics of the river are those of a broad tranquil stream with a moderate current. The bottom is usually of rock or coarse gravel, and its banks are remarkably firm and stable. The river, as a whole, presents an unusual fixity of regimen, although while passing through the mountains below Chattanooga, a stretch of perhaps 30 miles, it assumes many of the characteristics of a mountain torrent. Its course is exceedingly crooked, the slope is excessive, and, owing to the narrow and congested channel, the current is irregular and generally very rapid. With the exception of this stretch the navigation of the river presents no difficulties, and from the time of the settlement of the country it has been one of the regular highways of commerce for the region through which it flows. The navigation of this "Mountain Section," however, is quite difficult and uncertain. At low water, on account of the rapids, it shows many obstructions, while at high water it is dangerous on account of the velocity of the current and of the eddies and whirlpools caused by its irregular and contracted cross-section and its excessive flow.



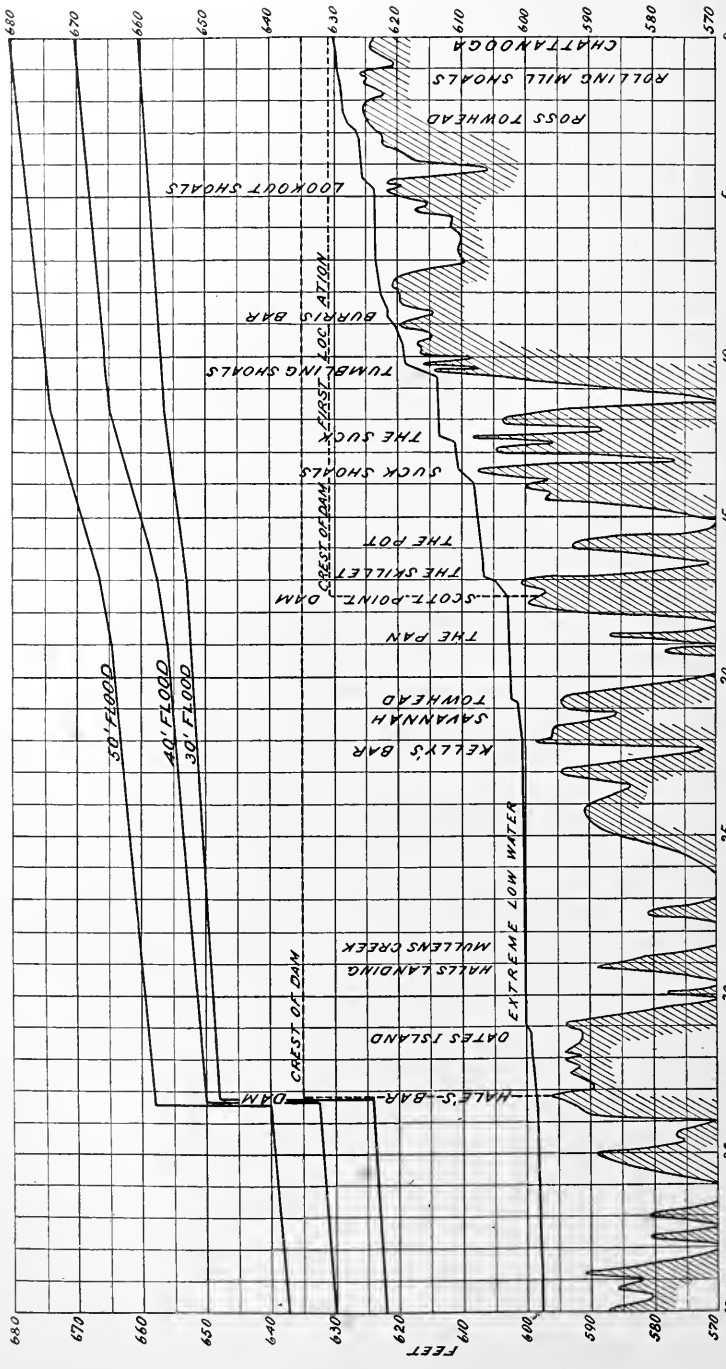
CHARACTERISTIC CROSS SECTIONS

HORIZONTAL SCALE

0 200 400 600 800 1000 FT

0 25 50 75 100 125 FT.

VERTICAL SCALE



LONGITUDINAL SECTION OF THE TENNESSEE RIVER.

Between Chattanooga and Shellmound—a distance of thirty-nine (39) miles by the river—there are ten (10) shoals at which the low-water channel depth is less than three (3) feet, and five (5) natural obstructions at which, although sufficient depth is found, navigation is difficult and somewhat dangerous at nearly every stage by reason of the contracted waterway and the swiftness of the current. Maps and profiles are given showing the shape of the river and the location of the shoals.

At the foot of Williams Island—ten (10) miles below the Walnut street Bridge at Chattanooga—the river enters the Cumberland mountains, and for the succeeding eight (8) miles it is practically a mountain torrent of unusual dimensions. Completely hemmed in by the mountains, it follows a narrow, tortuous, and rocky channel feared by steamboat men and others navigating the river.

The average width of the eight (8) miles through the mountains, which may be called the "Mountain Section," does not exceed one thousand (1,000) feet at the level of ordinary high water, ranging from seven hundred (700) feet at the "Pot" to fifteen hundred (1,500) feet at "Savannah Towhead." The full significance of these figures can best be understood by recalling the fact that the ordinary low-water width of the river, where it is normal, is about equal to the high-water width above given. The great variation from the normal in the width, area and form of the cross-sections is illustrated by the cross-section plate which shows the normal sections at various places in the river. The greatest engorgement takes place in the vicinity of the "Suck," where the range between extreme high and low water is nearly seventy (70) feet. This range is reduced to sixty (60) feet at the "Pot." Between these points the fall is excessive, and the flow through the narrow and somewhat uniform channel is similar in many respects to that in a sluiceway. Below the "Pot" the river widens out and becomes practically normal at "Savannah Towhead." From the area of the sections shown and the estimated maximum discharge at Chattanooga, the mean velocity of flow has been calculated for the stages on the Chattanooga gauge, increasing by five (5) feet from zero to extreme high water. These results are given in Table "A."

TABLE A.

Stage Chattanooga gauge.	Discharge c. f. s. Chattanooga.	Area, in Square Feet, and Mean Velocity, Feet per Second.								Remarks.
		Chattanooga.	Tumbling Shoals.	Suck Point.	The "Suck."	The "Pot."	Scott Point.	The "Pan."	Savannah Towhead.	
0.....	8,000	1.70	5.33	2.34	3.32	2.32	4.44	2.90	3.64	Mean Velocity
		4,710	1,500	3,425	2,410	3,450	1,800	2,760	2,200	Area.
5.....	28,000	2.78	4.06	3.65	5.76	4.94	4.25	5.06	3.59	
		10,080	6,900	7,675	4,860	5,670	6.580	5,530	7.800	
10.....	52,000	3.33	4.37	4.64	6.60	6.40	4.29	6.08	3.50	
		15.600	11,900	11,200	7.885	8,120	12,110	8,560	14,850	
15.....	85,000	4.00	5.09	5.88	7.23	7.74	4.69	6.91	4.06	
		21,300	16,700	14,450	11,765	10,990	18,120	12,310	20,925	
20.....	120,000	4.45	5.59	6.70	7.59	8.70	5.19	7.15	4.42	
		27,000	21,470	17,900	15,825	13,780	23,050	16,780	27.175	
25.....	160,000	4.97	6.19	7.24	7.96	9.72	5.69	7.65	4.75	
		32,170	25,780	21,600	20,100	16,470	28,120	20,880	33.725	
30.....	205,000	5.16	6.64	8.27	8.38	10.80	6.14	8.30	5.20	
		39,720	30,860	24,800	24,450	19,000	33,370	24,700	39,425	
35.....	250,000	5.02	6.89	8.33	8.53	11.36	6.59	8.72	5.44	
		49,750	36,280	30,000	29,300	22,000	37,950	28.650	45,925	
40.....	310,000	5.11	7.35	9.52	9.00	12.30	6.97	9.34	5.64	
		60,700	42,170	32,550	34,450	25,200	44,480	33,200	54,925	
50.....	475,000	5.57	8.86	11.42	10.60	15.25	8.07	11.45	6.58	
		85,200	53,600	41,600	44,800	31,170	58,880	41,500	72,250	
58.....	700,000	6.76	10.95	13.95	12.92	19 18	10.30	14.42	8.18	
		106,000	64,000	50,130	54,200	36,500	68,060	48,900	85,575	

The difficulties of navigation of this "Mountain Section" were early brought to the attention of the National Government, and as far back as 1830 the first attempts at improving the channel of the river were made. The proposed improvements in this case amounted only to the obtaining of a low-water channel, having a depth of about two feet, high-water navigation of the "Mountain Section" at that time being practically impossible. This portion of the river has been examined and reported upon a number of times by the United States Engineer Officers; the first report was made by Colonel Long in 1830. The next report was by Colonel McClellan in 1853, and other reports were made in 1854, 1868, 1890, 1892 and 1898. In all of these reports it has been generally conceded that the obstructions to navigation offered by the "Moun-

tain Section" were the most serious of any to be found upon the river from Knoxville down. Colonel Long in his report outlined a plan for the improvement of the "Mountain Section," although the degree of improvement which he sought to obtain was exceedingly moderate. It appeared to have reference to a depth of two feet at low water, and it was expected that ascending boats would make use of ropes and be warped through the swift water of the "Mountain Section." The other reports submitted have generally proposed to carry the improvement a little further, to remove a greater number of boulders, to dredge a little deeper through certain bars and points, and in some cases to attempt to diminish the high-water velocity by cutting trees and removing boulders from the sides of the high-water channel. These plans have gradually been carried out from time to time, as money was available for the purpose. In all about $150,000 has been expended by the government upon this portion of the river in the construction and maintenance of the various works for channel improvement. As a result, navigation through the "Mountain Section" is somewhat less dangerous than it was originally, and it is also less difficult at the stages at which the channel can be used. However, the season of navigation has not been materially lengthened by all the work which has been done, and navigation through the "Mountain Section" is still entirely suspended at extreme low water, and the period of suspension is still very long. Navigation through the "Mountain Section" is generally considered unsafe for any boat of sufficient size to be useful for the purposes of commerce when the river falls below a 3-foot stage by the Chattanooga gauge, and the records would indicate that there is an average suspension of navigation on the river for at least three months out of every year, and this suspension occurs in the late fall and early winter, at the time when the navigation of the river would be most useful and most advantageous.

In 1891-1892 an examination was made of the reach of the "Mountain Section," under the direction of G. W. Goethals, Corps of Engineers, U. S. A., during the course of which the velocity of the current in the channel was measured at most of the points given above for six stages. The results of these observations are given in table "B." The velocities given in the tables, while they represent in one case the mean conditions of the whole section, and in the other the actual conditions at the point of observation, do not always give an adequate idea of the difficulties of navigation at the points mentioned, on account of the complications caused by the

TABLE B.

SHOWING OBSERVED VELOCITIES AT VARIOUS STAGES AND LOCATIONS IN THE "MOUNTAIN SECTION."

Chattanooga Gauge.....	5.00	7.50	8.50	9.50	16.60	32.00
Tumbling Shoals.....	7.50	6.15	.....	6.20	7.90	7.10
Suck Point.....	7.65	8.15	8 45	9.30	9.75	10.50
The "Suck".....	10 90	11.05	11.65	11.45	10.00	12.20
Suck Shoals.....	7.40	.....	.....	.. ..	.....	.....
Richies Point.....	.....	.....	.....	.. ...	10.15	13.40
The "Pot".....	9.30	10.50	.....	11.75	13.00	15.00
The "Skillet".....	10.15	9.05	... ..	7 10	7.00	7.25

formation of whirlpools and eddies; for instance: The table shows the highest velocities at the "Pot" and it is natural to expect to encounter there the greatest difficulties, whereas it is claimed by steamboat men that both the "Suck" and "Suck Point" are more dangerous and difficult to pass at high stages.

At low water the fall is governed by the longitudinal profile of the river bed, and is consequently concentrated at the shoals and other obstructions where, in some instances, for a limited distance, it amounts to more than one (1) foot in one hundred (100) feet. The total fall of extreme low water between Chattanooga and Shellmound is thirty-four (34) feet. This naturally divides itself into four (4) reaches with comparatively uniform fall, as follows:

Chattanooga to Tumbling Shoals.....	10 miles;	11.94 feet fall
Tumbling Shoals to Scott Point.....	7.5 "	14.8 " "
Scott Point to Kellys Ferry.....	5.2 "	3.6 " "
Kellys Ferry to Shellmound.....	16.1 "	3.8 " "
Total.....	38.8 miles;	34.14 feet fall

The high-water fall is largely controlled by the contracted sections in the mountains, and may be divided into three reaches over which the fall is nearly uniform, as follows:

Chattanooga to the "Suck".....	12.7 miles;	7.8 feet fall
The "Suck" to Kellys Ferry.....	10 "	25.8 " "
Kellys Ferry to Shellmound.....	16.1 "	13.5 " "
Total.....	38.8 miles;	47.1 feet fall

Because the river is confined in a deep, narrow and crooked canyon in the mountains, and because its fall through this canyon is excessive, it was seen that the limit of improvement by channel

work had practically been reached, and in 1890 the Board of Engineers, which was appointed to consider the improvement of the "Suck," a name which is sometimes applied to the whole of the "Mountain Section," and sometimes is limited to only one of the obstructions, reported that the only complete and practical improvement of this section of the Tennessee River would be by the construction of canals, or by arrangements for slack-water navigation, but they report further that the great expense of slack-water navigation rendered it unworthy of consideration at that time. Since that time the project of slack-water navigation of the "Mountain Section" has been repeatedly taken up, and a number of proposals have been made by the government. In 1900 the government engineers reported on a system of slack-water navigation, which they estimated would cost in the neighborhood of one million dollars.

In planning a system of slack-water navigation for the "Mountain Section" a very serious difficulty is met with at the outset, and that is the enormous flood height which the river occasionally, although at rare intervals, attains in this particular place. As before stated, the banks of the river rise rapidly from the low-water channel. There is no flood plain, so that even at the highest stages the surface width of the river in some places in the "Mountain Section" is not more than 1,000 feet, although this does not exceed its average low-water width at and above Chattanooga. The consequence is that in time of flood there is an engorgement of the waters at this narrow point, and the water is backed up and held as by a dam until it has been known to attain a height in the mountains of 70 feet above its ordinary low-water level. This engorgement ponds the water, and diminishes the high-water slope for many miles above Chattanooga. It is true that such exceptional flood heights are of very rare occurence, only one authentic record of such a flood being in existence.

At such extreme floods down along the river the banks are generally inundated, bottom lands are all overflowed, the landings are under water, and it is a matter of indifference whether navigation is possible or not. It would seem, therefore, unwise and unnecessary to attempt to provide safe and easy navigation for such extreme and exceptional floods. The most difficult problem presented for solution in connection with the installation of a system of slack-water navigation has been the determination of the "guard" for the locks; that is, the height that the lock must have above the dam in order that it may continue in use until the dam

CHATTANOOGA ISLAND—VIEW FROM COUNTY BRIDGE.

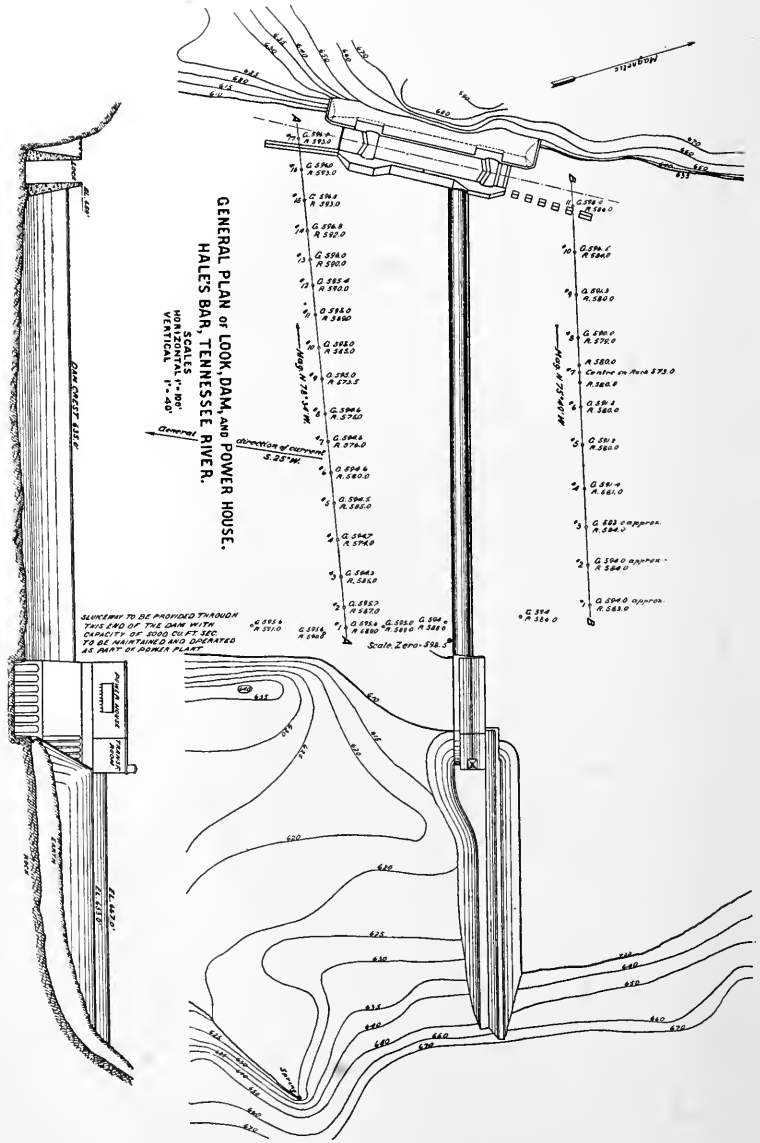
is so completely submerged that vessels may safely and easily pass over it.

Owing to the very narrow water way in the "Mountain Section," and to the great velocity of water at high stages, it seems doubtful if any dam of useful heighth would be submerged at any stage of the river, and it would, therefore, be necessary in order to insure an entirely uninterrupted navigation at every conceivable stage of the river to construct locks which could be operated at all stages, and this would involve a height of walls and of gates that would render the cost excessive. The alternative is to admit of a possible suspension of navigation during the time of great floods, knowing these periods of suspension must be short and of rare occurrence.

An examination of the hydrographs from 1875 to 1900 shows that if the stage of 35 feet on the Chattanooga gauge is assumed as the limiting height beyond which it will not pay to attempt to provide navigation, then in the past 25 years there would have been 17 suspensions of navigation, amounting in the aggregate to 85 days or a little more than 3 days per annum.

Records show that there were actually 2,317 days during which navigation even for very light draught boats was suspended, and probably quite as many more days when it was attended with difficulties and dangers that a slack-water improvement would have entirely obviated. During this period of 25 years there were 12 years in which the height of 35 feet on the Chattanooga gauge was not reached at all.

Thirty-five feet on the Chattanooga gauge was, therefore, assumed as the height up to which it must be possible to operate the locks. Having fixed upon this height, a number of different plans were considered: A plan to improve only the worst part of the "Mountain Section" by a dam which would back the water up over Tumbling Shoals; a plan to improve the entire reach from the "Skillet" to Chattanooga by a higher dam; a plan considering a site near the Savannah Towhead for a lock and dam to accomplish either of the above purposes; the plan finally reported being a single lock and dam in the vicinity of the "Skillet," the dam to have such a height that it would back the water up to Chattanooga and to secure at the lowest stages a navigable channel not less than 5 feet in depth for the entire distance and to use with this dam a single lock, the walls and gates of such height that it could be used until the river reached a stage of 35 feet on the Chattanooga gauge.


GENERAL PLAN of LOCK, DAM, AND POWER HOUSE.
HALE'S BAR, TENNESSEE RIVER.
SCALES
HORIZONTAL 1"=100'
VERTICAL 1"=40'
Horizontal Scale
100 200 300 400
Scale Zero-598.5
SLUICEWAY TO BE PROVIDED THROUGH THIS END OF THE DAM WITH CAPACITY OF 3000 CUBIC SEC. TO BE MAINTAINED AND OPERATED AS PART OF POWER PLANT
Axis of Dam S 71°-41' W.
Direction of current S 25° W.
Axis of Dam S 72°-41' W.
Magnetic
Power House
Earth
Rock
EL 637'
EL 635'
EL 625'

As might be expected in a place where the river has cut its way down 1,000 feet through rock of varying hardness, the bottom of the river is not composed, as a rule, of solid rock, but is made up of boulders, gravel and drift, so that considerable difficulty was experienced in finding a suitable foundation for a lock and dam. The locality known as "Scott Point" was finally selected, and after several hundred borings it was finally demonstrated that a suitable rock foundation at a reasonable depth could be had both for the lock and the dam.

The work proposed in the report of 1900 consisted of a lock of cut stone masonry, 65 feet wide in the clear and 300 feet long between hollow quoins. The dam was to be constructed of heavy timber cribs filled with stone, the crest of the dam to be perpendicular with the general direction of the current, and to be horizontal and straight, the deck to slope downward each way from the crest at a slope of two to one.

About this time, some of the business men in Chattanooga, who had been following the progress of the development of water power in various parts of the country, conceived the idea that these works for the amelioration of the traffic conditions on the Tennessee River might be made to pay for themselves, by the conversion of the water power generated at the dam into electrical energy; and the whole matter was taken up with a great deal of earnestness, notably by C. E. James and J. C. Guild. The scheme was examined in all its bearings, especially as to its influence on the development of the industrial situation in Chattanooga, and the aid of the Honorable John A. Moon, congressman from that district, was enlisted to obtain the necessary legislation.

These efforts culminated in an Act of Congress approved April 26, 1904, which authorized the Secretary of War to grant permission to the City of Chattanooga to build and construct a lock and dam across the Tennessee River at Scott Point, near Chattanooga, Tennessee, under his direction and control, in accordance with plans and designs made by Major D. C. Kingman, Corps of Engineers, United States Army. This act also provided that if the City of Chattanooga should fail within four (4) months from the date of the passage of the act to notify the Secretary of War of its intention to construct the lock and dam, then the Secretary of War was empowered to offer the franchise to C. E. James and J. C. Guild, residents of Chattanooga, Tennessee, for a further period of eight (8) months, and failing to contract with them, to contract with any private corporation, company, firm, or business,

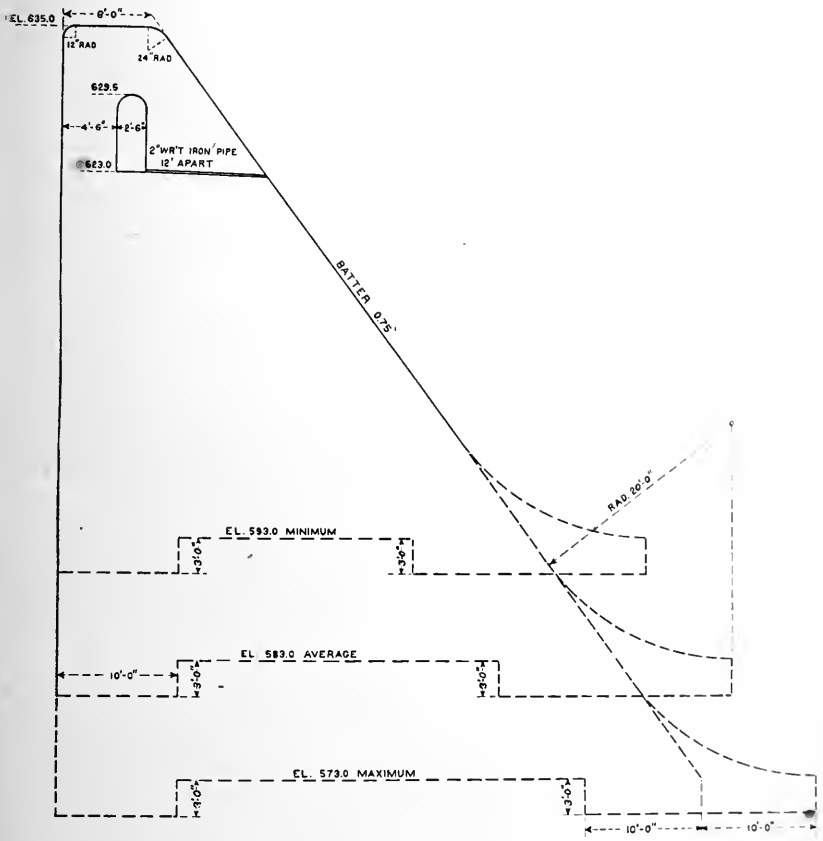
for the construction of the lock and dam on the terms and in the manner provided. The parties obtaining the franchise were to construct the lock and dam at their own expense, acquiring the land that might be necessary for that purpose. The United States was to furnish the machinery for the lock, but the power for the operation of the same was to be furnished by the company. And it was further provided that the utilization of power by means of the dam was not to interfere with the flow of water or the navigation of the river.

The City of Chattanooga failed to take advantage of the opportunity; but Messrs. James and Guild, seeing the advantages that would accrue to themselves and their associates, organized the Chattanooga and Tennessee River Power Company to undertake this work, with Mr. A. N. Brady as the leading spirit of the financial group. The active interest of Mr. A. N. Brady in industrial enterprises of this character and his appreciation of their possibilities has made feasible the development of many similar undertakings; he had associated with him as his technical advisers in this work Mr. John Bogart and the author of this paper. The Chattanooga and Tennessee River Power Company then entered into contract with the United States Government for the construction and maintenance of the works.

The question to be considered by Major Kingman when deciding upon a location for a lock and dam was one of economy; and a location which, while giving ample navigation facilities, would require the smallest expenditure of funds, was, therefore, the one to be sought, and it was found at Scott Point. When, however, Congress passed an act allowing private parties to build the lock and dam, in return for the use of the water power for ninety-nine years, a different aspect was put upon the case, and the paramount question was not economy. Provided that the interests of navigation were fully safeguarded, it was desirable to locate the works lower down the river and get the benefits of the extra fall in such distance. The use for ninety-nine years of the extra power so gained would far more than compensate for the extra cost of the structures, due to increased height.

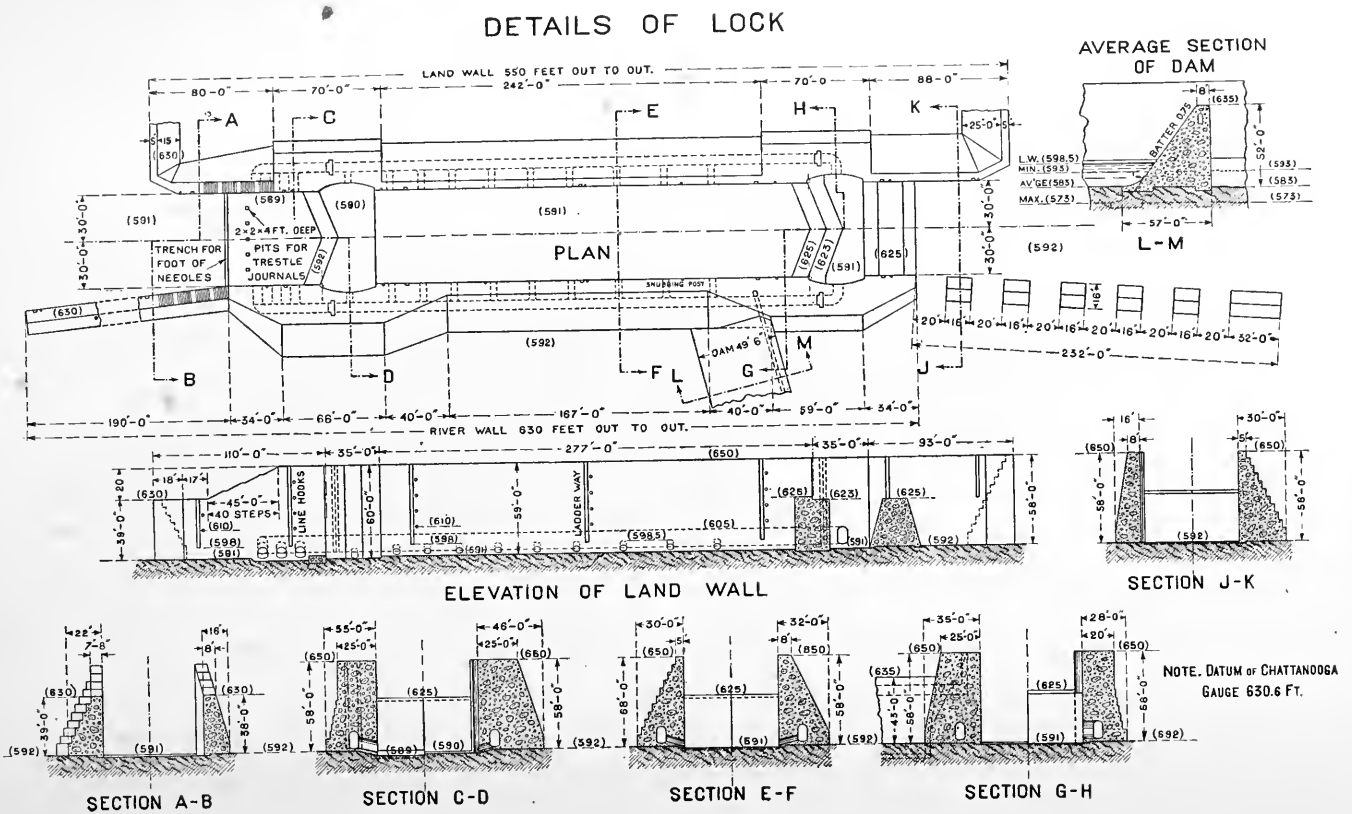
The original act of Congress in relation to this construction fixed the location of the dam and lock at Scott Point, about 16 miles, along the course of the Tennessee River, below the City of Chattanooga. A study of the conditions affecting the river, particularly in the higher stages of flow, showed that the head upon the turbines would be greatly decreased as the river rose. This would

be caused by the fact that below Scott Point there occur several narrow passes which in flood stages set the water back to such an extent that with a dam giving a head of over 35 feet at low stages there would be, at a flood of 25 feet, only about 17 feet head on the wheels. Also that at the time of a flood of 35 feet, which



CROSS SECTION OF DAM

occasionally occurs, the head would be reduced to about 12 feet, and that at a stage of 40 feet, which may occur, the head would be only 10 feet. The difficulties of securing a satisfactory development under these conditions were so great that after representation of the facts to the authorities at Washington an act was passed by Congress (approved January 7, 1905) authorizing the location of the dam at such other point or place in the mountain section


DETAILS OF LOCK
AVERAGE SECTION OF DAM
PLAN
L-M
ELEVATION OF LAND WALL
SECTION J-K
SECTION A-B
SECTION C-D
SECTION E-F
SECTION G-H
LAND WALL 550 FEET OUT TO OUT.
RIVER WALL 630 FEET OUT TO OUT.
TRENCH FOR FOOT OF NEEDLES
PITS FOR TRESTLE JOURNALS
2×2×4 FT. DEEP
SNUBBING POST
LINE HOOKS
LADDER WAY
45'-0" 40 STEPS
NOTE. DATUM OF CHATTANOOGA GAUGE 630.6 FT.

of the river below Scott Point as the Secretary of War might approve.

A location was then studied at Kellys Bar, 5½ miles below Scott Point. This was found to be a favorable place for the construction of the requisite works, but there being still a number of narrow places in the river below, the hydraulic conditions, while better than at Scott Point, were not satisfactory.

A location was finally found at Hale's Bar, 33 miles below Chattanooga, which is satisfactory from all points of view. The foundations for all structures are on solid rock, the river at this point leaves the mountain gorge and enters upon a wide valley, so that the backing up of flood waves is much less than at points above. The head on the turbines at low water will be 39½ feet. At a flood of 25 feet there will be 27 feet head, and at a flood of 35 feet there will be 21½ feet head, and at a stage of 40 feet the head would still be about 19 feet, thus assuring a large continuous output of power under all conditions of flow.

It has also been found practicable, with the sanction of the Government, to make the crest of the dam higher at this point than at the other places studied. The increased pool, extending to Chattanooga, gives very desirable and satisfactory storage for use in regulating power at times of low flow and also affords good navigation at several bad points not improved by constructions at the other locations. The Scott Point lock was to be of cut stone masonry, and the dam of timber cribs filled with stone. The Hale's Bar lock is designed to be of concrete; the dam also is to be of concrete, as being more durable and water-tight. The natural fall in the river at low water between Scott Point and Hale's Bar is five feet, and the crest of the dam, as now designed, is six and one-half feet higher than the Scott Point design, giving an extra head of eleven and one-half feet at extreme low water. With a discharge of 5,000 cubic feet, this means that the present plan will deliver at Chattanooga about 5,000 horse-power more than the old plan and location.

The lock and dam were designed under the direction of Major H. C. Newcomer, Corps of Engineers, U. S. A., by John M. G. Watt, Principal Assistant Engineer. The concern of the Government being only the conservation or improvement of the navigability of the river, it required that only the lock and dam be designed by the engineer officer in charge of the Tennessee River; the power house and all appurtenances for developing the water

power were to be designed by the grantees, subject, however, to the approval of the Secretary of War.

The designs for the power plant have been developed by John Bogart, C. E., who had many novel features to encounter and difficulties to overcome, the chief being how to deliver not less than a certain fixed minimum of power every hour in the year, irrespective of the stage of the river. In this connection I cannot do better than quote the words of Mr. Bogart: "The difficult hydraulic problem in the development of this power arises from the variations in volume of flow and in head upon the turbine wheels. The variation in volume runs from about 5,000 cubic feet per second up to 255,000 cubic feet per second, with the probability of an occasional flood reaching a volume of 320,000 cubic feet per second. Once during the past twenty years there was an unprecedented flood with a volume of possibly 600,000 cubic feet per second; the duration of this was brief.

"A rather general statement is that for an approximate average period of about two months of a year the flow will be between 8,000 and 16,000 cubic feet per second; for about four months between 12,000 and 59,000; for about four months between 16,500 and 59,000; for about two months between 21,500 and 92,000 cubic feet per second. The successful operation of the generators which transform the water power into electrical current requires that the speed shall be substantially constant at all times. If the variations in volume and head were not greater than those found it would not be difficult to secure this uniformity of speed. But the volume of flow has in the past and probably will in the future be at times less than 8,000 cubic feet per second, and this low flow may continue for a number of consecutive days, possibly for several consecutive weeks. To insure commercial success in the enterprise it is necessary that the electrical output should continue during this period. Therefore, the rate of speed of the turbine must continue uniform, and as the volume is limited the turbines must be designed to secure the highest efficiency during these periods of low flow, and it is also important that the head upon the wheels should then be as great as is in any reasonable way practicable.

"It is also the fact that there have been and doubtless will be periods when the volume of flow is considerably greater than the 92,000 cubic feet per second, which is the ordinary high-water flow. The flow has frequently exceeded that volume for many consecutive days; 157,000 for a week; 189,000 for a similar

period; and the volume has reached 320,000 more than once. Each of these additions of volume involves a reduction of head which will be lowered to less than 18 feet when these larger flows occur. To secure a uniformity of speed and a regular output of power under these conditions I have found it necessary to design a third turbine wheel upon the shaft on which the two turbines will be fixed for the lower volumes. This third wheel will be adapted to the utilization of great volume at the lower heads, there being then ample water which can better be utilized through the wheels than allowed to pass over the dam."

The lock and dam will be built of cyclopean concrete; that is to say, large stones, say up to ten tons weight, or larger, if the machinery can handle it, will be embedded in and completely covered with concrete to a depth of not less than nine inches; so that the body of the structure is chiefly of uncut blocks of stone, laid in random range, and separated from each other in every direction by nine inches or more of concrete. This will cheapen the construction, and acually be safer than simple concrete, as it will make a heavier mass, while with ordinary care in laying it will be just as impermeable.

The lock is located on the west or right bank of the river. It will be built against a rock bluff, thus obviating any danger from the river cutting around during high water. The dam will be 1,200 feet long and extend from the lock to the power house. The power house will be about 200 feet long and will be built as a continuation of the dam. The power house will be connected with the left bank of the river by means of an earth embankment with a concrete core wall. This core wall will extend to solid rock, will have a width of 4 feet on top and a maximum width of 8 feet at the bottom. Its top will be at elevation 665. The earth bank will be carried two feet higher, will have a top width of 12 feet, and will have side slopes of two to one. At elevation 653 it will have a berm on the lower side which will carry an approach to the power house. The total length between the rock bluff and the hill where the embankment will terminate is about 2,300 feet, of which the dam comprises 1,200 feet, the power and transformer houses about 300 feet, and the embankment about 700 feet.

The tops of the lock walls will be at elevation 650. The inner or land wall proper of the lock will be 427 feet long, with approach walls aggregating 123 feet more, or a total length over all of 550 feet. At each end there will be a wing wall running into the bank at the same elevation as the top of the main wall. The length

of the river wall proper is 440 feet, with a lower approach wall 190 feet long. The upper approach wall is formed of detached piers 16 feet long, with spaces of 20 feet between them and extending 232 feet upstream of the upper end of the lock. The height of the lock walls will be about 58 feet. The land wall will have a bottom width of 30 feet and a top width of 5 feet. The bottom and top widths of the river wall will be 32 and 8 feet respectively. At the buttresses supporting the gates the top width is increased in all cases to 25 feet, the base of the land wall to 33 feet, the base of the river wall to 35 feet at the upper end, and to 46 feet at the lower end.

The lock will have a clear width of 60 feet. The gates will be of the mitering type, horizontally framed, of mild steel, and will be opened and closed by rack bars operated by electricity, with arrangements for hand power in case of failure of the electric current. These gates will be remarkable for the head they will have to support. In extreme low water seasons, with flashboards on the dam, the difference in elevation between the two pools will be about 40 feet. Each leaf of the lower gate will be about 34 feet long by 59 feet high, and will weigh about 129 tons; each leaf of the upper gate will be about 26 feet high, and will weigh about 50 tons.

The lock chamber will be filled by two culverts, about 11 feet by 6 feet, one in each wall, running the whole length of the chamber, and having ten openings three feet below the level of low water. It will be emptied by means of two culverts of the same size, each having three openings into the lower bay. These culverts will be operated by Stoney sluice gates, operated from the top of the wall by electric or hand power. The chamber will admit at low water a fleet of boats or barges drawing six feet, with a width of 59 feet and a length of 300 feet.

In case of accident to the gates the lock can be closed by placing five steel trestles across each end, fitting into journals placed during construction. These trestles would then be connected by steel beams against which would rest needles or vertical beams of timber or steel.

The crest of the dam will be at elevation 635 and have a width of eight feet. The upstream face will be vertical while the downstream face will have a batter of three horizontal to four vertical, terminating in a curve with a radius of 20 feet. The height will vary from 42 feet to 62 feet, depending on the elevation of solid rock, with an average height of about 52 feet. Running the full

length of the dam there will be a passageway, as shown in the accompanying section. This will be two and a half feet wide by six and a half feet high. It will terminate in the land wall of the lock and in the power house in shafts extending above extreme high water. At the bottom of this passageway at intervals of 12 feet will be placed two-inch wrought-iron pipes extending out to the downstream face of the dam. These pipes will supply air under the falling sheet of water passing over the dam, and prevent the formation of a vacuum. This passageway will also be used as a means of crossing from the power house to the lock, and will carry the wires for furnishing the electricity for operating the machinery of the lock and for lighting the lock and other United States property. Near the power house the dam will contain a sluiceway to supply water to the lower pool at times when there is none passing over the dam or through the power house.

The power house will consist of seven bays, each containing two units. Each unit will consist of three turbines on a vertical shaft, carrying the generator at its upper end. Under ordinary stages of the river only two of the turbines will be used, the third being held in reserve and used when there is a large quantity of water flowing, but giving a reduced head. Each generator will have a normal capacity of 2,250 to 3,000 k.w. The main floor of the power house will be at elevation 653. Ten feet below this will be a floor carrying the supports of the rotating parts of the turbine and generators and also the governors.

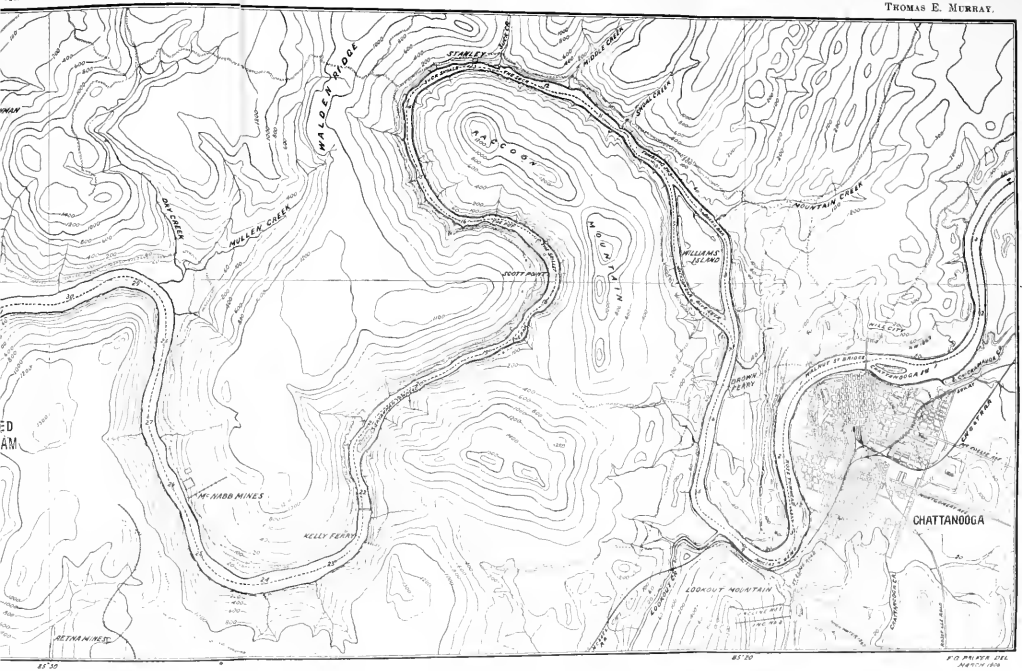
The water will be conducted to the power house by a headrace excavated in the bank of the river. The tailrace will also be excavated in the bank of the river, and will extend down into the rock, its elevation at the power house being 571. Low water below the dam will be at elevation 598.5. This will give a head of 36.5 feet, which can be increased three feet by the use of flashboards.

The lock, dam and power house are all to be built of concrete.

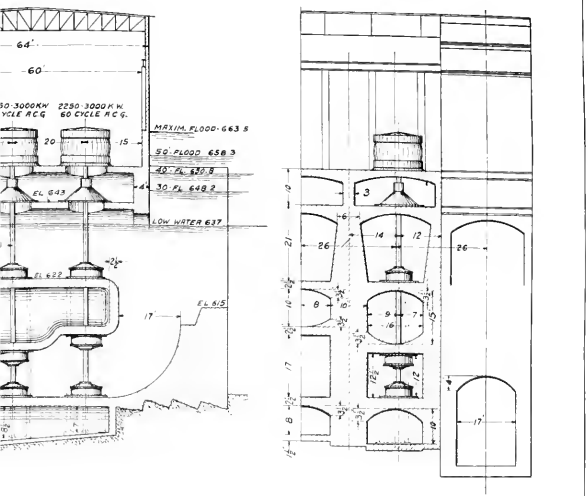
Although nothing has been definitely decided as yet regarding the electrical apparatus, it is the intention at the present time to generate current at 6,600 volts, 60 cycles, and step up through oil-insulated, water-cooled transformers to either 23,000 or 40,000 volts for the transmission line. The first transmission line will probably consist of two three-phase lines on the same pole, and will be carried in a straight line over the mountain to the south of the bend in the Tennessee River just below Kellys Ferry.

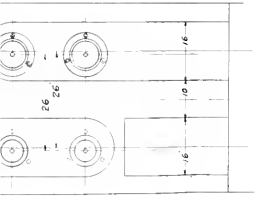
From this point the line will follow the carriage road through the hills to Chattanooga. The Receiving Sub-Station will probably be equipped with 23,000 or 40,000 volt air blast step-down transformers, with 2,300 volts distribution within the city.

It is expected that the entire plant will be completed and ready for operation about October 1, 1907. In conclusion, credit should be given for data and other help in the preparation of this paper to John Bogart, Consulting Engineer, and J. C. Guild, Chief Engineer of the Chattanooga and Tennessee River Power Company, and to C. E. James, Major H. C. Newcomer, Engineer Corps, U. S. A., and John M. G. Watt, Principal Assistant Engineer; to the reports of the War Department, and to my assistant, Geo. A. Orrok (Member A. S. M. E.).

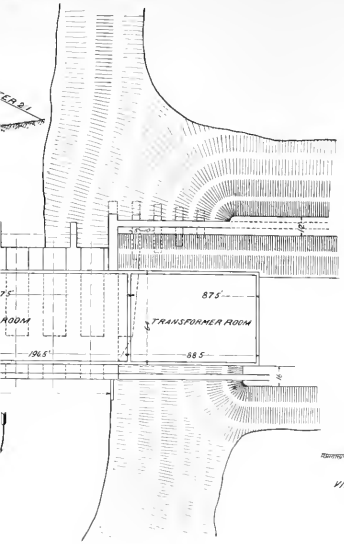


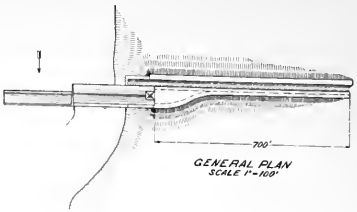
MAP OF "MOUNTAIN SECTION" OF TENNESSEE RIVER.



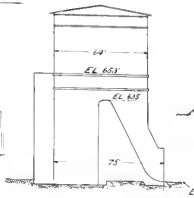


SKETCH OF POWERHOUSE
AND
TURBINE ARRANGEMENT.

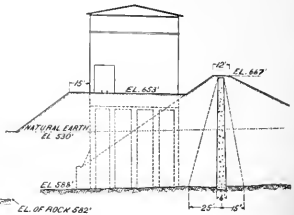




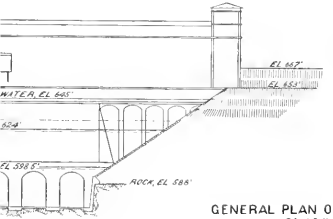
GENERAL PLAN
SCALE 1"=100'



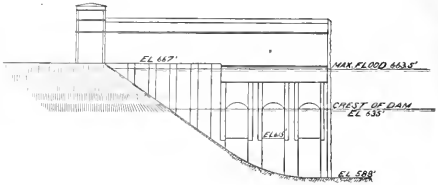
VIEW FROM THE RIVER SIDE.



VIEW FROM THE SHORE SIDE.



GENERAL PLAN OF POWER HOUSE.
SCALE 1"=20'



VIEW FROM UP STREAM SIDE

IDE

PORTION OF ARMY POST—FORT OGLETHORPE.

Climate and Progress

In the location of an industrial community an important consideration is that of climate. The East Tennessee climate is promotive of the highest state of human health and vigor. Nestled between mountains and ridges, Chattanooga is protected from the fierce northwesters that sweep through the Mississippi and Missouri valleys. The temperature is comparatively even and the rainfall is well distributed. Boiler-making and other heavy work can be done out doors practically all the year. This is the healthiest city of its size in the country. The normal death rate is 15 per 1,000 of the total population, and is much less when only the whites are included. This is mainly due to the proximity to the mountains, the pure water supply and to the high site of the city. Chattanooga is from 675 to 800 feet above the sea level. There is little malaria and typhoid fever and a surprising immunity from disease of like character.

Chattanooga manufacturers have a desirable laboring population open to them. The short winters, healthy climate and comparative cheapness of foodstuffs makes it possible for the laboring classes to live here much more cheaply than in many other cities, and wages are proportionately generally more reasonable. The laboring people of Chattanooga are above the average in intelligence and ambition, and for manufacturing purposes are just coming to their prime. It takes two generations of manufacturing before the best results can be obtained. Chattanooga's great industrial impetus began soon after 1880, and now the sons of these first workmen are coming to manhood with the benefit of their fathers' training and experience to begin with. They have been raised up in and around our factories and they know their every detail. Chattanooga experiences exceptionally little labor trouble and loss from strikes. The relations between employer and employe have been unusually cordial and satisfactory.

It is notable that recent large additions to the manufacturing plants of the city have nearly all been made by Chattanooga people who have made their money in manufacturing and who are thoroughly familiar with local conditions and the market in which Chattanooga must sell goods. This gives a new concern almost an established trade to commence with and accounts for some of the quick, phenomenal successes we have seen.

In considering Chattanooga's industrial growth it should not be forgotten that there has been no systematic effort to secure new industries here. Indeed, the substantial character of this growth

is shown by the fact that fully 75 per cent. of this increased capital has been provided at home. Our own people and others thoroughly familiar with conditions and markets have invested thus liberally in manufacturing here, arguing in the most emphatic way for our importance as a manufacturing center.

The market for Chattanooga-made goods is now constantly widening. The great diversity of our factories, making nearly 500 separate articles, attracts buyers and enables them to buy full lines here and to bunch shipments at car load rates. New railroads are being constructed penetrating territory that is to be rapidly built up. The south is growing at a remarkable rate, and its consumption of manufactured goods is constantly increasing. Transportation charges play a more important part than ever before in the cost of products, and it is against sound commercial principles to send raw materials away to be made up into manufactured products that are brought back for consumption to the district where the raw material is produced. Goods are sold on narrower margins and the competitive spirit is keener than ever before. The recognition of this principle helps Chattanooga factories.

Recognition should be made of the value of the Tradesman, the great trade paper of which the whole South is proud, in assisting to develop the industrial spirit in Chattanooga.

Locally a spirit of co-operation has sprung up among manufacturers determined to give their city the rank its natural advantages merit. The principle of every man for himself is giving way to a realization of the fact that it is by the united effort of its business men that an industrial community can make the best progress and best serve its patrons. The organization and success of the Chattanooga Manufacturers' Association, the union of furniture men under the name of the Chattanooga Furniture Association, and the co-operation of a number of leading manufacturers in the organization of new companies and the completion of lines only partially represented here, shows the development of this new era and its improved esprit de corps. Already an increasing business, a feeling of confidence locally and higher standing abroad are resulting. And factories are being modernized, waste eliminated, bi-products utilized and scientific principles applied to the production of high grade goods.

Industrial Chattanooga is measuring up to her opportunities. The publication of The Manufacturer, representing the industrial interests of this one city, evidences healthy vitality.

IN THE CITY OF THE SOLDIER DEAD—NATIONAL CEMETERY.

The State of Tennessee

The State of Tennessee lies between the boundaries of 35 and 36 degrees, 30 minutes north latitude, the zone of ideal temperate climate. It has an area of 42,050 square miles, comprising nearly 27,000,000 acres, and in 1900 its population is in round numbers 2,022,000, an increase of 250,000 since the census of 1890. The state is in the form of a quadrilateral, 432 miles in length from east to west, and 109 miles from north to south, taking the greatest length and width. It has more miles of navigable streams to the square mile than any state in the union, aggregating about 1,200 miles of navigable water.

The State of Tennessee, by reason of its peculiar topography, beginning in the eastern portion with chains of towering mountains, attaining an elevation of 6,600 feet above sea level, and descending in regular stages, penetrated by valleys of almost inconceivable richness, to the low savannahs, which border the deep flowing Mississippi on the west, combines within its boundaries a greater variety of soils and products, a larger diversity of mineral resources, a more genial climate and richer scenic attractions than any state of the union.

The difference in altitude between the extreme eastern and western boundaries of the state is 6,000 feet, equivalent to eighteen degrees of latitude, and producing a flora and a climate within the confines of the state the same as if it extended along the Atlantic ocean, from North Carolina to Labrador. It is a fact that every crop grown in the United States is produced to a greater or less extent in the State of Tennessee, and almost every mineral and timber found within the limits of our great union has been discovered in the state.

The average temperature in the center of the state is 58 degrees, and about 1 degree lower in the northern part and 1 degree higher in the southern; the average annual rainfall is 54 inches. The average period between killing frosts, as ascertained by a series of observations continued for twenty-two years, is 189 to 200 days, being nearly seven months in the southern part of the state and a trifle over six months in the northern portion.

THE PRODUCTIONS.

The latest statistics of agricultural products are for the year 1900, which give the farm products of the state as follows:

Wheat bushels	11,924,000
Corn, bushels	67,307,390
Oats, bushels	2,725,330
Rye, bushels	107,912
Buckwheat, bushels	8,597
Barley, bushels	21,636
Potatoes, bushels	1,404,097
Sweet potatoes, bushels	1,571,575
Hay, tons	679,450
Peanuts, bushels	747,668
Cotton, bales	234,592
Number of sheep	496,000
Wool, pounds	1,395,295
Tobacco crop, pounds	49,157,550
Horses	328,535
Mules	228,976
Meat cattle	912,183
Butter, pounds	29,091,696
Cheese, pounds	26,622
Honey, pounds	2,404,550
Beeswax, pounds	79,590
Swine	1,976,984
Poultry	7,759,264
Eggs, dozens	31,807,990

THE POPULATION.

The white population of the state increased 17.05 per cent. between 1880 and 1890, the negro increased 7.73 per cent.; from 1890 to 1900 the white population increased 15.2 per cent., the negro increase was 11.5 per cent.; this rate has been maintained since 1900, and the ratio between the races in the state today is about 76.2 per cent. white, 23.8 per cent. negro; 80 per cent. of the total population is rural. The white population is nearly all Anglo-Saxon and Scotch-Irish origin; the foreign element is not over 5 per cent. of the whole.

THE RAILROADS.

The total railroad mileage in the state is about 3,137 miles, penetrating seventy-four out of the ninety-six counties.

MINERAL WEALTH.

The mineral wealth of the state seems almost fabulous. Nature poured forth her riches with a lavish hand in this commonwealth, and every mineral known to arts in the temperate zone is found, and many in inexhaustible quantities and of surpassing richness.

There are 84 coal mines in the state which produce annually about 4,300,000 tons of coal, of which about 800,000 tons are manufactured into coke.

Iron ore and limestone are found in all three grand divisions of the state, and coal in abundant quantity in two divisions. The three lie in close juxtaposition in many portions of the state. The production of iron ore averages nearly 900,000 tons per year, of which 60 per cent. is brown hematite and 40 per cent. red hematite.

There are twenty-six blast furnaces in the state, with daily capacity of 1,800 tons of pig iron; 12 are charcoal and 14 coke stacks. The annual pig iron product of the state is about 350,000 tons, which is more than the total amount produced in the United States in 1842.

The Tennessee marbles are famous the world over and exist in greatest abundance in East Tennessee. There are 200 varieties found in the state ranging in color from the dazzling white to jet black. There are now 50 quarries in operation in the state producing annually about 55,000 tons.

Copper, zinc, lead, manganese, gold, iron pyrites, sulphate of iron, gypsum, salt, nitrate of potassa, legnite, alum and slate exist in workable quantities. Oil wells of great value are being developed. A new industry and a great source of wealth which has developed in the state within the last few years is the great phosphate beds, discovered in Middle and West Tennessee, and hundreds of thousands of tons are now annually mined.

BUILDING STONE.

Granite of a very rich color and great compactness is found in portions of the state; limestones and sandstones are everywhere abundant, and beds of burr or millstones are worked; lithograph and oil stones of high quality are also found.

Potters' clay, fire and brick clays and kaolin are very abundant, and are of excellent quality. Heavy spar and other mineral paints are found. Large deposits of asbestos exist in some localities; copperas is abundant and gympsum has been discovered.

THE TIMBER.

The total acreage of woodlands and wild lands in the state is placed at 17,062,316 acres. The following varieties are the chief timbers of the state: White, blue and water ash, beech, birch, buckeye, red cedar, chestnut, wild cherry, cotton wood, cypress, dogwood, elm, balsam, black fir, gum, six varieties of hickory, linden, locust, maple, red mulberry, from twelve to fifteen species of oak, white and yellow pine, blue, white and yellow poplar, sassafras as a shrub and as a forest tree, sycamore, black and white walnut, butternut, laurel, hornbeam, box elder, hackberry, persimmon, etc.

THE MANUFACTURING INTERESTS.

According to the census of 1900, $51,475,092 were invested in manufactories in Tennessee, with an annual output of $72,355,286 manufactured products. The manufacturing interests of the state are diversified, consisting chiefly of iron, cotton, lumber, furniture, textile, leather, cotton seed products, etc.

The progress of Tennessee in manufacturing is shown by the following figures from the census: The manufacturing capital in 1870 was $15,595,295; in 1900, $51,475,092, increase, 350 per cent.; hands employed, 1870, 19,412; 1900, 42,759, increase 250 per cent.; wages paid, 1870, $5,390,630; 1900, $16,899,351, increase, 300 per cent.; raw material used, 1870, $34,362,636; 1900, $72,365,286, gain over 100 per cent. The progress since 1900 has been steadily maintained and will show even a greater growth in the census of 1910.

EDUCATIONAL.

The scholastic population of the state free schools by the last census was 694,437, and is now about 800,000. The average daily attendance is 400,000. There are 7,500 schools in the state, employing about 2,500 teachers. The total annual receipts for public schools approximates $3,000,000, over $7.00 per capita for each pupil attending.

There are 1,000 private schools in the state and a large number of universities and colleges. Tennessee contains more seminaries and colleges than any state in the South.

Board of Officers

Forming the Council of the American Society of Mechanical Engineers, 1905-1906

President—Fred W. Taylor.

Vice-Presidents—S. M. Vauclain, H. H. Westinghouse, George H. Barrus, Walter M. McFarland, Edward N. Trump, Robert C. McKinney.

Managers—Geo. I. Rockwood, John W. Lieb, Jr., Asa M. Mattice, Geo. M. Brill, Fred J. Miller, Richard H. Rice, Walter Laidlaw, Frank G. Tallman, Frederick M. Prescott.

Treasurer—Wm. H. Wiley, 43-45 East Ninteenth street, New York, N. Y.

Secretary—F. R. Hutton, 12 West Thirty-first street, New York, N. Y.

Chairman of Finance Committee—E. D. Meier.

Honorary Councilors—Samuel T. Wellman, Edwin Reynolds, James M. Dodge, Ambrose Swasey, John R. Freeman.

Local Committee—No. 1, Fred W. Taylor, president; No. 2, Wm. H. Wiley, treasurer; No. 3, Frederick R. Hutton, secretary; No. 4, Francis W. Hoadley, assistant to treasurer and secretary; No. 5, Louis A. Gillet, assistant to secretary; No. 6, Charles A. Morrison, official stenographer; No. 7, Newell Sanders, A. S. M. E., chairman general local committee; No. 8, B. T. Burt, A. I. E. E., secretary general local committee; No. 9, H. S. Chamberlain, A. I. M. E.; No. 10, W. H. Collier, A. S. M. E.; No 11, J. C. Guild, A. S. C. E.; No. 12, Wm. H. Hume, A. S. M. E.; No. 13, Major H. C. Newcomer, Corps Engineers, U. S. A.

Headquarters throughout the entire meeting will be at the Read House, and will be opened Tuesday noon, May 1, 1906.

Tuesday afternoon, May 1, left free for assembly of members and for visits to points of interest throughout the city.

OPENING SESSION

Tuesday Evening, May 1, 9:00 O'clock

Assembly hall of the Read House.

Address of Welcome by Mayor W. L. Frierson, with response by Mr. Fred W. Taylor, president of the American Society of Mechanical Engineers.

SOCIAL REUNION.

This evening will give an opportunity for members to meet each other, to renew old acquaintances and to form new ones. It will be an informal gathering at which the ladies will be welcome.

SECOND SESSION

Wednesday Morning, May 2, 10:00 O'clock

Assembly Hall of the Read House.

Business session for the report of tellers and committees and general business. Any new business outside of the professional papers may be conveniently presented at this time.

Until the hour of adjournment after the executive business has been concluded, the following papers will be presented:

No. 085. "Report of Committee on Standard Proportions for Machine Screws."

No. 092. "Report of Committee Co-operating on Pennsylvania Railroad Locomotive Tests."

No. 096. Moseley, A. W., and Bacon, J. L.—"Effect of a Blow."

Wednesday Afternoon, May 2

EXCURSION.

At 1:00 o'clock sharp members and ladies will take trolley cars at the corner of Market and Ninth streets for the Chickamauga-Chattanooga National Military Park on Chickamauga Battlefield and United States Army Post.

A carriage drive will be taken over the battlefield and park, where hundreds of monuments and historic tablets will be seen.

It was on this ground that 60,000 troops were encamped at one time during the Spanish-American war.

Afterward the Twelfth United States Cavalry will give a regimental drill in honor of the visitors. There is only one other place in the United States where this can be seen.

THIRD SESSION

Wednesday Evening. May 2, 8:30 O'clock

Assembly Hall of the Read House.

Professional Papers as follows:

No. 090. Bristol, Wm. H.—"Low Resistance Thermo-Electric Pyrometer and Compensator."

No. 089. Hibbard, Henry D.—"Manganese Steel."

No. 094. Dodge, James M.—"An Introduction of the Taylor System."

No. 091. Stewart, R. T.—"Collapsing Pressures of Bessemer Steel Lap-Welded Tubes."

No. 093. Willcox, Geo. B.—"New Liquid Measuring Apparatus."

CLOSING SESSION

Thursday Morning, May 3, 9:30 O'clock

Assembly Hall of the Read House.

"Waterwheel Governing" is the subject which will be the principal matter of discussion at this session, and a number of short papers will be presented, to be followed by general discussion.

Among those who will present papers on this subject are: Messrs. Replogle, Mark A., Buvinger, Geo. W., Sturgess, John, Henry, Geo. J., Jr.

A number of others have also signified their intention of discussing this subject orally.

The following professional papers will then be presented:

No. 088. Webber, Wm. O.—"Efficiency Tests of Turbine Waterwheels."

No. 097. Murray, Thos. E.—"The Improvement of the Tennessee River and Power Installation of the Chattanooga and Tennessee River Power Company at Hale's Bar, Tennessee."

Thursday Afternoon, May 3

EXCURSION.

On Thursday afternoon at 2 o'clock there will be an excursion to Lookout Mountain by trolley and incline, from which will be viewed the city of Chattanooga, the windings of the Tennessee River, the Cumberland Mountains, the Blue Ridge Mountains, the battlefields and the whole historic panorama.

Thursday Evening, May 3, 8:30 O'clock

RECEPTION.

The local members of the American Engineering Societies, together with other citizens of Chattanooga, will tender a reception to the officers, members and ladies of the Society at the Read House at 8:30 o'clock.

Friday, May 4

MORNING EXCURSION.

On Friday morning at 9:00 there will be an excursion for members and ladies to Missionary Ridge and other points of interest about the city.

Also another excursion at the same time for members to industries about the city.

AFTERNOON EXCURSION.

On Friday afternoon there will be an excursion for members and ladies by the steamboat "Chattanooga" on the Tennessee River through the mountain section below Chattanooga to Hale's Bar, thirty-three miles by river, where a dam is being constructed to aid navigation, and which will furnish fifty thousand horse power to the factories in Chattanooga, twelve miles away in a straight line. The return trip will be by the Nashville, Chattanooga and St. Louis Railroad from Shellmound, where the party will leave the boat.

The expense of these trips, if anything, will not be large.

Some Information for Visitors and Strangers in the City

Market street is the main thoroughfare, and the cross streets are designated east and west from it and numbered from First to Eleventh, beginning at the river. Broad street, next west of Market, from Ninth to the river; Chestnut, next west of Broad. Georgia avenue heads on Market at Eleventh and runs diagonally to the river. Read House, headquarters of the American Society of Mechanical Engineers, faces Ninth, between Broad and Chestnut. Southern Hotel on Chestnut, facing Ninth. Williams House, corner Ninth and Market. Auditorium faces Ninth, near Georgia avenue. Times Building, corner Eighth and Georgia avenue. First National and American National Banks, corner Broad and Eighth. Postoffice on Eleventh street, near Market. Court House, Seventh street and Georgia avenue. Union Depot faces Ninth. Central Depot is on Market street.

The City Electric cars go to transfer station at Market and Fifth streets. Rapid Transit cars leave from Ninth and Market streets. Northside cars leave Ninth and Broad streets, near Read House.

The Rapid Transit cars reach National Cemetery, Orchard Knob, East Lake, Highland Park, Sherman Heights, Ridgedale, Rossville and Chickamauga Park. Inquire for time card and rates to Chickamauga Park at office in "Keith's," corner Ninth and Market streets. National Cemetery is specially attractive.

The Northside cars pass the Court House, cross the Tennessee river and reach Riverview and Golf and Country Club on one line and North Market on the other. North Market car leaves on the even hour and half past; Riverview car on the quarter hour.

The City Electric lines reach Orchard Knob, Ridgedale, East Lake, Missionary Ridge, National Cemetery and Lookout Mountain. Cars going in can be taken anywhere for transfer station and car wanted taken there without extra fare.

Lookout Mountain cars are so marked and pass Williams House, Read House, Southern Hotel and Union Depot; reach incline station at St. Elmo, where tickets are sold for the top. Inquire about

rates for incline tickets. Can make the mountain trip and return in about two hours, but take more time if possible.

The Government Park, on the side of the mountain, can be reached by way of the incline; Rock City and other points of interest on top of the mountain can be reached by carriages. Livery stable near the Inn. Also many points of interest by the electric cars on top, which leave upper incline station.

Hack fares in the city are 25 cents single fare in city limits; $1.00 for first hour; 75 cents for second hour; 50 cents for third hour, and 25 cents for each hour after that.

The National Military Park includes the top and side of Lookout Mountain, Orchard Knob, Missionary Ridge and the main park of Chickamauga battlefield. The main park can be reached by the Chattanooga, Rome and Southern Railway from the Central Depot, or by the Rapid Transit lines, or by carriages.

All the points named and many others can be easily visited by carriages from the livery stables. Special rates for parties. Inquire at the hotel for special rates.

A drive to the park can be made in from five to eight hours, distance from twenty to thirty miles, over the finest roads, but several days can be profitably spent in and about the park, as the territory is extensive, and the improvements and historical associations of surpassing interest.

The finest drive in the world (about twenty miles) from any of the hotels to the Court House and Fountain Square, out McCallie avenue, passing Fort Wood to National Cemetery, Orchard Knob and Missionary Ridge; along crest road to National Park, through the park and back via Rossville to the city; or, if preferred, back from Rossville to Lookout Mountain, inclines to the top and return to the city by electric cars or carriages.

N. B.—For Missionary Ridge and Bragg's Tower take "Oak street and Highland Park" car, which leaves transfer station on the even hour. Transfer at the foot of ridge, where an extra fare is paid. Ridge cars only make one trip an hour at present; inquire about this.