

# PART FIRST.

## PHYSICAL GEOGRAPHY OF TENNESSEE:

### INTRODUCTORY .

1. Before considering the geological structure and formations of Tennessee, it becomes necessary to present a preliminary view of its physical geography. The configuration of the surface of the State is intimately connected with its rocky, or internal structure; it is, indeed, but the expression of this rocky structure, as found sculptured in valleys, plateaus, and ridges, by running water and by atmospheric agencies. The one becomes an important guide to the other. This will be made apparent many times in the course of the Report.

Attention is therefore directed, at the first, to the form, relief, general relations, natural divisions, and climatic features of the surface.

### CHAPTER I.

#### THE STATE IN GENERAL.

BOUNDARIES, FORM, GENERAL SURFACE—GENERAL GEOGRAPHICAL RELATIONS: THE TENNESSEE AND NEW RIVER SLOPE—THE APPALACHIAN REGION—VARIETY AND CLASSIFICATION OF NATURAL FEATURES—THE GREAT NATURAL DIVISIONS OF THE STATE.—CLIMATE.

2. *Boundaries, Form, and General Surface.*—The State of Tennessee includes an area, that extends, in a belt-like form, from the Mississippi River directly eastward to one of the great ranges of the Alleghany, or Appalachian Mountains. The

high crest of this range\* is, for the most part, its eastern boundary.

The Southern boundary of the State coincides mainly with the parallel of latitude  $35^{\circ}$  north; its northern limit is a broken line lying between the parallels  $36^{\circ} 29'$  and  $36^{\circ} 41'$ . While the mean breadth of the State is but little over 109 miles, its mean length is about 385. In general outline, it has approximately the figure of a long rhomboid, and comprises an area of about 42000 square miles.

3. The *general surface* of the State, throwing out of view, for the time, some of the local geographical features,—the mountain ranges of the eastern portion, and the basins and valleys of the western,—coincides nearly with a great horizontal plane, having an elevation of about 900 feet above the sea. The surface, however, is to some extent a warped one, coinciding, at numerous points, with this plane, but at others, either rising above or sinking below it.

The upper or northeastern part of the great Valley of East Tennessee, for example, is, in general, a few hundred feet above, while its central and southern part at first coincides, and then very gradually falls below this plane. The highlands of Middle Tennessee, in some counties, as in Lawrence and Wayne, present a flat surface 100 feet higher, while in Montgomery and adjoining counties, the corresponding highlands are considerably lower. The ridge in West Tennessee, dividing the waters of the Tennessee and Mississippi Rivers, must, at some points, be nearly, if not quite, as high. West of this ridge, however, the general surface sloping off towards the Mississippi, falls considerably below the assumed plane, and may be regarded as terminating, at an average elevation not far from 400 feet, along the edge of the bluff-escarpment which faces the alluvial "bottom" of the great river. †

Upon the surface, as described, rest the mountains of the State, the most important of which are the Cumberland Mountain, or Table-land, and the great Unaka Chain; cut out of it,

\* This great range or chain of mountains, will be described hereafter. It may be denominated the *Unaka Chain*.

† Tables presenting the elevations of numerous characteristic points will be given the second and third chapters.

and below it, are the great Basin in Middle Tennessee and the river valleys of this and the Western Division.

4. The entire State, with the exception of a very small area in the southeastern part adjacent to the Georgia line,\* is drained by tributaries of the Ohio and Mississippi rivers, the most important of which are the Tennessee, the Cumberland, the Hatchee, and the Forked Deer. Referred to the beds of the principal rivers, the surface of the State is a long slope, which, (as characterized by the elevation of low water at the following points, namely: the State line on the French Broad, Knoxville, Nashville, and the Mississippi, at Fulton,) commences with an elevation of 1264 feet, and terminates with an elevation of about 200. Its fall is, therefore, in some degree, more than 1000 feet. About two-fifths of this is made on reaching Knoxville; four-fifths at Nashville, leaving but one-fifth for the remaining distance. The slope, therefore, descends less and less rapidly as we go westward. Along the northern boundary of the State the fall of this slope is greater than 1000 feet; along the southern boundary considerably less.

The view, however, before taken, of the general surface, in which it was referred to a horizontal plane 900 feet above the sea, is to be preferred, as it will best assist in making clear the physical features and geological structure of the State. In this, the high characteristic flat lands of Middle and West Tennessee are not lost sight of. The river-valleys of these divisions, moreover, are not, in general, characteristic of the face of the country; in the Valley of East Tennessee they are highly so, but there they conform sufficiently well to the plane.

5. *General Geographical Relations.*—Extending our view beyond the limits of the State, the general surface of Tennessee is but a part, although a large part, of a longer belt of surface generally sloping, which commencing along the crest of the Blue Ridge in North Carolina, terminates with the immediate Valley, or "Bottoms," of the Mississippi.

6. This is made apparent by regarding the valleys of the smaller rivers namely, the Watauga, Nolichucky, French Broad, Big Pigeon, Little

\* This area is an irregular segment of the State, drained by a portion of the Connasauga River, and by some of its tributaries. The Connasauga is a small stream, and lies mostly Georgia; it makes; however, a bend to the north, which reaches a few miles above the Tennessee line.

Tennessee, Hiwassee, and Ocoee, which, flowing from the southeast, empty into the Holston and the Tennessee. These rivers rise upon the northwestern side of the Blue Ridge, and flow, in a northwesterly direction, into the State of Tennessee, passing, without material deflection, the Unaka Chain, (§ 2, note,) in deep and grand mountain-cuts.

The two great ranges just mentioned are, in general, nearly parallel, the space between them being occupied by deep valleys and more or less isolated clusters or groups of mountains. It is a *remarkable fact*, that the Unaka Chain, although more massive than the other—the Blue Ridge—is intersected, and so directly, by all the streams enumerated above. It thus loses its importance as the summit of a great water shed.

7. With these facts before us, it is plain that the general surface of the entire region, extending from the crest of the Blue Ridge through the western part of North Carolina and through Tennessee, a distance of about 430 miles, may be viewed as one. Starting with this crest, at a mean elevation of about 4500 feet above the sea, the general surface, or slope, falls rapidly to the foot of the Blue Ridge, reaching the valleys of the rivers in North Carolina at a level of from 2000 to 2500 feet; then, coincident with these mountain-hemmed valleys, it extends westward, falls with the rapids of the Unaka passes, and finally becomes the floor of the Valley of East Tennessee, where it has a mean elevation of 900 feet. From this valley on, it is the general surface of Tennessee, as already described; or it may be regarded as coinciding with the slope of the river-beds. (§§ 3 & 4.) To low water of the Mississippi, the entire fall is about 4300 feet.

Upon this general surface rests, not only the Cumberland Table-land, but the whole of the Unaka Chain, and the groups of mountains between the latter and the Blue Ridge, of which the most prominent is the pre-eminently high-peaked group of the Black Mountain.

8. The view just taken exhibits important relations sustained by the surface of Tennessee to that of the western part of North Carolina. But a still more extended and instructive view of the geographical relations of the State may be presented.

*The Tennessee and New River Slope.*—The great and long slope, which reaches from the southwestern part of New York through the western parts of Pennsylvania and Virginia, the whole of Kentucky and Tennessee, and parts of other States,

to the Gulf, and which, facing the northwest, pours its waters into the Ohio and Mississippi Rivers, is divided transversely into three natural sections, or minor slopes. To the central and largest one of these our attention is here directed. This is a well defined area. Its southeastern limit is the high crest of that portion of the Blue Ridge which lies in North Carolina and in the southern part of Virginia. From this crest it descends, in a northwesterly direction, to the connected parts of the Ohio and Mississippi Rivers between Cincinnati and Memphis. The line between these cities, as traced by the rivers, is the northwestern boundary and foot of the slope. It includes within its limits, on the northeast, the valleys of the Great Kanawha and of New River, (which rivers, by the way, may be regarded as one,) and, on the southwest, those of the Hiwassee, the Tennessee, the Hatchee, and the Wolf. To the entire section I have given the name at the head of this paragraph.

9. The general direction in which the rivers flow, in other words, the general direction of drainage within this section, unlike that of those which adjoin it on the northeast and southwest, respectively, is to the northwest.\* This is seen in the connected courses of New River, of the Great Kanawha, and even of the Ohio, from the mouth of the Kanawha to Cincinnati ; it is seen, too, in the rivers of Kentucky, of Middle and West Tennessee, as well as in those which flow out of North Carolina into Tennessee.

To this northwesterly drainage, the upper part of New River, the portion of the Tennessee east of the Cumberland Tableland, and its Virginia tributaries, as well as a portion of the Cumberland River above Nashville, constitute apparent exceptions; these, however, as will be seen further on, may be consistently explained.

10. It is to be noted that the mountains in the western part of North Carolina present the culminating points, and the greatest masses of all the Appalachian Ridges. It is from this high belt—the Blue Ridge presenting the dividing line—that the Ohio and Atlantic waters flow away, the former to the northwest and the latter to the southeast; in these respective directions the rivers find their shortest and most rapid descent.

\* It is, in fact, in this respect, unlike any other large section east of the Mississippi River.

The fall from the summit of the Blue Ridge, in a westerly direction, to the Mississippi—a distance of about 430 miles,—is as we have seen, (§ 7) approximately 4300 feet. To the Ohio, in the normal northwesterly direction of the slope, nearly the same fall is made in a distance less by, at least, 100 miles. These facts account for the unusual northwesterly tendency of drainage within the area under consideration.

11. This slope must not, however, except in a general sense, be regarded as continuous and unbroken—as having a uniformly descending surface. It is furrowed by valleys and ridges, or other elevated ranges, which run mostly from the northeast to the southwest, transversely to the direction of general drainage, but parallel to the Blue Ridge, to each other, and to the foot of the slope on the northwest. This is especially true of the southeastern, or upper part of the slope; here the valleys and ridges are very prominent, and well marked in direction; such are the Unaka Chain, the great Valley of Virginia and East Tennessee, with all its subordinate valleys and ridges, and the Cumberland Table-land. In the northwestern or lower part, they are far less prominent, yet even here they, or rather the general surface-features, show a tendency to run in parallel belts to the northeast or southwest.

12. These local features, it is plain, must interfere more or less, with direct drainage. The long, straight ridges, running horizontally along the face of the slope, intercept the stream; which, therefore, must either break through in deep *gaps*, or else, turned aside at right angles to their normal courses, must run in the valleys, to the northeast or southwest, until they find a passage through which they can escape. The one they do, perhaps, as frequently as the other. This will serve to explain the apparent exception before referred to. ( § 9. )

13. Of all the elevated ranges, the Cumberland Table-land is the most effectual barrier in the way of general drainage. By it the Tennessee River is deflected to the southwest, and is made to run many miles before being permitted to pass and flow on in its northwesterly course. The range permits the passage of New River, in Virginia, but at no other point, between its intersections with this and the Tennessee, does it present a complete water-gap.

14. The Valley of Virginia and East Tennessee, as we shall

see hereafter, is part of a great and complex trough, which extends each way beyond the limits of the slope. It is comparatively deep, and almost causes New River, on the one hand, to flow into the streams, which empty into the Atlantic, and the Tennessee, on the other, to flow into those which empty into the Gulf. The portion of the Valley between these rivers is divided into two very unequal subordinate slopes. The region dividing the waters of the two rivers is an elevated water-shed, the crest of which, on the Virginia and East Tennessee Railroad, is 2594 feet above the level of the sea. The New River, or northeastern side, is short, while the Tennessee, or southwestern side, is very long. On both sides, the ridges of the Valley deflect the tributaries to the northeast and southwest respectively. This is seen, on a great scale, in the long Virginia tributaries of the Tennessee.

15. The great Unaka Chain is remarkable, as before stated, (§6,) for not deflecting the North Carolina tributaries of the Tennessee. It does, however, throw the upper part of New River many miles to the northeast.

It may be added here, finally, that the Cumberland River above Nashville, is deflected to the southwest by a range of highlands, which, in general is parallel, and bears certain relations, to the better marked ranges just mentioned.

16. Such is the *slope* of which Tennessee is a part, and which, with its ridges and valleys trending to the northeast and southwest, and differing much in their geological character, as well as in their surface features, the State traverses. The belt or surface already mentioned, (§ 5,) extending from the Blue Ridge through Tennessee to the Mississippi, is a complete cross-section of this slope. Of this belt Tennessee is, by far, the larger part, and, owing to the direct easterly and westerly course of the State, the slope is traversed obliquely, making the cross-section an oblique one. Hence results the general obliquity of the State, with reference to natural features, which is so conspicuous upon maps of its surface.

17. The reference of the State to the area just considered enables us to understand much better than before its drainage and many of its surface-features. The question, however, arises, Whence come these belts, the long straight valleys, the

direct ridges and mountain ranges which stretch so independently across and beyond the more easterly parts of the State and of the slope? They must sustain important relations to some other natural geographical area or system. This leads me to notice briefly the following remarkable region or belt:

18. *The Appalachian Region.*—Upon examining any good map of the country between the Gulf of Mexico and the Hudson River, we will see a long continuous area or belt, from 50 to 100 miles in width, traversing, the eastern part of Pennsylvania, Maryland, Middle Virginia, East Tennessee, and the western part of North Carolina, remarkable for its long, parallel, straight, or gracefully curving mountains, ridges, and valleys. The general trend of this belt and its ridges is northeast and southwest; its rivers, too, and especially the smaller tributaries, generally conform to the same direction. This is a well developed portion of the Appalachian, or Alleghany region. The entire region, however, extends much beyond the area designated. It is in fact, a long, great *belt*, stretching for more than 1200 miles, from Gaspe, in Canada, through Vermont, the western part of Massachusetts, the eastern part of New York and the States mentioned, to Georgia and Alabama. This great belt throughout, is noted for its peculiar topography, its beautiful scenery, and its geological structure. The parallelism of its numerous valleys and ridges, and the remarkable and singular uniformity they preserve for long distances, both in direction and outline, are its most striking topographical features.

" While varying little in height, the ridges pursue a remarkably straight course, sometimes hardly diverging from a straight line for a distance of fifty or sixty miles; and one ridge succeeding latterly beyond another— all continuing the same general course in parallel lines, like the successive waves of the sea. As one curves round in a new direction, all curve with it. Thus the valleys between the ridges preserve a uniform width, and are as remarkable for their parallelism as are the hills which bound them."\*

19. Many of the ridges of this region are well known mountains; the mountains of western New York, the Alleghanies, the Blue Ridge of Virginia and North Carolina, Clinch Mountain, the Unaka Chain of the latter State and Tennessee, the

\* New American Cyclopedia, Art., Appalachian Mountains

eastern part of the Cumberland Table land, "Walden's Ridge, Lookout, and the mountains of Georgia and Alabama, are examples. The valleys, which are often exceedingly beautiful, rich, and populous, have all special names; it would lead me, however, too far away to attempt to enumerate and describe here even the most important. The great valley of East Tennessee, with all its minor valleys and ridges, belongs to this region.

20. At its extreme ends the distinctive features of the Appalachian Region are gradually lost; in Alabama its rocks sink and disappear beneath beds of later formations.

Passing across its northwestern border, the ridges and valleys become less and less characteristic, losing their parallelism and their prominence, until, as Appalachian features, they are lost before reaching the great plains which lie to the northwest.\*

21. The great belt just considered intersects, or rather supplies, the elevated and mountainous southeastern half of the slope to which Tennessee belongs. From it, come, therefore, the parallel ridges and valleys which make up the eastern part of the State; in other words, these are Appalachian features. A glance at the map, accompanying this Report will show to some extent, their peculiar character.

22. It may be remarked finally, that Tennessee, especially its eastern portion, might be studied topographically from two points of view. If, in the first place, we take its river-system, or, in other words, its drainage, as the basis of surface-features, then we will be led to the northwest, (with, however, one great offset,) down the face of the slope as described; but, in the second place, if we make all-important the elevated belts and valleys, then, losing sight of the slope, we will be borne off at right-angles to the former direction, either to the southwest into Georgia and Alabama, or far to the northeast, through the Appalachian troughs. The correct understanding of the topography, however, will depend upon a proper combination of the two views.

\*A low and broad "axis of elevation" (or bending up of the rocky strata) which runs through the central part of Tennessee and Kentucky, and the western part of Ohio, may be regarded as an outlying Appalachian feature. Along its course lie flat highlands, and, where greatly denuded, basins—the latter bounded by escarpments of highlands, all of which, with the axis itself, tend to run in a northeasterly and southwesterly direction. (See § 11.)

23. *Variety and Classification of Natural Features.*—Owing, for the most part, to the extent and varied nature of the country traversed by the State, one of its most prominent characteristics, with reference to natural features, is *great variety*. This is seen not only in the numerous divisions of its surface, but also in its geological formation and structure, as well as in its climatic and agricultural features. The number and diversity of its rocks, minerals and soils, are certainly not a little remarkable. Nearly all the important physical and geological features of the States around it are represented more or less—brought together as if by way of contrast—within its borders. Tennessee has, for example, on the one hand, some of the greatest ridges of the Appalachians, with their “bald” summits and ancient rocks; on the other, the low lands and cypress swamps and alluvial beds of the Mississippi; it has, also, well represented the singular parallel valleys and ridges of Middle Virginia; the high lands, the “barrens,” and the rich limestone lands of Kentucky; the orange-colored sand hills, the cretaceous beds and cotton soils of North Mississippi. In climate, especially during the summer months, there are the same variety and contrast. The valley lands of upper East Tennessee have the summer of New Jersey and of Ohio; the low lands of Middle Tennessee, east of Nashville, that of the northern part of Georgia; while West Tennessee is warmed by the summer of the central parts of Georgia and South Carolina. And further to heighten the contrast, there is an extended line of high points just within the southeastern border of the State, which have the cool breezes, without the extremes, of a Canadian summer, and which, to some extent, are clothed with a Canadian flora.

24. The varied natural features, formations, and products of the State, such at least as will be treated of in this Report, may be grouped into four distinct classes, constituting as many general subjects, as follows:

(1.) THE LEADING GEOGRAPHICAL FEATURES, or the prominent natural divisions of the surface, such as great valleys, plateaus, and leading mountain ranges, with their external characteristics, including climate.

(2.) THE ROCKS, OF GEOLOGICAL FORMATIONS, including the internal structure of the State.

(3.) THE MINERALS AND MINERAL RESOURCES.

(4.) THE SOILS AND AGRICULTURAL FEATURES.

The first of these pertain to this Part of the Report. The others will be the subjects, respectively, of three succeeding Parts.

25. *Leading Geographical Features, or the Great Natural Divisions of Tennessee.* The State is divided into *eight* well defined natural divisions. These, though prominent and well marked, are not, I may add here, sufficiently known or appreciated as distinctive features. A knowledge of them is important in many ways. They have relations to the civil and political history of the State, aside from its geology, mineralogy, and agriculture, which make them well worthy of notice and study. Their special sanitary relations, too, are of great interest, for which reason they deserve the attention of medical men.

Several of these divisions have been already incidentally mentioned. They are all enumerated in the table below. In the next two chapters they will be described in some detail. The first forms the eastern border of the State; the others occur successively as we go westward.\*

(1.) *The Unaka Chain.*—This name has been given to the great range of mountains that lies along the boundary line between Tennessee and North Carolina. (§ 2, note.)

(2.) *The Valley of East Tennessee.*—This division runs obliquely through the State, and constitutes one of its most populous and beautiful portions. It is bounded on the southeast by the Unaka Chain, and on the west, or northwest, by the eastern escarpment of the succeeding division.

(3.) *The Cumberland Table-land.*—The natural division thus named is usually known as the "Cumberland Mountain." It should be called the *Table-land*. It has a broad and generally level top, and stands in well defined and bold relief above the low lands on each side.

(4.) *The Highlands, or Highland Rim, of Middle Tennessee.*—The flat highlands of Middle Tennessee form an extensive and complete *Rim*, which encircles, terrace-like, a *Basin* of rich lowlands in the very centre of the State. The *Rim* lies next below, and west of, the Cumberland Table-land, and terminates

\* These divisions are also indicated upon the map of the State accompanying this Report. This, and the general section upon the same sheet, should be consulted by the reader, in connection with the enumeration here given.

more than a hundred miles westward in the counties of Hardin, Wayne, Perry, Humphreys, and Stewart, breaking off in the high fringing ridges that bound the Valley of the Tennessee River on the east.

(5.) *The Central Basin*.—The Basin of rich lowlands mentioned above, encircled by the Rim, constitutes this division. It is the central part of Tennessee, furnishes the site for its capital, and is truly designated the garden-spot of the State.

(6.) *The Western Valley of the Tennessee River, or the Western Valley*.—This is the narrow, broken Valley of the Tennessee River in the western part of the State. It is bounded, on both sides, by high dividing ridges, whose spurs frequently run in close to the river.

(7.) *The Plateau, or Slope, of West Tennessee*.—This division includes the entire area between the dividing ridge west of the Tennessee River, and the low "Bottoms" of the Mississippi. It slopes towards the latter river, and terminates in a line of "Bluffs," or an escarpment, overlooking the bottoms.

(8.) *The Mississippi Bottoms, or Bottom*.—This, the last division, is a well marked feature. It embraces the Tennessee portion of the great alluvial and low plain through which the Mississippi flows.

26. *Climate*.—The learned Humboldt, in his *Cosmos*, says :\*

" The expression *climate*, taken in its most general sense, signifies all those states and changes of the atmosphere which sensibly affect our organs : temperature, humidity, variation of barometric pressure, a calm state of the air or the effects of different winds, the amount of electric tension, the purity of the atmosphere or its admixture with more or less deleterious exhalations, and lastly, the degree of habitual transparency of the air and serenity of the sky, which has an important influence not only on the organic developments of plants and ripening of fruits, but also on the feelings and the whole mental disposition of man."

From this definition, it is seen, that to determine the climate of any region satisfactorily, in all its relations, is no small task. In fact, it can only be done after daily and varied observations, (bearing upon all the different features of climate,) have been made, at a number of characteristic points, for a long series of years.

\* Col. Sabine's Translation, vol. i., p. 312.

27. Such extended observations are far from having been made in Tennessee. Enough has been done, however, to enable us to know, with a near approach to truth, the general features, and, to some extent, the local peculiarities of the climate of the State. At about a dozen points reliable observations, extending through periods respectively, of from a few months to ten years, have been made, for which we are indebted to the intelligence and industry of a number of private citizens, to the well directed efforts of the Smithsonian Institution, and to the officers of the Navy Yard formerly at Memphis.\* The facts thus accumulated are, as far as they go, very valuable, and, for present purposes, may be regarded as giving good approximations, which, in connection with what has been done in the States around, will furnish much information in regard to the climate of Tennessee.

28. It is by no means proposed to enter fully into this subject, but simply to notice briefly, the leading features of climate, or those most commonly recognized, such as the averages and extremes of temperature, the length of period between frosts, the quantity and distribution of rain, and the character of the winds.

What may be said in this place will have reference to the State in general, with the exception of two of its natural divisions—the Unaka Chain of mountains and the Cumberland Table-land. These, owing to their elevation, have marked peculiarities of climate that require for them special notices. Some of the other great divisions, too, although, in this general view brought together, have, to a greater or less extent, peculiarities that will be spoken of when the divisions come to be considered separately.

29. The climate with which Tennessee is favored, is midway in character between that of a temperate and that of a tropical region; or rather, it combines the milder features of the two.

\* For observations, the means and general results of which are, in part, given in this Report and which have not hitherto been published, or at most but partially so, I am personally indebted to the kindness of Prof. W. M. Stewart, of Glenwood, near Clarksville; Prof. A. P. Stewart, of Cumberland University, at Lebanon; Prof. A. H. Buchanan, of the same place; Mr. P. F. Tavel, of Nashville; the Messrs. Chas. T. and Wm. Bosson of the Falls of Caney Fork, and Mr. B. Bentley, of Spring Grove, Cumberland county. To Rev. B. O. Currey, of Knoxville, I am also indebted for the use of observations made by Pres. Geo. Cooke and Prof. T. L. Griswold, formerly of East Tennessee University.

The means of temperature and quantities of rain for Nashville, previously to the year 1850, given in the following pages, have been derived from the observations made at the University of Nashville, by Prof. James Hamilton.

The observations made at Glenwood by Prof. W. M. Stewart, constitute the most complete and extended series yet made in Tennessee. This able observer has completed a series covering an entire *decade* of years. Had we, for the same decade, four or five such series—one for each of the most characteristic natural divisions of the State—a most interesting and useful comparative climatology could be made out for Tennessee.

Although subject to comparatively great extremes, in common with a large part of the Valley of the Mississippi, yet these extremes never reach the excessive cold of the northern States, nor the highest temperature of the tropics. Herbage is often green throughout the year, and cattle can generally graze, with but little interruption from cold or snow, during all the months of winter. Many shrubs, which in States further North, lose their leaves during winter, here, not unfrequently, retain them the year round. Light coats of snow sometimes cover the surface, but their stay is brief.

30. The *mean temperature of the year*, along the parallel of latitude running through the middle of the State, is not far from 57° in the Valley of East Tennessee, 58° in Middle, and 59° .5, or 60°, in West Tennessee. Between the first and last divisions there is, according to this, a difference in mean yearly temperature of 2°.5, or 3°. This is partly, but not wholly, due to difference in elevation. After correcting for this, it will still be found that a gradual increase in mean yearly heat occurs in passing westward through the State.

For points on the same meridian, a difference in latitude, north or south, forty or forty-five miles, diminishes, or increases, the yearly mean, about one degree. In West Tennessee, for example, in passing from the northern to the southern part of the State, the mean will range from 58°.5, or 59°, to 60°.5, or 61°.

The following table presents annual means derived from observations made at six stations.

*Annual means, in degrees and hundredths of a degree. \**

	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	Aver- age of Means.
Knoxville..	"	55.67	"	57.67	57.75	"	"	"	"	"	57.03
Lebanon...	57.43	58.10	"	"	"	"	"	"	"	"	57.76
Nashville..	"	"	"	"	59.83	57.77	57.05	59.16	58.52	"	58.47
Glenwood..	59.31	58.09	57.62	59.46	57.34	54.23	54.54	57.12	56.63	58.25	57.26
Falls of Ca- ney Fork.	Period of 2 years, (1855 & 1856.)										58.48
Nashville..	" " 5 years, (1840 — 1844.)										58.44
Memphis...	" " 3 years, (1850 — 1852.)										60.80

\*The following are the names of the observers, hours of observation, elevations above the sea, when known, etc.:

*Knoxville.*-1852, O. W. Morris, Deaf and Dumb Institute, elevation 960 feet. —1854 and

31. In reference to *seasons*, the means of spring and autumn do not differ materially from those of the year. Summer is the characteristic season; its mean heat, along the parallel traversing the middle of the State) is from about 74° (Valley of East Tennessee) to 77°.5 (West Tennessee.) Such, at least, it is, according to the limited data we possess. Were observations more extended, there is reason to believe a greater difference would appear between the summer temperatures of the extreme parts of the State.

As to winter, its average temperature, which is near 40°, is doubtless nearly uniform along the same parallel. The table below presents means of the two seasons just mentioned.

*Mean Temperatures of Winter and Summer.*

	1852.		1853.		1854.		1855.		Average.	
	Win.	Sum.	Win.	Sum.	Win.	Sum.	Win.	Sum.	Win.	Sum.
Knoxville....	39.28	70.87	.....	.....	37.76	75.85	38.40	74.09	38.48	73.60
Lebanon.....	39.96	74.41	.....	77.40	.....	.....	.....	.....	39.96	75.90
Glenwood....	40.11	73.92	38.62	75.51	40.12	77.75	37.37	74.29	39.05	75.37
Nashville.....	Observations of 5 years (1840-1844).....								39.50	77.30
Memphis.....	Observations of 3 years (1850-1852).....								42.60	78.10

32. The *average of the yearly minimum temperatures* or of the extreme low temperatures, for the last ten years, is, in the northern part of Middle Tennessee, not far from 2°. The temperature, during winter, rarely falls below zero. In only five, out of the ten last winters; has it fallen below. The lowest degree reported is 13°.8 below zero, observed at Lebanon, January, 1852, by Professor A. P. Stewart.

1855, Pres. George Cooke and Prof. T. L. Griswold; 7 A. M., 2 P. M., and 9 P. M.; East Tennessee University; elevation nearly 1000.

*Lebanon.*—Prof. A. P. Stewart; from January to March, 1851, inclusive, sunrise, 9 A. M., 3 P. M., and 9 P. M., remainder of period, 6 A. M., 2 P. M., and 10 P. M.

*Nashville.*—1840 to 1844, Prof. James Hamilton, University of Nashville—1855 to 1859, inclusive, P. F. Tavel; sunrise, noon, and sunset.

*Glenwood*—near Clarksville; Prof. W. M. Stewart; from January, 1851, to January, 1853, sunrise, 9 A. M., 3 P. M., and 9 P. M.; for remainder of period, 7 A. M., 2 P. M., and 9 P. M., elevation 486.

*Falls of Caney Fork.*—Charles T. and Wm. Bosson; sunrise, noon, and sunset. The period of two years is complete, excepting January, 1855, which is not included.

*Memphis.*—Navy Yard; see Blodget's Climatology, page 46.

The latitude and longitude of the places given may be found by referring to the map accompanying this Report.

During the ten years mentioned, the highest of the yearly maximum temperatures reported, in the northern part of Middle Tennessee, is 100°, observed January, 1852, likewise at Lebanon. The *average of the maximum temperatures* is considerably lower than this, being about 94°.

33. From the above data, it is seen, that the *mean yearly range* of the thermometer, in this part of the State, is 92°; in the southern part it will be found to be less.

The data before me are not sufficient for the determination of a good approximation to the average yearly maximum and minimum temperatures of the Valley of East Tennessee. For points on the same parallel, the former would be probably about three degrees less than in the central part of the State.

34. The length of the *period between killing frosts*, is, especially to the farmer and gardener, an important element of climate. It is, to a great extent, the measure of the "growing" season. The following table, prepared by Prof. W. M. Stewart, will give correct information as to the approximate length of this period in the northern part of Middle Tennessee:

*Tabular Statement of the occurrence of frost, from observations made at Glenwood, near Clarksville, Tennessee.*

YEARS.	Last frost in spring.	First frost in autumn.	First skim ice.	Days free from frost.	Days free from killing frost.
1851 .....	May 2d	Oct. 23d	Oct. 23d	173	173
1852 .....	Mar. 23d	Oct. 15th	Nov. 8th	205	228
1853 .....	Mar. 29th	Oct. 11th	Oct. 25th	195	210
1854 .....	Apr. 18th	Oct. 19th	Nov. 5th	184	201
1855 .....	Apr. 7th	Oct. 22d	Oct. 25th	187	200
1856 .....	Apr. 23d	Oct. 16th	Oct. 18th	175	176
1857 .....	Apr. 20th	Sept. 30th	Oct. 20th	162	181
1858 .....	Apr. 25th	Oct. 9th	Nov. 14th	166	201
1859 .....	Apr. 18th	Oct. 10th	Oct. 19th	174	182
1860 .....	Apr. 2d	Sept. 21st	Oct. 12th	171	192
Means .....				179.2	194.4

According to this table, the average length of the growing season is about 194 days. It is seen, too, that the last frost month of spring and the first of autumn, are pre-eminently April and October, months in which the farmer must be on the

lookout for frost. From the third week in April, however, to the middle of October, it is hardly to be expected.

In the northern part of East Tennessee the growing season is doubtless a few days shorter. In the southern part of the State, and especially in the southwestern part, this period is twelve days, or two weeks, longer, than on the parallel of Glenwood; its length, therefore, will not be far from 208 days. This difference is of considerable importance to the cotton region of the State.

35. The *winds* act an important part in modifying climate, and therefore deserve a passing notice.

Tennessee belongs to a belt of North America, over which prevail two great systems of winds. The lower consists of currents flowing to the northeast and north; these are the southwesterly and southerly surface-winds of Tennessee. They come to us charged with warmth and moisture from the Gulf of Mexico, and give fertility and geniality of climate to the State. The upper system is one of northwesterly and northerly winds. These, dry and cool, flow, at a high elevation, above the fertilizing winds of the surface.

Such is the general circulation, were there no perturbing influences, each system would move on, in its normal direction, quietly, and without interfering with the other. But every rain, or change of temperature at the surface, is a disturbing cause tending to destroy the equilibrium and mingle the winds. Thus arises a conflict between the great systems, producing, to a greater or less extent, westerly winds, but often ending in the triumph of the northwest and upper system, and in the precipitation of a "Norther" upon the surface. Such a change is usually followed by a few days of cool, clear weather, when the southwest wind quietly resumes its course and position again.

36. From what has been said, it is seen that the regular winds of Tennessee are those from the south, southwest, west, northwest, north, and northeast, all of which belong to the general circulation, while those from the easterly and southeasterly directions, are due to abnormal influences.\*

Such data as I have bearing upon the winds, are given below.

\* For an able discussion of the subject of North American winds, illustrated by diagrams and maps, see Prof. Henry's articles in the Patent Office Agricultural Reports of 1855, 1856, and 1858, more especially the last. In these articles the distinguished secretary of the Smithsonian Institution gives an exposition of the general principles of climatology, which he applies especially to the climate of the United States. They are of great value, and well worthy of the attention of all interested in this subject. I here acknowledge my indebtedness to them.

The table is the result of the observations of Prof. W. M. Stewart, and presents the means of three years:

*Tabular statement of Winds for the different seasons of the year.*

Point from which, &c.	Spring.	Summer.	Autumn.	Winter.	Amount.	
N. E.	18	14	24	27	83	} N. quadrant, 236.
N. N. E.	8	8	5	9	30	
N.	-29	17	15	42	103	
N. N. W.	8	2	2	8	20	
N. W.	21	8	12	33	74	} W. quadrant, 178.
W. N. W.	3	4	5	10	22	
W.	11	18	15	18	62	
W. S. W.	5	3	3	9	20	
S. W.	15	17	15	14	61	} S. quadrant, 318.
S. S. W.	13	10	10	9	42	
S.	42	42	39	31	154	
S. S. E.	20	8	12	16	56	
S. E.	15	10	23	17	65	} E. quadrant, 160.
E. S. E.	3	2	3	0	8	
E.	12	30	22	7	71	
E. N. E.	4	5	3	4	16	
Calm.	43	81	65	34	223	

From this it is seen, that, for the three years at Glenwood, the order of the winds, (grouping them in quadrants,) is, in point of frequency, as follows: First, the southerly winds, followed by the northerly; then the westerly, and finally the easterly.

37. At Knoxville, in East Tennessee, the order for the same number of years, is as follows:

- |                                  |                    |
|----------------------------------|--------------------|
| (1) Westerly and southwesterly.  | (4) Northwesterly. |
| (2) Northerly and northeasterly. | (5) Easterly.      |
| (3) Southerly.                   | (6) Southeasterly. |

These facts agree with the views expressed above. Although limited and insufficient, they clearly indicate, that, at the surface, the prevailing winds are from the south and west; that next to these, those from the north are most prevalent, and, finally, that easterly winds are the least so. The observations of a greater number of years would make this order more definite, but would not change it materially.

38. The quantity of *rain* which falls upon the surface of the State is not excessive, nor is it equal to that precipitated upon the States further South. In general, however, the supply

is amply sufficient. Temporary droughts do occasionally occur, especially during the summer season, and sometimes with serious consequences. That of 1860, felt so severely in Tennessee and in other Southern States, is an example. Such droughts however, are exceptional.

The following table presents the mean aggregate quantities of rain and snow (melted) precipitated at the places, and for the periods specified. The water is supposed to remain, for the different periods, where it fell in uniform sheets or strata, the vertical depth being, in each case, the measure of the quantity.

*Quantities of Rain and melted Snow for the seasons and the year, in inches and hundredths of an inch. The years of observation are given under each Station.*

	Knoxville, 1854-1855, two years.	Lebanon, Dec. '50, Aug. 1853, nearly three years.	Nashville, 1844-1849, five years.	Glenwood, 1851-1859, nine years.
Spring.....	10.12	10.55	15.04	12.28
Summer.....	15.45	9.57	14.47	9.74
Autumn.....	8.02	7.54	13.49	9.15
Winter.....	11.02	15.95	11.99	12.89
Annual.....	44.61	43.61	54.99	44.06

39. I close this notice with an extract from a recent work on the climatology of the United States.\* The author is speaking of the Mississippi Valley and the Atlantic States.

"The principal feature of this area, as a whole, is its adaptation to a great range of vegetable and animal life. It [the climate] is extreme without being destructive, and it brings in tropical summer temperatures, and profusion of rain, with low winter temperatures, near to those of the extreme continental climates; and the result is a condition extremely favorable to the acclimation of tropical and semi-tropical plants and animals. This is the great advantage the area of the eastern United States and Mississippi Valley undoubtedly has over Western Europe, or the distinction, if not an advantage.

"The semi-tropical summer is, perhaps, the most noticeable feature of the measure of heat here. ••••• At Baltimore, Cincinnati, and St. Louis, we have a mean of 75°; and over an immense area bordering the Gulf of Mexico, and reaching north, nearly to the 35th parallel,

\* Climatology of the United States, &c., by Lorin Blodget, Philadelphia, 1857.

we have a mean temperature of 80° or more, which is considerably above that of many portions of the tropical seas of Central and South America. And this high temperature is associated with the peculiar features of the temperate climates in other respects, with equally distributed, yet abundant rains, and with the high curve of daily changes which belongs to the same districts. It is simply an excess of temperature and of humidity, engrafted on, without otherwise changing the characteristic laws elsewhere belonging to much lower temperatures. •••••• If this measure of heat occurred without this great daily range, it would make the climate simply tropical; but, occurring under existing circumstances, it renders the country capable of great elasticity in the adaptation of vegetable and animal forms. Cotton, Indian corn, and the cane, find their natural climates here, but not elsewhere, in any considerable degree, beyond the tropics."