120

REPORT OF THE SUPERINTENDENT

OF THE

COAST AND GEODETIC SURVEY

SHOWING

THE PROGRESS OF THE WORK

FROM

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APPENDIX No. 9.

REPORT 1898-99.

GENERAL REPORT ON THE MAGNETIC SURVEY OF NORTH CAROLINA.

By JAMES B. BAYLOR and DANIEL L. HAZARD,

UNDER THE DIRECTION OF

L. A. BAUER,

Chief of Division of Terrestrial Magnetism.

CONTENTS.

APPENDIX No. 9. 1898-99.

GENERAL REPORT UPON THE MAGNETIC SURVEY OF NORTH CAROLINA, WITH A BRIEF HISTORICAL SKETCH OF THE FUNDAMENTAL PHENOMENA OF THE EARTH'S MAGNETISM.

INTRODUCTION.

A magnetic survey was conducted during the spring, summer, and fall of 1898 and 1899, under the joint auspices of the United States Coast and Geodetic Survey and the North Carolina Geological Survey. The three magnetic elements, declination, inclination, and horizontal intensity, were determined at each station. True north and south lines were located at the various county towns, and standards of length for testing surveyors' chains were marked at some convenient place in the court-house.

At the instance of the State geologist of North Carolina, the Superintendent of the United States Coast and Geodetic Survey detailed an officer with the necessary instrumental outfit to carry out the survey, his excellency the governor of the State having requested this detail.

The State geologist furnished, during 1898, all the funds required for the field work other than the salary of the officer engaged in making the survey. During the spring and summer and part of the fall of 1899, both the salary and board of the observer were paid by the United States Coast and Geodetic Survey, funds for all other field expenses having been furnished by the State geologist.

Wherever the honorable board of county commissioners could be induced to do so, the State geologist has obtained from each county the State's share in the field expenses of the work. Many of the counties have refunded the money advanced by the State geological survey for this work, amounting to not over $25 for any county.

The State geologist of North Carolina, Prof. J. A. Holmes, at all times and in all seasons has labored for the successful completion of the survey. Through his untiring energy and interest, counties were induced to make subscriptions.

Valuable assistance was rendered by county commissioners, registers of deeds, surveyors, and others in the selection of suitable locations for the meridian stones at the various county towns. Wherever the local surroundings permitted it, these meridian stones were placed in the court-house square, and in every case, with one single exception, they were located on *public property*.

Time signals, wherever practicable, were obtained from the Western Union Telegraph Company at noon, seventy-fifth meridian time.

To all those who have aided in the furtherance of the object of this survey, the observer wishes herewith to make suitable acknowledgment.

This preliminary report will be devoted exclusively to the consideration of one of the elements of the Earth's magnetism, the declination, or, as surveyors frequently call it, the variation of the compass, and especially to its application to land surveys. The utility of true meridian lines when established and permanently marked, how they should be used by land surveyors, etc., will be explained.

The Division of Terrestrial Magnetism of the United States Coast and Geodetic Survey has projected upon the map of North Carolina the "isogonic lines," or lines of equal magnetic declination (variation), giving the most probable positions for these lines for January 1, 1900, as derived from observations made at the county towns during the progress of the magnetic survey, and embodying with them other observations made with the same class of instruments near the boundary lines of adjoining States.

Tables have also been prepared by this Division giving the most probable magnetic declination (variation) at the county seats for every ten years between 1750 and 1910. These quantities will be given for the surveyor's convenience in degrees and minutes.

The prime object of this preliminary report will be to furnish a short manual for the use and convenience of land surveyors in North Carolina. As an introduction to the report some account, therefore, of the leading phenomena of the Earth's magnetism, when and by whom discovered, will not be out of place.

Mr. L. A. Bauer, in his "First Report Upon Magnetic Work in Maryland," has fully explained the purposes of magnetic surveys, and in connection with it has published an historical account of the fundamental facts bearing on the Earth's magnetism. It is proposed to embody in this short manual some of the most interesting features of his report.

The respective authorship of the various chapters is as follows:

Mr. Daniel L. Hazard has prepared the two chapters on "The Secular Variation of the Magnetic Declination of North Carolina" and on "The Distribution of the Magnetic Declination in North Carolina for 1900," while Mr. James B. Baylor has prepared the remaining chapters. Mr. Hazard has furthermore revised all of the observers' computations and has prepared the results for final publication, and has constructed with their aid the lines of equal magnetic declination given on Plates I and III.

HISTORICAL SKETCH OF THE FUNDAMENTAL PHENOMENA OF THE EARTH'S MAGNETISM.

The Magnetic Declination (Variation of Compass).

There are few places on the Earth's surface where the magnetic needle points true north. Where it does point north, at any particular time (year, day, hour, or even minute), it will not long remain in this direction. "As true as the needle to the pole" is a false simile of speech, and does much to mislead the uninitiated.

In the United States proper the needle changes its relationship to the true north from 21 degrees *west* of north, in the eastern part of Maine, to 23 degrees *east* of north, in the extreme northwestern part of Washington. In North Carolina the needle changes

its direction from 4 degrees west of north in the extreme eastern part of the State to 2 degrees east of north in the extreme western part of the State. There are places on the Earth's surface where the needle, far from being "true to the pole," points due *east* and *west*. Again there are other places between the magnetic north pole and the true north pole where the "north" end of the needle actually points *south*.

The magnetic declination or variation of compass may be defined as "the angle between the true north and south line and the magnetic north and south line as pointed out by a compass needle, i. e., a magnetized needle so mounted as to swing freely about a vertical axis."

After the introduction of the compass in Europe it was several centuries before it was discovered that the needle was not "true to the pole." This, Mr. Bauer believes, was probably due to the fact that the deviation of the needle from the north, according to his investigations, appears to have been small at that time in the Mediterranean Sea. It was Columbus on his famous voyage of discovery who first found out that the compass needle had a "variation or declination" from the true north. On September 13, 1492, Columbus appears to have crossed the line of no magnetic declination, or variation, situated at that time a little west of Fayal Island of the Azores. Before this time his compass had pointed east of north, but subsequently it bore west of north and by an ever increasing amount as he sailed westward. The discovery of Columbus that the magnetic needle had a declination, or "variation," was not generally accepted until the middle of the sixteenth century, the declination of the compass being generally believed to be due to mechanical defects of the compass itself. And so the compass cards of that time were frequently roughly corrected for the amount of magnetic declination.

The earliest land observations of the declination of the needle were made in the early part of the sixteenth century at Rome by George Hartmann, vicar of Nuremburg. In the year 1600 Dr. William Gilbert, of Colchester, physician-in-ordinary to Queen Elizabeth, published his great treatise on magnetism, "De Magnete." He first announced that "The terrestrial globe itself is a great magnet." To-day all that can be said is that the globe itself acts as a magnet. We can not say with certainty whether the Earth's magnetism is permanent, like that of a bar magnet, or is induced by currents of electricity.

Secular Variation of the Magnetic Declination.

It was left for a professor of mathematics, Henry Gellibrand, of Gresham College, England, to discover that the needle did not continue to have the same direction at the same place year after year, but that it changed its direction with the lapse of time. The observations upon which this discovery was based were made at Deptford, near London, in 1634. Gellibrand found that the needle bore 4° 6′ east, while Gunter in 1622 had found 5° 56′ east, and Boroughs in 1580 11° 15′ east. There was, therefore, no mistaking the fact that the needle was changing its direction from year to year.

This progressive change of the compass needle from year to year is known as the "secular variation of the magnetic declination." It is called secular for the reason that it may require several hundred years before the needle returns approximately to the same position it had occupied at some previous time. At London, England, for example, the needle varied from 11° east in 1580 to nearly 25° west in 1812, a change of 36° in two hundred and thirty-two years. It now points about 17° west at London.

While this secular change has not been so great for places in the United States, still in the central portion of North Carolina it amounts to a change of about 4½° between the beginning and the end of the nineteenth century. (See p. 906.)

The cause of this secular variation can no more be positively announced at the present time than when Professor Gellibrand first made his discovery in the sixteenth century. The fact that the magnetic declination is subject to this variation, as is evident, has a most important bearing upon all directions obtained with a magnetic needle, whether observed at sea or on land.

The directions of most land boundaries have been recorded from the earliest days in this country by the compass needle. On account of its practical bearing, many observations have been taken at various places to determine both the declination of the needle and its secular change. This country is peculiarly rich in data for determining the amount of secular change in the magnetic declination since 1700. Magnetic observations are being collected and published as never before. The declination may be called the first element of the Earth's magnetism.

The Magnetic Inclination (Dip).

When a magnetic needle is permitted to swing freely in a vertical plane, it does not remain horizontal, but dips from the horizontal plane. The angle of dip is smallest when the needle swings in the vertical plane containing the magnetic meridian and this particular angle is termed the "magnetic inclination." The dip measured in a plane at right angles to the plane of the magnetic meridian amounts to 90°, i. e., the needle stands vertical, with the north end down in our hemisphere. The dip is different in different localities and is also subject to secular change. In the surveyor's compass the dip of the magnetic needle is counteracted by a small bit of brass attached (in the northern hemisphere) to the south end of the needle. A mathematical instrument maker, Robert Norman, of London, first definitely announced to the world, in 1576, that the magnetic needle had a dip. George Hartmann had observed the dip of the needle as early as 1544, but he failed to accurately determine the angular amount.

At what is commonly called the "magnetic equator" the dipping needle remains horizontal. As we advance from this so-called magnetic equator, either north or south, along a magnetic meridian, we will find that the needle dips, increasing its dip as we advance, until we reach two points on the Earth's surface, one in the northern hemisphere, the other in the southern hemisphere, where the needle will stand vertical, not only in the plane of the magnetic meridian, but in all other vertical planes. These points are commonly called the "magnetic poles," a very misleading term, as they are not poles in the sense of those of a bar magnet, but are simply places on the Earth's surface where the direction assumed by the dipping needle coincides with that of the plumb line and to which the compass needle points. So far only two such points are known to us; here the compass needle may point in any direction, from 0° to 360°. While only two "magnetic poles" are known to us, there are *four* foci of maximum magnetic force (intensity), two in the northern and two in the southern hemisphere, none of which coincide with the magnetic poles. The Earth is not homogeneously magnetized, hence the so-called magnetic poles do not lie diametrically opposite to each other, and the lines of equal declination (isogonic lines) are not straight lines leading to the "magnetic poles," but far from it. Knowing both the magnetic declination and the dip at

any given place, we know the *direction* in which the Earth's magnetism acts at that place.

The dip may be called the second of the elements of the Earth's magnetism.

The Intensity of the Earth's Magnetic Force.

There remains now but one more element of the Earth's magnetism to be considered, the *intensity* of the attractive force which the Earth, as a magnet, exerts on a magnetic needle. This may be called the third element of the Earth's magnetism.

William Whiston, the famous translator of Josephus, made the first observations on the intensity of the Earth's magnetism. A prize offered about 1720 for the best method of determining the longitude at sea first turned Whiston's attention to terrestrial magnetism, and led to his making observations which greatly increased our knowledge of the Earth's magnetism of that day. Whiston only determined the *relative* intensity of the Earth's magnetism, i. e., he ascertained how much stronger the force was at other places than at London. It was left for Gauss to determine *absolutely* the intensity of the Earth's magnetism and to establish the necessary formulæ.

The *absolute* horizontal intensity of the Earth's magnetism is now determined, in a magnetic survey like that of North Carolina, by vibrating a magnet of certain weight, figure, and distribution of magnetism, and then by determining the effect of this magnet upon another magnet suspended in its place, at certain fixed distances. Knowing the horizontal intensity and dip, we can then determine, by calculation, the vertical force and total force of the Earth's magnetism.

The Diurnal Variation of the Earth's Magnetism.

In 1722 another London instrument maker, Graham, made an important discovery in terrestrial magnetism, viz, that the needle has a daily change as well as an annual and secular change. This applies to the declination, dip, and force (intensity) of the Earth's magnetism. The precise cause of these daily changes can not be positively given. We know that the Sun plays an important part.

The Elements Involved in Magnetic Surveys.

No magnetic survey is complete without having determined, at each place where observations are made, the three elements—declination, dip, and intensity. At every station in North Carolina all three elements have been obtained, and they will all be ultimately published.

Every civilized country in the world is now having some such surveys made. Thus only can we expect to increase our knowledge of the magnetism of the Earth and hope to know the *causes* of some of the remarkable phenomena of the Earth's magnetism above described, and which Helmholtz has well said are the most puzzling of natural phenomena.

Magnetism and Geology.

Aside from any irregularity in the form of the lines of equal magnetic declination due to the heterogeneous condition of the earth's magnetism, there are other marked irregularities in the form and location of these lines, due to the geological formations of the places where observations are made.

There may be a direct relationship between geology and terrestrial magnetism. Unexpected and marked magnetic deflections, at any particular place, where the surface geological strata and local surroundings do not indicate the presence of disturbing influences, lead us at once to believe there are hidden geological causes below the surface of the earth. Thus, a magnetic survey of a State may have a very important bearing on the geological survey of the same region, and reveal the presence of substances attracting the needle and which lie some distance below the surface of the earth.

Prof. A. W. Rücker, of England, in his "Recent researches on terrestrial magnetism," an account of which is published in Terrestrial Magnetism for March, 1898, has traced out from the magnetic surveys of Great Britain "ridge lines" of concealed masses of magnetic rocks "which are the foundations upon which the deposits studied by geologists have been laid." These concealed ridge lines have not only been located by magnetic surveys in England but have been carried across the British Channel and likewise traced out by magnetic surveys in France. We can safely say that in every country there is a network of these magnetic ridge lines which should be located by magnetic surveys, and that the geological conformation of the country should be studied in connection with them.

On account of these ridge lines of local magnetic influence it is impossible to construct an isogonic chart upon any scale which shall cover so large an area as the State of North Carolina, and give with accuracy the exact magnetic declination (variation) in any particular locality as taken from this chart of equal magnetic declinations. The chart of Lines of Equal Magnetic Declination can give but an approximation to the true variation of the compass at any given place and for any specified time. The greater the number of stations where observations have been made the more closely can the surveyor be furnished with the true variation of his compass.

Where any of the county meridian lines, as located in this survey, are so situated as to be surrounded by ridge lines of marked local influence quite different from the magnetic conditions in other sections of the county, they still can be made extremely useful to the county surveyor, as will be explained later.

GENERAL ACCOUNT OF THE MAGNETIC SURVEY OF NORTH CAROLINA.

Magnetic Instruments.

The Superintendent of the Coast and Geodetic Survey, Dr. Henry S. Pritchett, having detailed Mr. James B. Baylor, Assistant of the Survey, to carry out the magnetic work in North Carolina, put the following instrumental outfit at his disposal:

Theodolite and magnetometer, No. 20, and stand;
Dip circle, No. 5676;
Mean-time chronometer, No. 1507;
Magnetic tent;
Fifty-foot steel tape (standardized), No. 218.

A short description of these instruments will not be out of place. In the accompanying plate (No. 2) are shown the magnetic instruments used in the work. The mean-time chronometer used in connection with the astronomical (Sun) observations, and also in determining the rapidity with which a collimator magnet vibrated at a given place, is not shown in the plate. The time of one complete vibration of the magnet is necessary,

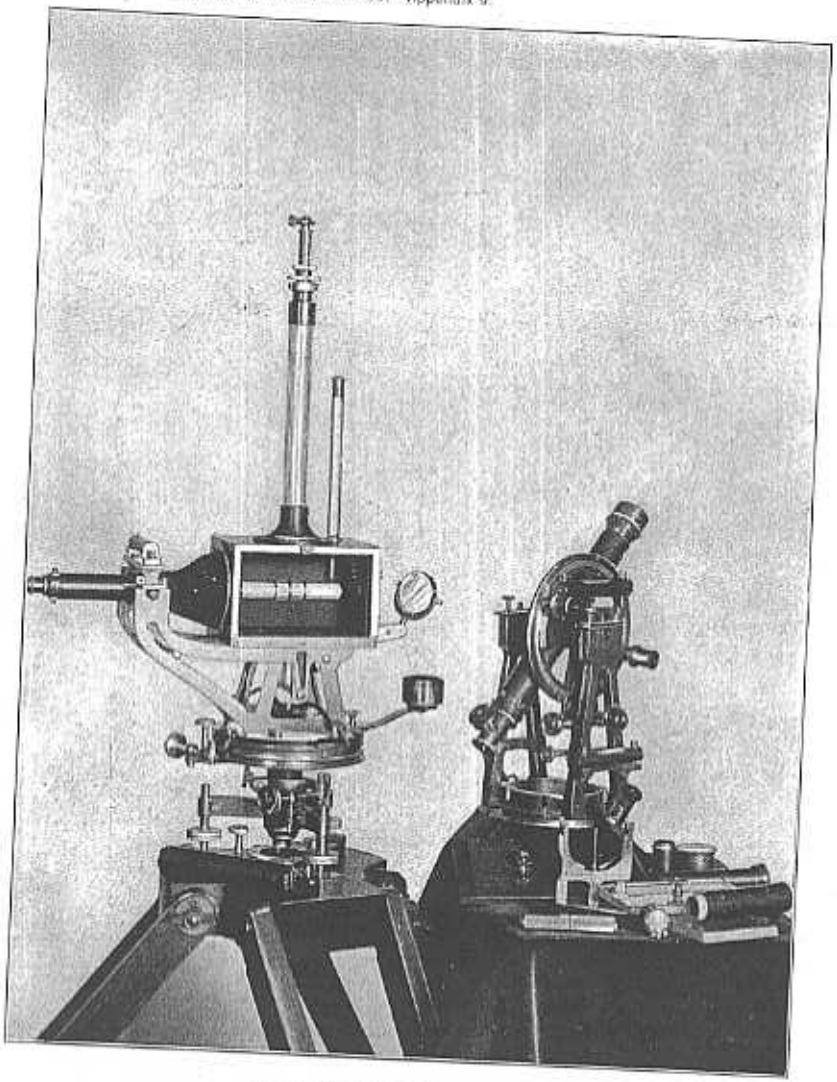

FIG. 1.—MAGNETOMETER NO. 20.

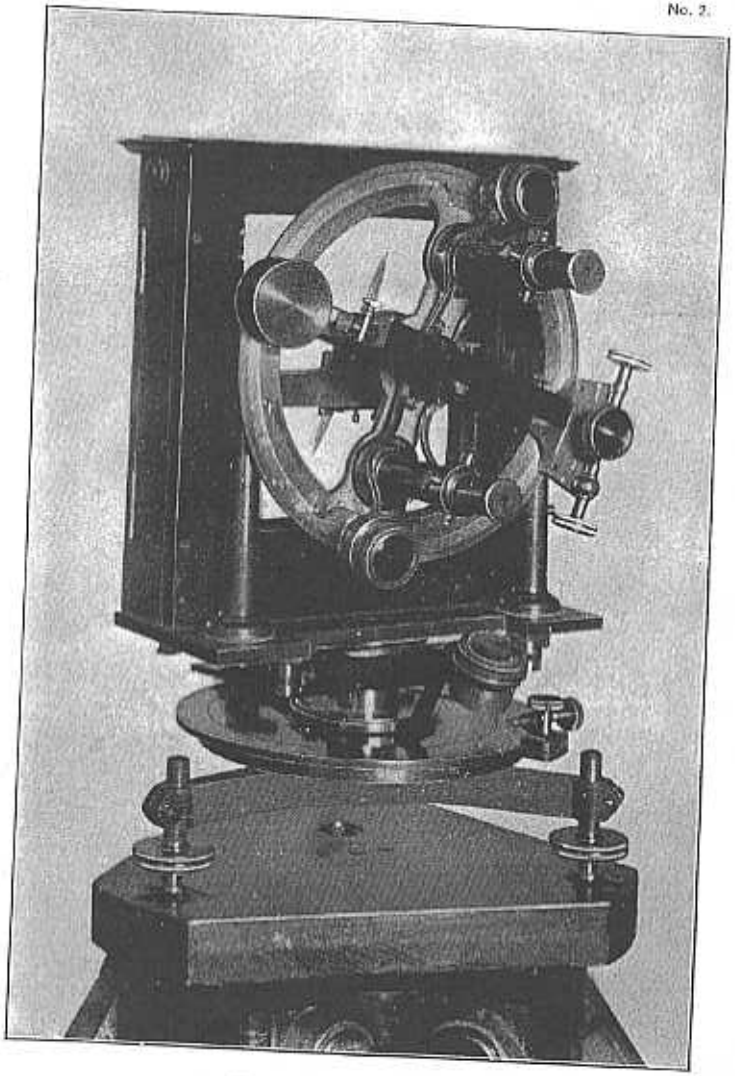

FIG. 2.—KEW DIP CIRCLE.

as we have already seen, for determining the horizontal force (intensity) of the Earth's magnetism.

The magnetometer is a combination instrument—magnetometer and theodolite combined. It was constructed at the Coast and Geodetic Survey Office, and answered all purposes admirably in the magnetic survey. The theodolite, with its prismatic eyepiece, just as it was used in the Sun (astronomical) observations for determining the true meridian, is shown on the right of the magnetometer. A specimen of these observations, with the accompanying computations, will be given in this chapter. The magnetometer proper, ready for determining the magnetic declination, is shown on the left of the theodolite.

The collimator magnet used with this magnetometer is an octagonal, hollow steel bar about 3 inches long and nearly one-half inch in diameter. It is used in the place of the magnetic needle in the surveyor's compass. Instead of having a needle swinging on a pivot with friction, we have here a magnet suspended in mid-air by one or two delicate silk fibers and swinging in a horizontal plane with all friction practically eliminated.

These fibers are hung in the glass tube above the box in which the magnet swings. In the plate (No. 2, Fig. 1) one side of the box is removed, so as to reveal the magnet. At the lower end the silk fibers are tied to a copper stirrup made to fit the collimator magnet. At the upper end they are fastened to an adjustable torsion head, permitting the raising and the lowering of the magnet to the proper height. The torsion of the silk fibers is eliminated by first using a copper bar of the same weight and figure as the collimator magnet and turning the torsion head until this nonmagnetic copper bar remains parallel to the sides of the box, when the telescope points in the direction of the magnetic meridian.

The effect of dip, removed in the ordinary surveyor's compass by a bit of brass attached to the arm of the needle, is here counteracted by causing the point of suspension to be considerably raised above the center of gravity of the magnet, so that it swings practically in a horizontal plane.

When observing the magnetic declination, the observer stands north of the instrument and looks south through the small telescope and hollow magnet and takes his reading on a scale etched on the glass closing the south end of the magnet. This scale is divided into 60 equal parts, each part representing an angle of 2 minutes. One-tenth of a space can be estimated, thus enabling pointings to one-fifth of a minute being made. On the north end of the magnet is a small lens, so shaped as to bring the scale into the focus of the small observing telescope when the latter has been focused on a distant reference mark. The telescope is mounted eccentrically and is provided with collimation and wye adjustments and a striding level. The box in which the magnet swings is centered over the vertical axis of the horizontal circle of the magnetometer.

The azimuth, or reference mark, can be seen with the telescope through this box before the magnet is raised into position by turning aside the glass window which covers the small round hole in the end of the box farthest from the end of the telescope. A dark hood is fastened to the other end of the box, fitting tightly over the telescope tube and shutting out all air currents.

The magnetic axis of the collimator magnet and the central line of the scale can not be made to accurately correspond. And if the mechanician did succeed in securing

exact coincidence, it would not remain so on account of the inevitable jarrings and loss of magnetism to which the magnet is subjected in the course of the work. It thus becomes necessary to determine the correction, due to the fact that the geometric axis and the magnetic axis of the magnet do not coincide. The reading of the magnetic axis on the scale of the collimator magnet can be determined at any time by simply inverting the magnet in its stirrup, reading the scale in the direct and in the inverted position, and combining the results to a mean. To the scale reading of the magnetic axis thus obtained, all observations for magnetic declination are reduced. As intimated, the scale reading of the magnetic axis changes from time to time, as the magnet itself changes its magnetic conditions. In its frequent and accurate determination, we have a means of eliminating an error that can not be removed in determining a magnetic declination with the ordinary surveyor's compass.

The small tube shown on the right of the glass tube containing the suspension fibres is a centigrade thermometer for noting the temperature of the inside of the box, to be used in computing the observations for horizontal intensity of the Earth's magnetism.

The upper part of the magnetometer, bearing the box and its telescope, can be removed from the horizontal circle, to which it is attached by two screws, and the upper part of the theodolite, bearing the vertical circle, can then be quickly fastened in its place.

This theodolite was used in determining the true astronomical directions, the local mean time, and latitude, the Sun being used for this purpose. Its horizontal circle is 11·2 centimetres (4·4 inches) in diameter and its vertical circle 9·8 centimetres (3·86 inches) in diameter. Each circle is graduated to half degrees and read by opposite verniers to minutes of arc.

The horizontal circle is graduated, in the direction of the motion of the hands of a watch, from 0° to 360°, while the vertical circle is graduated, in the opposite direction and from 0° to 90°, in each quadrant, giving in one direction the altitude of an object and in the reversed position the zenith distance of the object, thus making it possible to eliminate all index errors of the vertical circle when the telescope is reversed.

In the intensity observations, the collimator magnet, above described, is used to deflect, at fixed distances, another collimator magnet suspended in the stirrup in its place. Wooden arms are inserted under the box of the magnetometer, with riders supporting the deflecting magnet at the same height as the suspended (auxiliary) magnet.

On the extreme right of this same plate (No. 2, Fig. 2) we have an illustration of the instrument used in determining the magnetic inclination or dip. This instrument is of the Kew pattern. The magnetic needles which go with it are 3½ inches long, flat, and taper to points. These needles are so mounted as to swing freely in a vertical plane, and their pivots rest on agate planes carefully ground and which can be accurately leveled. The needle, when in position, is inclosed in a glass case to shut out the currents of air, and the instrument is provided with a lifter for raising the needle off the agates and letting it down before observing.

There is a vertical circle for reading the angle of the dip. The pointings on the needle are made with the two microscopes. The box and vertical circle can be turned in azimuth and set in the vertical plane of the magnetic meridian by means of the hori-

zontal circle. The circles of this instrument are about 5 inches in diameter. The vertical circle is provided with two opposite verniers reading to minutes of arc, and the horizontal circle is read with the vernier to minutes of arc.

With the dip circle are two "bar magnets" used in reversing the polarities of the dipping needles. We can thus, by combining to a mean, eliminate any error due to the fact that the center of gravity of the needle may not lie quite in the axis of suspension of the needle.

I. Example of the Astronomical (Sun) Observations and Computations Made at the County Seats.

INSTRUMENTS.

The theodolite of the magnetometer (No. 20) and the mean time chronometer (time piece) No. 1507 were used. These instruments have already been described. The diaphragm of the telescope of the theodolite has a simple + in it.

ASTRONOMICAL SYMBOLS.

⊙ = Symbol for the Sun.
⊕ = Apparent lower limb of the Sun observed.
⊖ = Apparent upper limb of the Sun observed.
⊖ = Apparent upper and left-hand limb of the Sun observed.
⊖ = Apparent upper and right-hand limb of the Sun observed.
⊕ = Apparent lower and left-hand limb of the Sun observed.
⊕ = Apparent lower and right-hand limb of the Sun observed.
D = Telescope of the theodolite in direct position.
R = Telescope of the theodolite in reversed position.

OBSERVATIONS FOR LATITUDE.

To determine the latitude of a place, the Sun's altitude was measured at intervals of a minute for a short time before and after apparent noon. The Sun's upper limb with telescope direct and lower limb with telescope reversed were observed alternately, the reading of the vertical circle giving zenith distance in the latter case. The theodolite was carefully leveled and adjusted.

Station: Wentworth, N. C. Date: Tuesday, September 26, 1899.

Telescope.	⊙	Chronometer time.	Vertical circle.	Remarks.
		h. *m.* *s.*	° ′	
D.	⊕	12 14 00	51 48·5	Clear and calm.
R.	⊖	15 00	37 18·0	
D.	⊕	16 00	51 50·0	
R.	⊖	17 00	37 17·5	
D.	⊕	18 00	51 50·0	
R.	⊖	19 00	37 17·0	
D.	⊕	20 00	51 50·0	
R.	⊖	21 00	37 17·0	
D.	⊕	22 00	51 50·0	
R.	⊖	12 23 00	37 18·0	

FIELD COMPUTATION OF LATITUDE.

For the purposes of the field computation we may assume that the Sun reaches its maximum altitude at apparent noon. This maximum altitude, corrected for parallax in altitude and atmospheric refraction, is combined with the Sun's declination at the same time to find the latitude of the place. The Sun's declination is taken from the American Ephemeris and Nautical Almanac.

Wentworth, N. C., Tuesday, September 26, 1899.

	°	′
Sun's observed altitude at apparent noon	52	16·5
Correction to observed altitude for refraction and parallax		−0·7
Sun's corrected altitude at apparent noon	52	15·8
Sun's zenith distance (Z) at apparent noon	37	44·2
Sun's north polar distance (P) at apparent noon	91	20·6
$P-Z$ = colatitude	53	36·4
Hence, approximate latitude (φ)	36	23·6

In the Office at Washington a more elaborate method of computation is employed, use being made of all of the observations, instead of simply the maximum altitude, as was done above.

OBSERVATIONS FOR DETERMINING THE TRUE NORTH AND SOUTH LINE.

Below are specimens of observations for ascertaining the true north and south line or azimuth of the "mark" or range from which the true meridian is laid off. The theodolite is carefully adjusted and centered over the "reference monument." The altitude or zenith distance of the Sun and its bearing with reference to the range or mark, and the time by chronometer are observed simultaneously. This is done when the Sun is at least 2½ hours from apparent noon; so that both the altitude and azimuth of the Sun are changing with sufficient rapidity. Four independent sets of observations are taken; two in the morning and two in the afternoon. The same sets of observations also give the approximate longitude of the place.

From the apparent time of observation the local mean time is found by applying the "equation of time" as taken from the American Ephemeris and Nautical Almanac. The difference between the chronometer time of observation and the local mean time thus found gives the correction of the chronometer on local mean time. Its correction on seventy-fifth meridian time is found by means of Western Union Telegraph Company time signals received at 12 o'clock. The difference between these two corrections, converted into arc (1 minute of time equals 15 minutes of arc) gives the difference of longitude from the seventy-fifth meridian.

Observations for Azimuth of Mark at Wentworth, N. C.

Tuesday, September 26, 1899, P. M.						Wednesday, September 27, 1899, A. M.					
Set.	Tel.	Object.	Chronometer time.	Horizontal circle.	Vertical circle.	Set.	Tel.	Object.	Chronometer time.	Horizontal circle.	Vertical circle.
			h. m. s.	° ′	° ′				*h. m. s.*	° ′	° ′
	D	Mark.		156 40·0 336 39·0			D	Mark.		157 02·0 337 00·0	
	D	☉ ☉	4 50 00 4 51 00	45 43·0 45 54·0	16 36·0 16 23·5		D	☉ ☉	7 20 00 7 21 00	251 26·0 251 36·0	11 18·0 11 31·0
I	R	☉ ☉	4 53 00 4 54 00	225 36·0 225 45·0	73 06·0 73 18·5	III	R	☉ ☉	7 23 00 7 24 00	71 15·0 71 25·0	78 18·5 78 05·0
	R	Mark.		336 37·0 156 36·0			R	Mark.		336 57·5 156 57·0	
	R	Mark.		336 36·0 156 36·0			R	Mark.		336 57·5 156 57·0	
	R	☉ ☉	5 04 00 5 05 00	227 22·0 227 32·0	75 16·0 75 29·0		R	☉ ☉	7 28 00 7 29 00	72 04·0 72 13·0	77 19·5 77 07·5
II	D	☉ ☉	5 07 00 5 08 00	48 28·0 48 38·0	13 17·0 13 05·0	IV	D	☉ ☉	7 31 00 7 32 00	253 09·0 253 18·0	13 28·0 13 39·0
	D	Mark.		156 41·0 336 40·0			D	Mark.		157 02·0 337 00·0	

MEANS.

Set.	No. of observation.	Chronometer time.	Horizontal circle.	Altitude of ☉	Mark.
		h. m. s.	° ′	° ′	° ′
I	1 and 4	4 52 00	45 44·0	16 38·75	156 38·0
	2 and 3	4 52 00	45 45·0	16 38·75	
II	1 and 4	5 06 00	48 00·0	13 54·50	156 38·2
	2 and 3	5 06 00	48 00·0	13 54·00	
III	1 and 4	7 22 00	251 25·5	11 36·50	156 59·1
	2 and 3	7 22 00	251 25·5	11 36·25	
IV	1 and 4	7 30 00	252 41·0	13 09·75	156 59·1
	2 and 3	7 30 00	252 41·0	13 10·25	

Computation of azimuth observations at Wentworth, N. C.

The formulæ used in the computation of the azimuth or bearing of the "mark" and in the computation of the local mean time of observation are as follows:

$$\tan^2 \tfrac{1}{2} A = \frac{\sin (s-\varphi) \sin (s-h)}{\cos s \cos (s-p)}$$

$$= \sec s \sec (s-p) \sin (s-h) \sin (s-\varphi)$$

$$\tan \tfrac{1}{2} t = \frac{\sin (s-h) \sec (s-p)}{\tan \tfrac{1}{2} A}$$

A=azimuth of Sun, east of north in the morning, west of north in the afternoon.
φ=latitude of the place.
h=altitude of the Sun corrected for refraction and parallax in altitude.
p=Polar distance of the Sun, at the time of observation, taken from the American Ephemeris and Nautical Almanac.
$s=\frac{1}{2}(h+\varphi+p)$.
t=The hour angle of the Sun or apparent time of observation expressed in arc.

COMPUTATION.

Date, 1899	September 26, p. m.		September 27, a. m.	
Set	I.	II.	III.	IV.
	° ′	° ′	° ′	° ′
Observed altitude	16 38·8	13 54·2	11 36·4	13 10·0
Refraction and parallax	− 3·1	− 3·8	− 4·5	− 4·0
h	16 35·7	13 50·4	11 31·9	13 06·0
φ	36 23·6	36 23·6	36 23·6	36 23·6
p	91 25·0	91 25·3	91 39·2	91 39·3
$2s$	144 24·3	141 39·3	139 34·7	141 08·9
s	72 12·1	70 49·6	69 47·3	70 34·4
$s-p$	− 19 12·9	− 20 35·7	− 21 51·9	− 21 04·9
$s-h$	55 36·4	56 59·2	58 15·4	57 28·4
$s-\varphi$	35 48·5	34 26·0	33 23·7	34 10·8
log. sec. s	0·51477	0·48357	0·46158	0·47810
log. sec. $(s-p)$	0·02490	0·02868	0·03242	0·03009
log. sin $(s-h)$	9·91655	9·92352	9·92963	9·92590
log. sin $(s-\varphi)$	9·76721	9·75239	9·74068	9·74958
log. tan^2 $\frac{1}{2}A$	0·22343	0·18816	0·16431	0·18367
log. tan $\frac{1}{2}A$	0·11171	0·09408	0·08215	0·09185
	° ′	° ′	° ′	° ′
$\frac{1}{2}A$	52 17·4	51 09·5	50 23·2	51 00·8
A from north	104 34·8	102 19·0	100 46·4	102 01·6
⊙ reads	45 44·5	48 00·0	251 25·5	252 41·0
North reads	150 19·3	150 19·0	150 39·1	150 39·4
Mark reads	156 38·0	156 38·2	156 59·1	156 59·1
Mark east of north	6 18·7	6 19·2	6 20·0	6 19·7
log. sin $(s-h)$ sec. $(s-p)$	9·94145	9·95220	9·96205	9·95599
log. tan $\frac{1}{2}t$	9·82974	9·85812	9·87990	9·86414
	° ′ ″	° ′ ″	° ′ ″	° ′ ″
$\frac{1}{2}t$	34 02 45	35 48 12	37 10 35	36 10 54
t in arc	68 05 30	71 36 24	74 21 10	72 21 48
	h. m. s.	h. m. s.	h. m. s.	h. m. s.
t in time	4 32 22·0	4 46 25·6	− 4 57 24·7	− 4 49 27·2
E	− 8 48·7	− 8 48·9	− 9 00·9	− 9 01·0
Local mean time	4 23 33·3	4 37 36·7	6 53 34·4	7 01 31·8
Chronometer time	4 52 00·0	5 06 00·0	7 22 00·0	7 30 00·0
Chronometer fast on local mean time	28 26·7	28 23·3	28 25·6	28 28·2

Recapitulation of the astronomical data at Wentworth, N. C., 1899.

Date and set.	Mark east of true north.	Chronometer No. 1 507 fast on local mean time.
	° ′	m. s.
Sept. 26, p. m., set I	6 18·7	28 26·7
Sept. 26, p. m., set II	19·2	23·3
Sept. 27, a. m., set III	20·0	25·6
Sept. 27, a. m., set IV	19·7	28·2
Mean	6 19·4	28 26·0

By properly laying off the angle, 6° 19′·4, the meridian line was determined and permanently marked by two substantial granite posts.

Computation of the approximate longitude.

Chronometer fast on local mean time	$28^m\ 26^s{\cdot}0$
Chronometer fast on seventy-fifth meridian time	$9^m\ 17^s{\cdot}8$
Local time fast on seventy-fifth meridian time	$19^m\ 08^s{\cdot}2$
In arc	4° 47′
Longitude=75° 00′+4° 47′	79° 47′

II. Example of the Observations Necessary to Determine with a Magnetometer the Magnetic Declination, together with the Computation of the Same. Similar Observations and Computations made at other County Seats.

A small observing tent is pitched over the point of observation to protect the instrument and the observer from the wind and weather.

Theodolite No. 20 is converted into magnetometer No. 20, as already described in this report.

Magnetometer No. 20 is carefully adjusted and leveled over the reference monument. The "mark" selected in the Sun observations, is pointed on through the little box in which the collimator magnet will swing. As an additional check pointings are also made on the center of the range monument which is in the true meridian. The horizontal circle is read and recorded in each case. The instrument is then turned around its vertical axis until the sides of the box are approximately parallel to the magnetic (compass) meridian and the telescope points south (magnetic).

The copper weight is then inserted in the stirrup and the torsion of the silk fibers carefully eliminated in a manner as already described. The long collimator magnet (L 20) is then used to replace the copper weight. This magnet is so delicately suspended that it is never entirely at rest and has to be brought approximately to rest with a knife blade or a small bit of iron, which is then removed.

The instrument is then turned about its vertical axis until the middle division of the scale of the magnet oscillates equally to right and left of the vertical line on the diaphragm of the telescope. The horizontal circle is then clamped and read. Then at intervals of five or ten minutes the scale readings of the magnet at the extremities of a swing are recorded with the corresponding times.

These observations are started early enough in the morning and continued long

enough (about an hour) to enable us to observe the eastern elongation of the needle, i. e., when the north end of the needle points nearest to the East during the day. This takes place somewhere between 7.30 a. m. and 9 a. m., local mean time, the precise time varying with the season of the year and with meteorological conditions.

The observations are begun again in the afternoon in time to include the western elongation, i. e., the time when the north end of the needle points its nearest to the West during the day. This usually takes place between 1 and 2 p. m., local mean time, the precise time varying as before with the season of the year and with the meteorological conditions. The mean of these two extreme positions of the needle is taken as the average position for the day. This method of obtaining the average value for the day, sufficing for all practical purposes, must at present be employed in regions where there are no magnetic observatories in operation.

The magnetic axis of the magnet is determined by inverting the magnet in the stirrup, as already described. The horizontal circle is carefully read and the torsion tested from time to time.

Magnetic observations—Declination.

Date, September 27th, 1899.

Station, Wentworth, N. C.; reference monument.

Instrument, magnetometer No. 20.

Magnet, L 20 suspended, scale erect—i. e., scale readings increasing from apparent right to apparent left. Facing south.

Line of detorsion, 5°.

Local time.	Scale readings.		Mean.	Azimuth circle, A. 304° 41′0 B. 124 42′0
s. m.	Left.	Right.		
h. m.	*d.*	*d.*	*d.*	
6 40	30'0	31'0	30'50	Remarks: Weather, clear and calm. Thermometer, 15° C.
45	30'0	31'2	30'60	
6 50	29'0	32'3	30'65	
7 00	30'0	31'0	30'50	
				Magnetometer converted into a theodolite and sun observed, a. m. sets.
8 00	30'0	30'7	30'35	Magnetometer remounted.
05	29'0	31'7	30'35	
10	29'0	31'3	30'15	
8 15	29'0	31'0	30'00	
8 30	29'0	30'4	29'70	
p. m.	Line of detorsion, 3°. Torsion carefully tested.			Azimuth circle, A. 304° 41′0 B. 124 42′0
12 20	25'0	27'0	26'00	Remarks: Weather, clear and pleasant. Wind, very light from north. Thermometer, 23° C.
25	25'0	27'0	26'00	
30	24'8	27'0	25'90	[A decreased reading of the scale of the collimator magnet shows a movement of the north end of the magnet to the *west*.]
35	24'8	26'8	25'80	
40	25'0	25'9	25'45	
45	25'3	25'5	25'40	
12 50	25'2	25'4	25'30	
1 00	25'3	25'3	25'30	
05	25'0	25'7	25'35	
10	25'0	25'8	25'40	

Magnetic observations—Declination—Continued.

	Reading of azimuth mark.	Range monument.
	° ′	° ′
At beginning of observations, A	132 57·0	126 37·0
B	312 56·0	306 37·0
At end of observations, A	132 57·0	
B	312 56·0	
Mean.	132 56·5	

Observer, J. B. Baylor.

Computation.

Determination of scale value of magnet.			Determination of axis of magnet.				
Scale.	Circle readings, mean of verniers.	Value of divisions.	Scale.	Scale readings.	Mean.	Alternate mean.	Axis.
				d. *d.*	*d.*	*d.*	*d.*
			E	25·0 27·6	26·30		
			I	31·0 32·4	31·70	26·30	29·00
One division of the scale of the collimator magnet equals two minutes of arc, as measured on the horizontal circle.			E	25·0 27·6	26·30	31·72	29·01
			I	31·0 32·5	31·75	26·28	29·02
			E	25·0 27·5	26·25		
Value of one div'n of scale = 2·00′			Scale reading of axis				29·01
Mean scale reading of east and west magnetic elongation (30·65) (25·30)							27·98
Reduction to axis				° ′ — 2·1	= diff. =		1·03
Azimuth circle reads				304 41·5			
Magnetic south meridian reads				304 39·4	Daily range in the declination = 10′·7.		
Mean reading of mark				132 56·5			
Azimuth of mark east of true north *a*				6 19·4			
True south meridian reads				306 37·1			
Magnetic declination				1 57·7	West of true north.		

a From sun observations and computations.

THE VARIATIONS OF THE MAGNETIC DECLINATION.

As already stated, the pointing of the compass needle is forever changing. The term "variations" will be used hereafter exclusively to denote the *changes* which take place in the value of the magnetic declination. Surveyors would do well were they likewise to use the word "variation" only in this sense, for they have, unfortunately, fallen into the habit of using the term "variation" in two different senses, first, to denote the quantity by which the compass points away from the true north—i. e., the

magnetic declination; secondly, to denote the *amount of change* in the magnetic declination for a certain period of years. This has given rise to considerable confusion in land surveys. The Division of Terrestrial Magnetism of the United States Coast and Geodetic Survey has difficulty at times in properly interpreting letters from surveyors regarding the "magnetic variation."

The chief variations of the magnetic declination concerning the surveyor may be classified as "the secular variation," "the daily or the diurnal variation," and the disturbance variation, due to magnetic storms.

It will be the special purpose of this chapter to show in a practical way the effect of these variations on land surveys in North Carolina made with a compass needle, and to furnish tables which may be useful to the surveyor in eliminating some of these errors.

The Secular Variation.

In the last one hundred years the compass needle has changed its relationship to the north line in the central portion of North Carolina about 4⅓° of arc. This means that in the central portion of North Carolina a surveyor starting from the same corner used in 1800, and retracing at the present time (1900) a line, say, 1 mile long, between two contiguous properties, using the compass bearing of 1800, the corner at the other end of the line would be shifted 399 feet from its original position.

During the last ten years the compass needle has changed its direction on an average in North Carolina about 3′ of arc each year. If this quantity is not taken into account it causes an error in the mile line of 4·6 feet for each year. Not knowing the causes which operate to produce the secular variation, we can not predict with certainty the amount of these changes.

A surveyor in North Carolina, by making use of the county meridians, as he is required by law to do, should determine for himself the amount of the secular change, and not be guided in the future solely by the changes in the compass bearings of old lines when they are retraced. The original bearing of an old line and the date of the survey may have been recorded wrong; the ends of the line as recovered may be in error and thus an erroneous value of the amount of change in the magnetic declination obtained.

Judge J. W. Bowman, of Mitchell County, N. C., in retracing numerous old lines estimates that in the last one hundred years the north end of the compass needle has moved westward just about 5° in Mitchell County, N. C.

Prof. William Cain, of the North Carolina State Univerity, from observations made in the vicinity of Chapel Hill, Orange County, N. C., estimates that the north end of the compass needle moved westward 2° 54′ between 1852 and 1895.

Tables giving the amount of change in declination between any two years between 1750 and 1910, for the various county seats, are given in the special chapter on this very important subject.

The Diurnal Variation.

A magnetic needle which swings freely in a horizontal plane changes its bearing from hour to hour. The range of this daily change is quite different in different months in the same year. It is greater in the Summer than in the Winter.

In the month of August the north end of the needle will point in North Carolina at 8 a. m. as much as 10′ of arc, on the average, nearer the east than it does at 1 p. m.

This means that in a mile line traced out with compass in August at 8 a. m. and retraced at 1 p. m. on the same day, there would be a difference in the location of a corner of 15'3 feet.

The following table gives the correction to an observed magnetic declination for diurnal variation for every month and for every hour from 6 a. m. to 6 p. m. The time given in this table is local mean time. Everywhere in North Carolina the local time for any place is slow on the time used. A surveyor in using this table should correct the railroad time to local time. For every degree of longitude he is west of the seventy-fifth meridian he should substract four minutes of time from the railroad time. The table should then be entered with the time as corrected.

TABLE I.—*Corrections of an observed magnetic declination for diurnal variation.*

[Apply the tabular quantities to the observed westerly declination with the sign as affixed, and with the reversed sign for easterly declination.]

Month.	6 a. m.	7.	8.	9.	10.	11.	Noon.	1.	2.	3.	4.	5.	6 p. m.
	′	′	′	′	′	′	′	′	′	′	′	′	′
January	−0'1	+0'2	+1'0	+2'1	+2'4	+1'2	−1'1	−2'5	−2'6	−2'1	−1'3	−0'2	+0'2
February	+0'6	+0'7	+1'5	+1'9	+1'4	−0'1	−1'5	−2'1	−2'5	−2'0	−1'2	−0'8	−0'4
March.....	+1'2	+2'0	+3'0	+2'8	+1'6	−0'6	−2'5	−3'4	−3'7	−3'3	−2'3	−1'2	−0'5
April.....	+2'5	+3'1	+3'4	+2'6	+0'8	−2'1	−4'0	−4'1	−4'2	−3'6	−2'3	−1'2	−0'2
May	+3'0	+3'8	+3'9	+2'6	+0'1	−2'4	−4'0	−5'0	−4'5	−3'6	−2'3	−0'9	+0'1
June	+2'9	+4'4	+4'4	+3'3	+1'1	−2'0	−3'6	−4'5	−4'5	−3'8	−2'6	−1'2	−0'2
July.....	+3'1	+4'6	+4'9	+3'9	+1'8	−1'2	−3'4	−4'4	−4'7	−4'2	−2'8	−1'3	−0'3
August.....	+2'9	+4'9	+5'4	+3'7	+0'4	−2'8	−4'7	−5'1	−4'9	−3'7	−1'9	−0'6	+0'3
September...	+1'8	+2'8	+3'4	+2'5	+0'3	−2'7	−4'4	−4'6	−4'2	−4'0	−1'4	−0'3	−0'1
October	+0'5	+1'6	+3'1	+2'8	+1'4	−1'0	−2'7	−3'3	−3'4	−2'4	−1'3	−0'4	−0'4
November ...	+0'5	+1'2	+1'7	+1'8	+1'1	−0'5	−2'0	−2'7	−2'6	−1'8	−1'0	−0'2	+0'2
December ...	+0'2	+0'3	+0'8	+1'8	+1'8	−0'0	−1'6	−2'4	−2'3	−1'8	−1'1	−0'3	+0'1

These figures represent the mean results of the continuous magnetic observations made at the old site of the Washington Magnetic Observatory—the old Naval Observatory grounds—during the four years 1888–1891.

THE DISTURBANCE VARIATION IN THE MAGNETIC DECLINATION. (MAGNETIC STORMS.)

There are variations in the direction of the compass needle due to spasmodic fluctuations in the Earth's magnetism. During the prevalence of these abnormal conditions the compass needle is occasionally in error as much as one-fourth of a degree and sometimes even more.

Magnetic storms are more frequent in the Summer than in the Winter. Fortunately about 75 to 90 per cent of the disturbances produced by magnetic storms are very small, and occur at times when they will not appreciably affect the surveyor's work.

MINOR PERIODIC FLUCTUATIONS.

There are other changes affecting the value of the magnetic declination than those already mentioned, which are known as "minor periodic fluctuations." These depend upon the declination of the Sun, upon its period of rotation, and upon the position of the Moon with reference to the Sun and Earth. These changes are too minute to be noted by the surveyor.

SECULAR VARIATION OF THE MAGNETIC DECLINATION IN NORTH CAROLINA.

While we can not say that the secular motion of the magnetic needle is strictly periodic, i. e., that after a certain long period of years the needle will return to the same position and exactly retrace the course it had previously followed, yet it has been shown by the investigations of Mr. Charles A. Schott, of the United States Coast and Geodetic Survey, and others, that the secular variation of the magnetic declination for the past two hundred years may be represented very closely by an al- ..aic expression based on the assumption of such a periodic motion. The observations at a great many stations in the United States have been treated in this way by Mr. Schott, and the latest results are published in Appendix I of the Coast and Geodetic Survey Report for 1895.

The only place in North Carolina where we have a sufficient number of observations to warrant a discussion of the secular variation of the magnetic declination is Newbern, and even there our results only go back to 1750. We may, however, supplement the data at Newbern by the observations at Cape Henry, Virginia, and Charleston, S. C. At each of these stations the observations cover the period from 1700 to 1895. The individual values of declination for each of these three places are given below, together with the secular-variation expression derived therefrom, and a comparison of the declinations computed from the formula with the observed quantities. The addition of Mr. Baylor's observation at Newbern in 1898 necessitated a new discussion for that station. With this exception the material is taken directly from the above-mentioned Appendix, pages 227–230.

COLLECTION OF THE MAGNETIC DECLINATIONS OBSERVED AT CAPE HENRY, VA.

[Latitude=36° 55′.6. Longitude=76° 00′.4 west of Greenwich.]

No.	Date.	Declination.	Reference and remarks.
		° ′	
1	1700	4 W.	Edmund Halley's Tabula Nautica.
2	1728, Mar. 6	3 W.	W. Byrd at head of Currituck Sound. Reduction to Cape Henry, +20′.
3	1732	4 42 W.	W. Hoxton, 7 miles from Cape Henry. Reduction, −10′.
	1732	4 40 W.	Douglass. Not used.
4	1750	1 47 W.	Value deduced from observations at 19 stations.
	1775	5 00 W.	Des Barres's Atlantic Neptune. Not used.
5	1809	0 00	President Madison at Norfolk. Reduction doubtful.
6	1832, June 9, 11	0 45 W.	Prof. J. N. Nicollet.
7	1856, Sept. 11, 12	1 28 W.	C. A. Schott, U. S. C. S. Near the light-house.
8	1874, Nov. 26–28	2 39′4 W.	Dr. T. C. Hilgard. Near the light-house.
9	1879, May and June	2 32 W.	Lieut. S. W. Very, U. S. N., at the Rip-Raps. Reduction, +10′.
10	1881, June 16	3 11 W.	Lieut. C. P. Perkins, U. S. N. Reduction, +5′.
11	1883, Jan. 2	3 10 W.	Lieut. G. A. Norris, U. S. N. Reduction, +5′.
	1883, June 30	3 06 W.	Lieut. C. Belknap, U. S. N.
	1883, Aug. 29	3 35 W.	Lieut. H. W. Lyon, U. S. N. Reduction, −5′.
	1883, Dec. 10	3 39 W.	Lieut. C. Belknap, U. S. N.
12	1884, May 10	3 37 W.	Lieut. F. Hanford, U. S. N. Reduction, −15′.
	1884, Oct. 10	2 55 W.	Lieut. C. C. Cornwell, U. S. N. Reduction, +5′.
13	1887, Apr. 14–16	3 20′1 W.	J. B. Baylor, U. S. C. and G. S. Near old light-house.
14	1895, June 13, 14	3 56′5 W.	Do.

From these observations has been derived the formula

$$D = +2^{\circ}\cdot42 + 2^{\circ}\cdot25 \sin (1\cdot47\, m - 30^{\circ}\cdot6),$$

in which $m = t - 1850$, t being the time of observation expressed in years and decimals. The agreement of the observed and computed quantities is shown in the following table, the plus sign standing for *west* declination and "*C. — O.*" for "computed minus observed value:"

Date.	Observed *D.*	Computed *D.*	*C.—O.*	Date.	Observed *D.*	Computed *D.*	*C.—O.*
	°	°	°		°	°	°
1700·0	− 4·00	+ 4·55	+0·55	1874·9	+ 2·66	+ 2·66	0·00
1728·2	3·33	3·60	+0·27	1879·4	2·70	2·91	+0·21
1732·5	4·53	3·31	−1·22	1881·4	3·27	3·02	−0·25
1750·0	1·78	2·33	+0·55	1883·5	3·37	3·14	−0·23
1809·5	0·00	0·77	+0·17	1884·5	3·18	3·19	+0·01
1832·4	0·75	0·54	−0·21	1887·3	3·34	3·34	0·00
1856·7	+ 1·47	+ 1·62	+0·15	1895·5	+ 3·94	+ 3·75	−0·19

COLLECTION OF THE MAGNETIC DECLINATIONS OBSERVED AT NEWBERN, N. C.

[Latitude=35° 06′. Longitude=77° 01′ west of Greenwich.]

No.	Date.	Declination.	Reference and remarks.
		° ′	
1	1750	0.5 W.	Value deduced from observations at 19 stations.
2	1779	1 59 E.	H. A. Brown, letter of Nov. 6, 1893. From 3 bearings of streets in 1779 and 1810, at which epochs they were the same.
3	1796	2 40 E.	J. Price.
4	1806	2 00 E.	Do.
5	1809	1 45 E.	Do.
6	1810, Apr. 23	1 59 E.	H. A. Brown, see above. Difference of bearings between 1810·3 and 1893·8 was 4° 23′·3. For 1893·8 assume 2° 24′ W.
7	1840	0 00	Sir E. Sabine's isogonic chart for 1840.
8	1874, Dec. 21, 23, 24	1 20·4 W.	J. B. Baylor, U. S. C. S., in national cemetery.
9	1887, Mar. 19, 20	1 54·4 W.	Do.
10	1898, July 9	2 46·6 W.	J. B. Baylor, U. S. C. and G. S., in Cedar Grove Cemetery.

$$D = +0^{\circ}\cdot54 + 2\cdot64 \sin (1\cdot45\, m - 16^{\circ}\cdot1).$$

Date.	Observed *D.*	Weight.	Computed *D.*	*C.—O.*	Date.	Observed *D.*	Weight.	Computed *D.*	*C.—O.*
	°		°	°		°		°	
1750·0	+0·3	½	−0·32	−0·62	1810·3	−1·98	1	−1·99	−0·01
1779·5	−1·98	1	−1·78	+0·20	1840·0	0·00	½	−0·80	−0·80
1796·5	−2·67	1	−2·09	+0·58	1875·0	+1·34	1	+1·44	+0·10
1806·5	−2·00	1	−2·05	−0·05	1887·2	+1·91	1	+2·16	+0·25
1809·5	−1·75	1	−2·01	−0·26	1898·5	+2·78	1	+2·68	−0·10

COLLECTION OF THE MAGNETIC DECLINATIONS OBSERVED AT CHARLESTON, S. C.

[Latitude=32° 47′. Longitude=79° 56′.]

No.	Date.	Declination.			Reference and remarks.
		°	′		
1	1700	½		E.	Edmund Halley's Tabula Nautica.
	1700	½		W.	Deduced from observations at 17 stations. Not used.
	1742	5	23	E.	English Pilot, 1794. Not used.
2	1750	1	39	E.	Deduced from observations at 19 stations.
3	1775	3	48	E.	Des Barres's Atlantic Neptune.
	1777	3	48	E.	From a chart. Not used.
4	1784, February	3	15	E.	J. Purchell.
5	1785, October	3	45	E.	Do.
6	1824–25	3	45	E.	Lieutenant Sherburne, U. S. N.
7	1833·0	4	00	E.	P. Barlow's isogonic chart.
8	1837	2	54	E.	Captain Missroom.
9	1840	2	44	E.	Dr. C. Davies.
10	1841, May	2	24	E.	Barnet.
11	1847, October	2	15	E.	Parker.
12	1849, Apr. 1–22	2	16·5	E.	C. O. Boutelle, U. S. C. S. At Breach Inlet.
13	1874, May 27, 28, 29	0	58·2	E.	C. O. Boutelle, U. S. C. S. At Fort Marshall.
14	1880, Jan. 21, 22	0	25·6	E.	J. B. Baylor, U. S. C. and G. S. At Fort Marshall.
15	1885, Dec. 29, 30	0	14·2	E.	J. B. Baylor, U. S. C. and G. S. Near Breach Inlet.
16	1895, June 5, 6	0	19·3	W.	Do.

$$D = -1^{\circ}\cdot82 + 2^{\circ}\cdot75 \sin (1\cdot40\, m - 12^{\circ}\cdot1).$$

Date.	Observed D.	Weight.	Computed D.	$C-O$.	Date.	Observed D.	Weight.	Computed D.	$C-O$.
	°		°	°		°		°	°
1700·0	−0·50	½	+0·06	−0·56	1840·5	−2·73	1	−2·99	−0·26
1750·0	−1·65	1	−3·10	−1·45	1841·4	2·40	1	2·93	−0·53
1775·5	−3·80	1	4·28	−0·48	1847·8	2·25	1	2·53	−0·28
1784·1	−5·25	1	4·48	+0·77	1849·3	2·28	1	2·43	−0·15
1785·8	−5·75	1	4·51	+1·24	1874·4	0·97	1	0·76	+0·21
1825·0	−3·75	1	3·83	−0·08	1880·1	0·43	1	0·42	+0·01
1833·0	−4·00	1	3·42	+0·58	1886·0	−0·24	1	−0·08	+0·16
1837·5	−2·90	1	−3·17	−0·27	1895·4	+0·32	1	+0·33	+0·01

We have, then, the three expressions:

For Cape Henry, Va., $D = +2^{\circ}\cdot42 + 2^{\circ}\cdot25 \sin (1^{\circ}\cdot47\, m - 30^{\circ}\cdot6)$.

For Newbern, N. C., $D = +0^{\circ}\cdot54 + 2^{\circ}\cdot64 \sin (1^{\circ}\cdot45\, m - 16^{\circ}\cdot1)$.

For Charleston, S. C., $D = -1^{\circ}\cdot82 + 2^{\circ}\cdot75 \sin (1^{\circ}\cdot40\, m - 12^{\circ}\cdot1)$.

In these formulæ the plus sign indicates west declination, the minus sign east declination. The first term of the second member represents the average value of the declination during an entire period. The constant multiplier of the second term is one-half the range in declination. Accordingly, for Cape Henry the maximum declination would be $2^{\circ}\cdot42 + 2^{\circ}\cdot25 = +4^{\circ}\cdot67$, or 4° 40′ west, and the minimum declination $2^{\circ}\cdot42 - 2^{\circ}\cdot25 = +0^{\circ}\cdot17$, or 0° 10′ west.

It will be noticed that the three expressions agree in their general characteristics, though differing in detail. Of course the first term varies with the distribution of declination, but the variation in the second term may be due more to imperfect data than to differing conditions. Accordingly, an expression derived by taking the mean of the three will be used for the eastern part of North Carolina in preference to the

COLLECTION OF THE MAGNETIC DECLINATIONS OBSERVED AT CHARLESTON, S. C.

[Latitude=32° 47′. Longitude=79° 56′.]

No.	Date.	Declination.			Reference and remarks.
		°	′		
1	1700	½		E.	Edmund Halley's Tabula Nautica.
	1700	½		W.	Deduced from observations at 17 stations. Not used.
	1742	5	25	E.	English Pilot, 1794. Not used.
2	1750	1	39	E.	Deduced from observations at 19 stations.
3	1775	3	48	E.	Des Barres's Atlantic Neptune.
	1777	3	48	E.	From a chart. Not used.
4	1784, February	5	15	E.	J. Purchell.
5	1785, October	5	45	E.	Do.
6	1824–25	3	45	E.	Lieutenant Sherburne, U. S. N.
7	1833·0	4	00	E.	P. Barlow's isogonic chart.
8	1857	2	54	E.	Captain Missroom.
9	1840	2	44	E.	Dr. C. Davies.
10	1841, May	2	24	E.	Barnet.
11	1847, October	2	15	E.	Parker.
12	1849, Apr. 1–22	2	16·5	E.	C. O. Boutelle, U. S. C. S. At Breach Inlet.
13	1874, May 27, 28, 29	0	58·2	E.	C. O. Boutelle, U. S. C. S. At Fort Marshall.
14	1880, Jan. 21, 22	0	25·6	E.	J. B. Baylor, U. S. C. and G. S. At Fort Marshall.
15	1885, Dec. 29, 30	0	14·2	E.	J. B. Baylor, U. S. C. and G. S. Near Breach Inlet.
16	1895, June 5, 6	0	19·3	W.	Do.

$$D = -1^{\circ}\cdot82 + 2^{\circ}\cdot75 \sin (1^{\circ}\cdot40\, m - 12^{\circ}\cdot1).$$

Date.	Observed D.	Weight.	Computed D.	$C-O$.	Date.	Observed D.	Weight.	Computed D.	$C-O$.
	°		°	°		°		°	°
1700·0	−0·50	½	+0·06	+0·56	1840·5	−2·73	1	−2·99	−0·26
1750·0	−1·65	1	−3·10	−1·45	1841·4	2·40	1	2·93	−0·53
1775·5	−3·80	1	4·28	−0·48	1847·8	2·25	1	2·53	−0·28
1784·1	−5·25	1	4·48	+0·77	1849·3	2·28	1	2·43	−0·15
1785·8	−5·75	1	4·51	+1·24	1874·4	0·97	1	0·76	+0·21
1825·0	−3·75	1	3·83	−0·08	1880·1	0·43	1	0·42	+0·01
1833·0	−4·00	1	3·42	+0·58	1886·0	−0·24	1	−0·08	+0·16
1837·5	−2·90	1	−3·17	−0·27	1895·4	+0·32	1	+0·33	+0·01

We have, then, the three expressions:

For Cape Henry, Va., $D = +2^{\circ}\cdot42 + 2^{\circ}\cdot25 \sin (1^{\circ}\cdot47\, m - 30^{\circ}\cdot6)$.

For Newbern, N. C., $D = +0^{\circ}\cdot54 + 2^{\circ}\cdot64 \sin (1^{\circ}\cdot45\, m - 16^{\circ}\cdot1)$.

For Charleston, S. C., $D = -1^{\circ}\cdot82 + 2^{\circ}\cdot75 \sin (1^{\circ}\cdot40\, m - 12^{\circ}\cdot1)$.

In these formulæ the plus sign indicates west declination, the minus sign east declination. The first term of the second member represents the average value of the declination during an entire period. The constant multiplier of the second term is one-half the range in declination. Accordingly, for Cape Henry the maximum declination would be $2^{\circ}\cdot42 + 2^{\circ}\cdot25 = +4^{\circ}\cdot67$, or 4° 40′ west, and the minimum declination $2^{\circ}\cdot42 - 2^{\circ}\cdot25 = +0^{\circ}\cdot17$, or 0° 10′ west.

It will be noticed that the three expressions agree in their general characteristics, though differing in detail. Of course the first term varies with the distribution of declination, but the variation in the second term may be due more to imperfect data than to differing conditions. Accordingly, an expression derived by taking the mean of the three will be used for the eastern part of North Carolina in preference to the

expression for Newbern. It is $D = x + 2°.55 \sin (1°.44\, m - 19°.6)$ in which x is found for any place by means of the observed declination.

It is known that the phases of secular variation of declination occur, in general, later as we go west. From a comparison of the secular variation discussion for stations in various longitudes, it is estimated that the phases would occur ten years later in the western part of North Carolina than in the eastern. The above expression may accordingly be modified to suit other portions of the State, as follows:

I. To longitude 78° 00′ $D = x + 2°.55 \sin (1°.44\, m - 19°.6)$.
II. 78° 00′ to 79° 30′ $D = x + 2°.55 \sin (1°.44\, m - 23°.2)$.
III. 79° 30′ to 81° 00′ $D = x + 2°.55 \sin (1°.44\, m - 26°.8)$.
IV. 81° 00′ to 82° 30′ $D = x + 2°.55 \sin (1°.44\, m - 30°.4)$.
V. 82° 30′ westward $D = x + 2°.55 \sin (1°.44\, m - 34°.0)$.

The values of the portions of these expressions which vary with the time, viz, the second terms, are given for various epochs in the following table. The tabular quantities refer to the 1st of January of the corresponding date.

Auxiliary table used in constructing the secular variation table for the county seats.

Year.	Limits of longitude.				
	75° 30′ to 78° 00′.	78° 00′ to 79° 30′.	79° 30′ to 81° 00′.	81° 00′ to 82° 30′.	82° 30′ to 84° 00′.
	° ′	° ′	° ′	° ′	° ′
1750	−0 43	−0 34	−0 24	−0 15	−0 05
1760	−1 18	−1 10	−1 01	−0 52	−0 43
1770	−1 49	−1 42	−1 34	−1 26	−1 18
1780	−2 12	−2 07	−2 01	−1 55	−1 49
1790	−2 27	−2 24	−2 21	−2 17	−2 12
1800	−2 33	−2 32	−2 31	−2 29	−2 27
1810	−2 29	−2 31	−2 32	−2 33	−2 33
1820	−2 16	−2 20	−2 24	−2 27	−2 29
1830	−1 54	−2 01	−2 06	−2 11	−2 16
1840	−1 26	−1 33	−1 41	−1 48	−1 54
1850	−0 51	−1 00	−1 09	−1 18	−1 26
1860	−0 14	−0 23	−0 33	−0 42	−0 51
1870	+0 24	+0 15	+0 05	−0 04	−0 14
1880	+1 01	+0 52	+0 43	+0 34	+0 24
1890	+1 34	+1 26	+1 18	+1 10	+1 01
1900	+2 01	+1 55	+1 49	+1 42	+1 34
1910	+2 21	+2 17	+2 12	+2 07	+2 01

N. B.—The *surveyor* not to use this table, but Table No. II.

Secular Variation Table for the County Seats.

The manner in which the table was constructed will be readily understood from the following remarks:

To derive a secular variation table for a particular station, find by interpolation from the proper column of the foregoing table the value for the date of observation. The difference between that quantity and the observed declination must then be applied as a constant correction to that column. For example, the declination observed at Chapel Hill, March 25, 26, 1898, was +1° 28′·6. The value for that date from Column II of the table is +1° 50′·2. Hence the quantities in that column must be diminished (algebraically) by 22′ to be applicable to Chapel Hill. As before stated, a *plus* sign indicates *west* declination, a *minus* sign *east* declination. In this way the quantities in the following table have been derived for each place where a meridian line was established and magnetic observations made. The arrangement of the columns is alphabetically by counties.

For the county seats where meridian lines have not yet been established and where magnetic observations have not yet been made—indicated in the table by an asterisk (*)—estimated values of the magnetic declination for January 1, 1900, as derived from observations in the vicinity of the county seats, were utilized in the construction of the respective columns. Whatever errors these estimated values may be subject to will not affect the use of the columns for determining the change in the magnetic declination between any two periods of time, as all of the quantities in a particular column will be affected by the same error.

As soon as magnetic observations have been made at the remaining county seats, surveyors, by applying to the Superintendent of the United States Coast and Geodetic Survey, can obtain the precise corrections to the estimated values referred to above.

Example of the practical application of the table.

The following table will be of special value in finding the *change* in the magnetic declination at any place in the county. Suppose it were desired to retrace in May, 1900, a boundary line in Wake County, which bore magnetically N. 76° E. in July, 1813. From the table for Raleigh we find that the magnetic declination was 1° 53′ east in 1813 and 2° 30′ west for the later date. Consequently the change in the interval is 4° 23′ to the westward, and a line which bore N. 76° E. in 1813 should be rerun in May, 1900, with the magetic bearing N. 80° 23′ E.

Our information regarding the distribution of declination in the United States in the eighteenth century is so uncertain, owing to the small amount of data available and the inferior instruments then in use, that the portions of our secular variation tables covering that period may be in error by as much as half a degree, and an uncertainty of a quarter of a degree may be assigned to the values for the early part of the nineteenth century. These facts should be borne in mind when using the tables.

TABLE II.—*Values of the magnetic declination at the county seats from 1750 to 1910.*

Year.	County and town.								
	Alamance, Graham.	Alexander, Taylorsville.*	Alleghany, Sparta.*	Anson, Wadesboro.†	Ashe, Jefferson.*	Beaufort, Washington.	Bertie, Windsor.	Bladen, Elizabethtown.	Brunswick, Southport.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1750	0 26 E	1 17 E	1 00 E	2 15 E	1 12 E	0 04 W	1 50 W	0 51 E	0 35 E
1760	1 02	1 54	1 37	2 52	1 49	0 31 E	1 15	1 27	1 11
1770	1 34	2 28	2 11	3 25	2 23	1 02	0 44	1 59	1 43
1780	1 59	2 57	2 40	3 52	2 52	1 25	0 21	2 24	2 08
1790	2 16	3 19	3 02	4 12	3 14	1 40	0 06	2 41	2 25
1800	2 24	3 31	3 14	4 22	3 26	1 46	0 00	2 49	2 33
1810	2 23	3 35	3 18	4 23	3 30	1 42	0 04	2 48	2 32
1820	2 12	3 29	3 12	4 15	3 24	1 29	0 17	2 37	2 21
1830	1 53	3 13	2 56	3 57	3 08	1 07	0 39	2 18	2 02
1840	1 25	2 50	2 33	3 32	2 45	0 39	1 07	1 50	1 34
1850	0 52	2 20	2 03	3 00	2 15	0 04 E	1 42	1 17	1 01
1860	0 15 E	1 44	1 27	2 24	1 39	0 33 W	2 19	0 40	0 24 E
1870	0 23 W	1 06	0 49	1 46	1 01	1 11	2 57	0 02 E	0 14 W
1880	1 00	0 28 E	0 11 E	1 08	0 23 E	1 48	3 34	0 35 W	0 51
1890	1 34	0 08 W	0 25 W	0 33	0 13 W	2 21	4 07	1 09	1 25
1900	2 03	0 40	0 57	0 02 E	0 45	2 48	4 34	1 38	1 54
1910	2 25 W	1 05 W	1 22 W	0 21 W	1 10 W	3 08 W	4 54 W	2 00 W	2 16 W

Year.	County and town.								
	Buncombe, Asheville.	Burke, Morganton.*	Cabarrus, Concord.	Caldwell, Lenoir.*	Camden, Camden.*	Carteret, Beaufort.	Caswell, Yanceyville.*	Catawba, Newton.*	Chatham, Pittsboro.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1750	1 48 E	1 35 E	0 37 W	1 22 E	1 26 W	0 02 E	0 15 E	1 19 E	0 07 W
1760	2 26	2 12	0 00	1 59	0 51	0 37	0 52	1 56	0 29 E
1770	3 01	2 46	0 33 E	2 33	0 20 W	1 08	1 25	2 30	1 01
1780	3 32	3 15	1 00	3 02	0 03 E	1 31	1 52	2 59	1 26
1790	3 55	3 37	1 20	3 24	0 18	1 46	2 12	3 21	1 43
1800	4 10	3 49	1 30	3 36	0 24	1 52	2 22	3 33	1 51
1810	4 16	3 53	1 31	3 40	0 20	1 48	2 23	3 37	1 50
1820	4 12	3 47	1 23	3 34	0 07 E	1 35	2 15	3 31	1 39
1830	3 59	3 31	1 05	3 18	0 15 W	1 13	1 57	3 15	1 20
1840	3 37	3 08	0 40	2 55	0 43	0 45	1 32	2 52	0 52
1850	3 09	2 38	0 08 E	2 25	1 18	0 10 E	1 00	2 22	0 19 E
1860	2 34	2 02	0 28 W	1 49	1 55	0 27 W	0 24 E	1 46	0 18 W
1870	1 57	1 24	1 06	1 11	2 33	1 05	0 14 W	1 08	0 56
1880	1 19	0 46	1 44	0 33 E	3 10	1 42	0 52	0 30 E	1 33
1890	0 42	0 10 E	2 19	0 03 W	3 43	2 15	1 27	0 06 W	2 07
1900	0 09 E	0 22 W	2 50	0 35	4 10	2 42	1 58	0 38	2 36
1910	0 18 W	0 47 W	3 13 W	1 00 W	4 30 W	3 02 W	2 21 W	1 03 W	2 58 W

* At these county seats meridian lines have not yet been established nor magnetic observations made. See text, page 912, regarding constant errors that may affect these columns.

† Based upon magnetic observations made on May 27 and 28, 1900, by G. R. Putnam, of the Coast and Geodetic Survey, at a place 91 yards east of meridian line established by him. See description of station, page 952.

TABLE II.— *Values of the magnetic declination at the county seats from 1750 to 1910*—Continued.

Year.	County and town.								
	Cherokee, Murphy.	Chowan, Edenton.	Clay, Hayesville.*	Cleveland, Shelby.	Columbus, Whiteville.	Craven, Newbern.	Cumberland, Fayetteville.	Currituck, Currituck.	Dare, Manteo.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1750	3 53 E	0 49 W	3 39 E	1 50 E	0 45 E	0 07 W	0 46 E	2 06 W	1 42 W
1760	4 31	0 14 W	4 17	2 27	1 21	0 28 E	1 22	1 31	1 07
1770	5 06	0 17 E	4 52	3 01	1 53	0 59	1 54	1 00	0 36
1780	5 37	0 40	5 23	3 30	2 18	1 22	2 19	0 37	0 13 W
1790	6 00	0 55	5 46	3 52	2 35	1 37	2 36	0 22	0 02 E
1800	6 15	1 01	6 01	4 04	2 43	1 43	2 44	0 16	0 08
1810	6 21	0 57	6 07	4 08	2 42	1 39	2 43	0 20	0 04 E
1820	6 17	0 44	6 03	4 02	2 31	1 26	2 32	0 33	0 09 W
1830	6 04	0 22 E	5 50	3 46	2 12	1 04	2 13	0 55	0 31
1840	5 42	0 06 W	5 28	3 23	1 44	0 36	1 45	1 23	0 59
1850	5 14	0 41	5 00	2 53	1 11	0 01 E	1 12	1 58	1 34
1860	4 39	1 18	4 25	2 17	0 34 E	0 36 W	0 35 E	2 35	2 11
1870	4 02	1 56	3 48	1 39	0 04 W	1 14	0 03 W	3 13	2 49
1880	3 24	2 33	3 10	1 01	0 41	1 51	0 40	3 50	3 26
1890	2 47	3 06	2 33	0 25 E	1 15	2 24	1 14	4 23	3 59
1900	2 14	3 33	2 00	0 07 W	1 44	2 51	1 43	4 50	4 26
1910	1 47 E	3 53 W	1 33 E	0 32 W	2 06 W	3 11 W	2 05 W	5 10 W	4 46 W

Year.	County and town.								
	Davidson, Lexington.*	Davie, Mocksville.*	Duplin, Kenansville.	Durham, Durham.	Edgecombe, Tarboro.	Forsyth, Winston-Salem.	Franklin, Louisburg.	Gaston, Dallas.*	Gates, Gatesville.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1750	1 03 E	1 13 E	1 06 E	1 05 E	0 51 W	0 29 E	0 05 E	1 27 E	1 03 W
1760	1 40	1 50	1 41	1 41	0 16 W	1 06	0 41	2 04	0 28 W
1770	2 13	2 23	2 12	2 13	0 15 E	1 39	1 13	2 38	0 03 E
1780	2 40	2 50	2 35	2 38	0 38	2 06	1 38	3 07	0 26
1790	3 00	3 10	2 50	2 55	0 53	2 26	1 55	3 29	0 41
1800	3 10	3 20	2 56	3 03	0 59	2 36	2 03	3 41	0 47
1810	3 11	3 21	2 52	3 02	0 55	2 37	2 02	3 45	0 43
1820	3 03	3 13	2 39	2 51	0 42	2 29	1 51	3 39	0 30
1830	2 45	2 55	2 17	2 32	0 20 E	2 11	1 32	3 23	0 08 E
1840	2 20	2 30	1 49	2 04	0 08 W	1 46	1 04	3 00	0 20 W
1850	1 48	1 58	1 14	1 31	0 43	1 14	0 31 E	2 30	0 55
1860	1 12	1 22	0 37 E	0 54	1 20	0 38 E	0 06 W	1 54	1 32
1870	0 34 E	0 44	0 01 W	0 16 E	1 58	0 00	0 44	1 16	2 10
1880	0 04 W	0 06 E	0 38	0 21 W	2 35	0 38 W	1 21	0 38	2 47
1890	0 39	0 29 W	1 11	0 55	3 08	1 13	1 55	0 02 E	3 20
1900	1 10	1 00	1 38	1 24	3 35	1 44	2 24	0 30 W	3 47
1910	1 33 W	1 23 W	1 58 W	1 46 W	3 55 W	2 07 W	2 46 W	0 55 W	4 07 W

TABLE II.—*Values of the magnetic declination at the county seats from 1750 to 1910*—Continued.

Year.	County and town.								
	Graham, Robbinsville.*	Granville, Oxford.	Greene, Snow Hill.	Guilford, Greensboro.	Halifax, Halifax.	Harnett, Lillington.	Haywood, Waynesville.*	Henderson, Hendersonville.*	Hertford, Winton.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1750	3 04 E	0 24 E	0 43 W	1 22 E	0 42 E	0 29 E	2 34 E	2 00 E	0 34 W
1760	3 42	1 00	0 08 W	1 59	1 17	1 05	3 12	2 38	0 01 E
1770	4 17	1 32	0 23 E	2 32	1 48	1 37	3 47	3 12	0 32
1780	4 48	1 57	0 46	2 59	2 11	2 02	4 18	3 42	0 55
1790	5 11	2 14	1 01	3 19	2 26	2 19	4 41	4 04	1 10
1800	5 26	2 22	1 07	3 29	2 32	2 27	4 56	4 18	1 16
1810	5 32	2 21	1 03	3 30	2 28	2 26	5 02	4 23	1 12
1820	5 28	2 10	0 50	3 22	2 15	2 15	4 58	4 18	0 59
1830	5 15	1 51	0 28 E	3 04	1 53	1 56	4 45	4 04	0 37
1840	4 53	1 23	0 00	2 39	1 25	1 28	4 23	3 41	0 09 E
1850	4 25	0 50	0 35 W	2 07	0 50	0 55	3 55	3 12	0 26 W
1860	3 50	0 13 E	1 12	1 31	0 13 E	0 18 E	3 20	2 36	1 03
1870	3 13	0 25 W	1 50	0 53	0 25 W	0 20 W	2 43	1 59	1 41
1880	2 35	1 02	2 27	0 15 E	1 02	0 57	2 05	1 21	2 18
1890	1 58	1 36	3 00	0 20 W	1 35	1 31	1 28	0 46	2 51
1900	1 25	2 05	3 27	0 51	2 02	2 00	0 55	0 12 E	3 18
1910	0 58 E	2 27 W	3 47 W	1 14 W	2 22 W	2 22 W	0 28 E	0 14 W	3 38 W

Year.	County and town.								
	Hyde, Swanquarter.	Iredell, Statesville.	Jackson, Webster.	Johnston, Smithfield.	Jones, Trenton.*	Lenoir, Kinston.	Lincoln, Lincolnton.	McDowell, Marion.	Macon, Franklin.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1750	0 39 W	1 22 E	3 18 E	1 31 E	0 24 E	0 52 E	1 20 E	0 59 E	3 11 E
1760	0 04 W	1 59	3 56	2 07	0 59	1 27	1 57	1 36	3 49
1770	0 27 E	2 32	4 31	2 39	1 30	1 58	2 31	2 10	4 24
1780	0 50	2 59	5 02	3 04	1 53	2 21	3 00	2 39	4 55
1790	1 05	3 19	5 25	3 21	2 08	2 36	3 22	3 01	5 18
1800	1 11	3 29	5 40	3 29	2 14	2 42	3 34	3 13	5 33
1810	1 07	3 30	5 46	3 28	2 10	2 38	3 38	3 17	5 39
1820	0 54	3 22	5 42	3 17	1 57	2 25	3 32	3 11	5 35
1830	0 32	3 04	5 29	2 58	1 35	2 03	3 16	2 55	5 22
1840	0 04 E	2 39	5 09	2 30	1 07	1 35	2 53	2 32	5 00
1850	0 31 W	2 07	4 39	1 57	0 32 E	1 00	2 23	2 02	4 32
1860	1 08	1 31	4 04	1 20	0 05 W	0 23 E	1 47	1 26	3 57
1870	1 46	0 53	3 27	0 42	0 43	0 15 W	1 09	0 48	3 20
1880	2 23	0 15 E	2 49	0 05 E	1 20	0 52	0 31 E	0 10 E	2 42
1890	2 56	0 20 W	2 12	0 29 W	1 53	1 25	0 05 W	0 26 W	2 05
1900	3 23	0 51	1 39	0 58	2 20	1 52	0 37	0 58	1 32
1910	3 43 W	1 14 W	1 12 E	1 20 W	2 40 W	2 12 W	1 02 W	1 23 W	1 05 E

TABLE II.—*Values of the magnetic declination at the county seats from 1750 to 1910*—Continued.

Year.	County and town.								
	Madison, Marshall.	Martin, Williamston.	Mecklenburg, Charlotte.	Mitchell, Bakersville.*	Montgomery, Troy.	Moore, Carthage.	Nash, Nashville.	New Hanover, Wilmington.	Northampton, Jackson.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1750	1 49 E	0 21 W	1 48 E	1 47 E	0 46 E	1 11 E	1 00 E	0 50 E	0 29 W
1760	2 27	0 14 E	2 25	2 24	1 23	1 47	1 35	1 25	0 06 E
1770	3 02	0 45	2 58	2 58	1 56	2 19	2 06	1 56	0 37
1780	3 33	1 08	3 25	3 27	2 23	2 44	2 29	2 19	1 00
1790	3 56	1 23	3 45	3 49	2 43	3 01	2 44	2 34	1 15
1800	4 11	1 29	3 55	4 01	2 53	3 09	2 50	2 40	1 21
1810	4 17	1 25	3 56	4 05	2 54	3 08	2 46	2 36	1 17
1820	4 13	1 12	3 48	3 59	2 46	2 57	2 33	2 23	1 04
1830	4 00	0 50	3 30	3 43	2 28	2 38	2 11	2 01	0 42
1840	3 38	0 22 E	3 05	3 20	2 03	2 10	1 43	1 33	0 14 E
1850	3 10	0 13 W	2 33	2 50	1 31	1 37	1 08	0 58	0 21 W
1860	2 35	0 50	1 57	2 14	0 55	1 00	0 31 E	0 21 E	0 58
1870	1 58	1 28	1 19	1 36	0 17 E	0 22 E	0 07 W	0 17 W	1 36
1880	1 20	2 05	0 41	0 58	0 21 W	0 15 W	0 44	0 54	2 13
1890	0 43	2 38	0 06 E	0 22 E	0 56	0 49	1 17	1 27	2 46
1900	0 10 E	3 05	0 25 W	0 10 W	1 27	1 18	1 44	1 54	3 13
1910	0 17 W	3 25 W	0 48 W	0 35 W	1 50 W	1 40 W	2 04 W	2 14 W	3 33 W

Year.	County and town.								
	Onslow, Jacksonville.	Orange, Hillsboro.	Orange, Chapel Hill.	Pamlico, Bayboro.	Pasquotank, Elizabeth City.	Pender, Burgaw.	Perquimans, Hertford.	Person, Roxboro.	Pitt, Greenville.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1750	0 11 E	0 20 E	0 55 E	0 03 W	1 35 W	1 14 E	0 33 W	0 13 E	0 07 E
1760	0 46	0 56	1 31	0 32 E	1 00	1 49	0 02 E	0 49	0 42
1770	1 17	1 28	2 03	1 03	0 29	2 20	0 33	1 21	1 13
1780	1 40	1 53	2 28	1 26	0 06 W	2 43	0 56	1 46	1 36
1790	1 55	2 10	2 45	1 41	0 09 E	2 58	1 11	2 03	1 51
1800	2 01	2 18	2 53	1 47	0 15	3 04	1 17	2 11	1 57
1810	1 57	2 17	2 52	1 43	0 11 E	3 00	1 13	2 10	1 53
1820	1 44	2 06	2 41	1 30	0 02 W	2 47	1 00	1 59	1 40
1830	1 22	1 47	2 22	1 08	0 24	2 25	0 38	1 40	1 18
1840	0 54	1 19	1 54	0 40	0 52	1 57	0 10 E	1 12	0 50
1850	0 19 E	0 46	1 21	0 05 E	1 27	1 22	0 25 W	0 30	0 15 E
1860	0 18 W	0 09 E	0 44	0 32 W	2 04	0 45	1 02	0 02 E	0 22 W
1870	0 56	0 29 W	0 06 E	1 10	2 42	0 07 E	1 40	0 36 W	1 00
1880	1 33	1 06	0 31 W	1 47	3 19	0 30 W	2 17	1 13	1 37
1890	2 06	1 40	1 05	2 20	3 52	1 03	2 50	1 47	2 10
1900	2 33	2 09	1 34	2 47	4 19	1 30	3 17	2 16	2 37
1910	2 53 W	2 31 W	1 56 W	3 07 W	4 39 W	1 50 W	3 37 W	2 38 W	2 57 W

TABLE II.—*Values of the magnetic declination at the county seats from 1750 to 1910*—Continued.

Year.	County and town.								
	Polk, Columbus.*	Randolph, Ashboro.	Richmond, Rockingham.	Robeson, Lumberton.	Rockingham, Wentworth.	Rowan, Salisbury.	Rutherford, Rutherfordton.	Sampson, Clinton.	Scotland, Laurinburg.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1750	1 55 E	0 14 E	0 48 E	1 17 E	0 15 E	1 30 E	1 40 E	0 54 E	1 08 E
1760	2 32	0 51	1 25	1 53	0 52	2 07	2 17	1 30	1 44
1770	3 06	1 24	1 58	2 25	1 25	2 40	2 51	2 02	2 16
1780	3 35	1 51	2 25	2 50	1 52	3 07	3 20	2 27	2 41
1790	3 57	2 11	2 45	3 07	2 12	3 27	3 42	2 44	2 58
1800	4 09	2 21	2 55	3 15	2 22	3 37	3 54	2 52	3 06
1810	4 13	2 22	2 56	3 14	2 23	3 38	3 58	2 51	3 05
1820	4 07	2 14	2 48	3 03	2 15	3 30	3 52	2 40	2 54
1830	3 51	1 56	2 30	2 44	1 57	3 12	3 36	2 21	2 35
1840	3 28	1 31	2 05	2 16	1 32	2 47	3 13	1 53	2 07
1850	2 58	0 59	1 33	1 43	1 00	2 15	2 43	1 20	1 34
1860	2 22	0 23 E	0 57	1 06	0 24 E	1 39	2 07	0 43	0 57
1870	1 44	0 15 W	0 19 E	0 28 E	0 14 W	1 01	1 29	0 05 E	0 19 E
1880	1 06	0 53	0 19 W	0 09 W	0 52	0 23 E	0 51	0 32 W	0 18 W
1890	0 30 E	1 28	0 54	0 43	1 27	0 12 W	0 15 E	1 06	0 52
1900	0 02 W	1 59	1 25	1 12	1 58	0 43	0·17 W	1 35	1 21
1910	0 27 W	2 22 W	1 48 W	1 34 W	2 21 W	1 06 W	0 42 W	1 57 W	1 43 W

Year.	County and town.								
	Stanly, Albemarle.*	Stokes, Danbury.*	Surry, Mount Airy.†	Swain, Bryson City.	Transylvania, Brevard.	Tyrrell, Columbia.	Union, Monroe.	Vance, Henderson.	Wake, Raleigh.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1750	1 13 E	0 48 E	0 59 E	2 30 E	2 03 E	1 19 W	1 56 E	0 03 W	0 00
1760	1 50	1 25	1 36	3 08	2 41	0 44	2 33	0 33 E	0 36 E
1770	2 23	1 58	2 09	3 43	3 16	0 13 W	3 06	1 05	1 08
1780	2 50	2 25	2 36	4 14	3 47	0 10 E	3 33	1 30	1 33
1790	3 10	2 45	2 56	4 37	4 10	0 25	3 53	1 47	1 50
1800	3 20	2 55	3 06	4 52	4 25	0 31	4 03	1 55	1 58
1810	3 21	2 56	3 07	4 58	4 31	0 27	4 04	1 54	1 57
1820	3 13	2 48	2 59	4 54	4 27	0 14 E	3 56	1 43	1 46
1830	2 55	2 30	2 41	4 41	4 14	0 08 W	3 38	1 24	1 27
1840	2 30	2 05	2 16	4 19	3 52	0 36	3 13	0 56	0 59
1850	1 58	1 33	1 44	3 51	3 24	1 11	2 41	0 23 E	0 26 E
1860	1 22	0 57	1 08	3 16	2 49	1 48	2 05	0 14 W	0 11 W
1870	0 44	0 19 E	0 30 E	2 39	2 12	2 26	1 27	0 52	0 49
1880	0 06 E	0 19 W	0 08 W	2 01	1 34	3 03	0 49	1 29	1 26
1890	0 29 W	0 54	0 43	1 24	0 57	3 36	0 14 E	2 03	2 00
1900	1 00	1 25	1 14	0 51	0 24 E	4 03	0 17 W	2 32	2 29
1910	1 23 W	1 48 W	1 37 W	0 24 E	0 03 W	4 23 W	0 40 W	2 54 W	2 51 W

† For the county seat, Dobson, it is estimated that the figures in this column will have to be corrected as follows: For east declination (1750–1870) add 7′ to the tabular quantities, and for west declination (1880–1910) subtract 7′ from the tabular quantities.

TABLE II.—*Values of the magnetic declination at the county seats from 1750 to 1910*—Continued.

Year.	County and town.							
	Warren, Warrenton.	Washington, Plymouth.	Watauga, Boone.*	Wayne, Goldsboro.	Wilkes, Wilkesboro.	Wilson, Wilson.	Yadkin, Yadkinville.*	Yancey, Burnsville.*
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1750	0 01 W	0 47 W	1 27 E	0 52 E	1 26 E	0 43 E	1 09 E	1 52 E
1760	0 35 E	0 12 W	2 04	1 27	2 03	1 18	1 46	2 29
1770	1 07	0 19 E	2 38	1 58	2 37	1 49	2 19	3 03
1780	1 32	0 42	3 07	2 21	3 06	2 12	2 46	3 32
1790	1 49	0 57	3 29	2 36	3 28	2 27	3 06	3 54
1800	1 57	1 03	3 41	2 42	3 40	2 33	3 16	4 06
1810	1 56	0 59	3 45	2 38	3 44	2 29	3 17	4 10
1820	1 45	0 46	3 39	2 25	3 38	2 16	3 09	4 04
1830	1 26	0 24 E	3 23	2 03	3 22	1 54	2 51	3 48
1840	0 58	0 04 W	3 00	1 35	2 59	1 26	2 26	3 25
1850	0 25 E	0 39	2 30	1 00	2 29	0 51	1 54	2 55
1860	0 12 W	1 16	1 54	0 23 E	1 53	0 14 E	1 18	2 19
1870	0 50	1 54	1 16	0 15 W	1 15	0 24 W	0 40	1 41
1880	1 27	2 31	0 38	0 52	0 37	1 01	0 02 E	1 03
1890	2 01	3 04	0 02 E	1 25	0 01 E	1 34	0 33 W	0 27 E
1900	2 30	3 31	0 30 W	1 52	0 31 W	2 01	1 04	0 05 W
1910	2 52 W	3 51 W	0 55 W	2 12 W	0 56 W	2 21 W	1 27 W	0 30 W

DISTRIBUTION OF THE MAGNETIC DECLINATION IN NORTH CAROLINA FOR THE YEAR 1900.

By the term "distribution of the magnetic declination" is meant the geographic distribution, i. e., the relation which the declination at a station bears to its geographic location. It is usually shown by means of a chart on which lines are drawn through all places having the same declination. This is called an "isogonic chart," and the lines "isogonic lines," or "lines of equal magnetic declination." As it seldom happens, however, that there are many stations having exactly the same declination, in practice the lines are drawn to represent declinations differing successively by equal amounts—as, for example, by one degree.

We have seen that the declination varies from year to year, so that such a chart must be constructed from observations referring to the same epoch and applies only to that particular time. In general, the observations of a magnetic survey extend over a period of years, but they may be reduced to the same epoch by means of a knowledge of the secular variation of the declination. In the case of North Carolina the 1st of January, 1900, has been selected as the epoch for the isogonic chart, being the same as the latest isogonic charts for the United States and for other countries. By means of the secular variation tables (No. II) given in the preceding chapter all the available observations in North Carolina and parts of the adjoining States have been reduced to that epoch. These reduced values were then plotted on a map (Pl. I, frontispiece) of the State and the isogonic lines drawn in free hand for whole degrees of declination,

conforming as well as possible to the irregularities of distribution, though the stations are not sufficiently numerous to do so except in a general way.

The distribution of the magnetic declination in North Carolina is so irregular that but little dependence can be placed on the isogonic chart as a substitute for actual observations. A comparison of the observed declinations with corresponding values scaled from the isogonic chart shows that a difference of half a degree is not unusual, and that as much as one degree is reached in several cases, while for Concord, Cabarrus County, the observed declination differs about two degrees from what the surrounding stations would lead us to expect. The observations are too widely distributed to enable us to decide whether these differences are due to causes extending over large areas or to purely local disturbances, and it has therefore been deemed inexpedient to attempt more than a representation of the general features of the distribution. It will be noticed that the quantities as actually derived by observation and reduced to January 1, 1900, are given on the isogonic chart.

In the following tables the stations are arranged alphabetically by counties. The first table contains the observations made by Mr. J. B. Baylor, Assistant, United States Coast and Geodetic Survey, in connection with the North Carolina Geological Survey. In the last column is indicated by the letter N. or S. whether observations were made over the north or south meridian monument. The columns headed "*D* observed" and "*D* 1900" contain, respectively, the observed declination and the same reduced to January 1, 1900. The declinations as published in this table are the means of the two extreme positions of the needle during the day. The mean of these two extreme positions corresponds, for all practical purposes, with the average direction of a compass during the day. The remaining tables contain declinations observed and collected from various sources by the United States Coast and Geodetic Survey. The general arrangement is the same, but here the date of observation is given to the nearest tenth of a year and the name of the observer or authority is given in the last column. The letters B. F. refer to observations made at the charge of the "Bache fund" of the National Academy of Sciences.

In regard to the latitudes and longitudes given in the tables, it should be borne in mind that they are only intended for use in computing the azimuth observations and in locating the stations on the map. As the azimuth observations are made in every case at nearly equal times before and after noon, the effect on the azimuth of a small error in latitude is nearly eliminated in the mean. It is thought that none of the latitudes and longitudes are in error by more than two minutes of arc and few by more than one minute. For the stations along the coast they are derived from the charts of the Coast and Geodetic Survey. In the interior a few are scaled from the maps of the United States Geological Survey and the remainder are computed from the Sun observations checked by the State maps of Rand, McNally & Co. and North Carolina Geological Survey.

THE SECULAR MOTION OF THE AGONIC LINE OVER NORTH CAROLINA.

The agonic line, or line of no declination, has always been of special interest to users of the compass, as it indicates those places where the needle points true north. A study of the county tables in the preceding chapter shows that the agonic line passed near Newbern, Greenville, and Warrenton in 1750 and moved steadily eastward until

about 1800, when it reached its extreme easterly position, a short distance off Cape Hatteras. Since that time its motion has been westward, until it has now almost reached the western boundary. The following table gives its approximate location at different dates:

Asheville	1903.
Statesville	1903.
Carthage	1884.
Goldsboro	1876.
Newbern	1866.
Manteo	1752 and 1850.
	1788 and 1814.

By glancing at Plate No. III the surveyor can get an idea of the approximate distributions of the magnetic declination for the three years 1750, 1800, and 1850. Thus in 1750 the magnetic declination was west of north for the extreme northeastern part of the State and east over the remainder. For the year 1800, however, the declination appears to have been east over the entire State, and for 1850 the distribution was about the same as the year 1750. For 1900 the declination is east for only the extreme southwestern portion of the State, being now west over almost the entire State. It is thus seen how comparatively rapid the whole aspect of the distribution of the magnetic declination is changed over North Carolina.

TABLE III.—*Summary of magnetic declinations in North Carolina, determined by J. B. Baylor, Assistant, United States Coast and Geodetic Survey, in connection with the North Carolina Geological Survey.*

County.	Town.	Latitude.	Longitude.	Date.	Declination observed.	Declination Jan. 1, 1900.	Remarks.
		° ′	° ′		° ′	° ′	
Alamance	Graham	36 04	79 24	Dec. 19, 1899	2 02·9 W.	2 03 W.	S.
Beaufort	Washington	35 33	77 03	June 25, 1898	2 44·0 W.	2 48 W.	S.
Bertie	Windsor	36 00	76 59	May 14, 1898	4 29·6 W.	4 34 W.	N.
Bladen	Elizabethtown	34 38	78 32	Nov. 22, 1899	1 57·8 W.	1 58 W.	S.
Brunswick	Southport	33 55	78 01	Aug. 5, 1898	1 59·4 W.	1 54 W.	N.
Buncombe	Asheville	35 35	82 32	Aug. 31, 1898	0 11·4 E.	0 09 E.	S.
Cabarrus	Concord	35 24	80 35	Aug. 26, 1899	2 45·8 W.	2 50 W.	N.
Chatham	Pittsboro	35 43	79 11	July 15, 1899	2 35·9 W.	2 36 W.	S.
Cherokee	Murphy	35 05	84 03	Sept. 21, 1898	2 18·2 E.	2 14 E.	N.
Chowan	Edenton	36 04	76 36	May 19, 1898	3 29·2 W.	3 33 W.	S.
Cleveland	Shelby	35 17	81 33	Aug. 17, 1899	0 05·4 W.	0 07 W.	S.
Columbus	Whiteville	34 19	78 42	Nov. 25, 1899	1 43·8 W.	1 44 W.	N.
Craven	Newbern	35 07	77 03	July 5, 1898	2 46·6 W.	2 51 W.	S.
Cumberland	Fayetteville	35 03	78 52	May 31, 1899	1 41·7 W.	1 43 W.	S.
Currituck	Currituck	36 27	76 01	May 31, 1898	4 46·1 W.	4 50 W.	S.
Dare	Manteo	35 55	75 40	June 8, 1898	4 22·9 W.	4 26 W.	S.
"	Chicamicomico	35 35	75 28	June 11, 1898	3 52·3 W.	3 56 W.	
"	Cape Hatteras L. H.	35 15	75 32	June 13, 1898	3 53·0 W.	3 57 W.	
Duplin	Kenansville	34 58	77 58	July 4, 1899	1 37·0 W.	1 38 W.	S.
Durham	Durham	36 03	78 55	Apr. 7, 1898	1 18·9 W.	1 24 W.	N.
Edgecombe	Tarboro	35 54	77 37	May 4, 1899	3 33·2 W.	3 35 W.	S.
Forsyth	Winston-Salem	36 06	80 15	Sept. 8, 1899	1 42·9 W.	1 44 W.	S.
Franklin	Louisburg	36 03	78 19	Dec. 14, 1899	2 24·1 W.	2 24 W.	N.
Gates	Gatesville	36 23	76 43	Apr. 12, 1899	3 45·2 W.	3 47 W.	S.
Granville	Oxford	36 18	78 38	Apr. 26, 1898	2 00·5 W.	2 05 W.	S.
Greene	Snow Hill	35 28	77 37	June 25, 1899	3 26·9 W.	3 27 W.	N.
Guilford	Greensboro	36 04	79 49	Sept. 22, 1899	0 50·3 W.	0 51 W.	N.
Halifax	Halifax	36 19	77 35	Apr. 29, 1899	2 00·9 W.	2 02 W.	N.
Harnett	Lillington	35 22	78 47	Dec. 1, 1899	1 59·4 W.	2 00 W.	S.
Hertford	Winton	36 24	76 59	Apr. 15, 1899	3 15·6 W.	3 18 W.	S.
Hyde	Swanquarter	35 24	76 19	June 17, 1898	3 15·9 W.	3 23 W.	S.
Iredell	Statesville	35 47	80 53	Sept. 1, 1899	0 50·5 W.	0 51 W.	S.
Jackson	Webster	35 21	83 14	Oct. 6, 1898	1 43·9 E.	1 39 E.	S.
Johnston	Smithfield	35 32	78 21	June 6, 1899	0 56·8 W.	0 58 W.	S.
Lenoir	Kinston	35 16	77 35	May 20, 1899	1 50·9 W.	1 52 W.	N.
Lincoln	Lincolnton	35 28	81 16	Aug. 12, 1899	0 35·6 W.	0 37 W.	N.
McDowell	Marion	35 40	82 01	Aug. 22, 1898	0 53·6 W.	0 58 W.	N.
Macon	Franklin	35 11	83 23	Sept. 27, 1898	1 36·5 E.	1 32 E.	N.
Madison	Marshall	35 47	82 40	Sept. 8, 1898	0 14·6 E.	0 10 E.	N.
Martin	Williamston	35 50	77 02	Dec. 6, 1899	3 05·3 W.	3 05 W.	S.

No. 3

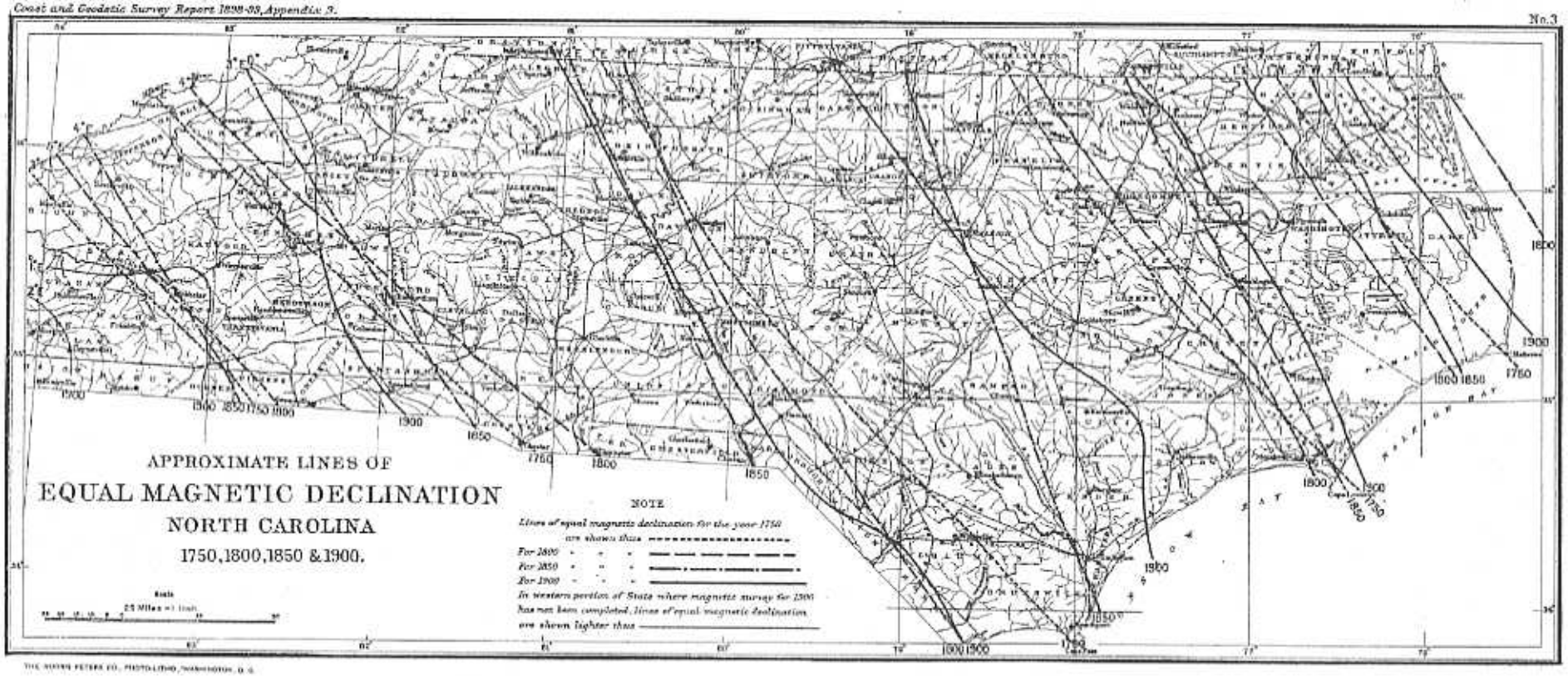

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TABLE III.—*Summary of magnetic declinations in North Carolina, etc.*—Continued.

County.	Town.	Latitude.	Longitude.	Date.	Declination observed.	Declination Jan. 1, 1900.	Remarks.
		° ′	° ′		° ′	° ′	
Mecklenburg	Charlotte	35 13	80 51	Aug. 9, 1899	0 23·5 W.	0 25 W.	S.
Montgomery	Troy	35 22	79 53	Oct. 7, 1899	1 26·3 W.	1 27 W.	N.
Moore	Carthage	35 20	79 25	July 21, 1899	1 16·2 W.	1 18 W.	S.
Nash	Nashville	35 56	77 58	May 10, 1899	1 42·2 W.	1 44 W.	N.
New Hanover	Wilmington	34 14	77 57	July 30, 1898	1 50·2 W.	1 54 W.	S.
Northampton	Jackson	36 23	77 29	Apr. 24, 1899	3 11·1 W.	3 13 W.	N.
Onslow	Jacksonville	34 44	77 22	July 23, 1898	2 28·8 W.	2 33 W.	S.
Orange	Hillsboro	36 04	79 05	Apr. 13, 1898	2 03·9 W.	2 09 W.	S.
Do.	Chapel Hill	35 54	79 03	Mar. 25, 26, 1898	1 28·6 W.	1 34 W.	S.
Pamlico	Bayboro	35 08	76 45	July 14, 1898	2 43·2 W.	2 47 W.	S.
Pasquotank	Elizabeth City	36 18	76 13	May 27, 1898	4 14·4 W.	4 19 W.	N.
Pender	Burgaw	34 32	77 55	July 8, 1899	1 26·8 W.	1 30 W.	S.
Perquimans	Hertford	36 11	76 28	Apr. 2, 1899	3 15·1 W.	3 17 W.	S.
Person	Roxboro	36 23	78 59	Apr. 19, 1898	2 11·4 W.	2 16 W.	S.
Pitt	Greenville	35 36	77 22	June 30, 1898	2 33·5 W.	2 37 W.	S.
Randolph	Ashboro	35 42	79 49	Oct. 2, 1899	1 58·6 W.	1 59 W.	S.
Richmond	Rockingham	34 54	79 46	July 28, 1899	1 24·0 W.	1 25 W.	S.
Robeson	Lumberton	34 36	78 58	Nov. 16, 1899	1 12·0 W.	1 12 W.	N.
Rockingham	Wentworth	36 24	79 47	Sept. 27, 1899	1 57·7 W.	1 58 W.	S.
Rowan	Salisbury	35 39	80 32	Aug. 18, 1898	0 38·5 W.	0 43 W.	N.
Rutherford	Rutherfordton	35 22	81 57	Aug. 22, 1899	0 13·6 W.	0 17 W.	S.
Sampson	Clinton	35 00	78 19	June 30, 1899	1 33·3 W.	1 35 W.	S.
Scotland	Laurinburg	34 47	79 28	Nov. 11, 1899	1 20·6 W.	1 21 W.	N.
Surry	Mount Airy	36 30	80 37	Sept. 13, 1899	1 13·0 W.	1 14 W.	N.
Swain	Bryson City	35 25	83 27	Sept. 15, 1898	0 55·5 E.	0 51 E.	S.
Transylvania	Brevard	35 14	82 44	Oct. 13, 1898	0 27·8 E.	0 24 E.	S.
Tyrrell	Columbia	35 55	76 15	Apr. 6, 1899	4 01·1 W.	4 03 W.	N.
Union	Monroe	34 58	80 34	July 31, 1899	0 15·8 W.	0 17 W.	N.
Vance	Henderson	36 22	78 23	Dec. 9, 1899	2 32·0 W.	2 32 W.	N.
Wake	Raleigh	35 48	78 36	June 10, 1899	2 27·1 W.	2 29 W.	S.
Warren	Warrenton	36 24	78 09	May 3, 1898	2 25·2 W.	2 30 W.	S.
Washington	Plymouth	35 52	76 44	May 10, 1898	3 26·9 W.	3 31 W.	N.
Wayne	Goldsboro	35 23	77 59	May 25, 1899	1 50·3 W.	1 52 W.	S.
Wilkes	Wilkesboro	36 09	81 09	Sept. 15, 1899	0 29·7 W.	0 31 W.	N.
Wilson	Wilson	35 44	77 55	May 15, 1899	1 59·6 W.	2 01 W.	N.

TABLE IV.—*Declinations in North Carolina and vicinity observed and collected by the U. S. Coast and Geodetic Survey.*

NORTH CAROLINA.

County.	Station.	Latitude.	Longitude.	Date.	D. observed.	D. Jan. 1, 1900.	Authority.
		° ′	° ′		° ′	° ′	
Anson	Wadesboro	34 58	80 04	1900·4	0 00·3 E.	0 02 E.	G. R. Putnam, C. and G. S.
Beaufort	Washington	35 33	77 05	1891·4	2 13·5 W.	2 37 W.	J. B. Baylor, C. and G. S.
Brunswick*	Fort Johnson	33 55	78 01	1859·3	0 38·1 E.	1 42 W.	G. W. Dean, C. and G. S.
Do.	do	33 55	78 01	1875·0	0 23·3 W.	1 42 W.	J. B. Baylor, C. and G. S.
Do.	do	33 55	78 01	1887·2	1 07·8 W.	1 44 W.	Do.
Buncombe	Asheville	35 35	82 32	1873·6	1 58·2 E.	0 24 E.	F. E. Hilgard, B. F.
Burke	Morganton	35 44	81 41	1873·6	1 11·0 E.	0 22 W.	Do.
Camden	Dismal Swamp †	36 33	76 23	1886·9	3 15·9 W.	3 53 W.	C. H. Sinclair, C. and G. S.
Carteret	Beaufort	34 43	76 40	1888·0	1 44·1 W.	2 44 W.	J. B. Baylor, C. and G. S.
Do.	do	34 43	76 40	1898·3	2 36·3 W.	2 41 W.	C. C. Yates, C. and G. S.
Do.	Portsmouth Island	35 04	76 03	1871·3	2 22·0 W.	3 53 W.	A. T. Mosman, C. and G. S.
Chowan	Edenton	36 04	76 36	1891·3	2 52·1 W.	3 15 W.	J. B. Baylor, C. and G. S.
Columbus	Fair Bluff	34 19	79 01	1891·4	0 36·5 W.	1 01 W.	Do.
Do.	Lake Waccamaw	34 18	78 32	1891·4	0 41·2 W.	1 06 W.	Do.
Craven	Newbern ‡						
Currituck	Knott Island †	36 33	75 56	1887·1	3 33·2 W.	4 10 W.	C. H. Sinclair, C. and G. S.
Do.	North West †	36 33	76 12	1887·0	2 54·0 W.	3 31 W.	Do.
Do.	Shellbank	36 04	75 44	1847·2	1 44·8 W.	4 47 W.	C. O. Boutelle, C. and G. S.
Dare	Bodies Island	35 48	75 32	1847·0	1 13·4 W.	4 16 W.	Do.
Do.	Sand Island	35 50	75 40	1876·1	2 58·9 W.	4 13 W.	E. Smith, C. and G. S.
Duplin	Warsaw	34 59	78 05	1891·4	1 34·9 W.	1 58 W.	J. B. Baylor, C. and G. S.
Edgecombe	Tarboro	35 54	77 37	1891·4	2 56·2 W.	3 19 W.	Do.
Forsyth	Winston	36 06	80 15	1891·7	1 20·0 W.	1 46 W.	J. N. Ambler.
Gates	Hines †	36 33	76 34	1887·1	3 04·7 W.	3 41 W.	C. H. Sinclair, C. and G. S.
Guilford	Greensboro	36 04	79 49	1873·6	0 43·0 E.	0 47 W.	F. E. Hilgard, B. F.

* Where more than one result is given for one place, either in this table or this and the preceding one combined, preference should be given to the latest value, since it is least affected by the uncertainty of the secular change. Though the same latitude and longitude are given for the different results, the stations occupied were generally not identical. The stations Goldsboro, Tarboro, and Edenton of 1891 are identical with those of the same name in the preceding table.

† On North Carolina-Virginia boundary.

‡ See secular variation discussion.

TABLE IV.—*Declinations in North Carolina and vicinity observed and collected by the U. S. Coast and Geodetic Survey*—Continued.

NORTH CAROLINA—Continued.

County.	Station.	Latitude.	Longitude.	Date.	D. observed.	D. Jan. 1, 1900.	Authority.
		° ′	° ′		° ′	° ′	
Halifax	Weldon	36 27	77 35	1875·5	1 49·7 W.	3 57 W.	J. M. Poole, B. F.
Do.	do	36 27	77 38	1887·2	2 30·8 W.	3 07 W.	J. B. Baylor, C. and G. S.
Hertford	Riddicksville	36 32	76 56	1887·2	2 30·1 W.	3 06 W.	C. H. Sinclair, C. and G. S.
Lenoir	Kinston	35 16	77 35	1891·4	1 32·4 W.	1 55 W.	J. B. Baylor, C. and G. S.
Martin	Jamesville	35 48	76 52	1891·5	2 09·2 W.	2 32 W.	Do.
Mecklenburg	Charlotte	35 13	80 51	1873·6	1 03·9 E.	0 26 W.	P. H. Hilgard, B. F.
Mitchell	Roan High Bluff	36 06	82 09	1894·8	0 33·4 E.	0 17 E.	A. H. Buchanan, C. and G. S.
New Hanover	Wilmington	34 14	77 57	1864·4	1 13·5 E.	1 22 W.	G. W. Dean, C. and G. S.
Do.	do	34 14	77 57	1891·4	1 16·1 W.	1 39 W.	J. B. Baylor, C. and G. S.
Pasquotank	Elizabeth City	36 18	76 13	1891·5	3 42·9 W.	4 06 W.	Do.
Pender	Burgaw	34 32	77 55	1891·4	0 53·2 W.	1 16 W.	Do.
Perquimans	Stevenson Point	36 06	76 11	1847·1	1 39·6 W.	4 42 W.	C. O. Boutelle, C. and G. S.
Rowan	Salisbury	35 39	80 32	1873·6	0 52·1 E.	0 38 W.	P. E. Hilgard, B. F.
Wake	Raleigh	35 47	78 38	1854·0	0 44·5 E.	1 56 W.	G. W. Dean, C. and G. S.
Do.	do	35 47	78 38	1887·2	1 17·8 W.	1 56 W.	J. B. Baylor, C. and G. S.
Wayne	Goldsboro	35 23	77 59	1873·5	0 15·1 W.	1 32 W.	J. M. Poole, B. F.
Do.	do	35 23	77 59	1891·4	1 16·7 W.	1 40 W.	J. B. Baylor, C. and G. S.
Wilkes	Poore	36 05	81 09	1895·7	0 25·7 W.	0 40 W.	A. H. Buchanan, C. and G. S.
Wilson	Wilson	35 44	77 55	1891·4	1 42·2 W.	2 05 W.	J. B. Baylor, C. and G. S.

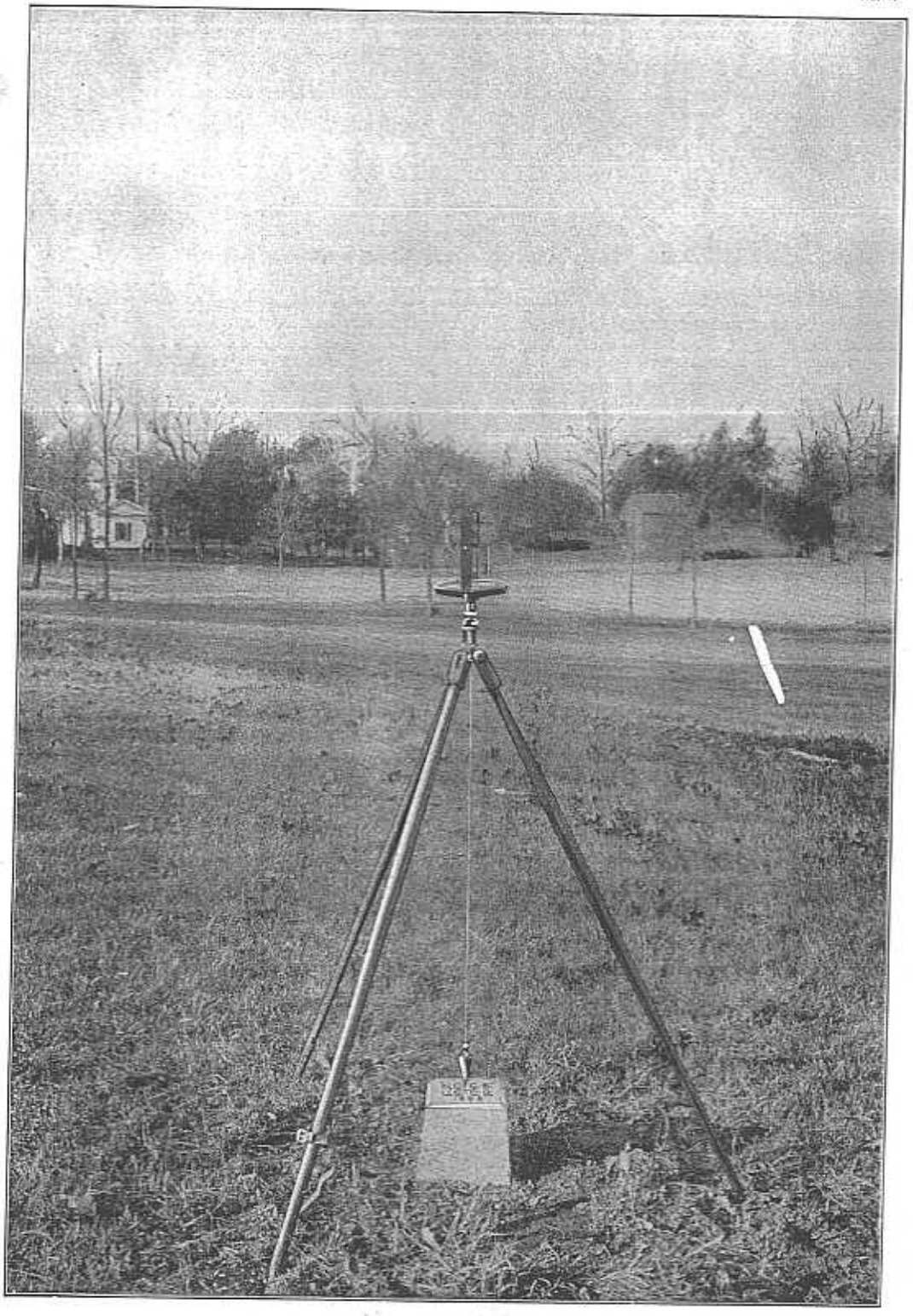
SOUTH CAROLINA.

County.	Station.	Latitude.	Longitude.	Date.	D. observed.	D. 1900.	Authority.
		° ′	° ′		° ′	° ′	
Florence	Florence	34 09	79 43	1875·5	1 12·2 E.	0 12 W.	J. M. Poole, B. F.
Do.	do	34 09	79 43	1891·4	0 00·9 W.	0 28 W.	J. B. Baylor, C. and G. S.
Marion	Marion	34 09	79 22	1891·4	0 22·2 W.	0 47 W.	Do.
Richland	Columbia	34 00	81 02	1854·1	3 02·2 E.	0 17 E.	G. W. Dean, C. and G. S.
Do.	do	34 00	81 02	1875·5	1 49·3 E.	0 24 E.	J. M. Poole, B. F.
Do.	do	34 00	81 02	1900·2	0 12·6 E.	0 13 E.	D. L. Hazard, C. and G. S.
Spartanburg	Pacolet	34 54	81 45	1886·4	1 15·0 E.	0 30 E.	G. E. Ladshaw.
Do.	Block House*	35 12	82 13	1896·9	0 16·8 E.	0 07 E.	W. C. Hodgkins, C. and G. S.
Do.	Talent*	35 09	82 13	1896·9	0 05·4 E.	0 05 W.	Do.
Do.	Gowensville*	35 07	82 13	1896·9	0 33·4 E.	0 23 E.	Do
Do.	Gold Mine*	35 02	82 13	1896·9	0 25·8 E.	0 16 E.	Do.
Do.	Flint Rock*	34 59	82 13	1896·9	0 03·2 E.	0 07 W.	Do.
Do.	Spartanburg	34 58	81 56	1896·9	0 04·3 E.	0 06 W.	Do.
Do.	Greers*	34 57	82 13	1896·9	0 06·5 E.	0 04 W.	Do.
Do.	Pelham*	34 52	82 13	1896·9	0 17·7 E.	0 08 E.	Do.
Do.	Baker*	34 51	82 13	1896·9	0 09·6 E.	0 00	Do.
Do.	Green*	34 49	82 13	1896·9	0 15·9 E.	0 06 E.	Do.

* Station on the boundary line between Spartanburg and Greenville counties.

TENNESSEE.

County.	Station.	Latitude.	Longitude.	Date.	D. observed.	D. 1900.	Authority.
		° ′	° ′		° ′	° ′	
Hawkins	Rogersville	36 25	83 03	1873·6	1 49·0 E.	0 15 E.	P. E. Hilgard, B. F.
Knox	Knoxville	35 58	83 55	1873·6	1 52·6 E.	0 19 E.	Do.
Do.	do	35 58	83 55	1875·5	1 39·6 E.	0 13 E.	Do.
Do.	do	35 58	83 55	1899·5	0 35·0 E.	0 04 E.	J. B. Baylor, C. and G. S.
Do.	do	35 58	83 55	1900·5	0 00·2 W.	0 01 E.	D. L. Hazard, C. and G. S.
McMinn	Athens	35 27	84 37	1881·6	1 44·2 E.	0 41 E.	J. B. Baylor, C. and G. S.
Sullivan	Bristol	36 36	82 11	1873·6	1 19·5 E.	0 14 W.	P. E. Hilgard, B. F.
Do.	do	36 36	82 11	1881·5	0 38·5 E.	0 24 W.	J. B. Baylor, C. and G. S.
Do.	do	36 36	82 11	1890·5	0 07·6 E.	0 23 W.	Do.
Do.	do	36 36	82 11	1898·4	0 21·2 W.	0 26 W.	H. Smith, C. and G. S.
Unicoi	Big Butte △	36 04	82 38	1893·8	0 39·0 E.	0 19 E.	A. H. Buchanan, C. and G. S.



MERIDIAN LINE AT CHAPEL HILL, N. C.

TABLE IV.—*Declinations in North Carolina and vicinity observed and collected by the U. S. Coast and Geodetic Survey*—Continued.

VIRGINIA.

County.	Station.	Latitude.	Longitude.	Date.	D. observed.	D. 1900.	Authority.
		° ′	° ′		° ′	° ′	
Floyd	Buffalo △	36 48	80 29	1895.7	0 08.9 W.	0 22 W.	A. H. Buchanan, C. and G. S.
Grayson	Peach Bottom	36 36	81 00	1824.0	3 50.0 E.	0 14 W.	Hoye.
Do	Rogers △	36 40	81 33	1894.6	0 13.3 E.	0 04 W.	A. H. Buchanan, C. and G. S.
Greensville	Cor. of Brunswick Co.	36 36	77 48	1824.0	0 55 E.	3 13 W.	Hoye.
Do	Emporia	36 40	77 32	1897.4	3 29.2 W.	3 36 W.	J. B. Baylor, C. and G. S.
Halifax	Mount Airy	36 52	79 06	1873.6	0 55.2 E.	0 32 W.	F. E. Hilgard, B. F.
Do	Meadville	36 47	78 57	1882.0	1 50 W.	2 46 W.	M. French.
Do	do	36 47	78 57	1885.3	1 28 W.	2 12 W.	Do.
Do	do	36 47	78 57	1886.7	1 30 W.	2 12 W.	Do.
Do	Houston	36 46	78 56	1897.6	2 23.9 W.	2 31 W.	O. B. French, C. and G. S.
Norfolk	N. C. boundary	36 33	75 52	1726.2	3 00 W.	4 22 W.	Colonel Byrd.
Do	N. end Knott Island	36 34	75 55	1873.3	2 54.8 W.	4 19 W.	A. T. Mosman, C. and G. S.
Pittsylvania	Danville	36 37	79 25	1873.6	1 16.3 W.	2 43 W.	F. E. Hilgard, B. F.
Scott	Big Knob △	36 40	82 30	1898.7	0 19.2 W.	0 40 W.	A. H. Buchanan, C. and G. S.
Smyth	Marion	36 50	81 31	1881.5	0 01.7 W.	1 04 W.	J. B. Baylor, C. and G. S.
Do	do	36 50	81 31	1898.4	1 02.0 W.	1 07 W.	E. Smith, C. and G. S.
Washington	Emory	36 40	81 46	1855	2 05 E.	0 37 W.	Prof. J. A. Davis.
Do	do	36 40	81 46	1881.2	1 00 E.	0 04 W.	Do.
Do	do	36 38	81 47	1892.7	0 08 E.	0 16 W.	F. D. Leffingwell.
Do	Abingdon	36 42	81 58	1897.6	0 12.9 W.	0 21 W.	O. B. French, C. and G. S.
Wythe	Wytheville	36 57	81 04	1873.3	2 41 E.	0 51 W.	J. M. Gibboney.
Do	do	36 57	81 04	1881.5	0 01.3 E.	1 01 W.	J. B. Baylor, C. and G. S.
Do	do	36 57	81 04	1882.3	0 11 E.	0 49 W.	J. M. Gibboney.
Do	do	36 57	81 04	1898.4	0 49.4 W.	0 54 W.	E. Smith, C. and G. S.

DIRECTIONS TO SURVEYORS CONCERNING THE USE OF THE COUNTY MERIDIAN LINES.

The following directions to surveyors concerning the use of the county meridian lines either for determining the magnetic declination or for ascertaining the index errors of their instruments should be followed.

If the instrument used be mounted on a tripod, it should be carefully centered and leveled over the cross on top of the same monument—the "reference" monument—over which observations were made in the magnetic survey and described in the descriptions of stations as published in this report. The monument to be sighted on is termed the "range" monument.

Should the instrument used be mounted on a simple Jacob's staff, it can be placed in the meridian line as close to the "reference" monument as possible and leveled.

A small rod should then be held in a vertical position over the cross in the top of the other monument—the "range" monument. The compass needle is released and magnetic bearing of the small rod read. This should be done with a small nonmagnetic magnifying glass, and it should be repeated about ten times, disturbing the needle with a bit of iron and letting it come to rest before each reading. The mean of all these bearings should be taken as the magnetic declination west or east, as the case may be.

In order to obtain the mean declination for the day (24 hours) these results should be obtained between 10 and 10·30 a. m. or about 6 p. m. local mean time. (See Table I, page 907.) The local mean time is obtained by subtracting from the railroad time four minutes for every degree of longitude the surveyor is west of the seventy-fifth meridian of longitude. No observations should be made during times of violent changes of the pointing of the magnetic needle, as, e. g., during magnetic storms.

Should the resulting declination differ essentially from the declination as obtained from the published value in this report, it proves conclusively that the surveyor's instrument has an error, which should be gotten rid of as nearly as possible by putting the instrument and needle in good adjustment. Any difference still remaining after the surveyor has satisfied himself that his instrument is in first-class condition and in good adjustment should be duly allowed for and recorded by the surveyor. The correct declination for the next ten years can be obtained by interpolation from Table II.

According to the act of March 7, 1899, a copy of which is given below, all results for declination taken over any of these monuments should be entered in the book kept by the Register of Deeds, giving the year, the day, and the local time the observations were made, and should also be entered on surveys made at that time. (See specimen record for keeping these observations.)

AN ACT REGULATING THE USE OF AND FOR THE PROTECTION OF MERIDIAN MONUMENTS AND STANDARDS OF MEASURE AT THE SEVERAL COUNTY SEATS IN NORTH CAROLINA.—MARCH 7, 1899.

Whereas Meridian monuments for determining the variations of the magnetic needle of the compass from the true north and a standard length for measuring surveyors' chains have already been established in nearly one-half of the counties of the State by the North Carolina Geological Survey and the United States Coast and Geodetic Survey, cooperating with the Commissioners in the several counties, and similar provision has been made for establishing such standards at the remaining county seats of the State during the present year; and whereas it is of great importance in the making of all surveys of boundaries of land, townships, counties, etc., that the chains, compasses, and other instruments used by surveyors should at intervals be properly tested,

The General Assembly of North Carolina do enact--

SECTION 1. That every surveyor operating in any of the counties of this State with magnetic instruments, whether in a public or private capacity, shall, between the first day of January and the thirty-first day of December in each and every year, carefully test his needle upon the official meridian monuments in the county in which he resides, or the nearest county in which such monuments have been erected, by adjusting his instrument over the intersection of the lines cut into the top of one of the meridian monuments so established and sighting to the intersection of the lines cut into the top of the other meridian monument, noting the variation of the magnetic from the true meridian and the direction thereof, and shall test the chain or other instrument of linear measure upon the distance from center to center, as indicated by intersecting lines of the two brass tablets or other official monuments set at or near the county court-house for this purpose, noting the error of such instrument as compared with the standard of the monuments. Such tests and the corrections, if any resulting therefrom, shall be returned by the surveyor in writing and under oath to the Register of Deeds for the county in which such meridian is situate within ten days from the taking of the observations aforesaid, setting forth the name of the surveyor, his residence, the character of the instrument tested, the date of the observations, the declination east or west of the magnetic needle from the true meridian, together with a fee of ten cents for filing and recording the same; and such return shall be filed and recorded by the Register of Deeds in a book properly ruled and lettered, to be furnished by the Board of Commissioners of the county, to be used for such purpose exclusively, and entitled "The Meridian Record:" Provided, That before making surveys in any county other than the one in which the magnetic instruments and instruments for linear measure to be used have already been tested, said surveyor shall procure in writing from the Register of Deeds of the county in which said monuments have been established, nearest to the point where the survey is to be made, a statement giving the declination of the magnetic needle for the year in which it was last determined and the rate and direction of variation of said magnetic needle since that time, and this data shall be recorded as a part of the record of his survey: Provided, further, That no surveyor shall be required to go outside of the county in which he resides for the purpose of testing the instruments herein named.

SEC. 2. That it shall be the duty of the Board of County Commissioners to maintain and protect such meridian monuments and tablets or monuments for the testing of chains or other instruments of linear measure, established by the State or National surveys, cooperating with the county authorities, in good order and condition as the official standards of the county.

SEC. 3. Any person or persons who shall in any manner injure, deface, remove, or destroy such monuments or tablets, or any part thereof, or who shall fail, neglect, or refuse to do and perform any act, matter, or thing by this act required of him or them to be done, shall be guilty of a misdemeanor, and upon conviction thereof shall pay a fine or be imprisoned, or both, at the discretion of the court, for every such offense.

SEC. 4. That this act shall be in force from and after its ratification.

Meridian Record, County , State: North Carolina.

[Act of March 7, 1899.]

Day (of week).	Date.	Meridian stone. (North or south.)	Time of day, Standard time.	Instrument tested. (Compass or transit.)	Declination of needle. E. or W.	Mark sighted on.	Chain or tape tested.	Error of chain or tape.		Surveyor's name.	Residence.	Date of his report.	Remarks—Kind of weather, etc.
								Long or short.	Feet or links.				

DESCRIPTIONS OF THE MAGNETIC STATIONS.

A.—Stations in North Carolina Occupied by J. B. Baylor, Assistant, U. S. Coast and Geodetic Survey in Connection with the North Carolina Geological Survey in 1898 and 1899.

The arrangement of the stations is by counties, in alphabetical order. The stations are marked with solid granite posts, weighing about 400 pounds each. The top of the monument is dressed about 6 inches square and is lettered

The center of the cross marks the precise point. These granite posts are about 4½ feet long. Four feet of the stone is left in the rough, undressed, this part of the stone being sunk into the ground; the rest of the stone is dressed and projects 6 inches out of the ground. These granite monuments are used to mark the north and south ends of the true meridian lines established in connection with the magnetic survey.

Alamance County, Graham, 1899.—Observations made over the monument in the southwest corner of the Court-House square. The other monument is true north of this monument near the northwestern boundary of the Court-House property.

Anson County, Wadesboro, 1900.—See Group B, p. 932.

Beaufort County, Washington, 1898.—Observations made over the monument in the city cemetery near its southern inclosure. The other monument is true north of this monument near the western entrance of the cemetery.

Bertie County, Windsor, 1898.—Observations were made over monument at the "County Home," 2 miles southeast of Windsor, near the superintendent's house. The other monument is true south of this monument and near the fence.

Bladen County, Elizabethtown, 1899.—Observations were made over the monument in the southeast corner of the Court-House square. The other monument is true north of this monument, near the Court-House building.

Brunswick County, Southport, 1898.—Observations made over the monument in the northeast corner of the ground of Fort Johnson. The other monument is true south of this monument, near the river bank.

Buncombe County, Asheville, 1898.—Observations made over the monument in the "Asheville Cemetery," in front of the William Johnston section. The other monument is true north of this monument, near the entrance of the cemetery.

Cabarrus County, Concord, 1899.—Observations made over the monument in the open square in the rear of the Court-House. The other monument is true south of this monument, in the Court-House square.

Carteret County, Beaufort, 1898.—A true north and south line, marked with two monuments, was established in the Court-House square. A surveyor should mount his compass over the south monument.

CHATHAM COUNTY, PITTSBORO, 1899.—Observations made over the monument in the southeast corner of the Court-House square. The other monument is true north of this monument, on the Court-House property.

CHEROKEE COUNTY, MURPHY, 1898.—Observations made over the monument on the open lot east of High School. The other monument is true south of this monument, on the edge of the hill, and also on county property.

CHOWAN COUNTY, EDENTON, 1898.—Observations made over the monument in the southeast corner of the Court-House square. The other monument is also in the Court-House square, true north of this monument.

CLEVELAND COUNTY, SHELBY, 1899.—Observations made over the monument in the Court-House square southeast of the building. The other monument is true north of this monument, in the Court-House square.

COLUMBUS COUNTY, WHITEVILLE, 1899.—Observations made over the monument in the northwest corner of the Court-House lot. The other monument is true south of this monument, near the southern boundary of the Court-House property.

CRAVEN COUNTY, NEWBERN, 1898.—Observations made over the monument in the extreme northern part of Cedar Grove cemetery. The other monument is true north of this monument, in a grove of pines.

CUMBERLAND COUNTY, FAYETTEVILLE, 1899.—Observations made over the monument in the lot owned by the city near the old Court-House square, in front of Mr. Underwood's house. The other monument is true north of this monument, in the old Court-House square.

CURRITUCK COUNTY, CURRITUCK, 1898.—Observations made over the monument in the southeast corner of the Court-House square. The other monument is true north of this monument, and also in the Court-House square.

DARE COUNTY, MANTEO, 1898.—Observations made over the monument in the southwest corner of the Court-House square. The other monument is true north of this monument, near the fence.

DARE COUNTY, CHICAMICOMICO, 1898.—No monuments marking the true north and south line were established here. Station marked by a stub and tack 30 yards from inner beach and east of house owned by Aaron O'Neal.

DARE COUNTY, CAPE HATTERAS, 1898.—No monuments marking the true north and south line were established here. Station marked by a stub and tack 50 yards from inner beach, on a point of land southeast of house owned by Dr. J. J. Davis.

DUPLIN COUNTY, KENANSVILLE, 1899.—Observations made over the monument in the large open square (the property of Duplin County) west of the Court-House. The other monument is true north of this monument, and also in this square.

DURHAM COUNTY, DURHAM, 1898.—At the County Home, 3 miles from the city of Durham, observations made over the monument just in front of superintendent's house. The other monument is true south of this monument, near the public road.

EDGECOMBE COUNTY, TARBORO, 1899.—Observations made over the monument in "The City Common," in front of the High School. The other monument is true north of this monument, in "The Common."

FORSYTH COUNTY, WINSTON-SALEM, 1899.—Observations made over the monument near the southern boundary fence of the Moravian cemetery. The other monument is also in the cemetery, true north of this monument. The monuments at this place are rough granite posts with a small hole marking the center.

FRANKLIN COUNTY, LOUISBURG, 1899.—Observations made over the monument in the county lot in the rear of the jail. The other monument is true south of this monument, in the same county lot, near the river.

GATES COUNTY, GATESVILLE, 1899.—Observations made over the monument in the southwest corner of the Court-House lot. The other monument is true north of this monument, in the Court-House lot.

GRANVILLE COUNTY, OXFORD, 1898.—Observations made over the monument in the grounds of the Orphan Asylum. The other meridian stone is also in the Orphan Asylum grounds and true north of this monument.

GREENE COUNTY, SNOW HILL, 1899.—Observations made over the monument on the bluff on the side of the road which runs in front of the Court-House. The other monument is true south of this monument, near the Court-House building.

GUILFORD COUNTY, GREENSBORO, 1899.—Observations made over the monument in the park in front of the Greensboro Female College. The other monument is true north of this monument, near the street.

HALIFAX COUNTY, HALIFAX, 1899.—Observations made over the monument in the Court-House lot, northeast of the building. The other monument is true south of this monument, near the eastern fence of the Court-House square.

HARNETT COUNTY, LILLINGTON, 1899.—Observations made over the monument in the southeast corner of the Court-House square. The other monument is true north of this monument, in the Court-House square.

HERTFORD COUNTY, WINTON, 1899.—Observations made over the monument near the southern edge of the Court-House lot. The other monument is true north of this monument, in the Court-House lot, near the fence.

HYDE COUNTY, SWANQUARTER, 1898.—Observations made over monument in southwest corner of the Court-House square. The other monument is true north of this monument, near the Court-House building.

IREDELL COUNTY, STATESVILLE, 1899.—Observations made over the monument in the grounds of the Statesville Graded School. The other monument is true north of this monument, near the street. The monuments at this place are of marble instead of granite.

JACKSON COUNTY, WEBSTER, 1898.—Observations made over the monument on the edge of the public road which runs in front of the Court-House. The other monument is true north of this monument, near the Court-House building.

JOHNSTON COUNTY, SMITHFIELD, 1899.—Observations made over the monument in the southeast corner of the Court-House square. The other monument is true north of this monument, near the edge of the street.

LENOIR COUNTY, KINSTON, 1899.—Observations made over the monument in the northeast corner of the Court-House lot. The other monument is true south of this monument, near the street.

LINCOLN COUNTY, LINCOLNTON, 1899.—Observations made over the monument in the open Court-House square. The other monument is true south of this monument, near the Court-House building.

MCDOWELL COUNTY, MARION, 1898.—Observations made over the monument in the northeast corner of the Court-House square. The other monument is true south of this monument, near the edge of the Court-House square.

MACON COUNTY, FRANKLIN, 1898.—Observations made over the monument in the northeast corner of the Court-House square. The other monument is true south of this monument, in the open space near the jail.

MADISON COUNTY, MARSHALL, 1898.—Observations made over the monument on the side of the hill above the Court-House. The other monument is true south of this monument, near the jail fence.

MARTIN COUNTY, WILLIAMSTON, 1899.—Observations made over the monument in the rear of the Court-House. The other monument is true north of this monument, near the boundary fence of the Court-House yard.

MECKLENBURG COUNTY, CHARLOTTE, 1899.—Observations made over the monument in the large open lot in the rear of "The Charlotte Graded School." This lot is the property of the school. The other monument is on this same lot, true north of this monument.

MONTGOMERY COUNTY, TROY, 1899.—Observations made over the monument in the northeast corner of the Court-House lot. The other monument is true south of this monument, near the southern boundary of the Court-House lot.

MOORE COUNTY, CARTHAGE, 1899.—Observations made over the monument southwest of the Court-House building. The other monument is true north of this monument, on the Court-House property.

NASH COUNTY, NASHVILLE, 1899.—Observations made over the monument in the Court-House lot near its northern boundary. The other monument is true south of this monument in the Court-House lot.

NEW HANOVER COUNTY, WILMINGTON, 1898.—Observations made over the monument in the grounds of "The City Hospital." The other monument is true north of this monument, near northern inclosure of the grounds.

NORTHAMPTON COUNTY, JACKSON, 1899.—Observations made over the monument in the Court-House lot northwest of the building. The other monument is true south of this monument in the Court House lot, near the fence.

ONSLOW COUNTY, JACKSONVILLE, 1898.—Observations made over the monument in the southeast corner of the Court-House square. The other monument is near the jail and is true north of this monument.

ORANGE COUNTY, HILLSBORO, 1898.—Observations made over monument on edge of the public road, east of the town. The other monument is also on the edge of the public road and is true north of this monument.

ORANGE COUNTY, CHAPEL HILL, 1898.—On the campus of the University of North Carolina; observations made over the monument just east of the building used by the State Geological Survey. The other monument also on the campus near the Episcopal Church, and true north of this monument.

PAMLICO COUNTY, BAYBORO, 1898.—Observations made over the monument in the northeast corner of the Court-House square. The other monument is true north of this monument, near the northern edge of the Court-House square.

PASQUOTANK COUNTY, ELIZABETH CITY, 1898.—Observations made over the monument at the "County Home," west of the building. The other monument is near the fence and is true south of this monument.

PENDER COUNTY, BURGAW, 1899.—Observations made over the monument southeast of the Court-House building. The other monument is also in the Court-House lot, true north of this monument.

PERQUIMANS COUNTY, HERTFORD, 1899.—Observations made over the monument in the broad avenue of "The City Cemetery." The other monument is true north of this monument, near the gate of the cemetery.

PERSON COUNTY, ROXBORO, 1898.—Observations made over the monument in the city cemetery, 1½ miles from town. The other monument is also in the city cemetery and true north of this monument.

PITT COUNTY, GREENVILLE, 1898.—Observations made over the monument in the open space just north of the Methodist cemetery. The other monument is true north of this monument, in edge of the city cemetery.

RANDOLPH COUNTY, ASHBORO, 1899.—Observations made over the monument in the southwest corner of the Court-House square. The other monument is true north of this monument, near the northern boundary of the Court-House square.

RICHMOND COUNTY, ROCKINGHAM, 1899.—Observations made over the monument in the grounds of "The Graded School." The other monument is true north of this monument in the grounds of the school, and near the street.

ROBESON COUNTY, LUMBERTON, 1899.—Observations made over the monument in the northeast corner of the Court-House square. The other monument is true south of this monument, near the southern boundary of the Court-House square.

ROCKINGHAM COUNTY, WENTWORTH, 1899.—Observations made over the monument in the southeast corner of the Court-House square. The other monument is true north of this monument, near the jail fence.

ROWAN COUNTY, SALISBURY, 1898.—Observations made over the monument near the center of the city cemetery. The other monument is true south of this monument, near the southern gate.

RUTHERFORD COUNTY, RUTHERFORDTON, 1899.—Observations made over the monument in the open lot in the rear of the Court-House near the southern boundary of the Court-House property. The other monument is true north of this monument, on the Court-House property.

SAMPSON COUNTY, CLINTON, 1899.—Observations made over the monument in the open space in front of the city cemetery. The other monument is true north of this monument, on the edge of the road.

SCOTLAND COUNTY, LAURINBURG, 1899.—Observations made over the monument in the northern edge of the ground of the Presbyterian Church. The other monument is true south of this monument near the public road.

SURRY COUNTY, MOUNT AIRY, 1899.—Observations made over the monument in the front yard of the residence of Thomas Woodroffe, of the Mount Airy granite quarry. The other monument is true south of this monument in the same yard.

SWAIN COUNTY, BRYSON CITY, 1898.—Observations made over the monument on top of the hill in the city cemetery, near the Collins section. The other monument is true north of this monument, near crest of the hill.

TRANSYLVANIA COUNTY, BREVARD, 1898.—Observations made over the monument in the southeast corner of the Court-House square. The other monument is true north of this monument, in the Court-House square.

TYRRELL COUNTY, COLUMBIA, 1899.—Observations made over the monument in "The Academy" grounds east of the town. The other monument is true south of this monument, near the southeast corner of the Academy grounds.

UNION COUNTY, MONROE, 1899.—Observations made over the monument in the northeast corner of the Court-House square. The other monument is true south of this monument, also in the Court-House lot.

VANCE COUNTY, HENDERSON, 1899.—Observations made over the monument in the northern corner of the Court-House square. The other monument is true south of this monument, near the boundary fence of the Court-House property.

WAKE COUNTY, RALEIGH, 1899.—Observations made over the monument in the open park in front of the "A. M. College." The other monument is also in this park true north of this monument, near a small summerhouse.

WARREN COUNTY, WARRENTON, 1898.—Observations made over monument in the new city cemetery. The other monument is also in the city cemetery true north of this monument.

WASHINGTON COUNTY, PLYMOUTH, 1898.—Observations made over monument in the paddock adjoining the house of W. H. Stubbs on edge of road. The other monument is also on the edge of road true south of this monument.

WAYNE COUNTY, GOLDSBORO, 1899.—Observations made over the monument in the southeast corner of the Court-House square. The other monument is true north of this monument, near the register's office.

WILKES COUNTY, WILKESBORO, 1899.—Observations made over the monument in the northwest corner of the Court-House property. The other monument is true south of this monument at the corner of the street.

WILSON COUNTY, WILSON, 1899.—Observations made over the monument in the grounds of "The Graded School" in the eastern section of the city. The other monument is true south of this monument in the school lot, near the edge of the street.

B.—STATIONS IN NORTH CAROLINA OCCUPIED CHIEFLY BY THE UNITED STATES COAST AND GEODETIC SURVEY SINCE 1847.

ANSON COUNTY, WADESBORO, 1900.—In the field occupied by the Smithsonian eclipse expedition in May, 1900. A meridian line was established and permanently marked by two marble blocks 9 by 9 inches square and 2 feet long. The magnetic observations were made by G. R. Putnam at a point 91 yards east of the line, the meridian line having been established later.

BEAUFORT COUNTY, WASHINGTON, 1891.—Observations of 1891 made in the open space near the foot of Main street and its intersection with Telfair street. The lot is held in trust by the Episcopal church, and in it is the monument to Augustus Harvey and wife. The station is marked by a copper tack in a yellow-pine post, with a bottle filled with coal dust sunk 2 feet in the ground under this post. It is 27·1 metres distant from a stone post at the center of Main and Telfair streets. It is distant 16·7 metres from the fence east of the magnetic station.

BRUNSWICK COUNTY, FORT JOHNSON, 1859.—Station of 1859 on the parade ground at Fort Johnson, near the river bank. It is 89·2 metres in a westerly direction from the Coast Survey geodetic station. Station of 1875 is also on the parade ground at Fort Johnson near the river bank 150 feet south of the flagstaff. Station of 1887 is identical with the station of 1875.

BUNCOMBE COUNTY, ASHEVILLE, 1873.—Station of 1873 is in the grounds of the old Eagle hotel at Asheville, 5 paces west of the east wall and 3 paces north of the south wall.

BURKE COUNTY, MORGANTON, 1873.—Station of 1873 is in the front lawn of Maj. J. W. Wilson's dwelling, opposite the Episcopal church. It is 10 paces west of the east fence and 15 paces south of the north fence of the yard.

CAMDEN COUNTY, DISMAL SWAMP, 1886.—Station of 1886 is about 100 feet north of the "Dismal Swamp Canal, Virginia and North Carolina boundary stone." This is where the State boundary crosses the Dismal Swamp Canal, 4 miles south of Wallaceton.

CARTERET COUNTY, BEAUFORT, 1880.—Station of 1880 is in the open lot in the rear of Miss Davis's boarding house, 80 yards from the rear of the house and 40 yards from Ann street. Station of 1898 is in the same lot and in about the same spot. Miss Davis's boarding house is near the steamboat dock.

CARTERET COUNTY, PORTSMOUTH ISLAND, 1871.—Station of 1871 is at Northeast Base on Portsmouth Island. Northeast Base is one of the Coast and Geodetic Survey stations used in the survey of the island and is where a base line was measured.

CHOWAN COUNTY, EDENTON, 1891.—Station of 1891 is in the southeast corner of the Court-House square in about the same spot as the station of 1898.

COLUMBUS COUNTY, FAIRBLUFF, 1891.—Station of 1891 is in the open space just one block south of the Atlantic Coast Line Railroad between the properties of Col. T. F. Toms and Mr. J. A. Mearsand, near the center of the street. It is marked with a yellow-pine post and a copper tack. This post has a bottle under it filled with coal dust and sunk 2 feet in the ground.

COLUMBUS COUNTY, LAKE WACCAMAW, 1891.—Station of 1891 is in the yard of Mr. G. S. Gillespie in northern suburbs of village. It is 62·5 feet from the southwest corner of Mr. Gillespie's house and is 12 feet from the west fence and 74·3 feet from the north fence of the yard. The station is marked by a yellow-pine post and copper tack, with a bottle filled with coal dust sunk 2 feet in the ground under the post.

CRAVEN COUNTY, NEWBERN, 1874.—Station of 1874 is located in the solid brick inclosure of the national cemetery, in the open space to the west of the superintendent's house.

CURRITUCK COUNTY, KNOTT ISLAND, 1887.—Station of 1887 is on the Virginia and North Carolina boundary on Knott Island about 1 700 feet from Back Bay, a little north of Mr. Williams's stable and 52 feet east of the latitude station of the Virginia and North Carolina boundary line.

CURRITUCK COUNTY, NORTHWEST, 1887.—Station of 1887 is on the Virginia and North Carolina boundary, 10 miles east of where the State line crosses the Dismal Swamp Canal.

CURRITUCK COUNTY, SHELLBANK, 1847.—Station of 1847 is northeast of the Coast Survey geodetic station at Shellbank, which was used in the survey of the coast.

DARE COUNTY, BODIES ISLAND, 1847.—Station of 1847 is at Station LXXII of base line which was measured on Bodies Island in the survey of the coast. It is 7 223 metres from the south end of this base line and is near the house of Mr. E. B. Midgett.

DARE COUNTY, SAND ISLAND, 1876.—Station of 1876 is 50 yards from the geodetic station at Sand Island which was used in the survey of the coast, and it bears from it 64° 35′ west of south.

DUPLIN COUNTY, WARSAW, 1891.—Station of 1891 is in the open lot adjoining the Methodist church in the southeastern suburbs of the village. It is marked by a copper tack in a yellow-pine post. A bottle filled with coal dust is sunk 2 feet in the ground under this post. The point is distant 30·3 metres from the southwest corner of the Methodist church and is distant 13·15 metres from the southwest corner of the ditch in rear of the church.

EDGECOMBE COUNTY, TARBORO, 1891.—Station of 1891 is in the "Town Common" in front of the high school and within a few feet of the station of 1899.

FORSYTH COUNTY, WINSTON, 1891.—Station of 1891 was occupied by Mr. J. N. Ambler, at Winston, but no description is filed giving the exact locality where observations were made.

GATES COUNTY, HINES, 1887.—Station of 1887 is 54 feet north of the latitude station of the Virginia and North Carolina line. It is located on the land of Dr. Hines and near the Mathias farm.

GUILFORD COUNTY, GREENSBORO, 1873.—Station of 1873 is in the ground of Mr. Colwell, on Gaston street above Green. It is 4 paces from the east side of the carriage road and 9 paces from the front fence, in the northeast corner of the front lawn.

HALIFAX COUNTY, WELDON, 1875 and 1887.—Station of 1873 is in the lot west of the Methodist church. This lot is bounded by property owned by Mr. Smalley, Mrs. Allen, and Mrs. Brown. The station is 15 paces from Mrs. Allen's fence and northwest of it. Station of 1887 is the same as the station of 1875 and is in the Methodist churchyard.

HERTFORD COUNTY, RIDDICKSVILLE, 1887.—Station of 1887 is 1 mile south of the Nottaway River on the lawn in front of the house of Mr. James D. Riddick.

LENOIR COUNTY, KINSTON, 1891.—Station of 1891 is in the open space in the center of King avenue, in the southeastern suburbs of the town. It is distant 14·2 metres from the northern limits of King avenue and 17 metres from the southern limits of King avenue. It is between two elm trees, the sixth and seventh trees counting from East street. The station is marked by a yellow pine post and copper tack. A bottle filled with coal dust is sunk 2 feet in the ground under this post.

MARTIN COUNTY, JAMESVILLE, 1891.—Station of 1891 in the open lot adjoining the "White Methodist church," in the southeastern suburbs of the town. The station is marked with a yellow pine post and copper tack. A bottle filled with coal dust is sunk 2 feet in the ground under this post. The station is distant 28·3 metres from the northeast corner of the Methodist church and 32·5 metres from the southeast corner of this church.

MECKLENBURG COUNTY, CHARLOTTE, 1873.—Station of 1873 is in the front yard of Mr. Reidiger, living on the northeast corner of Church and Sixth streets. It is 3 paces northeast of the fence corner.

MITCHELL COUNTY, ROAN HIGH BLUFF, 1895.—Station of 1895 is at Roan High Bluff triangulation station. It is on a very high bluff three-fourths mile from "Cloudland hotel," near the State line in Mitchell County. It is on a very large rock on the edge of High Bluff. Roan High Knob is the highest point in this vicinity.

NEW HANOVER COUNTY, WILMINGTON, 1854 and 1891.—Station of 1854 is upon the land adjoining Dr. Drane's residence, north side of Market street, near the Episcopal church. It is due north of the astronomical transit station on this lot used by the Coast Survey in 1854.

Station of 1891 is on the grounds of the United States marine-hospital in the eastern suburbs of the city. It is distant 22·1 metres from the southern inclosure of the grounds and 33·5 metres from the eastern inclosure of the hospital grounds. The station is marked with a copper tack in a yellow pine post. A bottle filled with coal dust is sunk 2 feet in the ground under this post.

PASQUOTANK COUNTY, ELIZABETH CITY, 1891.—Station of 1891 is in the Albemarle park fair grounds. This park is just 1 mile east of the center of the town on the bank of Pasquotank River. The station is in the open space just south of the ticket office and 47 metres from it and 21 metres northwest of a walnut tree. It is marked by a cross on a granite bowlder. A bottle filled with coal dust is sunk in the ground 2 feet under this bowlder.

PENDER COUNTY, BURGAW, 1891.—Station of 1891 is in southwest corner of the Court-House grounds. It is 42·2 metres from the southwest corner of the Court-House building and 14·5 metres east and 33·3 metres north of the inner edge of the ditch around the grounds. It is marked with a yellow pine post and copper tack, with a bottle filled with coal dust sunk 2 feet in the ground under it.

PERQUIMANS COUNTY, STEVENSON POINT, 1847.—Station of 1847 is in a line bearing 10° 13′ west of north from the Coast Survey geodetic station at Stevenson Point, which was used in the survey of the coast.

ROWAN COUNTY, SALISBURY, 1873.—Station of 1873 is located in the pasture of Mr. J. K. Burk, on Main street, just out of town going west. It is 20 paces southwest of the sixth fork of the fence running north and south.

WAKE COUNTY, RALEIGH, 1854.—Station of 1854 is 105 feet east and 26·6 feet north of the center of the State capitol dome.

WAKE COUNTY, RALEIGH, 1887.—Station of 1887 is in the Capitol grounds, 23·5 metres due north of the center of the stone occupied by the transit instrument of United States Coast and Geodetic Survey in 1854.

WAYNE COUNTY, GOLDSBORO, 1875.—Station of 1875 is on the lot on the southeast corner of John and Spruce streets. It is 30 paces from the sidewalk on Spruce street and 30 paces from John street.

WAYNE COUNTY, GOLDSBORO, 1891.—Station of 1891 in the southeast corner of the Court-House square and within a few feet of the station of 1899.

WILKES COUNTY, POORE, 1895.—Station of 1895 is at Poore triangulation station, which is on the summit of Poore's Knob, Brushy mountains, near the county line of Alexander county, N. C.

WILSON COUNTY, WILSON, 1891.—Station of 1891 is in the grounds of the Wilson graded school, in the northern suburbs of the town. The station is located in the open space just in front of the center of the school building and distant 23·4 metres from the inner edge of Maplewood avenue and 37·2 metres from the outer edge of the front steps of the graded school building. The station is marked by a tack in a yellow pine post. A bottle filled with coal dust is sunk under this post 2 feet in the ground.

C. MAGNETIC STATIONS IN SOUTH CAROLINA OCCUPIED CHIEFLY BY THE U. S COAST AND GEODETIC SURVEY BETWEEN 1854 AND 1900.

FLORENCE COUNTY, FLORENCE, 1875.—Station of 1875 is on Coit street, about 600 yards from the railroad, and is 25 paces southeast of the old African church, and on a line with the sidewalk of the street.

FLORENCE COUNTY, FLORENCE, 1891.—Station of 1891 is in the northwest corner of the National cemetery. It is marked by a copper tack in a yellow pine post and with a bottle filled with coal dust sunk 2 feet under it.

MARION COUNTY, MARION, 1891.—Station of 1891 is in the northwest suburbs of the town in the open lot just in front of the livery stable of the Planters hotel and just south of and adjoining the property of Mr. W. H. Cross. The station is marked with a yellow pine post and copper tack, with a bottle filled with coal dust sunk 2 feet under this post.

RICHLAND COUNTY, COLUMBIA, 1854, 1875, and 1900.—Station of 1854 is in the Capitol grounds, 164 feet from the southwest corner and 293 feet from the northwest corner of the new Capitol building.

Station of 1875 is in the southwest corner of the Capitol square, as near the location of the old station as could be determined. It is 20 paces from the fence.

Station of 1900 is in southwest corner of Capitol grounds, 40 feet from Senate street and about 225 feet from the southwest corner of the State house.

SPARTANBURG COUNTY, PACOLET, 1886.—Station of 1886 was occupied by Mr. G. E. Ladshaw in the town of Pacolet, in Spartanburg county, S. C., and no description of the locality is filed.

SPARTANBURG COUNTY, BLOCK HOUSE, 1896.—Station of 1896 is 100 feet northeast of the road leading from Landrum, S. C., to Tyron, N. C., and about 700 feet northeast of the Spartanburg and Asheville railroad. It is on the North Carolina and South Carolina boundary line and is marked by a large stone marked N. C. on the north side and S. C. on the south side. This stone also marks the boundary between the counties of Spartanburg and Greenville.

SPARTANBURG COUNTY, TALENT, 1896.—Station of 1896 is on the farm of Mr. B. S. Talent about 1 mile north of Earles' mill on the road from Gowensville to Landrum, S. C. It is west of the road and just south of a clump of woods opposite Mr. Talent's house, and on the county line as marked at the time.

SPARTANBURG COUNTY, GOWENSVILLE, 1896.—Station of 1896 is on the south side of the road leading from the village of Gowensville, S. C., to Campbell and Spartanburg and is about 750 metres east of Gowensville. It is marked by a square stone post placed there to mark the county boundary, and it is 36 metres west of the so-called "old boundary" at the forks of the road where there is an old stone.

SPARTANBURG COUNTY, GOLD MINE, 1896.—Station of 1896 is between Gowensville and Greers and nearly on the line between Spartanburg and Greenville counties, S. C., being 8 metres west of a stake left by the Greenville surveyor in March, 1896. This land belongs to the McBee family, whose agent, Mr. Steele, lives in the house a little east of station. The gold mine from which the name is derived is a short distance south of the station.

SPARTANBURG COUNTY, FLINT ROCK, 1896.—Station of 1896 is on the crest of the ridge immediately south of Gap creek road. It is about 50 yards to the eastward of a small blacksmith shop belonging to Mr. "Bill" Farmer, whose house is west of the shop. This small shop is directly on the line marked as the county boundary in 1896 by the Greenville surveyor. The locality called "Gap Creek Stone" or "Old Flint Rock" is on the north side of the road.

SPARTANBURG COUNTY, SPARTANBURG, 1896.—Station of 1896 is in the ground of Wofford College. It is on the college campus and in front of the main building. It is 67·25 metres nearly south from the Coast and Geodetic Survey primary triangulation station Wofford, which is on roof of college building. The magnetic station is marked by a stone post about 6 inches square, lettered U. S. C. S. and also M. S.

SPARTANBURG COUNTY, GREERS, 1896.—Station of 1896 is in the eastern part of Greers, S. C., and just on the Spartanburg side of the "old county line," which is here marked by a lane, said to have been laid out equally on each side of the boundary. The line marked by the Greenville surveyor in 1896 lies a little farther west. The station is in the yard of Mr. Wyatt, who keeps an inn here. It is west of the house and between it and the lane, near the fence.

SPARTANBURG COUNTY, PELHAM, 1896.—Station of 1896 is on the west side of the road leading from Greers, S. C., to Pelham, S. C., and is on the outskirts of the latter village. It is about a quarter

of a mile north of Pelham bridge, on the summit of the ridge overlooking the factory and surroundings. The station is marked by a square stone post, placed there by the Greenville surveyor to mark the boundary line.

SPARTANBURG COUNTY, BAKER, 1896.—Station of 1896 is in Greenville County, S. C., on the land of Mr. Baker, about a mile south of Pelham. It is about 100 metres east of the old Indian boundary line on the top of a small knoll east of the road and about 150 metres southeast of Sam Hitching's old store.

SPARTANBURG COUNTY, GREEN, 1896.—Station of 1896 is in Greenville County, S. C., about 2 miles south of Pelham bridge and near the old Indian boundary line, being a little west of that line and a little east of the road, and on land belonging to Luce Green.

D. MAGNETIC STATIONS IN TENNESSEE OCCUPIED CHIEFLY BY THE U. S. COAST AND GEODETIC SURVEY BETWEEN 1873 AND 1900.

HAWKINS COUNTY, ROGERSVILLE, 1873.—Station of 1873 is in the garden of Capt. F. A. Butler, keeper of the Rogersville house. It is 3 paces from the west fence and 7 from the south fence of the garden.

KNOX COUNTY, KNOXVILLE, 1873, 1875, 1890, and 1900.—Station of 1873 is in the asylum for the Deaf and Dumb, 3 paces southeast of the large tree in front of the house of the director, Professor Imes.

Station of 1875 is probably the same as the station of 1873.

Station of 1890 is on the grounds of the University of Tennessee, in the open space west of Agricultural building and conservatory. It is on the side of the hill, in the triangular strip of grass between the two roads, and is marked with a solid limestone post 4 by 4 inches on top and sunk 2 feet in the ground.

Station of 1900 is identical with that of 1890.

MCMINN COUNTY, ATHENS, 1881.—Station of 1881 is the grounds of the East Tennessee and Wesleyan University, southeast of the main building; it is marked by a post.

SULLIVAN COUNTY, BRISTOL, 1873, 1881, 1890, and 1898.—Station of 1873 is in Mr. Jameson's lot on the spot occupied by the eclipse party, nearly midway between the pillar holes. It is 12 paces from the south fence and is 8 paces from the east fence.

Station of 1881 is the same as the station of 1873 on the Jameson lot, on the summit of the hill on Cumberland street west of the Union railroad station.

Station of 1890 is 112·2 feet almost north of the station of 1881, distant 70·5 feet from the inner edge of Cross street, and 138 feet from the inner edge of Cumberland street. It is marked with a limestone rock.

Station of 1898 is the grounds of the Southwestern Virginia Institute. It is 107 feet from the front line of the grounds of the institute, and is 60 feet to the right of the center of the walk leading to the main building. The station is marked by a solid limestone, lettered:

U. S. C. & G. S.
⊙
1898

A similar stone (excepting as to lettering) was set 120½ feet true south of this stone.

UNICOI COUNTY, BIG BUTTE TRIANGULATION STATION, 1893.—Station of 1893 is at Big Butte Triangulation Station, on the North Carolina and Tennessee boundary line, between the counties of Unicoi, Tenn., and Madison, N. C. It is 15 miles south of Fullens.

E. STATIONS IN VIRGINIA OCCUPIED BETWEEN 1839 AND 1898.

FLOYD COUNTY, BUFFALO TRIANGULATION STATION, 1895.—Station of 1895 at Buffalo Triangulation Station, is on the summit of Buffalo Mountain, Floyd County, Va. This is a well-known mountain.

GRAYSON COUNTY, PEACH BOTTOM, 1824.—Station of 1824 was probably in suburbs of the little town of Peach Bottom, Grayson County, Va.

GRAYSON COUNTY, ROGERS, 1894.—Station of 1894 is at Rogers Triangulation Station, Grayson County, Va., 20 miles southeast of Chilhowee, Va. This is a well-known point in this section.

GREENVILLE COUNTY, CORNER OF BRUNSWICK COUNTY, 1824.—Station of 1824 is probably at the corner of Brunswick and Greenville counties, Va.

GREENVILLE COUNTY, EMPORIA, 1897.—Station of 1897 is in the open lot (owned by the county) in front of the graded school. It is marked by a solid granite post, lettered:

U. S.
C. S.

with a bolt marking the point.

True north of this post, and in the same lot, a similar post was sunk marking the true north and south line. These granite posts are dressed about 4 inches square on top and the center of the bolt marks the point.

HALIFAX COUNTY, MOUNT AIRY, 1873.—Station of 1873 is in the front yard of Mr. Buck's residence. It is 13 paces from the west fence and 9 paces from the north fence.

HALIFAX COUNTY, MEADVILLE, 1882, 1885, and 1886.—Station of 1882 was occupied by Mr. M. French, in the small town of Meadville, on the Banister River, west of Halifax County Court-House.

Station of 1885 was occupied by Mr. M. French, and probably over the same point occupied by him in 1882.

Station of 1886 was also occupied by Mr. M. French, and probably over the same point occupied in 1886 and 1882 by Mr. French.

HALIFAX COUNTY, HOUSTON, 1897.—Station of 1897 is on the vacant lot southwest of the county Court-House. This lot is owned by Mrs. Bolden, whose residence is just opposite. The station is marked by solid granite post set 3½ feet in the ground. Its top is dressed 6 inches square and is lettered:

U. S.
C. S.

The other meridian stone was to have been set by the county surveyor of Halifax, Va.

NORFOLK COUNTY, NORTH CAROLINA BOUNDARY, 1728.—No description of this station is filed. The observations were made along the southern boundary of Norfolk County, Va., and the northern boundary of North Carolina.

NORFOLK COUNTY, NORTH END OF KNOTT ISLAND, 1873.—Station of 1873 is on the north end of Knott Island, about 1 foot above water in the marsh overlaid by a stratum of sand 1 foot in thickness.

PITTSYLVANIA COUNTY, DANVILLE, 1873.—Station of 1873 is on Clayburn's hill, on the north side of Dan River. It is on top of the small hill, part of Clayburn's hill, nearly in a straight line with the end of the toll bridge.

SCOTT COUNTY, BIG KNOB TRIANGULATION STATION, 1893.—Station of 1893 is at Big Knob triangulation station, Scott County, Va. Big Knob is a well-known mountain summit in this county.

SMYTH COUNTY, MARION, 1881.—Station of 1881 is in the grounds of the Marion Female College, in the lot just west of the main building. It is marked by a locust post sunk even with the ground.

WASHINGTON COUNTY, EMORY, 1855, 1881, and 1892.—Station of 1855 was occupied by Prof. J. A. Davis, at Emory and Henry College. No description of the exact locality is filed.

Station of 1881 was occupied by Prof. J. A. Davis, at Emory and Henry College. No description of the exact locality is filed.

Station of 1892, observations were made by Mr. Leffingwell, about 2 miles south and 1 mile west of Emory and Henry College.

WASHINGTON COUNTY, ABINGDON, 1897.—Station of 1897 is on the property belonging to Gen. Arthur C. Cummings, on the west side of the Norfolk and Western Railroad, a little east of the station at Abingdon. A solid granite post 4 feet long and dressed 6 inches square on the top, lettered:

U. S.

C. S.

marks the station.

A south meridian stone, similar to the north meridian stone (excepting it is not lettered), was set just below the summit 150 or 200 metres from the north meridian stone.

WYTHE COUNTY, WYTHEVILLE, 1839, 1881, 1882, and 1898.—Station of 1839, no description filed. The observations were probably made in the suburbs of the town of Wytheville by Mr. J. M. Gibboney.

Station of 1881 is in the open grass field about 100 yards southeast of Boyd's hotel, and south of the railroad. It is marked by a post sunk even with the ground.

Station of 1882 was occupied by Mr. J. M. Gibboney, and probably in the same locality where he observed in 1839.

Station of 1898 is on the hill back of Boyd's hotel, and is marked with limestone rock, lettered:

U. S. C. & G. S.

⊙

1898

A similar limestone rock, with the center marked (but with no lettering), was set near the railroad, opposite the Mountain View hotel. The centers of these two stones mark the true north and south line.