A FLORISTIC STUDY OF THE NATIVE OR NATURALIZED ANGIOSPERM PLANTS OF WASHINGTON COUNTY, OKLAHOMA

By

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PREFACE

This study provides a list of native or naturalized flowering plants as well as background information on geology, soils, climate, etc., that would be useful to individuals doing field work in Washington County. Although every effort was made to include all the county's flowering plants, it should be understood that such a list can never be complete. It would be impossible to collect the county's entire flora without many years of work and even then new taxa would continually appear while other taxa were being eliminated from the area.

I would like to express appreciation to my advisor, Dr. Ronald J. Tyrl, for his direction and assistance throughout this study and to the other members of my committee, Dr. P.E. Richardson and Dr. J.K. McPherson for their assistance in preparation of the final manuscript.

Thanks is given to my parents, Mr. and Mr. C.B. McDonald, Jr. of Bartlesville, Oklahoma, for their help during the summer collecting periods and to William E. Blanton and E.T. Cason for their assistance in developing and printing the manuscript photographs.

Special thanks is given the late Dr. U.T. Waterfall who inspired my interest in plant identification and classification and suggested this thesis problem.

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CHAPTER I

INTRODUCTION

Washington County is located in the northeastern part of Oklahoma with Bartlesville, the county seat, being 40 miles north of Tulsa and some 120 miles northeast of Oklahoma City. The county is about 10.5 miles from east to west and 40 miles from north to south with a total area of 425 square miles or 271,713 acres (Figure 1).

The late Dr. U.T. Waterfall suggested that a systematic effort to collect the flora of Washington County would be a worthwhile project. As the author of this paper was raised in Bartlesville and already somewhat familiar with the area, this undertaking seemed an excellent way for him to develop a background in plant identification and classification as well as providing information useful to agriculturalists, conservationists, naturalists, teachers and others studying the area.

During the fall of 1971 and the entire growing seasons of 1972 and 1973, specimens of the angiosperm flora were collected and identified. Collecting trips throughout the county were made on a regular basis - about once a week during the growing seasons. An attempt was made to collect plants from as many different locations and habitats as possible. One thousand and fifty-seven accessions were made and the identified specimens with labels deposited in the Oklahoma State University Herbarium (Okla).

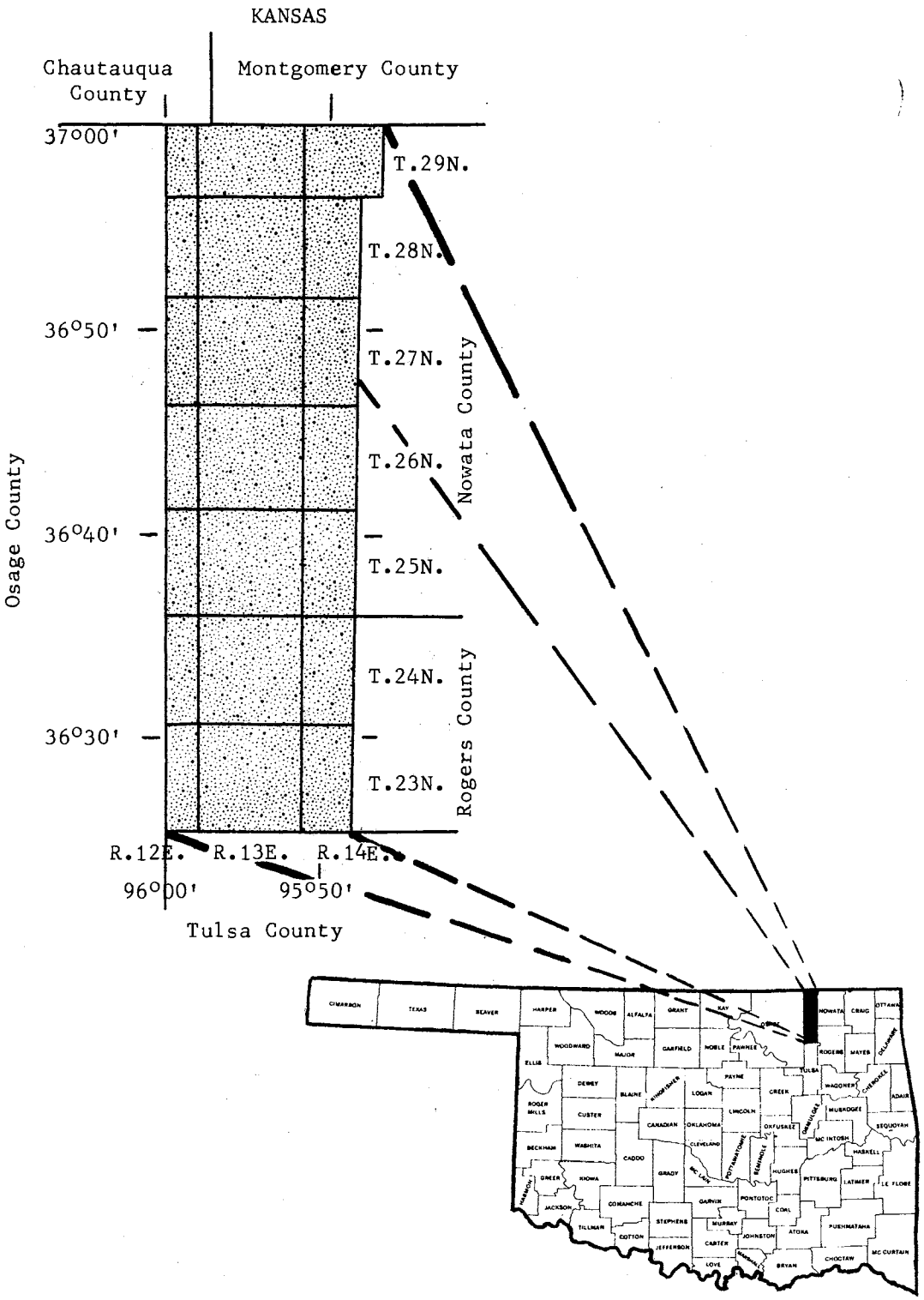

Figure 1. Location Map. (Modified from Polone, 1968)

In the following chapters, discussions of historical botanizing, geological and ecological conditions, and lists of the 712 native or naturalized taxa identified from the collected specimens are presented.

CHAPTER II

GEOLOGY AND TOPOGRAPHY

Washington County is located at the western edge of the Claremore Cuesta Plains geomorphic (physiographic) province with the Eastern Sandstone Cuesta Plains province extending into the western edge of the county at various points (Figure 2). As described by Curtis and Ham (1972), these two provinces are characterized by Pennsylvanian series sandstones and limestones that form ridges (cuestas) between broad shale plains; the rock strata running north, northeast and dipping westward at the approximate rate of thirty feet per mile. In Washington County this regional monocline is broken locally by a number of westward plunging anticlinal noses and intervening synclines and the Dewey faulted flexure.

A detailed study of the geology of Washington County was made by M.C. Oakes in 1940. His observations are summarized in part below. Formations in the county from which soil has weathered are all of the Missouri subseries which dates approximately 290 million years in age (Table I). Neither its basal nor uppermost units are exposed in the county. It is set off from the underlying Des Moines subseries by an unconformity and faunal change that has been observed from the Kansas-Oklahoma line to the Arbuckle Mountains and it is separated from the overlying Virgil subseries by a large unconformity marked by changes in lithography and large scale truncation.

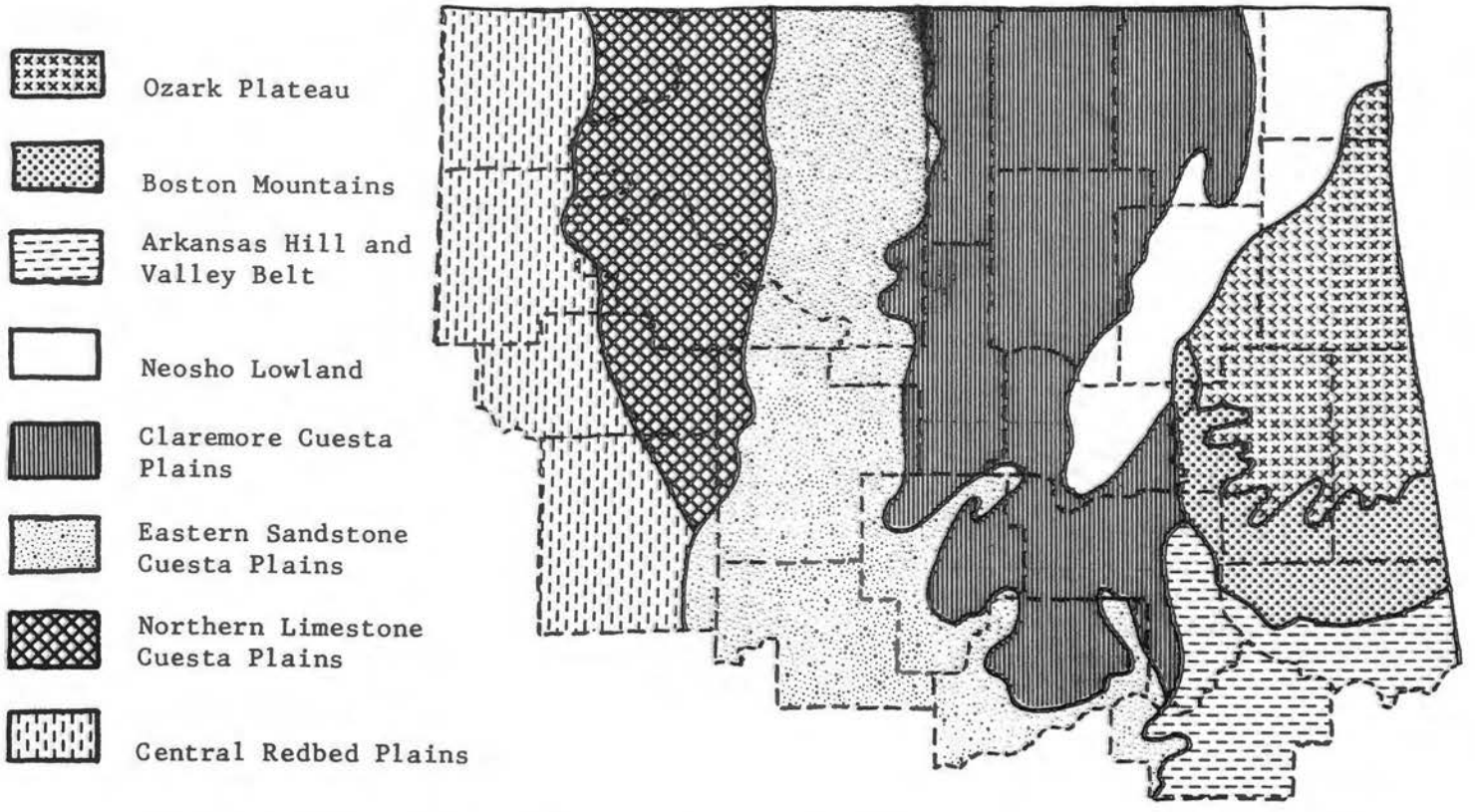

Figure 2. Geomorphic Provinces of Northeastern Oklahoma (Curtis & Ham, 1972)

TABLE I

GEOLOGIC FORMATIONS EXPOSED AT THE SURFACE
IN WASHINGTON COUNTY

Major Divisions of Geologic Time

Era	Period	How Long Ago*
Cenozoic	Quaternary	0-3
	Tertiary	3-65
Mesozoic	Cretaceous	65-130
	Jurassic	130-185
	Triassic	185-225
Paleozoic	Permian	225-270
	Upper Carboniferous	270-305
	Lower Carboniferous	305-350
	Devonian	350-400
	Silurian	400-425
	Ordovician	425-485
	Cambrian	485-675
Proter-ozoic	Precambrian	675 +

*Time in millions of years.

Surface Exposed Strata

Subseries	Group	Formation
Virgil		
Missouri	Ochelata	Weston Shale
		Birch Creek Limestone
		Unnamed Shale
		Torpedo Sandstone
		Wann
		Iola
		Chanute
	Skiatook	Dewey Limestone
		Nellie Bly
		Hogshooter
		Coffeyville
		Checkerboard Limestone
		Seminole
Des Moines		

The Missouri subseries is divided into two groups, the Skiatook and the Ochelata, with the formations in the groups cropping out as shales, sandstones, and limestones. The county's surface topography is related to the weathering properties of these formations.

Three formations of the Skiatook group are relatively restricted and unimportant in Washington County. The widespread formations are:

1. The Coffeyville formation comprised of four zones of shale and three of sandstone that grade into each other with no definite changes. It underlies rolling prairie in the south central and southeastern portions of the county.

2. The Nellie Bly formation containing alternating shales and hard gray sandstones underlies rolling prairie in the south central portion of the county.

3. The Dewey Limestone, the uppermost formation of the Skiatook group, ranges in thickness from 24 to 32 feet and is exposed in a broad diagonal band across the county entering in the northeast (R 14E, T 27N) and leaving in the extreme southwest (R 12E, T 23N). Its greatest exposure is in the east central part of the county with an exposed outcrop nearly seven miles wide. The formation underlies nearly level to rather steeply rolling prairie that is often thin soiled and has many exposures of the limestone rock.

The Iola, Wann, Torpedo Sandstone, and Weston Shale are the Widespread formations of the Ochelata group:

1. The Iola formation has its greatest exposure in the southwestern portion of the county but is little exposed elsewhere. It underlies rolling prairie in the southwestern part of the county and its Avant Limestone member caps some wooded hills in the county's extreme southwest corner.

2. The Wann formation is composed of fine grained sandstones and shales that are rather easily eroded. The formation is up to 283 feet thick at one point and underlies nearly level prairies in the northeastern part of the county.

3. The Torpedo Sandstone is a massive cliff making formation composed of medium grained sandstone that breaks into large ripple-marked blocks. It is far more erosion resistant than the underlying Wann formation and caps tree covered hills on the western edge of the county as well as a hilly outcrop in the north central portion.

4. The Weston Shale is the uppermost formation of the Ochelata group. The portion exposed in Washington County is a sandstone

that underlies rolling prairies in the northwest and northeast corners of the county.

In addition to the formations of Pennsylvanian age, the county has limited Quaternary deposits. Terrace deposits of fine sand and silt are occasional above the flood plain on the east side of the Caney River and flood plain deposits are present along the river and its tributaries. The flood plain deposits range in character from fine sand to clay and these deposits are increased when the streams occasionally overflow.

Present topography in the county is the result of differential erosion of the various formations. The thin, resistant sandstone and limestone formations appear at intervals between the extensive, easily eroded shale formations. Erosion by water has worn away the soft shales, producing extensive plains. The eroded edges of the harder sandstones and limestones form long eastward-facing ridges. These ridges are characterized by steep faces opposed by gentle back slopes that descend to the level of the plains. The height of the ridge is dependent on the thickness of the underlying non-resistant shale. The county's most conspicuous ridges are present along the western border and extend, although broken in places, for almost the entire forty mile length.

Although the sandstone and limestone ridges are eroded somewhat by direct weathering, their principal breakdown is by erosion of the underlying softer shale and the subsequent slumping or collapse. As this process continues, the front of a ridge "migrates" westward in the direction of the dip.

The line of the ridge is frequently modified by locally greater erosion from streams which either head in or cross it. Headward cutting by streams may completely sever a promontory from the rest of

the ridge producing an isolated hill or butte. These hills are locally known as "mounds" and are conspicuous in several parts of the county, rising above the plains and located many miles from the ridges of which they were once a part. Perhaps the largest and most picturesque of these is Blue Mound located approximately seven miles east of Dewey (Sec 16, R 14E, T 27N).

The major drainage for the county is by the Caney River and its largest tributary Caney Creek (Figure 3). Flow of the river is generally southward except for a westward deflection at the prominent Caney River syncline in the central part of the county. The river's flood plain is quite level and lies well below the rolling prairie. Nowhere is the plain greater than one or two miles across. Limited terrace deposits above the plain are found on the east side of the river and indicate its westward migration down the prevailing dip of the strata.

With the exception of Double Creek, in the southwest part of the county, the river's larger tributaries have a southward or southwestward course entering the river from the east. They drain, for the greater part, only land within the boundaries of the county.

Maximum relief for the county is about 350 feet. Elevations along the Caney River range from 650 feet to 700 feet while elevations on the north line of the county and Blue Mound are 1000 feet. Elevations of the high ridges west of the Caney River range from 900 to 950 feet.

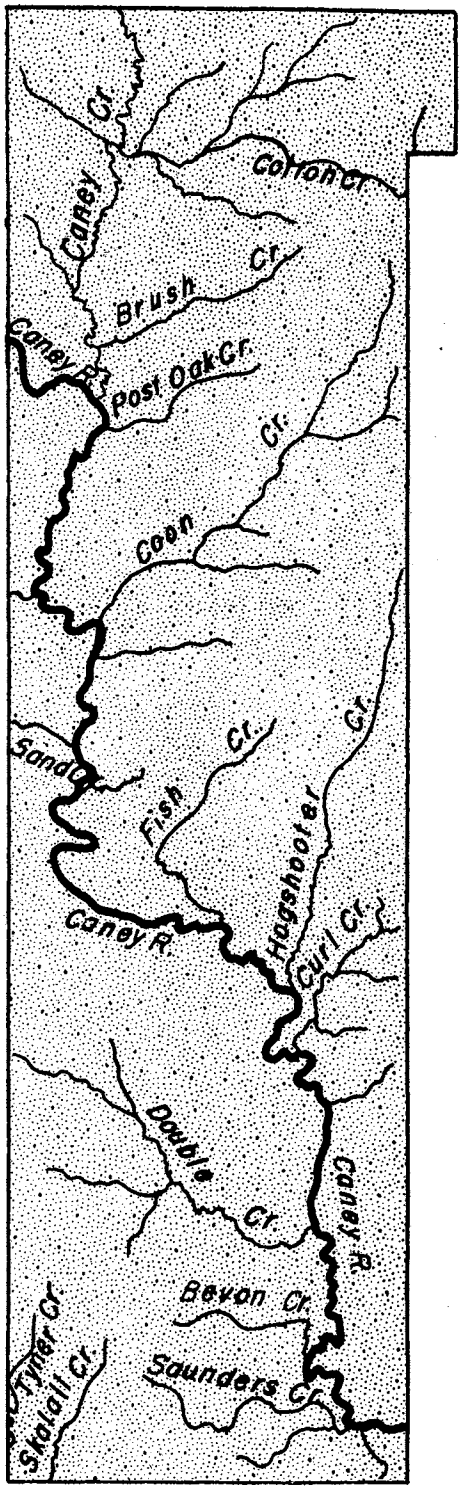

Figure 3. Drainage Systems.
(Polone, 1968)

CHAPTER III

SOILS

The soils of Washington County are mainly deep to moderately deep and nearly level to gently sloping. They have developed under a cover of tall grass prairie except for wooded areas on the western edge of the county and along streams. Polone (1968) describes sixteen soil series in Washington County. A series is defined as all soils having profiles almost alike and is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Twelve of the sixteen are abundant (Table II).

The soil series and its subgroupings, type and phase, are useful to agriculturalists and others on a local scale. However, certain landscapes have distinctive proportional patterns of soil called soil associations and this category of classification is of far greater value to floristic botany than the soil series. Soil associations cover large areas and are recognizable through their types of slope and the distinctive vegetation they support.

An association normally consists of one or more major soil series and at least one minor series, and is named for the major soils. Polone describes five soil associations for the county (Figure 4). Each is discussed briefly below.

1. The Dennis-Okemah-Parsons association consists of nearly level to gently sloping, deep soils on prairie uplands, occupying 37 percent of the county. Dennis soils make up 45 percent of the

TABLE II

MAJOR SOIL SERIES FOUND IN WASHINGTON COUNTY

Series	Surface Layer	Factors of Formation		
		Parent Material	Vegetation	Slope
Dennis	Silt Loam	Noncalcareous Silty or Sandy Shale	Tall Prairie Grasses	Very Gentle to Gentle
Okemah	Silt Loam	Noncalcareous Shale	Tall Prairie Grasses	Nearly Level to Very Gentle
Parsons	Silt Loam	Shale	Tall Prairie Grasses	Nearly Level
Collinsville	Light Loam	Noncalcareous Sandstone	Tall Prairie Grasses	Gentle to Moderately Steep
Talihina	Clay Loam	Noncalcareous Shale	Tall Prairie Grasses	Gentle to Moderately Steep
Bates	Sandy Loam	Noncalcareous Sandstone	Tall Prairie Grasses	Gentle
Summit	Silty Clay Loam	Limestone and Soft Calcareous Shale	Tall Prairie Grasses	Very Gentle to Gentle
Sogn	Silty Clay Loam	Limestone	Tall Prairie Grasses	Very Gentle to Moderately Steep
Osage	Clay	Recent Alluvium Washed From Prairie Soils	Scattered Trees and Tall Prairie Grasses	Nearly Level
Verdigris	Silt Loam	Recent Alluvium Washed From Prairie Soils	Scattered Trees and Tall Prairie Grasses	Nearly Level
Darnell	Sandy Loam	Coarse Grained Sandstone	Tall Native Grasses	Gentle to Steep
Stephenville	Sandy Loam	Sandstone	Scattered Scrub Oak and Tall Native Grasses	Gentle

Figure 4. Soil Associations. (Polone, 1968)

association, Okemah soils 20 percent, and Parsons soils 20 percent. Bates, Dwight and Eram soils are minor components totaling 15 percent of the association. Dennis soils are very gently to gently sloping, well drained and deep. Okemah soils are nearly level to to very gently sloping and moderately well drained while Parsons soils are level and somewhat poorly drained. The association is suitable for pasture, range and crops and is the only upland portion of the county used for crop production.

2. The Collinsville-Talihina-Bates association consists of gently sloping to hilly, very shallow to deep soils on prairie uplands and occupies about 28 percent of the county. Collinsville soils make up 40 percent of this association, Talihina soils 25 percent and Bates soils 20 percent. Dennis and Eram soils, minor components of the association are similar to Bates soils and make up the remaining 15 percent. Collinsville and Talihina soils are shallow to very shallow, sloping to moderately steep and well drained while Bates soils are moderately deep to deep, gently sloping and well drained. Because of the shallow soils and steep slopes, this association is only suitable for native grass pasture and range. However, under good management the native grasses grow vigorously making areas of this association as productive as any in the county.

3. The Summit-Sogn association consists of very gently sloping to moderately steep, deep, moderately deep and very shallow soils on prairie uplands and occupies about 11 percent of the county. Summit soils make up 43 percent of the association and Sogn soils 40 percent. Newtonia, Okemah, and Dennis are similar to Summit soils and as minor components make up the remaining 17 percent. Summit soils are deep to moderately deep, very gently to gently sloping and moderately well drained while Sogn soils are very shallow and stony, very gently sloping to moderately steep and moderately well drained. Summit and Sogn soils overlie limestone which is more resistant to weathering than the shales of other prairie areas in the county. For this reason the soils of this association are generally shallower and particularly the Sogn soils can be recognized by frequent outcrops of limestone. The shallow soils have less water holding capacity than other deeper soils and are the first in the county to show the effects of drought. This feature is reflected in the vegetation. The association is suitable for crops although little used in this way. Good management is necessary to prevent overgrazing and deterioration of the native vegetation.

4. The Osage-Verdigris association consists of nearly level, deep soils on bottomlands along the Caney River and other streams. It occupies about 20 percent of the county. Osage soils make up about 50 percent of the association and Verdigris soils the other 50 percent. Osage soils are deep, nearly level and somewhat poorly drained while Verdigris soils are deep, nearly level and moderately well drained. The soils support a cover of trees but many areas have been cleared for tame pasture and crops. Production can be quite high if flooding is controlled and drainage improved.

One common use is pecan production with cool season grasses sewn under the trees for winter pasture.

5. The Darnell-Stephenville association consists of gently sloping to steep, very shallow to deep soils on forested uplands and occupies about 4 percent of the county. Darnell soils make up about 60 percent of the association and Stephenville soils about 35 percent. The remaining 5 percent is rough stony land that occurs as very steep breaks. Darnell soils are shallow to very shallow, gently sloping to steep and well drained while Stephenville soils are deep to moderately deep, gently sloping and well drained. The soils are too steep for crops and their use as pasture is only practical when some of the woodland cover is removed and the soil is well managed to prevent erosion. This had been done very little in Washington County but in adjoining Osage County defoliation spraying has been used to convert thousands of acres of scrub oak timber into productive native grass range.

CHAPTER IV

CLIMATE

The climate of Washington County is continental with hot summers and cold dry winters. The prevailing southerly wind may change direction rapidly when frontal systems from the north and northwest pass through the county. The fronts usually cause the temperature to drop rapidly in winter and often trigger violent rainstorms during the spring and summer. Rainfall is distributed ideally for plant growth with the highest monthly average in May and the lowest in December (Table IV). The average yearly total is 35.55 inches with the record high being 67.64 inches in 1915 and the record low 19.84 inches in 1963. Snowfall averages 9.5 inches a year and seldom covers the ground for more than a few days at a time. A growing season of 209 days is normal with the average last spring freeze on April 2nd and the average first fall freeze on October 28th (Oklahoma Climatological Data, 1973).

Temperature and rainfall records for the collection period were taken from data compiled at the Bartlesville 2W Station.[1] The station is actually located in Osage County about one-half mile from the Washington-Osage County line. Evaporation data was taken from two locations, Hula Dam in Osage County about six miles west of Washington

[1] Weather records furnished through the courtesy of Ray A. White, cooperative observer of the United States Weather Bureau at the Bartlesville 2W Station.

County and Oolagah Dam in Rogers County about eight miles east of Washington County.

Temperatures for the collection period of August 1971 through October 1973 were generally above average for the fall, winter and early spring months of 1971-72 and were generally below average from the spring of 1972 to the end of the collection period (Table III). Actual length of the growing seasons was only a few days shorter than average.

Precipitation was higher than average for the months just prior to the beginning of the collection period and into the fall of 1971 but was well below average from the winter through spring of 1971-72 Beginning in the summer of 1972, precipitation rose above average and this trend continued for most months through the end of the collection period (Table IV).

Evaporation showed the same trends at both stations recording this information. During the spring and early summer of 1971 and 1972, evaporation was above average while it was below average for the fall of both years and all of 1973 (Table V).

By combining the temperature, precipitation and evaporation data, the following weather trends can be seen. It was average to slightly wet during the fall 1971 collecting period while the winter and early spring of 1971-72 were very warm and dry. The normal soil moisture build-up caused by low winter evaporation and plant dormancy did not occur and the situation improved little in the late spring of 1972. This retarded plant growth and stunted many of the spring specimens. Above average rainfall during the 1972 summer and fall replenished soil moisture and improved collecting during those seasons. A trend of

TABLE III

AVERAGE TEMPERATURES AND DEPARTURE FROM NORMAL FOR THE MONTHS AUGUST 1971 THROUGH OCTOBER 1973 *

	Jan		Feb		Mar		Apr		May		Jun	
	Temp	Dep	Temp	Dep	Temp	Dep	Temp	Dep	Temp	Dep	Temp	Dep
Normal	36.4		40.6		48.3		59.7		68.1		77.3	
1971												
1972	34.9	-1.5	41.2	+0.6	53.2	+4.9	63.8	+4.1	67.2	-0.9	77.1	-0.2
1973	34.0	-2.4	39.4	-1.2	53.7	+5.4	57.4	-2.3	66.7	-1.4	76.7	-0.6

	Jul		Aug		Sep		Oct		Nov		Dec	
	Temp	Dep	Temp	Dep	Temp	Dep	Temp	Dep	Temp	Dep	Temp	Dep
Normal	81.8		81.2		73.1		62.1		47.9		39.4	
1971			78.3	-2.9	72.9	-0.2	64.7	+2.6	49.7	+1.8	42.3	+2.9
1972	79.6	-2.2	80.2	-1.0	75.3	+2.2	59.7	-2.4	43.4	-4.5	33.3	-6.1
1973	81.2	-0.6	79.5	-1.7	72.6	-0.5	61.7	-0.4				

* From Oklahoma Climatological Data, Monthly and Annual Summaries, 1971-73.

TABLE IV

PRECIPITATION AND DEPARTURES FROM NORMAL FOR THE MONTHS
MAY 1971 THROUGH OCTOBER 1973 *

	Jan		Feb		Mar		Apr		May		Jun	
	Prec	Dep	Prec	Dep	Prec	Dep	Prec	Dep	Prec	Dep	Prec	Dep
Normal	1.56		1.56		2.25		3.55		5.20		4.62	
1971									2.49	-2.71	5.12	+0.50
1972	0.25	-1.31	0.14	-1.42	0.60	-1.65	4.20	+0.65	2.35	-2.82	1.64	-2.98
1973	4.18	+2.62	0.99	-0.57	8.83	+6.58	5.13	+1.68	3.15	-2.05	2.99	-1.63

	Jul		Aug		Sep		Oct		Nov		Dec	
	Prec	Dep	Prec	Dep	Prec	Dep	Prec	Dep	Prec	Dep	Prec	Dep
Normal	3.29		2.68		4.21		3.14		2.02		1.47	
1971	3.38	+0.09	0.63	-2.05	6.71	+2.50	6.16	+3.03	1.05	-0.97	4.93	+2.92
1972	5.72	+2.43	3.35	+0.67	5.24	+1.03	6.21	+3.07	4.99	+2.97	2.03	+0.56
1973	4.22	+0.93	1.06	-1.62	8.95	+4.72	3.52	+0.83				

* From Oklahoma Climatological Data, Monthly and Annual Summaries, 1971-73.

TABLE V

EVAPORATION AND DEPARTURES FROM NORMAL FOR THE MONTHS
MAY 1971 THROUGH OCTOBER 1973 *

	Jan		Feb		Mar		Apr		May		Jun	
	Evap[1]	Dep	Evap	Dep	Evap	Dep	Evap	Dep	Evap	Dep	Evap	Dep
Normal	-		-		5.00		7.09		7.66		9.19	
1971									8.46	+0.80	10.25	+1.05
1972	-	-	-	-	6.50	+1.50	8.06	+0.97	7.94	+0.28	10.63	+1.44
1973	-	-	-	-	3.88	-1.12	6.31	-0.78	8.20	+0.54	9.17	-0.02

	Jul		Aug		Sep		Oct		Nov		Dec	
	Evap	Dep	Evap	Dep	Evap	Dep	Evap	Dep	Evap	Dep	Evap	Dep
Normal	10.10		10.09		8.36		5.74		3.45		-	
1971	10.21	+0.11	9.73	-0.36	7.32	-1.04	5.07	-0.67	3.83	+0.30	-	-
1972	9.15	-0.95	9.60	-0.45	6.39	-1.97	4.26	-1.48	1.94	-1.54	-	-
1973	10.00	-0.10	-	-	5.41	-2.95	5.51	-0.23	-	-	-	-

[1] Evaporation is measured in inches from a standard weather service-type pan with a four foot diameter.

* From Oklahoma Climatological Data, Monthly and Annual Summaries, 1971-73 for the Hula Dam reporting station.

cool moist weather began in the fall of 1972 and continued through the end of the collecting period. Collecting was excellent throughout the 1973 season and the increased moisture made some specimens available that probably would not have been found in drier years.

CHAPTER V

ECONOMY

At the time of statehood in 1907, oil and cattle were Washington County's main industries and they remain so today. These and other industries support a population of 42,277 which is 80 percent urban (Census of Population, 1970). The largest city, Bartlesville, is the county seat and economic heart of the area. Here are located the executive offices of Phillips Petroleum Company, offices of TRW Corporation, a manufacturing plant for the TRW Reda Pump, offices for H.C. Price Company an oil pipeline firm, and the National Zinc Company smelters. These industries support a population of 29,683 in Bartlesville and a large part of the 3,958 population in nearby Dewey. All other towns in the county are rural farm communities with Ramona, population 600, being the largest. The others in order of size are Copan, population 558; Ochelata, population 330; Vera, population 212; and Oglesby, population about 150 (Figure 5).

Washington County was one of the first areas of the state to receive attention as a potential oil producing region. The state's first commercial well was drilled at Bartlesville in 1897. Production from this well and the county's proximity to producing fields in Kansas stimulated further exploration by early drillers. The Cudahy Oil Company had already leased 200,000 acres in the vicinity of Bartlesville in 1894 but drilling was prevented until 1904 when the

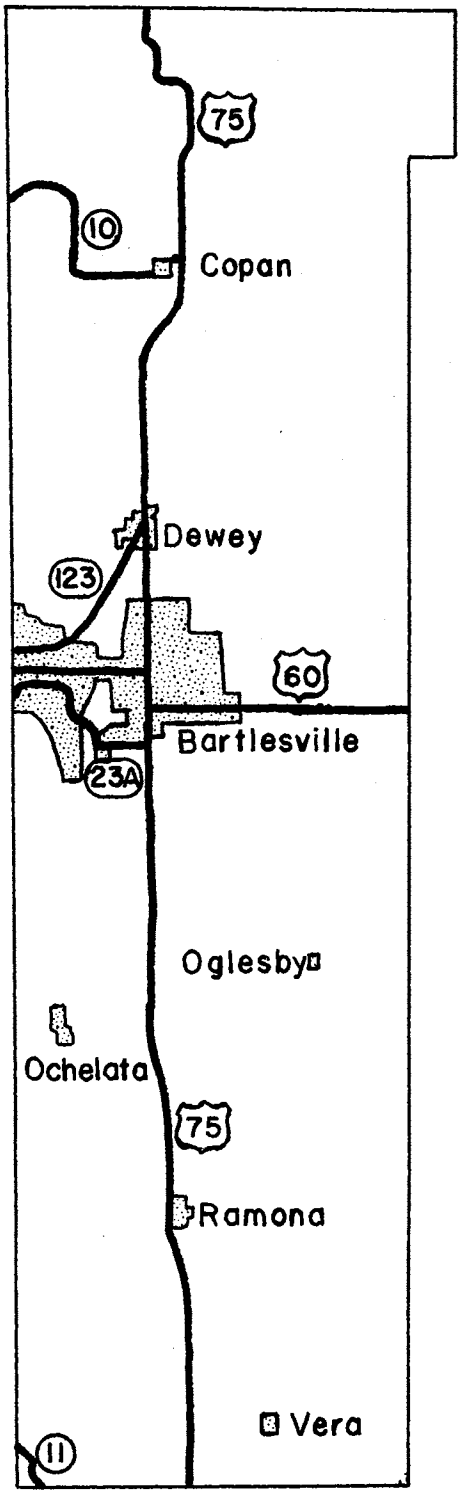

Figure 5. Towns and Major Highways. (Modified from Polone, 1968)

Department of the Interior approved the leases (Oakes, 1940). In 1904, 1905 and 1906 development was very active and several good oil and gas sands were discovered. Some of the large wells had an initial daily production of 500 barrels and peak production for the county was reached in 1906 (Oakes, 1940). Production has declined steadily since 1906, but wells are shallow and the pressure small so the rate of decline has been very slow.

The major ecological impact of oil has been the spillage of large quantities of oil well brine in some areas. The high salt content of the brine leaves areas almost sterile for plant growth and the bare ground is quickly eroded. In some places, poorly maintained oil lease roads have become badly eroded. Of some benefit is the fact that many of these roads let the collector reach areas away from highways or section lines and in bottomland they may save him some difficult hiking through dense underbrush.

Most of the county's agricultural land is used in some way for cattle production. According to estimates made by the Oklahoma Conservation Needs Inventory (1970) some 183,945 acres remains as native grass range with another 36,366 acres improved by the introduction of other forage species. 21,459 acres of forest land are grazed and this almost aquals the total forest acerage of 24,894 acres. Land devoted to tillage totals 37,459 acres and more than half of this, 22,686 acres, is in alfalfa, wheat and other small grains. Row crops of mostly corn, sorghum and soybeans total 12,390 acres.

Other elements of the economy having an effect on the vegetation are a zinc smelter in Bartlesville and a portland cement plant in Dewey. Both were originally established because of reasonable proximity

to raw products and a cheap local source of petroleum fuel. The cement plant which quarried Dewey limestone is no longer in production but the zinc smelter continues to operate. Around the smelter is a large waste area with little vegetation probably caused by the production of sulfide gases in the smelting process.

Some enterprises excluded from the county's economy are mentioned because they add insight to vegetative conditions in the area. One is lumber of which there is a very sparce commercial supply. Only 9,335 of the 24,894 forested acres are of commercial quality and this is mostly scattered walnut, pecan and oak in the Caney River bottomlands. Sand and gravel deposits are conspicuously absent. There are no sand and only two gravel deposits but crushed limestone which can be abundantly produced substitutes in most instances (Oakes, 1940). Commercial quantities of coal are absent so there are no abandoned strip pits in the county. Except for range 29N in the northern part of the county, there are only small supplies of underground water. For this reason, there are no upland irrigated crops and only small amounts of irrigation from relatively large wells in river bed alluvium.

CHAPTER VI

BOTANICAL HISTORY

Apparently none of the first botanists exploring what is now Oklahoma actually entered Washington County. However, several of these men did come near the area and must have collected in habitats similar to those in the county.

The first explorer was Thomas Nuttall. McKelvey (1955) gives a detailed account of this amazing man who traveled alone or joined military or trapping parties for his excursions into the botanically unexplored wilderness. On one trip in 1819, Nuttall journeyed up the Arkansas River to explore the Indian lands west of Arkansas. From Ft. Smith, he made a trip south mostly by way of the Kiamichi River to the Red River and returned by the same route. He then proceeded up the Arkansas River bound for a trading post at the mouth of the Verdigris River and reached it on July 6th. The trading post was his main camp until he returned to Ft. Smith in September. On July 17th, with two companions, he started by canoe up the "Grand" or Neosho River some fifty miles to visit the Osage Salt Works and returned to the Verdigris post on July 20th using a compass and proceeding overland south by west.

The portion of Nuttall's, Oklahoma explorations of most interest to this work began on August 11th. Accompanied by a trapper named Lee, he started on horseback up the Arkansas River bound for "...the Salt

River, or first Red River of the Arkansas, called by Pike the Grand Saline and about eighty or ninety miles distant [Grand Saline being the Cimarron River]" (McKelvey, p. 178). This journey brought him at one point within twenty miles of Washington County. On September 3rd, they reached the cimarron but their progress was slowed by Nuttall's illness caused by stagnant and tepid water that he drank on a very hot and oppressive day. The next day they went a few miles up the Cimarron and crossed the stream occasionally. "But, since the Osages were evidently in the vicinity, it was decided on the 5th to return to the Verdigris" (McKelvey, p. 179). Both horses being lost and alarmed by the threatening behavior of the Osages, they were forced to travel by night in a makeshift canoe. They reached the camp on the 15th where Nuttall remained until September 22nd when he returned to Ft. Smith by boat.

In the fall of 1832, Washington Irving traveled to Ft. Gibson which was established in 1824 near the Neosho River mouth as a post to oversee the Indian lands. His route from there took the Arkansas River to the mouth of the Cimarron Fiver then up the Cimarron making a broad loop as far southwest as Cleveland County and returning to Ft. Gibson. With this party was Henry L. Ellsworth who wrote his accounts of the journey as did Irving (Ellsworth, 1937). Neither were botanists and their accounts are more of events than descriptions of the flora, however Ellsworth provided some useful botanical information by describing edible plants in the Arkansas River valley (Ellsworth, p. 19). He wrote:

> ...during the last part of the day, we passed through oak land suitable for wheat and grain. The timber from the Fort to this place was an intermixture Peccan [Carya illinoensis], Cotton [Populus deltoides], wild cherry [probably Prunus serotina]-Elm [Ulmus spp.]-Sycamore [Platanus occidentalis] Walnut [Juglans nigra] and Hickory [Carya spp.]. The fruit

> trees were (besides the peccan which grows very large and bears abundant) the black Haws [Viburnum prunifolium] Persimmon [Diosporus virginiana]-Pawpaw [Asimina triloba] Chickasaw plumbs-(of these a great variety) [Prunus angustifolia and other Prunus spp.]-Mulberry [Morus rubra] Whortle berries [Vaccinium spp.] and some wild goose berries [Ribes odoratum] and strawberries [Fragaria virginiana] in great quantities - grape vines [Vitis spp.] entwined around many trees...

It was thirty years after Nuttall's explorations before another botanically oriented observer approached Washington County. This was Dr. S.W. Woodhouse, physician and naturalist, assigned with a party to survey the northern and western boundary line of the Creek Country. The entire party consisted of Cpt. L. Sitgreaves; 1Lt. J.C. Woodruff, topographical engineers; Mr. Isaac W. Smith, assistant surveyor; Dr. Woodhouse; a wagonmaster and thirty men; three ox wagons; one spring wagon; and five spare horses (Sitgreaves and Woodruff, 1858). The party set out on June 21,1849, and took two summers to complete its task. During the first summer, survey was made from Ft. Gibson north to 36°08'42" latitude, this point being just southeast of Chouteau in Mays County, and then west along that latitude to a point about twelve miles northeast of Yale on the Payne-Pawnee County line. This route passes within eighteen miles of Washington County, but, unlike Nuttall's route near the river, this route was overland and probably gave Dr. Woodhouse a different sampling of plant habitats.

As a naturalist, Dr. Woodhouse not only collected plants but also made observations of the geologic strata and collections of birds, shells, and insects. Several of his habitat descriptions would fit Washington County quite well. For example, he described the land southeast of Tulsa (Sitgreaves and Woodruff, p. 5):

> A short distance from the falls [of the Verdigris River near

> its mouth] we enter the great Osage prairie, a beautiful rolling country, interspersed with numerous remarkable natural mounds. In many places, however, we found it quite rough, the lime and sandstone making their appearance, and covered with a species of cactus, (C. ferox) [Mamillaria missouriensis].

In describing land where the survey line met the Arkansas River, now a part of downtown Tulsa, he wrote (Sitgreaves and Woodruff, p. 6):

> The large streams are all well timbered, the principle part of which timber consists of cottonwood, oak and pecan. ... The button-wood [sycamore] Platanus Occidentalis Linn., and also the cottonwood, Populus Loeoigate Willd. [Populus deltoides] grow to emmense size; some of which I have seen over four feet in diameter. ... Climbing over many of these trees is the trumpet-flower, Teconia radicans Jussien. [Campsis radicans].

Dr. Woodhouse was not a botanical specialist and other duties must have taken much of his time. For this reason, his plant collection was very incomplete, but it still contained 709 specimens, there being many duplicates, representing 27 families and 58 genera (Sitgreaves and Woodruff, 1858).

The party suspended work that fall and began again the following summer. Dr. Woodhouse was again with the party and although they took the same route, his observations and collecting did not start until they reached the previous year's stopping point.

In 1853 and 1854, money was appropriated by Congress for a survey to determine the best route for a railroad from the Mississippi River to California. Five different parties surveying various routes published their findings in nine parts as 33rd Congress, 2nd Session, Senate Executive Document No. 78. The reports contain a wealth of botanical information complete with line drawings of newly discovered species. The 1853 party passing through Oklahoma surveyed a route near the 35th parallel. Starting at Ft. Smith they followed a line south of the

Canadian River but always remained north of the Washita River until they left Oklahoma at the Antelope Hills in present day Roger Mills County. The party came no closer to Washington County than 100 miles which is unfortunate as Lt. A.W. Whipple, party commander and Dr. J.M. Bigelow, physician and botanist were both astute observers of the terrain and flora.

In 1858, a party was given the task of surveying the southern boundary of Kansas and directed on their return trip to acertain the most practical route for a railroad from southeast Kansas to the Rio Grande (Johnston, 1858). The westward survey was completed on September 10th and the party moved into Oklahoma for the return trip. At the point where the North Canadian River meets the Cimarron River, the party was split with Lt. Col. Johnston and a company of cavalry proceeding to the bend of the Canadian River near the 99th meridian and then moving in a straight line to Neosho, Missouri, while a Cpt. Wood with the rest of the party was instructed to continue the examination of the line along the Oklahoma-Kansas border. According to their maps, both parties moved through Washington County with Cpt. Wood passing along the northern border and Lt. Col. Johnston passing through the extreme southern part. Lt. Col. Johnston described the land that he crossed in the following manner (Johnston, p. 2):

> Between the arkansas and the verdigris the country is somewhat broken, but the valleys broad and rich, and the hills generally covered with post oak and black jack, with larger timber along the water-courses. Excellent building stone is very abundant, too; it is altogether a beautiful district. From the Verdigris to the Missouri line the country is rich, rolling prairie; the principle streams, however, are lined with heavy timber.

Although observations such as the preceeding were made of the terrain and general vegetation, neither party did any botanical collecting.

From the 1860's to the turn of the century, comparatively little collecting was done in Oklahoma. However, several men did make collections in Oklahoma Indian Territory and published lists of their findings. Among these men were George D. Butler (1878), M.A. Carlton (1892), and C.S. Sheldon (Holzinger, 1892). However, none of these men collected in the Cherokee Nation of which Washington County was then a part.

The establishment of Oklahoma Territory in 1889 renewed interest in Oklahoma botany. An Oklahoma A&M College, Agricultural Experiment Station was established at Stillwater and Mr. E.E. Bogue, M.S., became the staff botanist and entomologist from 1899 to 1901 (Henson, 1941). Mr. Bogue (1900) published a list of 750 native plants for the Oklahoma Territory which contained 22 trees, 34 shrubs, 91 grasses, 24 sedges, and the rest other annual and perennial forbs. The list gave locations and collectors for each species. Most were from Payne County or given a general description such as "widespread in prairies", however some were from Pawhuska or elsewhere in what was then the Osage Nation. The Pawhuska specimens were collected by Dr. J.W. Blankenship and the collection sites would have been only twenty miles west of Washington County.

Mr. C.H. Fitch (1900) compiled the surveyors reports of woodland in the Indian Territory of the five civilized tribes. There was a description for each township and all of Washington County was included. As an example, the description for T 26N, R 13E, in the center of the county stated, "The timber along Caney Creek [Caney River] and its tributaries consists of oak, ash, elm, hickory, pecan, walnut, box elder, and sycamore" (Fitch, p. 654).

George W. Stevens was perhaps the first botanist to actually

collect plant specimens in Washington County. He became head of the Department of Biology at Northwestern State Normal School at Alva in 1903 and remained there for fourteen years. As director of the Oklahoma Botanical Survey in 1913 he spent one summer in Osage County before making an extensive study of the flora of Oklahoma (Henson, 1941). To collect the state's flora, Stevens concentrated on the border counties and collected in Washington County on August 15,1913. Two of the specimens from that day's collecting were Prunus hortulana Bailey (2101), near Copan and Peplis diandra Nutt. (2107), also near Copan. He prepared two manuscripts from his work, one on the Plants of Oklahoma and one on the Birds of Oklahoma. Both are at the University of Oklahoma but neither was published (Henson, 1941).

Further records of plant collecting in Washington County are very limited. Examination of the field notebook of Robert Stratton, Curator of the Oklahoma State University Herbarium from 1920 to 1949, indicates that he made five collecting trips which passed through Washington County and collected 28 different specimens. His most extensive collecting was 18 specimens in the Copan area on July 14,1929.

The only Washington County specimens from 1949 until the collections for this work were made by Dr. U.T. Waterfall and his students who turned in specimens for an introductory plant identification course. There is no record of the actual number of specimens, but a partial search of the Oklahoma State University Herbarium indicated very few specimens were collected.

CHAPTER VII

ECOLOGICAL CONSIDERATIONS

Washington County is situated in a broad transition zone between the deciduous forests of eastern North America and the grasslands of the Great Plains (Blair, 1938). According to Blair and Hubbell (1938) the county lies in the Osage Savannah and Cherokee Prairie biotic districts[1]. The Osage Savannah is a district of sandstone hills and sandy soils. In Washington County it includes all vegetation covering the Eastern Sandstone Cuesta Plains geomorphic province and other areas of the county having soils of the Darnell-Stephenville association. The principal vegetation is a post oak (Quercus stellata) and blackjack (Quercus marilandica) woodland with an understory of big bluestem (Andropogon gerardii) and various forbs. Parts of the district with steep breaks and stony soils have closely spaced trees that exclude all but the more shade tolerant understory species while areas with deeper soils support prairies of big bluestem, little bluestem (Andropogon scoparius) and various forbs with only scattered stands of relatively open woodland. The Cherokee Prairie is a district of rolling hills that generally coincides with the Claremore Cuesta Plains geomorphic province. The principal vegetation is tall grasses on deep shale soils with the dominant species, big bluestem, little bluestem, switchgrass

[1] The floral component of a biotic district approximately equals the plant association of Weaver and the vegetation type of Kückler.

(Panicum virgatum) and Indiangrass (Sorghastrum nutans), forming a tight prairie sod.

Local edaphic and topographic factors alter the two provinces and produce distinctive plant communities which are recognized by their structure and species composition. Six different communities are found in Washington County, three woodland, two grassland and one aquatic (Figure 6). Each is described below. Descriptions are based on areas showing little disturbance and presumably at or near the climax state. The species composition of disturbed areas within these communities, eg., plowed fields, badly overgrazed pastures and cleared bottomlands, is disregarded.

Of the two grassland communities, the most extensive is a tall grass prairie growing in deep loam soils weathered from shale (Figures 6, 7, & 8). The distribution of this community corresponds to the county distribution of the Dennis-Okemah-Parsons and Collinsville-Talihina-Bates soil associations (cf. Figure 3). In composition, this community most closely resembles the tall grass prairies that extend into northeastern Oklahoma from Illinois and Indiana (Blair, 1938). The species aspect of this community is dynamic changing with the seasons. In the early spring, mid to late March, various forbs can be found that typically include:

> yellow star grass[2] (Hypoxis hirsuta), blue-eyed grass (Sisyrinchium campestre), pussytoes (Antennaria neglecta), celestial lily (Nemastylis geminiflora), Carolina anemone (Anemone caroliniana), bluets (Hedyotis crassifolia), Whitlow grass (Draba brachycarpa), corn speedwell (Veronica arvensis), sedges (Carex spp.).

By mid April, another set of forbs dominates the landscape. These will

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[2] Common names are not well standardized and may vary with the user or geographical region. Those listed here are taken primarily from Steyermark, 1963, and Fernald, 1950.

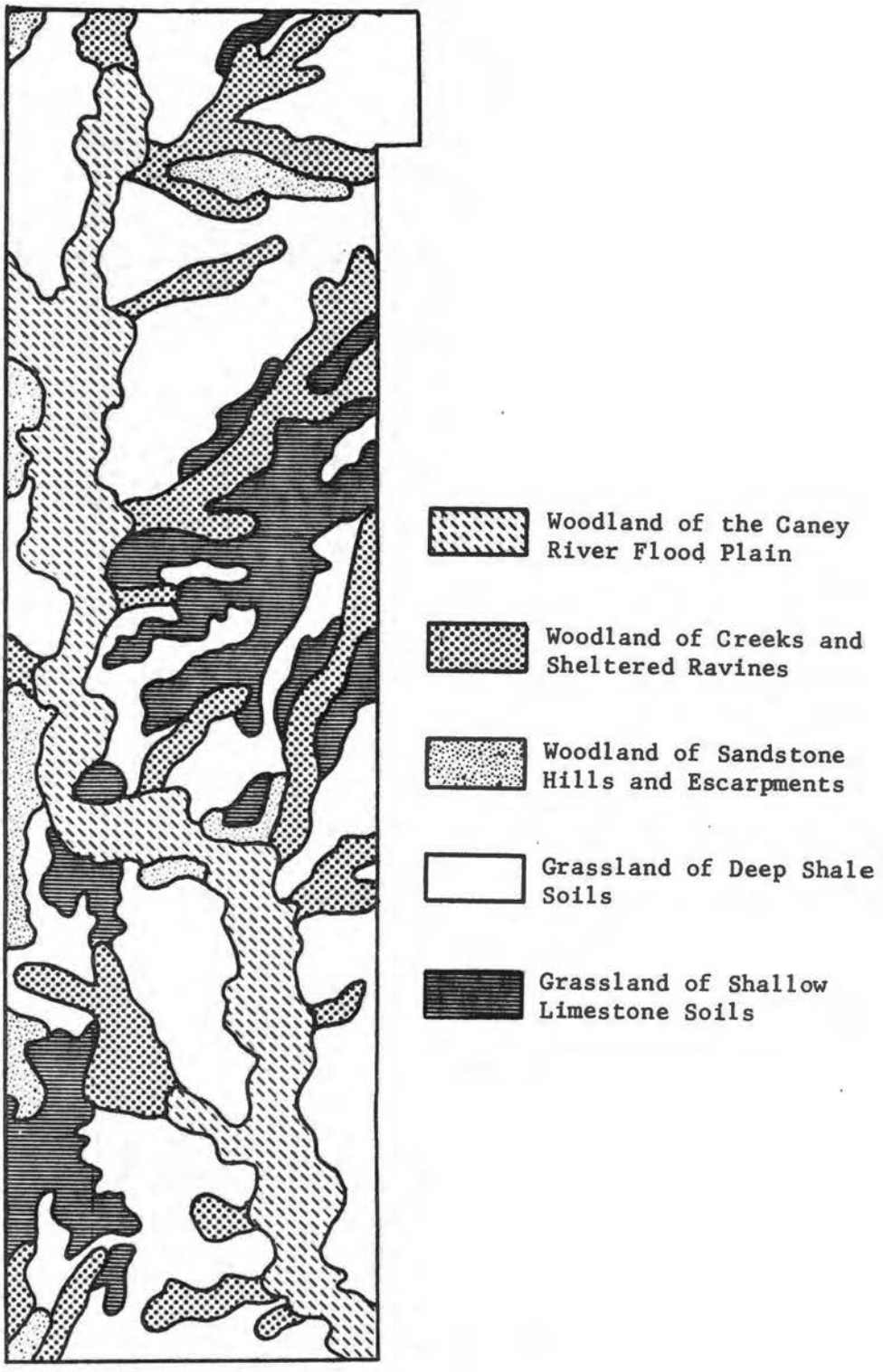

Figure 6. Plant Communities.

Figure 7. Grassland of the Dennis-Okemah-Parsons Soil Association.

Figure 8. Grassland of the Collinsville-Talihina-Bates Soil Association.

complete their life cycle before they must compete with the developing grasses and typically include:

> blue false indigo (Baptisia australis), cream wild indigo (Baptisia leucophaea), scorpion grass (Myosotis verna), phlox (Phlox pilosa), pasture rose (Rosa carolina), Indian paint brush (Castilleja coccinea), corn salad (Valerianella radiata), western yarrow (Achillea lanulosa), prairie grounsel (Senecio plattensis), wild hyacinth (Camassia angusta), wild garlic (Allium canadense), violet wood sorrel (Oxalis violacea), yellow wood sorrel (Oxalis dillenii).

By mid May the dominant grasses are growing vigorously. A number of forbs compete with these grasses blooming between late May and mid July. These include:

> butterfly weed (Asclepias tuberosa), whorled milkweed (Asclepias verticillata), deptford pink (Dianthus armeria), Indian plantain (Cacalia plantaginea), purple cudweed (Gnaphalium purpureum), hawkweed (Hieracium longipilum), rushes (Juncus interior), leadplant (Amorpha canescens), tick trefoil (Desmodium illinoensis), sensitive brier (Schrankia uncinata), lobelia (Lobelia spicata), milkwort (Polygala incarnata), blue hearts (Buchnera americana), beard tongue (Penstemon digitalis), mock bishop's weed (Ptilimnium nuttallii), flax (Linum sulcatum).

By mid July, the first prairie grasses begin flowering and continue until frost with most of the species flowering in September and October. Besides the four dominant prairie grasses, big bluestem, little bluestem, switchgrass and Indiangrass, others that may be locally abundant include:

> dropseed (Sporobolus asper), porcupine grass (Stipa spartea), Junegrass (Koeleria macrantha), purple lovegrass (Eragrostis spectabilis), purpletop (Tridens flavus), eastern gama grass (Tripsacum dactyloides), panic grass (Panicum anceps), paspalum (Paspalum floridanum, P. pubiflorum, P. laeve), canary grass (Phalaris caroliniana), Canada wild-rye (Elymus canadensis), prairie three-awn (Aristida oligantha).

Numerous forbs bloom from September until frost with the greatest number in the families Compositae and Leguminosae. Typical species include:

> asters (Aster ericoides and other Aster spp.), blazing star

(Liatris aspera, L. punctata, L. squarrosa), compassplant (Silphium laciniatum), goldenrod (Solidago missouriensis), stiff goldenrod (Solidago rigida), dodder (Cuscuta spp.), flowering spurge (Euphorbia corollata), Pitcher sage (Salvia azurea), prairie mimosa (Desmanthus illinoensis), bush clover (Lespedeza spp.), winged loosestrife (Lythrum alatum), slender ladies' tresses (Spiranthes gracilis), gerardia (Gerardia heterophylla).

The county's other grassland community contains a mixture of tall and short grasses growing in shallow soils weathered from limestone. The distribution of this community corresponds to the county distribution of the Summit-Sogn soil association (cf. Figures 3 & 6). Sogn soils, which are shallow and stony, support the community's most characteristic vegetation while the deeper Summit soils support a vegetation closely resembling the grassland of deep shale soils (Figures 9 & 10). Like the grassland of deep shale soils, the aspect of this community changes with the seasons. Typical spring forbs are:

ground plum (Astragalus crassicarpus), blue false indigo, cream wild indigo, prairie turnip (Psoralea esculenta), scurfy pea (Psoralea tenuifolia), yucca (Yucca glauca), evening primrose (Oenothera triloba), prairie larkspur (Delphinium virescens), hairy parsley (Lomatium daucifolium), evolvulus (Evolvulus nuttallianus), stonecrop (Sedum pulchellum), pin-cushion cactus (Mamillaria missouriensis), prickly pear (Opuntia compressa), Indian blanket (Gaillardia pulchella), goat's beard (Tragopogon major), death camus (Zigadenus nuttallii), fame flower (Talinum calycinum).

In this community, the summer forbs typically occupy rocky soil around limestone outcrops and do not compete directly with the dominant prairie grasses. These forbs often include:

heliotrope (Heliotropium tenellum), prairie spurge (Euphorbia missurica), stinging nettle (Tragia betonicifolia), St. John's wort (Hypericum sphaerocarpum), lemon horsemint (Monarda citriodora), acacia (Acacia angustissima), yellow puff (Neptunea lutea), prairie clover (Petalostemum candidum, P. multiflorum, P. purpureum), stick leaf (Mentzelia oligosperma), Missouri primrose (Oenothera macrocarpa), evening primrose (Stenosiphon virgatus), caltrop (Tribulus terrestris), buffalo gourd (Cucurbita foetidissima), ground cherry (Physalis pumila).

Grasses characteristic of disturbed sites occur with the prairie grasses

Figure 9. Grassland of the Summit-Sogn Soil Association with Blue Mound at the Horizon.

Figure 10. A Typical Rock Outcrop in Grassland of Shallow Limestone Soils.

in this community. These and the dominant prairie grasses include:

> silver beardgrass (Andropogon saccharoides), little bluestem, side-oats grama (Bouteloua curtipendula), hairy grama (Bouteloua hirsuta), buffalo grass (Buchloe dactyloides), windmill grass (Chloris verticillata), goosegrass (Eleusine indica), tumblegrass (Schedonnardus paniculatus), slim tridens (Tridens muticus).

Like the grasses, fall forbs in this community include many species normally typical of disturbed sites. Characteristic species are:

> oblong-leaf aster (Aster oblongifolius), golden aster (Chrysopsis pilosa), gumweed (Grindelia lanceolata), broomweed (Gutierrezia dracunculoides), willow-leaved sunflower (Helianthus salicifolius), blazing star, ironweed (Vernonia baldwinii), dodder (Cuscuta campestris, C. pentagona), flowering spurge, eryngo (Eryngium leavenworthii), hogwort (Croton capitatus).

The Caney River is the county's only permanently flowing stream and its flood plain supports a distinctive plant community (Figure 6). It is a mature forest growing in soils of the Osage-Verdigris association and is dominated by a relatively small number of species (Figures 11 & 12). These include:

> box elder (Acer negundo), silver maple (Acer saccharinum), bur oak (Quercus macrocarpa), shumard oak (Quercus shumardii), black oak (Quercus velutina), pecan (Carya illinoensis), walnut (Juglans nigra), white ash (Fraxinus americana), sycamore (Platanus occidentalis), cottonwood (Populus deltoides), soapberry (Sapindus drummondii), sugarberry (Celtis laevigata), American elm (Ulmus americana).

Growing above the forest floor but not reaching the height of the dominant trees are a number of small trees, shrubs and vines the include:

> pawpaw (Asimina triloba), trumpet creeper (Campsis radicans), elderberry (Sambuscus canadensis), wahoo (Euonymus atropurpureus), bristly greenbrier (Smilax tamnoides), red mulberry (Morus rubra), Virginia creeper (Parthenocissus quinquefolia), grayback grape (Vitis cinerea), river-bank grape (Vitis riparia).

In the leaf litter of the forest floor grow a number of forbs. Many of them bloom in the early spring before the larger trees foliate and intercept most of the light. The earliest blooming species are listed first and the group typically includes:

Figure 11. The Caney River.

Figure 12. Woodland of the Osage-Verdigris Soil Association.

toothwort (Dentaria laciniata), pale corydalis (Corydalis flavula), Dutchman's breeches (Dicentra cucullaria), blue phlox (Phlox divaricata), nettle (Urtica chamaedryoides), common violet (Viola papilionacea), yellow violet (Viola pensylvanica), green dragon (Arisaema dracontium), Solomon's seal (Polygonatum canaliculatum), butterweed (Senecio glabellus), wild petunia (Ruellia strepens), carrion flower (Smilax herbacea), purple rocket (Iodanthus pinnatifidus), purple meadow rue (Thalictrum dasycarpum), anise root (Ozmorhiza longistylis), May apple (Podophyllum peltatum), tall bellflower (Campanula americana), starry campion (Silene stellata), wild chervil (Cryptotaenia canadensis), tick trefoil (Desmodium pauciflorum, D. glutinosum, D. canescens, D. cuspidatum, D. paniculatum), leather flower (Clematis pitcheri), yellow giant hyssop (Agastache nepetoides), broadleaf uniola (Uniola latifolia), figwort (Scrophularia marilandica), bear's foot (Polymnia uvedalia), late goldenrod (Solidago gigantea), red spangletop (Leptochloa filiformis), whitegrass (Leersia virginica).

A woodland covering the sandstone hills and escarpments is found at the western edge of the county and in other locations having soils of the Darnell-Stephenville association (cf. Figures 3 & 6). This area is included by Blair and Hubbell (1938) in the Osage Savannah biotic district and resembles the district's dry scrubby, post oak-blackjack woodland. Although occupying very little area in the county, the woodland is still a prominant part of the landscape (Figures 13 & 14). It is dominated by a very small number of trees that include:

post oak, blackjack, chinquapin oak (Quercus muehlenbergii), black hickory (Carya texana), chittam-wood (Bumelia lanuginosa), deciduous holly (Ilex decidua).

Where the dominant trees are closely spaced, the understory is often sparce. Vines and shrubs found in these denser woods include:

coral berry (Symphoricarpos orbiculatus), greenbrier (Smilax bona-nox), bristly greenbrier, American bittersweet (Celastrus scandens), Virginia creeper.

In areas of moderate slope and on hilltops, the trees are more widely spaced and allow an understory of grasses and forbs that include:

pussy toes (Antennaria plantaginifolia), sedges, wild garlic, bedstraw (Galium aparine), skullcap (Scutellaria parvula), pellitory (Parientaria pensylvanica), wild licorice (Galium circaezans), rattlebox (Crotalaria sagittalis), agrimony (Agrimonia

Figure 13. Open Woodland of the Darnell-Stephenville Soil Association.

Figure 14. Post Oak - Blackjack Woodland on a Gently Sloping Hilltop.

pubescens), pinweed (Lechea tenuifolia), big bluestem, little bluestem, spreading aster (Aster patens), willow-leaved aster (Aster praealtus), aster (Aster sagittifolius), goldenrod (Solidago gymnospermoides, S. petiolaris), elm-leaf goldenrod (Solidago delicatula), muhly (Muhlenbergia capillaris, M. sobolifera), forked chickweed (Paronychia fastigiata), three-awn (Aristida dichotoma), arrowfeather (Aristida purpurascens), purpletop.

The county has many intermittently flowing streams with most having isolated pools of water even during drought. These creeks support a distinctive woodland community that contains elements of both the Caney River flood plain woodland and the woodland of sandstone hills and escarpments (Figure 6). Most of the creeks have limited flood plain deposits of the Osage-Verdigris soil association (cf. Figure 3). This alluvium supports a climax of trees quite similar to that of the Caney River flood plain and includes such species as:

black oak, shumard oak, bur oak, red mulberry, white ash, sycamore, American elm, bitternut hickory (Carya cordiformis), catalpa (Catalpa speciosa), Ohio buckeye (Aesculus glabra).

The creeks are partly dry much of the time and their beds consist of alluvium mixed with coarse to fine gravel. There is usually a good supply of subterranean moisture and moderate sunlight because the trees do not form the dense forest that is found in the Caney River flood plain (Figure 15). Growing in these conditions and in the narrow strips of alluvium along the creeks are grasses, forbs, and vines which include:

wood nettle (Laportia canadensis), Virginia knotweed (Tovara virginiana), hops (Humulus lupulus), bur cucumber (Sicyos angulatus), painted leaf (Euphorbia heterophylla), wild ageratum (Eupatorium coelestinum), wild goldenglow (Rudbeckia laciniata), three-seeded Mercury (Acalypha ostryaefolia), nimblewill (Muhlenbergia schreberi), whitegrass (Leersia virginica), beefsteak plant (Perilla fructescens), hog peanut (Amphicarpa bracteata), cardinal flower (Lobelia cardinalis), bloodleaf (Iresine rhizomotosa).

On creek and ravine slopes the character of the woodland changes and

closely resembles the woodland of sandstone hills and escarpments (Figure 16). The thin stony soils support a woodland mixture of small and large trees which include:

> deciduous holly, black haw (Viburnum prunifolium), blackjack oak, chinquapin oak, post oak, black hickory, red bud (Cercis canadensis), honey locust (Gleditsia triacanthos), hawthorn (Crataegus viridis), wild plum (Prunus americana), black cherry (Prunus serotina), chittam-wood, dwarf hackberry (Celtis tenuifolia).

The vine and shrub understory of these slopes includes:

> trumpet creeper, coral berry, American bittersweet, breenbrier, bristly greenbrier, moonseed (Menispermum canadense), Virginia creeper, gray back grape, winter grape (Vitis vulpina).

The understory grasses and forbs include:

> white trout lily (Erythronium albidum), pussy toes, sedges, skullcap, violet collinsia (Collinsia violacea), pellitory, bedstraw, wild licorice, cinquefoil (Potentilla simplex), yellow wood sorrel, white vervain (Verbena urticifolia), muhly, elm-leaf goldenrod, dropseed, forked chickweed, elephant's foot (Elephantopus carolinianus), asters.

At the head of ravines and in the margin between ravine woodland and grasslands are found a number of thicket forming trees and shrubs. The species are not mixed but form solid stands in the often rocky and gently sloping soils. Typical species are:

> fragrant sumac (Rhus aromatica), dwarf sumac (Rhus copallina), smooth sumac (Rhus glabra), rough-leaved dogwood (Cornus drummondii), persimmon (Diospyros virginiana), Osage orange (Maclura pomifera), buffalo current (Ribes odoratum), Chicksaw plum (Prunus angustifolia).

According to the Oklahoma Conservation Needs Inventory (1970) the county has 2,424 acres of impoundments. Most of these are small stock ponds with the only natural impoundments being oxbow lakes and sloughs near the Caney River. These areas support a distinctive community of aquatic and semi-aquatic plants. In this community the least aquatic species grow at pond margins near the high water point and include:

Figure 15. The Flood Plain and Gravel Stream Bed of Hogshooter Creek.

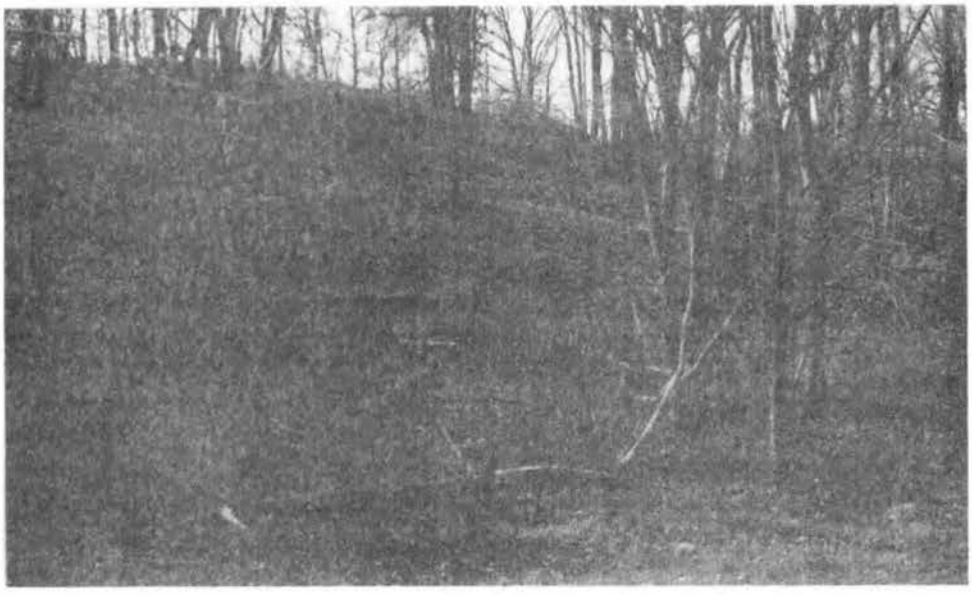

Figure 16. A Woodland Slope of Hogshooter Creek.

swamp milkweed (Asclepias incarnata), false indigo (Amorpha fruticosa), rose mallow (Hibiscus militaris), buttonbush (Cephalanthus occidentalis), black willow (Salix nigra), seedbox (Ludwigia alternifolia).

A number of species grow in muddy pond margins or rooted in shallow water. These include:

seaside heliotrope (Heliotropum curassavicum), sessile-flowered cress (Rorippa sessiliflora), umbrella grass (Fuirena simplex), American bugle weed (Lycopus americanus), tooth-cup (Ammannia coccinea), ditch stonecrop (Penthorum sedoides), frog fruit (Phyla lanceolata), water willow (Justicia americana), umbrella sedge (Cyperus spp.), spike rush (Eleocharis spp.), bulrush (Scirpus spp.), rush (Juncus spp.), false loosestrife (Ludwigia glandulosa), clammy hedge hyssop (Gratiola neglecta), common arrowhead (Sagittaria latifolia), water plantain (Alisma plantago-aquatica), false pimpernel (Lindernia anagallidea, L. dubia), cattail (Typha angustifolia, T. latifolia).

A few species grow totally floating or submerged but remain rooted at the bottom in shallow water and include:

water starwort (Callitriche heterophylla), water milfoil (Myriophyllum heterophyllum), American lotus (Nelumbo lutea), primrose willow (Jussiaea peploides), water purslane (Ludwigia palustris), pondweed (Potamogeton diversifolius, P. nodosus).

The last group of aquatics are free floating and often include:

duckweed (Lemna valdiviana), watermeal (Wolffia papulifera), bladderwort (Utricularia biflora), naiad (Najas guadalupensis), pondweed (Potamogeton foliosus).

CHAPTER VIII

ADDITIONS TO THE FLORA OF OKLAHOMA AND OTHER SPECIMENS OF SPECIAL SIGNIFICANCE

Two species, Tradescantia bracteata Small and Wolffia papulifera Thompson, were collected in Washington County and are beleived to be additions to the state flora. Tradescantia bracteata was tentatively identified by Shirley (1927) from Garfield County and later recorded by Eskew (1938) from Comanche County. Communication with Dr. George Goodman, curator of the Bebb Herbarium, University of Oklahoma, revealed that no specimens of this taxon were deposited there. Since there are no Tradescantia bracteata specimens filed in the Oklahoma State University Herbarium, vouchers of earlier reports must have been deposited somewhere other than the state's two major herbaria or they were reidentified and filed with some other taxon. The presence of this species in Washington County would be expected since its normal range according to Fernald (1950) is from Michigan to Montana and south to southern Indiana, Illinois, Missouri and Kansas. The specimens from Washington County do not extend the range greatly and are not unusual when the habitat is considered. They were found at Sec 7, R 13E, T 27N, approximately 2.2 miles north and 1.2 miles west of Dewey. The area is open, flat and boggy. Soils of the Osage series predominate and they are low enough to be inundated by major floods. Since Osage soils do not drain well, normal spring rains will keep this area very moist. In

aspect, Tradescantia bracteata closely resembles the much broader ranging species Tradescantia occidentalis and differs by having larger flowers and heavily viscid pubescent sepals (Fernald, 1950). Tradescantia bracteata also has quite variable flower color ranging from bright rose to purple and less frequently blue, lavander, violet or white (Steyermark, 1963). Two color forms were present in the Washington County population. A re-examination of Tradescantia occidentalis specimens from northern Oklahoma might reveal some that would be better placed with Tradescantia bracteata.

No earlier Oklahoma reports or specimens of Wolffia papulifera could be found. However, since the collection for this work, other specimens collected by James R. Parmley from a farm pond in Ottawa County have been received by the Oklahoma State University Herbarium and also referred to this taxon. Fernald (1950) describes the range of this species as occuring locally from Florida to Texas and north as far as Maryland, New York, southern Ontario, Michigan, Illinois and Minnesota. It is most likely transported northward each season by ducks and other waterfowl while only persisting in southern regions. This type of dispersal would make possible its sporadic occurance anywhere in the state. The lack of other state collections may partly be accounted for by the plant's inconspicuous nature. Wolffia papulifera is the smallest angiosperm having the look and feel of moderate sized green sand grains. As an individual plant it would certainly go unnoticed but it may be detected by the development of large colonies forming a green scum on the surface of quite lakes and sloughs. It may also be found mixed with aquatic plants such as Lemna and Spirodela or mixed with floating algae. The Washington County specimens were discovered in

a pond at Sec 29, R 13E, T 29N. This pond is one of three formed by excavation for railroad fill and is approximately 0.5 mile long while only 50 to 60 feet wide. It lies between the railroad "hogback" and an open bottomland pasture. The pond's shape and location form an ideal habitat for growth and the pond is large enough to attract numerous migratory waterfowl.

In addition to the state record collections, several accessions are mentioned below which are considered specially significant. These taxa have been infrequently collected in Oklahoma and are represented by four or less sheets in the Oklahoma State University Herbarium.

Achillea lanulosa Nutt., forma rubicunda Farwell (Acc. No. 465). This specimen was collected as a flower bed volunteer in residential Bartlesville. The ray flowers are a deeper red than is normal for the color form and it is likely that the specimen escaped from other cultivation or was planted inadvertently when mixed with some other type of seed.

Asclepias syriaca L. (Acc. Nos. 468, 634). Although this species is infrequently collected in Oklahoma, it is common in Kansas and was found at several locations in northern Washington County. It would probably be found frequently if more collecting was done in the state's northern tier of counties.

Aster pilosus Willd. (Acc. Nos. 136, 862). This species has been collected in Ottawa and Delaware counties in northeastern Oklahoma as well as in Creek County. It might be more frequently collected and identified if it were not a member of a large and taxonomically difficult genus.

Castilleja coccinea (L.) Spreng., forma lutescens Farwell (Acc. No. 251). The specimens of this color form in the Oklahoma State herbarium appear more cream colored than yellow although this may be due to fading. The specimen from Washington County was cream colored when fresh and might be placed with the color form alba. The specimen was found mixed with others of the common red bracteate form.

Dicentra cucullaria (L.) Berhn. (Acc. No. 206). All the Oklahoma State specimens of this beautiful early spring species were collected in Cherokee County although it has been collected in Tulsa County by Blair (1938) and Clark (1959). The Washington and Tulsa County collections are probably near the western limit of this species.

Dipsacus sylvestris Huds. (Acc. No. 668). Waterfall (1969) states that this species is "adventive and infrequently collected". It must have been introduced at the Washington County collection site which is a graded waste area southeast of downtown Bartlesville. It has formed a large population but does not seem to be spreading from that locality.

Leersia lenticularis Michx. (Acc No. 1028). Although seldom collected, one state collection was from Rogers County which ajoins Washington County on the southeast.

Leptochloa uninervia (Presl.) Hitch. (Acc. No. 1029). One of the three Oklahoma State sheets of this species was collected by Tyrl and McDonald in 1972 from Pawnee County and it was reported by Goodman at the 1973 Oklahoma Academy of Science meeting as being collected that year for the University of Oklahoma Herbarium. It is probable that this species is rapidly increasing its distributional range.

Mentha cardiaca Baker (Acc. No. 779). The Oklahoma State herbarium holds only one other sheet of this species, that collected in Kay County.

Paronychia canadensis (L.) Wood (Acc. No. 678). One of the three Oklahoma State sheets of this species was collected by Clark (1959) from northern Tulsa County. The species is a rather inconspicuous woodland plant and probably more common than the number of collections would indicate.

Potentilla norvegica L. (Acc. Nos. 466, 693). This species was collected along a natural drainageway in residential Bartlesville. It may have been introduced though certainly not on purpose. Further collections are needed to see if the species persists.

Urtica dioica L. (Acc No. 747). This species is represented in the Oklahoma State herbarium by collections from Ottawa County in 1963 and was collected by Clark (1959) in Tulsa County. Although specimens of this species may reach four feet in height, the flowers are green and inconspicous. It would certainly be overlooked by casual collectors.

Vicia villosa Roth, forma albiflora (Schur.) Gams. (Acc. No. 391). The white color form of this common blue flowered species is infrequently collected. The Washington County specimen was growing mixed with the blue form.

Viola papilionacea Pursh., forma albiflora Grover (Acc. No. 209). The blue form of this species is probably the commonest woodland violet in eastern Oklahoma. The white form was collected in a population of blue forms with many of the blue specimens of lighter shades tending toward the white.

No effort will be made to describe increases or changes in

distributional range for any of the collected taxa. As far as can be determined, none of the taxa and this includes the state record collections are unreasonably outside their known distributional limits. Any minor range extensions are better thought of as filling distribution gaps. The study of detailed distribution for individual taxa will be left to those working with specific groups who might utilize the information provided by this and other similar works.

CHAPTER IX

LIST OF TAXA

All native or naturalized taxa known by the author to occur in Washington County are listed below. The list is based on specimens collected by the author and deposited in the Oklahoma State University Herbarium. In addition, five taxa collected by previous workers and five observed but not collected taxa are included and so indicated. Taxa are listed alphabetically within their family and families are listed in order according to the Engler-Prantl classification scheme. Nomenclature follows that of Waterfall (1969).

TYPHACEAE

Typha angustifolia L
T. latifolia L.

ZOSTERACEAE

Potamogeton diversifolius Raf.
P. foliosus Raf., var. macellus Fern.
P. nodosus Poiret

NAJADACEAE

Najas guadalupensis (Spreng.) Mangus

ALISMATACEAE

Alisma plantago-aquatica L., var. parviflorum (Pursh.) Torr.

Echinodorus cordifolius (L.) Griseb. R. Stratton (505) Aug 31, 1927

Sagittaria latifolia Willd., var. latifolia, forma latifolia

GRAMINAE

Aegilops cylindrica Host, var. cylindrica

Agrostis hyemalis (Walt.) B.S.P.

Andropogon gerardii Vitman, var. chrysocomus (Nash) Fern.
A. gerardii Vitman, var. gerardii
A. saccharoides Sw.
A. scoparius Michx.

Aristida dichotoma Michx., var. dichotoma
A. oligantha Michx.
A. purpurascens Poir.

Bouteloua curtipendula (Michx.) Torr.
B. hirsuta Lag., var. hirsuta

Bromus inermis Leyss
B. japonicus Thumb.
B. pubescens Muhl. ex Willd.
B. tectorum L.
B. unioloides H.B.K.

Buchloe dactyloides (Nutt.) Engelm.

Cenchrus pauciflorus Benth.

Chloris verticillata Nutt.

Cinna arundinacea L., var. inexpansa Fern. & Grisc.

Cynodon dactylon (L.) Pers.

Dactylis glomerata L.

Diarrhena americana Beauv., var. obovata Gleason

Digitaria ischaemum (Schreb.) Muhl.
D. sanguinalis (L.) Scop.

Diplachne facicularis (Lam.) Beauv.

Echinochloa colonum (L.) Link
E. crusgalli (L.) Beauv.

Eleusine indica (L.) Gaertn.

Elymus canadensis L.
E. villosus Muhl., forma villosus
E. virginicus L., var. jejunus (Ramaley) Bush
E. virginicus L., var. virginicus, forma virginicus

Eragrostis barrelieri Daveau
E. cilianensis (All.) E. Mosher
E. hypnoides (Lam.) B.S.P.
E. intermedia Hitchc.
E. pectinacea (Michx.) Nees
E. pilosa (L.) Beauv.
E. spectabilis (Pursh.) Steud.

Eriochloa contracta Hitchc.

Festuca obtusa Biehler
F. octoflora Walt.
F. paradoxa Desv.
F. pratensis Huds.

Glyceria striata (Lam.) Hitchc.

Hordeum pusillum Nutt.

Koeleria macrantha (Lebed.) Spreng.

Leersia lenticularis Michx.
L. virginica Willd.

Leptochloa filiformis (Lam.) Beauv.
L. uninervia (Presl.) Hitchc.

Leptoloma cognatum (Schultes) Chase

Lolium multiflorum Lam.
L. perenne L.

Melica nitens Nutt.

Muhlenbergia capillaris (Lam.) Trin.
M. frondosa (Poir.) Fern.
M. schreberi J.F. Gmel.
M. sobolifera (Muhl.) Trin.

Panicum agrostoides Spreng., var. agrostoides
P. anceps Michx.

P. capillare L., var. capillare
P. cladenstinum L.
P. dichotomiflorum Michx.
P. lanuginosum Ell., var. fasciculatum (Torr.) Fern.
P. malacophyllum Nash
P. obtusum H.B.K.
P. oligosanthes Schultes, var. helleri (Nash) Fern.
P. praecocius Hitchc. & Chase
P. virgatum L.

Paspalum floridanum Michx., var. floridanum
P. laeve Michx., var. laeve
P. pubiflorum Rupr., var. glabrum Vasey
P. setaceum Michx., var. muehlenbergii (Nash) D. Banks

Phalaris caroliniana Walter

Poa annua L.
P. pratensis L.

Schedonnardus paniculatus (Nutt.) Trel.

Setaria lutescens (Wiegel) F.T. Hubb.
S. viridis (L.) Beauv.

Sorghastrum nutans (L.) Nash

Sorghum halapense (L.) Pers.

Spartina pectinata Link, var. suttiei (Farw.) Fern.

Sporobolus asper (Michx.) Kunth, var. asper
S. asper (Michx.) Kunth, var. hookeri (Trin.) Vasey
S. asper (Michx.) Kunth, var. pilosus (Vasey) Hitch.
S. pyramidatus (Lam.) Hitch.
S. texanus Vasey
S. vaginaflorus (Torr.) Wood, var. vaginaflorus

Stipa spartea Trin.

Tridens flavus (L.) Hitchc.
T. muticus (Torr.) Nash, var. elongatus (Buckley) Shinners
T. strictus (Nutt.) Nash

Tripsacum dactyloides (L.)

Uniola latifolia Michx.

CYPERACEAE

Bulbostylis capillaris (L.) C.B. Clarke, var. crebra Fern.

Carex amphibola Steud., var. amphibola
C. albolutescens Schw.
C. annectens Bickn.
C. blanda Dewey
C. caroliniana Schwein., var. cuspidata (Dewey) Shinners
C. cephalophora Muhl., var. leavenworthii (Dewey) Kukenth
C. flaccosperma Dewey
C. frankii Kunth
C. granularis Muhl.
C. hystricina Muhl.
C. microdonta Torr. & Hook.
C. muhlenbergii Schkuhr, var. enervis Boott
C. nigro-marginata Schw., var. muhlenbergii (Gray) Gleason

Cyperus acuminatus Torr. & Hook.
C. erythrorhizos Muhl.
C. esculentus L.
C. filiculmis Vahl.
C. odoratus L.
C. ovularis (Michx.) Torr., var. sphaericus Boeckl.
C. setigerus Torr. & Hook.
C. strigosus L.

Eleocharis compressa Sulliv.
E. engelmanii Steud.
E. macrostachya Britt.
E. obtusa (Willd.) Schultes, var. obtusa
E. parvula (R. & S.) Link, var. anachaeta (Torr.) Svens.

Fimbristylis autumnalis (L.) R. & S., var. autumnalis
F. spadicea (L.) Vahl.
F. vahlii (Lam.) Link

Fuirena simplex Vahl.

Scirpus americanus Pers., var. americanus
S. atrovirens Willd.
S. lineatus Michx.
S. paludosis A. Nels.

Scleria triglomerata Michx.

ARACEAE

Arisaema dracontium (L.) Schott

LEMNACEAE

Lemna valdiviana Phil.

Wolffia papulifera Thompson

COMMELINACEAE

Commelina communis L.
C. diffusa Burmf.
C. erecta L., var. deamiana Fern.
C. erecta L., var. erecta

Tradescantia bracteata Small
T. ohiensis Raf., forma ohiensis

JUNCACEAE

Juncus acuminatus Michx., var. robustus Engelm.
J. diffusissimus Buckl.
J. effusus L., var. solutus Fern. & Wieg.
J. interior Wieg.
J. marginatus Rostk.
J. tenuis Willd., var. dudleyi (Weig.) Hermann
J. tenuis Willd., var. tenuis
J. torreyi Coville

LILIACEAE

Allium canadense L., var. canadense
A. canadense L., var. mobilense (Regal) Ownbey

Asparagus officinalis L.

Camassia angusta (Engelm. & Gray) Blankenship

Erythronium albidum Nutt., var. albidum Observed only.
E. albidum Nutt., var. coloratum Sterns.

Nothoscordum bivalve (L.) Britton

Polygonatum canaliculatum (Muhl.) Pursh.

Smilax bona-nox L.
S. herbacea L., var. lasioneuron (Hook.) A. DC.
S. tamnoides L.

Yucca glauca Nutt., var. glauca
Y. glauca Nutt., var. gurneyi McKelv.

Zigadenus nuttallii Gray

AMARYLLIDACEAE

Hypoxis hirsuta (L.) Coville

IRIDACEAE

Nemastylis geminiflora Nuttall

Sisyrinchium angustifolium Miller
S. campestre Bicknell, forma campestre
S. campestre Bicknell, forma kansanum (Bicknell) Steyerm.

ORCHIDACEAE

Spiranthes cernua (L.) Richard
S. gracilis (Bigel.) Beck

SALICACEAE

Populus deltoides Marsh.

Salix nigra Marsh.

JUGLANDACEAE

Carya cordiformis (Wang.) K. Koch
C. illinoensis (Wang.) K. Koch
C. texana Buckl. Observed only.

Juglans nigra L.

FAGACEAE

Quercus macrocarpa Michx.
Q. marilandica Muenchh.
Q. muehlenbergii Engelm., var. muehlenbergii
Q. prinoides Willd.
Q. shumardii Buckl., var. shumardii
Q. stellata Wang.
Q. velutina Lam.

ULMACEAE

Celtis laevigata Willd.
C. tenuifolia Nutt.

Ulmus americana L.

MORACEAE

Maclura pomifera (Ref.) Schneider

Morus alba L.
M. rubra L.

CANNABINACEAE

Humulus lupulus L.

URTICACEAE

Boehmeria cylindrica (L.) Sw.

Laportea canadensis (L.) Wedd.

Parientaria pensylvanica Muhl.

Urtica chamaedryoides Pursh.
U. dioica L.

LORANTHACEAE

Phoradendron serotinum (Raf.) M.C. Johnston Observed only.

ARISTOLOCHIACEAE

Aristolochia tomentosa Sims

POLYGONACEAE

Polygonum aviculare L.
P. convolvulus L.
P. hydropiperoides Michx., var. hydropiperoides
P. lapathifolium L.
P. pensylvanicum L.
P. punctatum Ell.
P. scandens L.
P. tenue Michx.

Rumex altissimus Wood
R. crispus L.
R. hastatulus Baldw.

Tovara virginiana (L.) Raf.

CHENOPODIACEAE

Chenopodium album L.
C. ambrosioides L., var. anthelminticum (L.) Gray
C. ambrosioides L., var. ambrosioides
C. hybridum L., var. gigantospermum (Aellen) Rouleau
C. leptophyllum Nutt.
C. standleyanum Aellen

AMARANTHACEAE

Amaranthus albus L., var. albus
A. graecizans L.
A. spinosus L.
A. tamariscinus Nutt.

Froelichia gracilis (Hook.) Moq.

Iresine rhizomotosa Standl.

NYCTAGINACEAE

Mirabilis linearis (Pursh.) Heimerl, var. linearis
M. nyctaginea (Michx.) MacM.

PHYTOLACCACEAE

Phytolacca americana L.

AIZOACEAE

Mollugo verticillata L.

PORTULACACEAE

Claytonia virginica L.

Portulaca mundula J.M. Johnston
P. oleracea L.

Talinum calycinum Engelm.

CARYOPHYLLACEAE

Arenaria drummondii Shinners
A. patula Michx.

A. serpyllifolia L.

Cerastium viscosum L.
C. vulgatum L., var. vulgatum

Dianthus armeria L.

Silene antirrhina L., forma antirrhina
S. stellata (L.) Ait. F., var. scabrella (Nieuw.) Palm. & Steyerm.

Stellaria media (L.) Cyrillo

ILLECEBRACEAE

Paronychia canadensis (L.) Wood
P. fastigiata (Raf.)

NYMPHACEAE

Nelumbo lutea (Willd.) Pers.

Nymphaea odorata Ait.

RANUNCULACEAE

Anemone caroliniana Walt., forma caroliniana
A. caroliniana Walt., forma, violacea Clute

Clematis dioscoreifolia Levl. & Vaniot
C. pitcheri T. & G.

Delphinium tricorne Michx. forma tricorne Observed only.
D. virescens Nutt.

Ranunculus abortivus L.

Thalictrum dasycarpum Fisch. & Lall., var. hypoglaucum (Rydb.) Boivin

ANONACEAE

Asimina triloba (L.) Dunal

MENISPERMACEAE

Cocculus carolinus (L.) DC.

Menispermum canadense L.

BERBERIDACEAE

Podophyllum peltatum L.

FUMARIACEAE

Corydalis crystallina Engelm.
C. flavula (Raf.) DC.

Dicentra cucullaria (L.) Bernh.

CRUCIFERAE

Brassica juncea (L.) Coss.
B. kabar (DC.) Wheeler, var. pinnatifida (Stokes) Wheeler

Capsella bursa-pastoris (L.) Medic

Cardamine parviflora L., var. arenicola (Britt.) O.E. Schulz

Dentaria laciniata Muhl.

Descurainia pinnata (Walt.) Britt., var. brachycarpa (Richardson) Fern.

Draba brachycarpa Nuttall
D. cuneifolia Nutt., var. cuneifolia

Erysimum repandum L.

Iodanthus pinnatifidus (Michx.) Steud.

Lepidium densiflorum Schrad.
L. virginicum L.

Lesquerella gracilis (Hook.) Wats., var. gracilis

Rorippa sessiliflora (Nutt.) Hitch.

Sisymbrium officinale (L.) Scop., var. leiocarpum DC.

CRASSULACEAE

Sedum nuttallianum Raf.
S. pulchellum Michx.

SAXIFRAGACEAE

Penthorum sedoides L.

Ribes odoratum Wendl. f.

PLATANACEAE

Platanus occidentalis L. Observed only.

ROSACEAE

Agrimonia parviflora Ait.
A. pubescens Wallr.

Crataegus viridis L., var. lutensis (Sarg.) Palm.

Fragaria virginica Duchesne

Geum canadense Jacq., var. camporum (Rydb.) Fern.

Potentilla arguta Pursh.
P. novegica L.
P. recta L.
P. simplex Michx.

Prunus americana Marsh., var. lanata Sudw.
P. angustifolia Marsh.
P. hortulana Bailey G.W. Stevens (2101) August 15, 1913
P. serotina Ehrh.

Rosa carolina L.
R. foliosa Nutt.
R. mutiflora Thumb.

R. setigera Michx., var. tomentosa T. & G.
R. setigera Michx., var. setigera

Rubus allegheniensis Porter
R. occidentalis L.
R. oklahomus Bailey
R. summotus Bailey

LEGUMINOSAE

Acacia angustissima (Mill.) Kuntze, var. hirta (Nutt.) Robinson

Amorpha canescens Pursh., forma canescens
A. fruticosa L.

Amphicarpa bracteata (L.) Fern., var. comosa (L.) Fern.

Astragalus crassicarpus Nutt., var. crassicarpus
A. distortus T. & G.
A. nuttallianus DC. var. nuttallianus
A. plattensis Nutt.

Baptisia australis (L.) R. Br., var. minor (Lehm.) Fern.
B. leucantha T. & G.
B. leucophaea Nutt., var. leucophaea

Cassia fasciculata Michx.
C. marilandica L.

Cercis canadensis L., var. canadensis

Coronilla varia L.

Crotalaria sagittalis L.

Desmanthus illinoensis (Michx.)

Desmodium canescens (L.) DC.
D. ciliare (Muhl.) DC.
D. cuspidatum (Muhl.) Loud.
D. glutinosum (Muhl.) Wood
D. illinoensis Gray
D. paniculatum (L.) DC., var. paniculatum
D. pauciflorum (Nutt.) DC.
D. sessilifolium (Torr.) T. & G.

Gleditsia triacanthos L.

Gymnocladus dioica (L.) K. Koch

Lathyrus latifolius L.

Lespedeza capitata Michx.
L. cuneata (Dumont) G. Don
L. repens (L.) Bart.
L. stipulacea Maxim.
L. striata (Thunb.) H. & A.
L. violcea (L.) Pers.
L. virginica (L.) Britt.

Medicago minima (L.) Bartilini
M. sativa L.

Melilotus alba Desv.
M. officinalis (L.) Lam.

Neptunea lutea (Leavenw.) Bentham

Petalostemum candidum Willd., var. candidum
P. multiflorum Nuttall
P. purpureum (Vent.) Rydberg

Psoralea esculenta Pursh.
P. tenuiflora Pursh.

Robinia pseudo-acacia L.

Schrankia uncinata Willd.

Strophostyles helvola (L.) Ell.
S. leiosperma (T. & G.) Piper R. Stratton (1678) July 14, 1929

Stylosanthes biflora (L.) B.S.P., var. hispidissima (Michx.) Pollard & Ball

Tephrosia virginiana (L.) Pers., var. holosericea (Nutt.) T. & G.

Trifolium campestre Schreb.
T. pratense L.
T. repens L. R. Stratton (1675) July 13, 1929

Vicia villosa Roth., forma albiflora (Schur.) Gams.
V. villosa Roth., forma villosa

LINACEAE

Linum sulcatum Riddell

OXALIDACEAE

Oxalis dillenii Jacq.
O. stricta L.
O. violacea L., var. violacea

GERANIACEAE

Geranium carolinianum L.

ZYGOPHYLLACEAE

Tribulus terrestris L.

Kallstroemia intermedia Tydb.

RUTACEAE

Xanthoxylum americanum Mill.

POLYGALACEAE

Polygala incarnata L.
P. verticillata L., var. sphenostachya Pennell

EUPHORBIACEAE

Acalypha gracilens Gray
A. ostryaefolia Riddell
A. virginica L.

Argythamnia mercurialina (Nutt.) Muell. Arg.

Croton capitatus Michx., var. capitatus
C. glandulosus L., var. septentrionalis Muell. Arg.
C. monanthogynus Michx.

Euphorbia corollata L., var. corollata
E. dentata Michx., forma cuphosperma (Engelm.) Fern.
E. dentata Michx., forma dentata
E. heterophylla L., var. heterophylla
E. marginata Push.
E. missurica Raf.
E. nutans Lag.
E. serpens H.B.K.
E. spathulata Lam.
E. supina Raf.

Tragia betonicifolia Nuttall
T. ramosa Torrey

CALLITRICHACEAE

Callitriche heterophylla Pursh.

ANACARDIACEAE

Rhus aromatica Ait., var. serotina (Greene) Rehd.
R. copallina L., var. latifolia Engler
R. glabra L.
R. radicans L., var. radicans, forma negundo (Greene) Fern.

AQUIFOLIACEAE

Ilex decidua Walt.

CELASTRACEAE

Celastrus scandens L

Euonymus atropurpureus Jacq.

ACERACEAE

Acer negundo L., var. negundo

A. saccharinum L.

HIPPOCASTANACEAE

Aesculus glabra Willd., var. glabra

SAPINDACEAE

Cardiospermum halicacabum L.

Sapindus drummondii H. & A.

BALSAMINACEAE

Impatiens capensis Meerb.

RHAMNACEAE

Ceonothus americanus L., var. pitcheri T. & G.

VITACEAE

Parthenocissus quinquefolia (L.) Planch., forma hirsuta (Donn) Fern.
P. quinquefolia (L.) Planch., forma quinquefolia

Vitis cineria Engelm.
V. riparia Michx.
V. vulpina L.

MALVACEAE

Albutilon theophrasti Medic.

Callirhoe alcaeoides (Michx.) Gray
C. papaver (Cav.) Gray, var. bushii (Fern.) Waterfall

Hibiscus militaris Cav.
H. trioneum L.

Sida spinosa L.

Sidopsis hispida (Pursh.) Rydb. emend Kearney

GUTTIFERAE

Hypericum drummondii (Grev. & Hook.) T. & G.
H. punctatum Lam.
H. sphaerocarpum Michaux.

TAMARICACEAE

Tamarix gallica L.

CISTACEAE

Lechea tenuifolia Michx.

VIOLACEAE

Viola papilionacea Pursh., forma albiflora Grover
V. papilionacea Pursh., forma papilionacea
V. pensylvanica Michx., var. leiocarpa (Fern. & Wieg.) Fern.
V. rafinesquii Greene

PASSIFLORACEAE

Passiflora incarnata L., forma alba Waterfall

LOASACEAE

Mentzelia oligosperma Nutt.

CACTACEAE

Mamillaria missouriensis Sweet.

Opuntia compressa (Salisb.) Macbr.

LYTHRACEAE

Ammannia auriculata Willd.
A. coccinea Rothb.

Lythrum alatum Pursh., var. alatum
L. alatum Pursh., var. lanceolatum (Ell.) T. & G.

Peplis diandra Nutt. G.W. Stevens (2107) August 15, 1913

Rotala ramosior (L.) Koehne, var. interior Fern. & Grisc.

ONAGRACEAE

Gaura filiformis Small
G. parviflora Dougl., forma glabra Munz
G. tripetala Cav., var. triangulata (Buckl.) Munz

Jussiaea peploides (H.B.K.) Raven, var. glabrescens (Ktze.) Shinners

Ludwigia alternifolia L., var. pubescens Palm. & Steyerm.
L. glandulosa Walt., var. torreyi Munz
L. palustris (L.) Ell., var. americana (DC.) Fern. & Grisc.

Oenothera biennis L., var. canescens T. & G.
O. laciniata Hill, var. laciniata
O. linifolia Nutt.
O. macrocarpa Nutt., var. macrocarpa
O. serrulata Nutt.
O. speciosa Nutt.
O. triloba Nutt.

Stenosiphon virgatus Spach

HALORAGIDACEAE

Myriophyllum heterophyllum Michx.

UMBELLIFERAE

Chaerophyllum procumbens (L.) Crantz
C. tainturieri Hooker, var. *tainturieri*
C. texanum Coulter & Rose

Cicuta maculata L.

Conium maculatum L.

Cryptotaenia canadensis (L.) DC.

Daucus carota L.
D. pusillus Michx.

Eryngium leavenworthii T. & G.
E. yuccifolium Michx., var. *synchaetum* Gray

Limnosciadum pinnatum (DC.) Math. & Const.

Lomatium daucifolium (Nutt.) Coulter & Rose

Osmorhiza longistylis (Torr.) DC., var. *villicaulis* Fern.

Ptilimnium nuttallii (DC.) Britt.

Sanicula canadensis L.
S. gregaria Bickn.

Spermolepis divaricata (Walt.) Britt.
S. inermis (Nutt.) Math. & Const.

Torilis arvensis (Huds.) Link

Zizia aurea (L.) Koch

CORNACEAE

Cornus drummondii Meyer

SAPOTACEAE

Bumelia lanuginosa (Michx.) Pers.

EBENACEAE

Diosypros virginiana L., var. virginiana

OLEACEAE

Fraxinus americana L., var. americana

GENTIANACEAE

Sabatia campestris Nutt., forma campestris

APOCYNACEAE

Apocynum cannabinum L., var. pubescens (Mitchell) A. DC.

ASCLEPIADACEAE

Asclepias hirtella (Pennell) Woodson
A. incarnata L.
A. stenophylla Gray
A. sullivantii Engelm.
A. syriaca L.
A. tuberosa L.
A. verticillata L.
A. viridiflora Raf., var. lanceolata (Ives) Torr.
A. viridiflora Raf., var. viridiflora
A. viridis Walt.

Cynanchum laeve (Michx.) Pers.

CONVOLVULACEAE

Convolvulus arvensis L.

Cuscuta campestris Yuncker
C. glomerata Choisey

C. pentagona Engelm.

Evolvulus nuttallianus R. & S.

Ipomoea hederacea (L.) Jacq., var. hederacea
I. hederacea (L.) Jacq., var. intergriuscula Gray
I. lacunosa L.
I. pandurata (L.) G.F.W. Mey.
I. purpurea (L.) Roth.

POLEMONIACEAE

Phlox divaricata L., var. laphamii Wood
P. pilosa

HYDROPHYLLACEAE

Ellisia nyctelea L.

Phacelia hirsuta Nutt.

BORAGINACEAE

Hackelia virginiana (L.) J.M. Jtn.

Heliotropium curassavicum L.
H. tenellum (Nutt.) Torr.

Lithospermum incisum Lehm.

Myosotis verna Nutt.

Onosmodium molle Michx., var. occidentale (Mack.) J.M. Jtn.

VERBENACEAE

Phyla lanceolata (Michx.) Green

Verbena bracteata Lag. & Rodr.
V. canadensis (L.) Britt.
V. simplex Vent.

V. stricta Vent., forma stricta
V. urticifolia L.

LABIATAE

Agastache neptoides (L.) Kuntze

Hedeoma hispida Pursh.

Lamium amplexicaule L., forma amplexicaule

Lycopus americanus L., var. scabrilfolius Fern.

Mentha cardiaca Baker

Monarda citriodora Cerv. ex Lagasca
M. fistulosa L., var. fistulosa

Nepeta cataria L.

Perilla frutescens (L.) Britt.

Physostegia angustifolia Fern.

Prunella vulgaris L., var. lanceolata (Bart.) Fern.

Pycnanthemum tenuifolium Schrad.

Salvia azurea Lam., var. grandiflora Benth.

Scutellaria ovata Hill
S. parvula Michx., var. parvula

Stachys tenuifolia Willd.

Teucrium canadense L., var. virginicum (L.) Eat.

Trichostema brachiatum L.

SOLANACEAE

Datura stramonium L.

Physalis angulata L., var. pendula (Rydb.) Waterfall
P. pumila Nuttall
P. turbinata Medicus
P. virginiana Miller, var. sonorea (Torr.) Waterfall

P. virginiana Miller, var. subglabrata (Mack. & Bush) Waterfall, forma subglabrata

Solanum carolinense L., forma albiflorum (O. Ktze.) Benke
S. elaeagnifolium Cav., forma elaeagnifolium
S. nigrum L., var. americanum (Mill.) Schulz
S. rostratum Dunal

SCROPHULARIACEAE

Buchnera americana L.

Castilleja coccinea (L.) Spreng., forma coccinea
C. coccinea (L.) Spreng., forma lutescens Farwell

Collinsia violacea Nuttall

Gerardia heterophylla Nuttall

Gratiola neglecta Yorrey

Leucospora multifida (Michx.) Nutt.

Linaria canadensis (L.) Dumont, var. texana (Scheele) Pennell
L. vulgaris Hill

Lindernia anagillidea (Michx.) Pennell
L. dubia (L.) Pennell

Mimulus alatus Ait.

Penstemon cobea Nuttall
P. digitalis Nutt.

Scrophularia marilandica L.

Seymeria macrophylla Nuttall

Verbascum blattaria L., forma blattaria
V. thapsus L.

Veronica arvensis L.
V. peregrina L., var. peregrina
V. peregrina L., var. xalapensis (H.B.K.) St. John & Warren
V. polita Fries

BIGNONIACEAE

Campsis radicans (L.) Seem.

Catalpa speciosa Warder

LENTIBULARIACEAE

Utricularia biflora Lam.

ACANTHACEAE

Dicliptera brachiata (Pursh.) Spreng.

Justicia americana (L.) Vahl.

Ruellia humilis Nutt.
R. strepens L., forma cleistantha (Gray) S. McCoy

PHRYMACEAE

Phryma leptostachya L.

PLANTAGINACEAE

Plantago aristata Michx.
P. lanceolata L.
P. purshii R. & S., var. purshii
P. rhodosperma Dcne.
P. rugelii Dcne.
P. virginica L.

RUBIACEAE

Cephalanthus occidentalis L., var. occidentalis

Diodia teres Walt., var. setifera Fern. & Grisc.

Galium aparine L.
G. circaezans Michx.
G. virgatum Nutt.

Hedyotis crassifolia Raf.
H. nigricans (Lam.) Fosb.

Spermacoce glabra Michx.

CAPRIFOLIACEAE

Sambucus canadensis L., var. canadensis

Symphoricarpos orbiculatus Meonch.

Triosteum perfoliatum L.

Virburnum prunifolium L., var. ferrugineum T. & G.

VALERIANACEAE

Valerianella radiata Dufr., forma parviflora (Dyal) Eggers
V. radiata Dufr., forma radiata

DIPSACACEAE

Dipsacus sylvestris Huds.

CUCURBITACEAE

Cucurbita foetidissima H.B.K.

Melothria pendula L.

Sicyos angulatus L.

CAMPANULACEAE

Campanula americana L., var. illinoensis (Fresn.) Farw.

Specularia biflora (R. & P.) Fisch. & Mey.
S. leptocarpa (Nuttall) Gray
S. perfoliata (L.) A. DC.

LOBELIACEAE

Lobelia cardinalis L.
L. spicata Lam., var. leptostachys (A. DC.) Mark. & Bush
L. spicata Lam., var. spicata

COMPOSITAE

Achillea lanulosa Nutt., forma lanulosa
A. lanulosa Nutt., forma rubicunda Farwell

Ambrosia bidentata Michx.
A. psilostachya DC., var. coronopifolia (T. & G.) Farw.
A. trifida L., var. texana Scheele

Antennaria neglecta Greene
A. plantaginifolia (L.) Richards

Arctium minus (Hill) Bernh.

Artemisia ludoviciana Nutt., var. ludoviciana

Aster ericoides L.
A. oblongifolius Nutt.
A. patens Ait., var. patentissimus (Lindl.) T. & G.
A. pilosus Willd.
A. praealtus Poir.
A. sagittifolius Wedemeyer, var. drummondii Lindl.
A. subulatus Michx., var. lingulatus Shinners

Astranthium integrifolium (Michx.) Nutt.

Bidens bipinnata L.
B. frondosa L.
B. polylepis Blake

Boltonia diffusa Ell., var. interior Fern. & Grisc.
B. asteroides (L.) L. Her., var. latisquama (Gray) Cronq.

Cacalia plantaginea (Raf.) Shinners

Carduus nutans L.

Centaurea americana Nutt.

Chaetopappa asteroides DC.

Chrysanthemum leucanthemum L., var. pinnatifidum Lecoq. & Lamotte

Chrysopsis pilosa Nutt.

Circium altissimum (L.) Spreng.
C. undulatum (Nutt.) Spreng.

Conyza canadensis (L.) Cronq., var. glabrata (Gray) Cronq.
C. canadensis (L.) Cronq., var. canadensis

Coreopsis grandiflora Hogg., var. grandiflora
C. tinctoria Nutt., var. cardaminefolia (DC.) Smith & Parker
C. tinctoria Nutt., forma tinctoria

Echinacea pallida Nutt.

Eclipta alba (L.) Hassk.

Elephantopus carolinianus Willd.

Erechtites hieracifolia (L.) Raf., var. intermedia Fern.

Erigeron annuus (L.) Pers.
E. philadelphicus L.
E. strigosus Muhl. ex Willd.

Eupatorium altissimum L.
E. coelestinum L.
E. rugosum Houtt.
E. serotinum Michx.

Gaillardia pulchella Foug.

Gnaphalium obtusifolium L.
G. purpureum L.

Grindelia lanceolata Nutt.

Gutierrizia dracunculoides (DC.) Blake

Haplopappus ciliatus (Nutt.) DC.

Helenium amarum Raf., var. amarum
H. autumnale L.

Helianthus annuus L.
H. hirsutus Raf., var. hirsutus
H. hirsutus Raf., var. trachyphyllus T. & G.
H. laetiflorus Pers.

H. mollis Lam.
H. petiolaris Nutt.
H. salicifolius A. Dietr.
H. tuberosus L.

Heterotheca latifolia Buckl.

Hieracium longipilum Torr.

Hymenopappus scabiosaeus L.'Her., var. scabiosaeus

Iva angustifolia Nutt.
I. ciliata Willd.

Krigia oppositifolia Raf.

Kuhnia eupatorioides L., var. ozarkana Shinners

Lactuca canadensis L., var. latifolia (Michx.) Farw.
L. scariola L., forma scariola

Liatris aspera Michx., var. aspera
L. punctata Hooker, var. nebraskensis Graiser
L. pycnostachya Michx.
L. squarrosa (L.) Michx., var. hirsuta Rydberg

Parthenium hysterophorus L.

Pluchea purpurascens (Sw.) DC.

Polymnia uvedalia L., var. densipilis Blake

Pyrrhopappus carolinianus (Walt.) DC.

Ratibida columnifera (Nutt.) E. & S., forma columnifera

Rudbeckia amplexicaulis Vahl.
R. hirta L., var. pulcherrima Farwell
R. laciniata L.
R. triloba L.

Senecio glabellus Poiret
S. plattensis Nuttall

Silphium integrifolium Michx., var. integrifolium
S. laciniatum Torr., var. laciniatum
S. perfoliatum L.

Solidago delicatula Small
S. gigantea Ait.
S. gymnospermoides (Greene) Fern.
S. missouriensis Nutt., var. fasciculata Holz.
S. petiolaris Ait.

S. rigida L.

Sonchus asper (L.) Hill, forma glandulosus Beckl.

Taraxacum erythrospermum Andrz.
T. officinale Wiggers

Tragopogon major Jacq.

Verbesina helianthoides Michx.
V. virginica L.

Vernonia baldwinii Torr., var. baldwinii
V. baldwinii Torr., var. interior (Small) Schub.
V. crinata Raf.

Xanthium stumarium L., var. glabratum (DC.) Cronq.

CHAPTER X

TABULAR VIEW OF THE FAMILIES

The following is an alphabetical tabulation of the taxa enumerated in Chapter IX.

Families	Genera	Species	Species and Subordinate Taxa
Acanthaceae	3	4	4
Aceraceae	1	2	2
Alismataceae	3	3	3
Aizoaceae	1	1	1
Amaranthaceae	3	6	6
Amaryllidaceae	1	1	1
Anacardiaceae	1	4	4
Anonaceae	1	1	1
Apocynaceae	1	1	1
Aquifoliaceae	1	1	1
Araceae	1	1	1
Aristolochiaceae	1	1	1
Asclepiadaceae	2	10	11
Balsaminaceae	1	1	1
Berberidaceae	1	1	1
Bignoniaceae	2	2	2
Boraginaceae	5	6	6

Families	Genera	Species	Species and Subordinate Taxa
Cactaceae	2	2	2
Callitrichaceae	1	1	1
Campanulaceae	2	4	4
Cannabinaceae	1	1	1
Caprifoliaceae	4	4	4
Caryophyllaceae	5	9	9
Celastraceae	2	2	2
Chenopodiaceae	1	5	6
Cistaceae	1	1	1
Commelinaceae	2	5	6
Compositae	54	100	105
Convolvulaceae	4	9	10
Cornaceae	1	1	1
Crassulaceae	1	2	2
Cruciferae	12	15	15
Cucurbitaceae	3	3	3
Cyperaceae	8	36	36
Dipsacaceae	1	1	1
Ebenaceae	1	1	1
Euphorbiaceae	5	18	19
Fagaceae	1	7	7
Fumariaceae	2	3	3
Gentianaceae	1	1	1
Geraniaceae	1	1	1
Graminae	44	92	96
Guttiferae	1	3	3

Families	Genera	Species	Species and Subordinate Taxa
Haloragidaceae	1	1	1
Hippocastanaceae	1	1	1
Hydrophyllaceae	2	2	2
Illecebraceae	1	2	2
Iridaceae	2	3	4
Juglandaceae	2	4	4
Junaceae	1	7	8
Labiatae	16	18	18
Leguminosae	27	55	56
Lemnaceae	2	2	2
Lentibulariaceae	1	1	1
Liliaceae	9	11	14
Linaceae	1	1	1
Loasaceae	1	1	1
Lobeliaceae	1	2	3
Loranthaceae	1	1	1
Lythraceae	4	5	6
Malvaceae	5	7	7
Menispermaceae	2	2	2
Moraceae	2	3	3
Najadaceae	1	1	1
Nyctaginaceae	1	2	2
Nymphaceae	2	2	2
Oleaceae	1	1	1
Onagraceae	5	15	15
Orchidaceae	1	2	2

Families	Genera	Species	Species and Subordinate Taxa
Oxalidaceae	1	3	3
Passifloraceae	1	1	1
Phrymaceae	1	1	1
Phytolaccaceae	1	1	1
Plantaginaceae	1	6	6
Platanaceae	1	1	1
Polemoniaceae	1	2	2
Polygalaceae	1	2	2
Polygonaceae	3	12	12
Portulaceae	3	4	4
Ranunculaceae	5	7	8
Rhamnaceae	1	1	1
Rosaceae	8	21	22
Rubiaceae	5	8	8
Rutaceae	1	1	1
Salicaceae	2	2	2
Sapindaceae	2	2	2
Sapotaceae	1	1	1
Saxifragaceae	2	2	2
Scrophulariaceae	14	20	22
Solanaceae	3	9	10
Tamaricaceae	1	1	1
Typhaceae	1	2	2
Ulmaceae	2	3	3
Umbelliferae	14	20	20
Urticaceae	4	5	5

Families	Genera	Species	Species and Subordinate Taxa
Valerianaceae	1	1	2
Verbenaceae	2	6	6
Violaceae	1	3	4
Vitaceae	2	4	5
Zosteraceae	1	3	3
Zygophyllaceae	2	2	2

TOTALS

Families	Genera	Species	Species and Subordinate Taxa
101	372	682	712

CHAPTER XI

SUMMARY

During the period August, 1971, through October, 1973, one thousand and fifty-seven accessions were made by the author and the identified specimens with labels deposited in the Oklahoma State University Herbarium. From these specimens and a very few others collected by G.W. Stevens and Robert Stratton, a list of Washington County's native or naturalized angiosperm plants was compiled. The list contains 101 families, 372 genera, 682 species and 712 different taxa. Approximately 55% of the taxa are from 9 families: Compositae, 105; Graminae, 96; Leguminosae, 56; Cyperaceae, 36; Scrophulariaceae, 22; Rosaceae, 22; Umbelliferae, 20; Euphorbiaceae, 19; and Labiatae, 18. Two species, Tradescantia bracteata and Wolffia papulifera, are reported as additions to the state flora and 14 taxa seldom collected in Oklahoma are considered specially significant.

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