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Academy Editors

ARKANSAS ACADEMY OF SCIENCE

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VOLUME XIV 1960

Correspondence should be addressed as follows:

Manuscripts:
William K. Noyce, Editor
University of Arkansas
Fayetteville

Subscriptions and Exchanges
R. Reece Corey
University of Arkansas
Fayetteville

Price: Three Dollars

ARKANSAS ACADEMY OF SCIENCE

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proceedings

Volume XIV 1960

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ARKANSAS ACADEMY OF SCIENCE

Forty-fourth Annual Meeting
Arkansas Polytechnic College
April 1-2, 1960

OFFICERS

President	Neal D. Buffaloe
President-Elect	Herman L. Bogan
Secretary	W. L. Evans
Treasurer	R. S. Fairchild

SECRETARY'S REPORT

The first business meeting was called to order by President Neal Buffaloe at 11:20 a.m., April 1, with 43 members present. Mr. Truman McEver welcomed the Academy and its affiliated groups to the campus of Arkansas Polytechnic College, and announced program activities for the meeting.

The following recommendations of the Executive Committee were accepted:

1. The Academy shall set aside $500 as a reserve fund to meet future financial emergencies.
2. The Academy encourages the development of a Junior Academy of Science publication, and proposes to consider such a publication at the next annual meeting.
3. The President will appoint a committee to consider a proposal by Dr. Oren Rankin, Arkansas Polytechnic College, that the Academy undertake a study of science education in Arkansas secondary schools, this committee to report at the second business meeting of the Academy.
4. The Academy agrees to sponsor an NSF-supported program in which Academy members will present programs in science and mathematics in Arkansas schools.

Several officers of the Academy made reports. The Secretary's Report, read by Dr. Evans, was accepted. Dr. Fairchild reported a balance in the treasury of $1499.43. Dr. Noyce called attention to editorial policy requiring papers to be submitted for publication at the time of presentation.

Dr. Evans reported that the AAAS research grant of $50 was awarded to Donald Goodner, Waldron High School, for construction of an electron beam generator. The Secretary was empowered by action of the membership to select awards committees in the future.

Dr. Buffaloe appointed several ad hoc committees prior to adjournment at 12.15 p.m.

Nominations: Lowell Logan (chairman), Joe Pryor, Edward Amis.

Auditing: Charles Pitner (chairman), J. H. Quinn.

Meeting Place: Sam Siegel (chairman), Ronald McGee, R. W. Shideler.

The second business meeting was called to order by Dr. Buffaloe at 9:15 a.m., April 2. Twenty-six members were present. The Audit Committee reported the records of the Treasurer were in good order. Mr. McGee proposed that the 1961 meeting be held at the University of Arkansas. The proposal passed unanimously. Mr. McGee suggested that the 1962 meeting might be held at Hendrix College and the 1963 meeting at Arkansas A. and M. College. New Officers of the Academy were nominated by Dr. Logan as follows:

President	H. L. Bogan, Arkansas State College
President-Elect	Truman McEver, Arkansas Polytechnic College
Secretary	R. R. Corey, University of Arkansas
Treasurer	R. S. Fairchild, University of Arkansas
Editor	W. K. Noyce, University of Arkansas

These officers were elected.

The committee appointed by Dr. Buffaloe (L. F. Bailey, H. L. Bogan, Eugene Jones) reported on their meeting with Dr. Oren Rankin concerning the study of science education in Arkansas. Dr. Rankin is chairman of a subcommittee on science in the Curriculum Council of the State Department of Education. This subcommittee, charged with the responsibility for recommendations to the Curriculum Council, asked that the Academy undertake a two or three year study of science education in secondary schools in Arkansas. This study should include curricula, library holdings, laboratory facilities, teacher preparation, etc. The objective of the study would be a report to be transmitted to the State Department of Education which would be primarily a series of recommendations for improving science education in the State. No funds are available for the study, but the State Department will consider publication of the final report.

The membership voted to undertake this project and authorized the President to appoint a steering committee to identify areas for study and to suggest subcommittees to carry out specific assignments. The steering committee appointed by Mr. Bogan consists of L. F. Bailey (chairman), Neal Buffaloe, and Lowell Logan. This committee plans to have its first meeting in May.

The Academy voted to pay minimum travel expenses to Russellville for Science Talent Search winners, and to award them one-year subscriptions to Science News-letter.

Dr. Evans reported on a move to separate Junior Academies from the Senior Academies at the national level. Mr. McGee spoke against such a move in Arkansas. No formal action was taken.

Mr. Bogan expressed the need for better publicity of Academy of Science activities. At the suggestion of Mr. McEver, the President was requested to appoint a publicity director for the Academy and to authorize expenditures not exceeding $25 annually for publicity purposes. The Senior Academy should be the major concern of this publicity. Mr. Bogan appointed J. W. Sears to the publicity directorship.

Mrs. Giles sponsored a vote of thanks to the local committee concerned with the State Science Fair, and to Miss Reid, Miss Dunn, and Mrs. Hines for their sponsorship of science fair and Junior Academy activities.

The meeting adjourned at 10:15 a.m.

Respectfully submitted,

Lowell F. Bailey
Acting Secretary

PROGRAM

Friday, April 1

9:00 a.m. to 2:30 p.m.	Registration, Lobby of W. O. Young Student Center.
11:00 a.m.	Business Meeting, Ballroom of W. O. Young Student Center.
12:15 p.m.	Luncheon, College Cafeteria.
1:15 p.m.	Science Education Section, W. O. Young Student Center.
	"Science Education Activities Planned and in Progress in Arkansas," Lowell F. Bailey, University of Arkansas, in charge of program.
2:30 p.m. to 4:30 p.m.	Section Meetings.
4:30 p.m.	Arkansas Science Teachers Association Meeting, W. O. Young Student Center.
6:30 p.m.	Banquet, Cafeteria Dining Hall.
7:30 p.m.	Traveling Science Teacher Program, Mrs. Alice Brooks, Ozark Science Teacher, Cafeteria Dining Hall.
8:30 p.m.	Presentation of Science Fair Awards, Cafeteria Dining Hall.
8:30 p.m. to 10:00 p.m.	Science Fair Exhibit, Women's Gymnasium.

Saturday, April 2

9:00 a.m.	Second Business Meeting, W. O. Young Student Center. Treasurer's Report. Reports of standing committees and special committees. Election of officers. Location of next year's meeting. New business. Installation of officers.
10:30 a.m.	General Session with Junior Academy and Collegiate Academy, W. O. Young Student Center. Papers by Science Talent Search Winners. Dr. L. J. Paulissen in charge.
11:45 a.m.	Luncheon, College Cafeteria.

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University of Arkansas

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SOME RECENT FINDINGS CONCERNING THE AVIFAUNA OF ARKANSAS

Douglas James
University of Arkansas

Baerg's 1951 edition of "Birds of Arkansas" (1951. Univ. Ark., Agric. Exp. Sta., Bull. no. 258) is the most recent statewide appraisal of bird distribution. In 1953, Meanley and Neff (1953. Wilson Bull., 65:200-201) supplemented this with new data from the Grand Prairie region. The records which follow are some important findings since 1953, plus a few unpublished ones which preceded that date. The annotations that refer to previous status were based primarily on Baerg, supplemented by Wheeler (1924. The Birds of Arkansas. Ark. Bur. Mines. Manufactures and Agriculture) and Howell (1911. U. S. Dept. Agric., Biol. Sur., Bull. no. 38).

The specimen catalogue numbers refer to the University of Arkansas zoology collection (U.A.Z.). Recently, the important sight records have been described in writing on a standardized form distributed by the Arkansas Audubon Society. These documents (A.A.S.) are numbered serially and filed with the Society. Whether so documented or not all the sight records are followed by the names of the observers. The terminology and sequence follows the fifth edition of "The A.O.U. Check-list of North American Birds."

The collection and organization of the data used in this study was made possible by funds for research from the College of Arts and Sciences at the University of Arkansas, by the sponsorship of the Arkansas Audubon Society, and by assistance from Frances C. James. Beginning in 1955, all the Arkansas records have been catalogued in the files of bird abundance and distribution maintained by the Arkansas Audubon Society.

Gavia immer. Common Loon. Only three previous records existed, but it is now regular, though uncommon, at Fayetteville from March 21 to May 10, and from October 25 to November 16 (James, B. W. Beall), and has been observed at Conway on November 18, 1956 (V. B. Scarlett). A specimen taken at Lonoke on April 10, 1956, is in the Arkansas Game and Fish Commission collection and was pictured in the Arkansas Gazette newspaper on April 15, 1956.

Podiceps caspicus. Eared Grebe. Up to nine occurred at Conway from April 6 to 27, 1956 (W. M. Shepherd). This followed an eastward movement of wintering populations into Louisiana (Newman. 1956. Audubon Field Notes, 10:256-260). Another was seen (AAS 35) at Lonoke on December 26, 1959 by T. H. Johnston. There were two previous records.

Plegadis. Ibis. The first Arkansas record of this genus occurred at Lonoke on September 16, 1956, and was collected (UAZ 381) there the 21st. The species of this immature bird could not be determined (Belknap. Observations on the white-faced ibis in Louisiana. La. State Univ., Master's Thesis, p. 73).

Olor columbianus. Whistling Swan. The first specimen and third state record was an immature bird obtained at Gillett on January 23, 1959. The skin is at the Little Rock Natural History Museum. The sternum and trachea are in the University collection (UAZ 368). A flock of six swans occurred at the Holla Bend National Wildlife Refuge near Russellville from February 2 to March 18 in 1960 (J. M. Dale).

Anser albifrons. White-fronted Goose. Prior to 1955, this species was known only from an Audubon record, and from unpublished observations of 500 on October 13, and 800 on the 14th in 1937, at the Big Lake National Wildlife Refuge near Manila (S. Crossley), and two at Stuttgart on November 19, 1950 (F. T. Carney). From December 28, 1955, to January 27, 1956, an immature bird was seen at the White River National Wildlife Refuge near St. Charles (P. J. Van Huisen). Single birds were seen at Prairie Grove (James) and Conway (W. M. Shepherd) on November 17, 1956. An Adult photographed (UAZ 378) nine miles north of Fort Smith remained there from mid-October 1956, to April 21, 1957 (J. W. Price, J. S. Mulhollan). A flock of thirty-four occurred at the Big Lake Refuge on March 28, 1958 (W. H. Julian). Thirty-nine occurred at the Holla Bend Refuge from March 25 to April 7, 1958, and a flock of eight occurred there from February 27, 1960 to March 18, 1960 (J. M. Dale). A flock of 265 occurred at Fort Smith on March 18, 1960 (R. D. Fox).

Callipepla squamata pallida. Scaled Quail. One was collected (UAZ 353) by Rollie Rich five miles east of Griffithville on January 31, 1958, and identified by T. D. Burleigh of the U. S. National Museum. Since this sedentary bird was some five hundred miles east of its normal range, it probably was introduced even though it showed no external signs of a captive existence.

Porphyrula martinica. Purple Gallinule. A female with mature follicles was collected (UAZ 328) in a marshy reservoir four miles north of Grady on May 27, 1955, and another was seen at the same place on May 31. This species previously was known only from Lonoke.

Charadrius melodus. Piping Plover. Baerg listed one record. In 1956, one occurred at Lonoke on April 15 and September 21 (James), and three were observed at Fort Smith on August 21 (B. W. Beall, J. W. Price). Also at Fort Smith, one was seen on August 8, and two on September 5, in 1959 (B. W. Beall, J. W. Price).

Arenaria interpres. Ruddy Turnstone. Single birds were seen at Lonoke five times from September 10 to 21, 1956 (AAS 43; James, W. M. Shepherd, V. B. Scarlett, V. G. Springer et al.). Plumage variation indicated that at least two birds were present. The only previous record was from the last century.

Totanus flavipes. Lesser Yellowlegs. Winter occurrences of this common transient species were unknown previously. Three were seen at Horseshoe Lake near Bruins on February 10 and 24, 1952 (R. D. Smith, Jr.), and at Lonoke one was seen on January 1, 1954 (R. D. Smith, Jr.), two were seen on November 24, 1955 (B. B. Coffey, Jr., L. Coffey, James, F. C. James), and two were seen on December 24, 1955 (G. Payton).

Erolia alpina. Dunlin. Several were seen at Stuttgart on May 27, 1951 (B. Meanley), and one of two birds was collected (UAZ 342) three miles southwest of Rogers on November 15, 1957. These were the third and fourth occurrences in the state.

Limnodromus. Dowitcher. Baerg listed only one record of this form, but recently it has been a regular but uncommon autumn transient at Lonoke. There have been seven records since 1950, between August 20 and October 18. Spring records are from Morrilton, Conway, Lonoke, and Brinkley. It has occurred at Lonoke in three winters: Twelve on November 28, 1954 (B. B. Coffey, Jr.); and in 1955, six on January 1 (R. D. Smith, Jr., H. Landis, Jr., H. H. Wilcox); five on January 30 (B. B. Coffey, Jr.); two on December 24 (R. D. Smith, Jr.); and six on December 26, 1959 (AAS 38; James W. M. Shepherd, V. B. Scarlett). These last were called *scolopaceus* because their beaks were longer than the beaks of nearby Common Snipe (*Capella gallinago*). Otherwise, the species was not designated until a specimen (UAZ 358) was taken by W. P. Scarlett on August 30, 1958, at Lonoke, and another (UAZ 359) was collected there by myself on September 6, 1958. Both were *griseus*. Three specimens (UAZ 364, 365, 366) from a flock of fifty-nine near England on October 12, 1958, were *scolopaceus*. The rest of this flock emitted the "keek" sound of the long-billed form.

Limosa fedoa. Marbled Godwit. One at Lonoke on September 13, 16, 18, and 21, 1956 (James, V. B. Scarlett, V. G. Springer *et al*.) was the first state record.

Limosa haemastica. Hudsonian Godwit. Two occurred at Oppelo on April 29, 1956 (AAS 1). This was the first state record.

Recurvirostra americana. American Avocet. Baerg listed three records since 1930, one erroneously (Coffey, 1951. *Migrant*, 22: 50-52). Three were seen at Stuttgart on October 13, 1950 (B. Meanley); nineteen occurred at Fayetteville on October 14, 1954, and nine were observed there October 13, 1955 (B. W. Beall); one was collected (UAZ 361) at Lonoke on September 6, 1958; and two were seen near England on October 12, 1958 (James, R. D. Fox).

Lobipes lobatus. Northern Phalarope. One at Fort Smith on September 14, 1958 (AAS 19; B. W. Beall) was the first state record.

Sterna albifrons. Least Tern. It long has been speculated that this species nested in Arkansas, but direct proof was lacking. On June 8, 1958, B. W. Beall and R. D. Fox found a colony of six nests on the sand bars of the Arkansas River downstream from the Fort

Smith-Van Buren bridge. Three eggs were laid before the colony was inundated after June 21. In 1959, young hatched and probably were fledged in the same colony.

Geococcyx californianus. Roadrunner. Baerg found that this species entered the state from the Southwest in the mid-30's, and had spread through the western tier of counties north to Crawford County by 1950. Since then it has occupied Washington and Benton Counties to the north, and has moved eastward to Chidester in the southern part of the state, and Little Rock in central Arkansas. The Arkansas River Valley seems to have been a main route of eastward dispersal.

Crotophaga sulcirostris. Groove-billed Ani. Meanley and Neff (1953. Wilson Bull., 65:200-201) secured the first record in 1952. Subsequently, one was killed by a cat (UAZ 329) at Nashville in late November, 1955, and three were seen (AAS 32) at Fort Smith on November 17, 1959, by J. Keller.

Nyctea scandiaca. Snowy Owl. A mounted specimen in Matthews hardware store at Pine Bluff was collected near Moscow around 1946 by the late Charles Hunter. Another one was collected one mile east of Guy in mid-November, 1954, by James H. Maudlin of Quitman. I have seen both of these specimens. In the same winter of Maudlin's record still another was seen by Ruth Thomas at Morrilton on January 4, 1955. The only previous record was one reported by Audubon.

Aegolius acadicus. Saw-whet Owl. One was found dead by T. H. Holder on a road near Reydel on November 11, 1959. The only other record was an old one which Howell believed was invalid.

Colaptes cafer. Red-shafted Flicker. In autumn, winter and spring of 1956-57, single birds were seen in northwestern Arkansas at Fayetteville on October 6, and March 15 (B. W. Beall), at Lowell on February 21, and at Prairie Grove on the 24th (James, H. H. Daniel). T. G. Hoffman saw one at Texarkana on January 8, 1959 (AAS 25). The only previous record was dated 1911.

Pyrocephalus rubinus. Vermillion Flycatcher. The three previous records were from scattered localities in southern Arkansas. Recently, one or two birds have occurred nearly every winter at Calion.

Salpinctes obsoletus. Rock Wren. One seen (AAS 17) six miles north of Murfreesboro on May 31, 1958 (B. B. Coffey) was the first state record.

Anthus spraguei. Sprague's Pipit. This species apparently is a newcomer to Arkansas occurring in the short sparce grasslands, primarily airports, which have been produced by man. They have been reported from Benton, Farmington, Fort Smith, Hot Springs, Pine Bluff, Jonesboro, Wynne, West Helena, Hope, Texarkana, Conway, Lonoke, Carlisle, Stuttgart, Monroe County, Crittenden County, and occurred regularly at some of these places. Two specimens have been collected; one at Farmington (UAZ 336) on December 25, 1956, and one by B. B. Coffey, Jr., at Carlisle on April 3, 1955. Howell was justified in questioning the validity of the only previous record. The behavior and numbers of the birds referred to by Dr. Coues definitely describes spinoletta, and not the secretive solitude-seeking spragueii. Hunt's speculations on spragueii (1921. Auk, 38:370-381) were invalid for the same reason, plus the unsuitability of the habitat.

Vireo griseus. White-eyed Vireo. One was seen (AAS 7) by Dr. and Mrs. H. N. Marvin at Little Rock on December 29, 1957. This is the only winter record.

Vireo solitarius. Solitary Vireo. One was collected by A. J. Hoiberg at El Dorado on December 31, 1955. This is the only winter record.

Vermivora celata. Orange-crowned Warbler. Single birds were seen at Little Rock on December 28, 1957, by W. M. Shepherd (AAS 10), at El Dorado on December 31, 1955 (James) and throughout December in 1959 (AAS 34), including one specimen collected there by P. M. Mattocks, Jr. These are the only winter records.

Geothlypis trichas. Yellowthroat. One occurred at Stuttgart on February 23, 1954 (B. Meanley). At Lonoke one was seen on January 1, 1955 (R. D. Smith, Jr.), two on January 30, 1955 (James, B. B. Coffey, Jr.), and one on December 26, 1959 (AAS 39; W. M. Shepherd). These are the only winter records.

Sturnella neglecta. Western Meadowlark. The status of this species has been clarified and it no longer is considered unusual. It regularly occurs in winter in small numbers in the northwestern and east-central parts of the state.

Pheucticus melanocephalus. Black-headed Grosbeak. The first records in Arkansas coincided with a marked eastward movement of this species in the winter of 1956-57 (Pettingill. 1957. Audubon Field Notes, 11:244-246). Three birds were seen at Little Rock on December 28, 1956, by V. G. Springer (AAS 6), and another occurred throughout March, 1957, at El Dorado (AAS 8; A. J. Hoiberg et al.). One was trapped at El Dorado on February 11, 1959, by P. M. Mattocks, Jr., and subsequently was photographed (UAZ 369).

Acanthis flammea. Common Redpoll. A male and two females observed (AAS 28) by V. G. Springer ten miles north of Stuttgart on November 2, 1959, was the first state record.

Pipilo erythrophthalmus. Rufous-sided Towhee. Western forms recognized by their "spotted" plumage have been seen at Lowell, Fort Smith, Clarksville, Morrilton, and Little Rock. One was photographed at Little Rock in March 1955 (UAZ 377). There were no previous records of this form.

Passerherbulus caudacutus. Le Conte's Sparrow. This species is not as rare as previous records indicated. Recent records suggest that it is common in winter in tall-grass old fields. The Lonoke

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Christmas count often leads the nation in the number of this species. Specimens have been collected (UAZ 330, 331) at Calion and Petit Jean Mountain.

Junco oreganus. Oregon Junco. Previously there was only one record. Recently one was collected (UAZ 367) at Fayetteville on January 22, 1959. In the winter of 1960, this species was reported from Fayetteville, Little Rock (AAS 41), and Crittenden County.

Calcarius pictus. Smith's Longspur. Like the Sprague's Pipit, this species has followed man's artificial short-grass "prairies" eastward. It now occurs regularly in winter on airports and the like in the Arkansas River Valley and east-central region of the state. Also, it has been found in other regions. One was collected at Jonesboro on February 26, 1955 (B. B. Coffey, Jr.). Baerg listed only one record.

Calcarius ornatus. Chestnut-collared Longspur. Six observed at Fort Smith on December 25, 1953, by E. J. Wilhelm, Jr., was the first Arkansas record. One was collected there by myself (UAZ 337) from a flock of twenty on December 29, 1956, and three were seen at Lonoke on January 26, 1957, by W. M. Shepherd, L. Coffey and B. B. Coffey, Jr.

Plectrophenax nivalis. Snow Bunting. A specimen (UAZ 372) collected at Calion by H. H. Shugart and A. P. Parker on November 6, 1959, was the first state record.

NOTES ON THE SALAMANDERS OF ARKANSAS
#2 The Status of Desmognathus in Arkansas

Charles C. Smith
Arkansas College

Several workers have at different times dealt with the salamanders of the genus Desmognathus in Arkansas and adjacent states. The most comprehensive work is that of Grobman (1950) who summarizes the information on the distribution of the races of Desmognathus fuscus in the southern states as he could interpret data available up to 1950. He also discusses the color differences between Desmognathus fuscus auriculatus (Holbrook) and Desmognathus fuscus brimleyorum Stejneger in their respective ranges. Grobman lists collections in Arkansas from Eureka Springs (northwest), Walnut Ridge (northeast), Forrest City (east central), as well as several south of the Arkansas River. Dowling (1957) states that it is doubtful whether any species of Desmognathus occur north of the Arkansas River in Arkansas. Rossman (1958) recognizes a new race, Desmognathus fuscus conanti Rossman, with a range that included West Tennessee.

The writer had occasion in the spring of 1958 to make several collections of salamanders in the western part of Arkansas south of the Arkansas River. From several small streams southwest of Hot Springs many specimens of Desmognathus fuscus were obtained. All were of the race brimleyorum according to available literature, (Bishop 1943). In the collections were specimens that were quite like the race auriculatus and some very near the race Desmognathus fuscus fuscus (Rafinesque).

I decided that the problem deserved more study so I made a four-week reconnaissance trip through Mississippi, Alabama, Florida, Georgia, South Carolina, North Carolina, Virginia, and Tennessee to collect specimens. Additional trips into Missouri, Mississippi, Tennessee, and throughout Arkansas were made. Approximately 600 specimens of D. fuscus races were collected. In many cases the number of specimens per collection was small; in others numerous. Taken as a whole the series presents a much clearer picture than would be possible from miscellaneous collections taken at various times by various people.

PROCEDURE

Collections were made in small streams and around springs.

Financial assistance provided by Arkansas College is acknowledged.

Usually it is necessary to stir and move leaves, bark, stones, and moss in order to locate specimens. These are captured by hand or swept into a dip net. Because of their extreme agility, capture is often difficult. Field preservation was in 5% formalin solution, permanent storage in 50% isopropyl alcohol.

Collections were made from the following areas:

Garland County, Arkansas	103
Logan County, Arkansas	34
St. Francis County, Arkansas	9
Cross County, Arkansas	185
Baxter County, Arkansas	4
Marshall County, Mississippi	4
Lauderdale County, Tennessee	85
Henderson County, Tennessee	2
Tuscaloosa, Alabama	21
Alachua County, Florida	25
Western North Carolina	37

Collections have been made from some of the Crowley Ridge locations at different seasons of the year in order to follow changes in the color pattern.

The following measurements were recorded in millimeters for each specimen: head width, gular to snout length, total length, body length, center of gular to post anal. Figures for each sex were averaged and it was found that measurements of both sexes were about the same so they were combined to arrive at the figures in Table I. This table is made up of ratios and percentages for four subspecies of Desmognathus as indicated, with three population samples of D. f. conanti.

Identification follows Bishop (1943) with the exception of D. f. conanti Rossman. This subspecies was named in 1958 by Rossman (1958). Mr. Rossman has examined the collections from Crowley Ridge, Arkansas; Ripley, Tennessee; and Tuscaloosa, Alabama and has identified them as belonging to the subspecies conanti.

DISCUSSION

Data in the top row of Table I are from specimens collected in the mountains of western North Carolina. Only 34 specimens were available for measuring, but the data gives an idea of what fuscus is from a morphological standpoint. The gular to snout length in relation to body length is greater than the other races measured and the percentage of tail in total length is less than D. f. conanti and auriculatus, but greater than brimleyorum.

Three populations identified as conanti by Rossman who described the subspecies, were sampled. A total of 280 specimens were collected. The three populations are roughly north to south in orientation. The Crowley Ridge population is about 80 miles west

	* Gular to Snout / Head W	Trunk / Gular to Snout	Body / Head W	Tail % Total Length	% of Population with Pigmented Venters	% of Population with Lateral White Dots	Number of Specimens
Desmognathus fuscus fuscus North Carolina	1.28	3.38	5.70	46.	43	58	34
Desmognathus fuscus conanti Lauderdale, Tenn.	1.37	3.45	6.24	47.6	94	75	40
Desmognathus fuscus conanti Tuscaloosa, Ala.	1.31	3.56	6.10	47.8	60	40	21
Desmognathus fuscus conanti Arkansas	1.25	3.62	6.13	47.8	98	29	60
Desmognathus fuscus brimleyorum Arkansas	1.39	3.55	6.35	44.00	93	89	40
Desmognathus fuscus auriculatus Florida	1.22	4.12	6.24	49.3	100	96	26

* Divided by.

EXPLANATION: _Gular to snout_ is from center of gular fold to tip of snout. _Head width_ is widest part of head. _Trunk_ is from center of gular to post anal. _Body_ is from tip of snout to post anal. _Tail_ measured only where no regeneration obvious. _Pigment on venter_ represents all degrees from light mottling to almost black. _Lateral white dots_ includes those present on body segments between axilla and on sides of tail.

of the Ripley, Tennessee population, with the Mississippi River between them. The Tuscaloosa population is about 150 miles south and 100 miles east of the Ripley population.

The measurements for the three populations are very close. The Tuscaloosa population is the lightest in color and has more individuals with unspotted throats and venters. For purposes of comparison, the measurements of a population of auriculatus collected near Gainesville, Florida are presented in the bottom row. This race has a shorter head and longer tail than brimleyorum or conanti. The overall coloration approaches black in most specimens, with markings obscured by the heavy dark color. The young are marked about like the young of other races.

Brimleyorum has a slightly narrower head than any other race. The data on brimleyorum from Hot Springs, Arkansas and conanti from Crowley Ridge show that brimleyorum has a shorter tail; otherwise in size and markings they are very similar. Brimleyorum is darker in overall coloration than conanti, approaching auriculatus in this respect, but with more brown than black pigment. Both races have the majority of the individuals with mottled throats and venters and a high percentage of both have a row of white dots on the sides between the axilla and extending onto the sides of the tail.

The collections of Desmognathus from south of the Arkansas River are shown to be distinct from the other recognized races of the species in only one respect; that is, in tail length. This study verifies the work of Rossman (1958) who found brimleyorum to have a tail length less than 46% of total length and conanti greater. Color pattern alone cannot be used for positive field identification of conanti and brimleyorum because the general coloration and pattern are available in both races and in the case of conanti, at least, vary with the seasons.

Collections of conanti were made January 1, March 14, May 16, June 13, August 31, and November 15 from Coldwater Springs or nearby springs on Crowley Ridge. The specimens collected in March, May, and June were generally lighter in overall pigmentation and on most the dorsal pattern is much more distinct than specimens collected in August, November, or January. Also the mottling on the venter is much more pronounced on specimens collected during the winter months.

The Crowley Ridge, Arkansas, western Tennessee, and northern Alabama collections which have been designated as conanti by Rossman are all very close in physical measurements and obviously represent a wide-spread race of the sandy soils of the highlands of the southern states. Measurements of a good number of specimens from one site should provide identification. Conanti can be separated from brimleyorum by the greater tail length and from fuscus by the shorter body length of the latter (body/head w - 5.70 in fuscus, 6:10-6:20 in conanti).

The general resemblance of brimleyorum in its southern range to auriculatus is more in color than in morphology. The population of auriculatus collected at Gainesville, Florida, has the greatest percentage of tail length of any race in this study and the shortest head (gular to snout/head w ratio - 1.22 auriculatus; 1.39 brimleyorum).

With the finding of the colony of Desmognathus at Flippin in Baxter County, Arkansas, there is no reason to doubt the correctness of the locations at Eureka Springs and Walnut Ridge by Grobman and Bishop as was done by Dowling (1957). The abundance of Desmognathus fuscus conanti in Crowley Ridge removes all doubt about the presence of Desmognathus north of the Arkansas River in eastern Arkansas. This study reveals that the range of conanti extends over at least the northeast fourth of Arkansas.

SUMMARY

1. Races of Desmognathus fuscus are to be found in all parts of the state.
2. Desmognathus fuscus brimleyorum Stejneger is a form found in the rocky hills and mountains of Arkansas (Ouachita Mountains in southwest, Ozark Mountains in northwest and in the highlands of southeast Atlantic states). At three points Desmognathus has been collected near the Missouri line (Eureka Springs, Flippin, and Walnut Ridge) so it is reasonable to expect that it will be found in Missouri although unreported up to the present.
3. Desmognathus fuscus conanti Rossman is a form found in areas built up of loess or alluvial sand in Arkansas and western Tennessee. This form is closely related to both fuscus and brimleyorum, but this study shows that the three races are distinct morphologically.
4. Populations of salamanders from Arkansas and Tennessee have been compared with populations of auriculatus from Florida and fuscus from North Carolina and their likenesses and differences shown.
5. Coloration is not a reliable guide in the identification of Desmognathus, but furnishes helpful clues to identification established on a morphological basis.
6. This study reveals for the first time the extent of the range of Desmognathus fuscus conanti in a large part of Arkansas.

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THE LIGNEOUS FLORA ON CONTRASTING SITES AT LONGPOOL, POPE COUNTY, ARKANSAS

Lowell A. Logan
Arkansas Polytechnic College

Various studies have been made comparing the vegetation on contrasting sites in the same general habitat. Such studies as the vegetation on a north-facing slope versus that on a south-facing slope, shaded area versus direct sunlight, flood plains versus hill-sides, and heavy clay soils versus light sandy deposits are found in the literature. The purpose of this study was to compare the vegetation of a series of contrasting stations, but with close proximity to each other, scattered over an entire section of land.

Longpool is located on Piney Creek in Section 6 of the Treat Quadrangle of Arkansas, T10N, R20W, and is diagramed in Figure I. This particular area was chosen because it exhibited numerous sharply contrasting sites and also harbored several relic species of the eastern deciduous forest.

A survey was made of twelve specially selected transects. These are shown on Figure I. Each survey consisted of walking the area and identifying the woody specimens within a six foot area; i.e., three feet on either side of the transect line. Identifications were based on Sargent (5) and Steyermark (6). Nomenclature was made to coincide with that of Fernald (3). Specimen counts were made on each of the transects and totals were computed for each species. Specimens on contrasting stations were compared as to relative abundance. Of the twelve stations studied, four pairs were considered sufficiently different to be analyzed.

Superficial geological data was noted for each of the stations.

DESCRIPTION OF STATIONS

The Treat Quadrangle lies within the Interior Highlands of the Ozark Mountains (1). Geologically, Longpool is situated in the Atoka Formation. According to Croneis (2) "this formation consists of alternating beds of sandstone and shale and a few beds of calcareous sandstone of small areal extent." Within the area of this study numerous outcrops of sandstone were noted, particularly on the sides of the slopes. This sandstone was generally medium-grained and light brown in color. In the creek bed and along the

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The assistance of Dr. D. M. Moore of Arkansas A. and M. College and Prof. Eugene Jones of Arkansas Polytechnic College in this study is gratefully acknowledged.

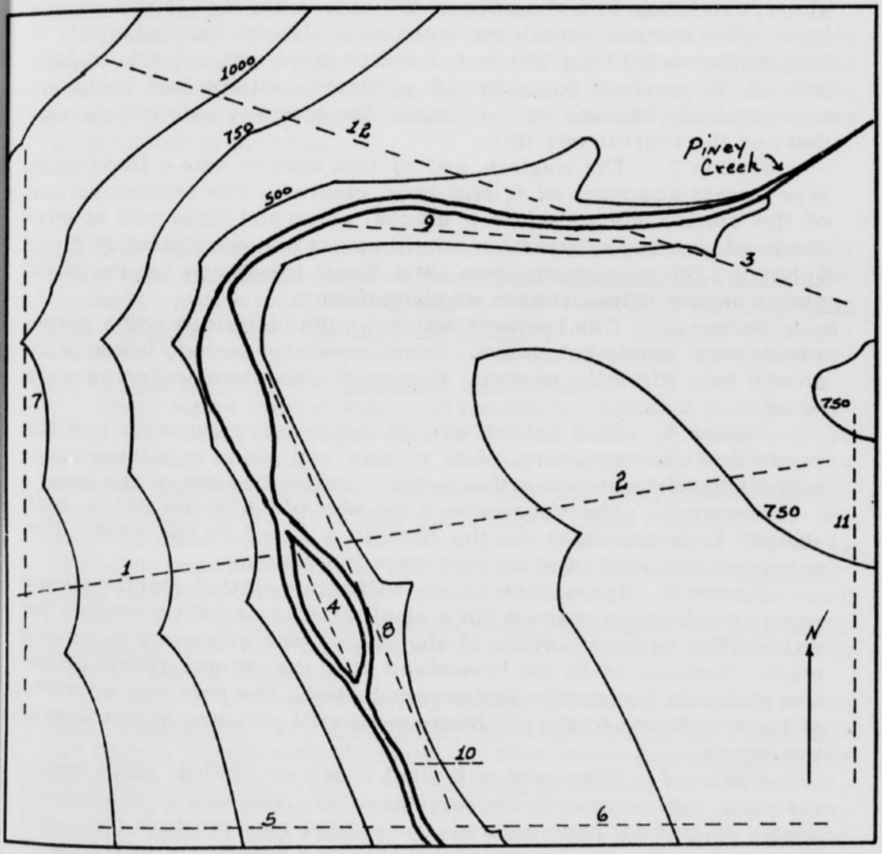

Figure I. Section 6 of Treat Quadrangle of Arkansas (4), showing location of Longpool, stations surveyed, and elevation contours.

creek banks shale deposits were in evidence. These varied from black to brown and were often associated with thin beds of dense ripply-marked sandstone. The stations used in this survey and shown in Figure I were chosen because of the variations in habitats which they exhibited.

Station 1. This was a densely wooded area on a very steep slope, extending from the edge of the water westward to the section line. This station, which was approximately one-third of a mile in length, increased from 500 feet elevation at the water level, to 1250 feet at its western boundary. A sandstone outcrop was prominent approximately halfway up the slope. The area was extensively eroded and the topsoil was thin.

Station 2. The western end of this station was a flood plain type terrain and much of it had been cleared. The eastern portion of the station consisted of a gradual slope and there was no evidence of clearing. Typical old field vegetation consisting of Pinus echinata, Juniperus virginiana, and Carya tomentosa on the flood plains sector of this station was significant.

Station 3. This transect covered a gradual slope and a ravine which were somewhat moist. Being severely eroded, lower story growth was virtually absent. Numerous sandstone outcrops were noted.

Station 4. This island was of sedimentary deposits and the vegetation was transitory. Soil texture and plant population were subject to constant change due to the periodic flooding of the area.

Station 5. The vegetation here was old and the slope rose sharply from the creek on the east to a bench on the west. Two prominent outcrops of sandstone were in evidence.

Station 6. Approximately one-half of this station near the stream was in cultivation, except for a small area immediately next to the water. The eastern portion of the station was extremely rocky and rough. Because of an old homestead site, the natural growth of native plants on this portion had been molested. The barn and a portion of the foundation of the old house were still standing at the time of this study.

Station 7. This was a typical bench of gradual slope before reaching the summit of the mountain. The soil was comparatively deep. It had not been cleared. An old log road ran from the top of the mountain down to the area of this station. Vegetation was dense.

Station 8. An eroded cliff and loose gravel characterized this station. The vegetation was somewhat temporary because the bank was constantly exposed to erosion.

Station 9. This station was a cliff overlooking the stream and was only partially wooded. The natural vegetation had been molested by the building of a road, a picnic area, and some drainage ditches.

Station 10. This area was densely covered with Pinus echinata and Juniperus virginiana. The station sloped toward the stream and had a man-made drainage ditch and terrace within it. Years earlier the area had been cleared, but at the time of this study possessed mature trees.

Station 11. This was a broad bench, dry, and with a floor of surface sandstone. The soil was very thin and vegetation sparse. There was no evidence that this area had been cleared.

Station 12. The eastern end of this station was of a flood plain type terrain and the topsoil was unstable due to the shifting of the stream. A portion was once in cultivation. The western end of the station was very sharply elevated, heavily wooded, and there was no evidence of clearing.

RESULTS

The vegetation of the section considered was of the oak-hickory forest type as demonstrated in the stations analyzed (Table 1). The dominant species on the steep slopes were invariably Carya tomentosa, Quercus alba, Quercus marilandica, and Quercus velutina, while on the sedimentary soils of the flood plains the dominants were Pinus echinata and Juniperus virginiana.

There was a greater variety of species on Station 1 than on Station 2; however, the vegetation of Station 1 was of small stature and generally of inferior quality. Common species on both stations included Carya tomentosa, Quercus alba, Quercus velutina, Liquidambar Styraciflua, and Ulmus americana. Pinus echinata was the most abundant species on the flood plain type habitat of Station 2, while only one specimen was recorded on Station 1. Fraxinus americana was absent on the flood plains of Station 2, but was common on Station 1. Quercus marilandica, Carya cordiformis and Diospyros virginiana were recorded frequently on the slopes of Station 2, but were absent on Station 1.

Station 3 included a moist, sandy, protected ravine in which Fagus grandifolia var. caroliniana, Acer rubrum, Nyssa sylvatica, and Cornus florida were abundant. In this ravine Polystichum acrostichoides, Asplenium spp., and Epifagus virginiana were numerous, indicating something of the moist conditions and the age of the community. Also in this station, Carya tomentosa and Pinus echinata were frequently recorded, but not within the more mesic habitat.

In comparing the vegetation of Stations 3 and 12, it was noted that Carya tomentosa, Quercus marilandica, Quercus alba, Pinus echinata, and Diospyros virginiana were present at both sites. Amelanchier canadensis, Callicarpa americana, and Fagus grandifolia var. caroliniana were recorded at Station 3, but not at Station 12. It is suggested that the absence of these species at Station 12 was due to the lack of protected habitats. Species found on the dry sandy terrain of Station 12 and not in Station 3 included Carya cor-

TABLE I

ABUNDANCE OF SPECIES IN CONTRASTING STATIONS
ARRANGED ALPHABETICALLY BY GENUS

SPECIES	PAIRS OF CONTRASTING STATIONS							
	1	2	3	12	7	11	5	6
Acer rubrum L.*	15	36	6	12	32	0	8	3
Acer saccharinum L.	0	0	0	0	0	0	3	0
Acer saccharum Marsh	9	0	0	0	0	0	1	0
Amelanchier canadensis (L.) Medic.	0	0	5	0	0	0	0	0
Asimina triloba (L.) Dunal	2	0	0	0	0	0	0	0
Betula nigra L.	0	0	0	0	0	0	3	10
Broussonetia papyrifera (L.) Vent.	0	0	0	0	0	0	5	0
Bumelia lanuginosa (Michx.) Pers.	0	2	0	0	0	0	0	0
Callicarpa americana L.	0	0	4	0	0	0	1	6
Carya cordiformis (Wang.) K. Koch	0	10	0	3	0	8	0	7
Carya glabra (Mill.) Sweet	0	0	0	0	0	0	1	0
Carya texana Buckl.	0	4	0	0	0	0	0	0
Carya tomentosa Nutt.	29	136	58	79	153	97	15	61
Castanea ozarkensis Ashe	2	0	0	0	0	0	0	0
Celtis occidentalis L.	1	0	0	0	0	0	0	7
Cephalanthus occidentalis L.	5	0	0	0	0	0	0	6
Cercis canadensis L.	0	0	0	0	0	0	4	0
Cornus florida L.	5	19	12	1	28	0	0	2

TABLE I (Continued)

SPECIES	PAIRS OF CONTRASTING STATIONS							
	1	2	3	12	7	11	5	6
Crataegus spp.	9	0	12	9	0	11	15	0
Diospyros virginiana L.	0	16	10	22	0	0	0	13
Euonymus americanus L.	0	0	0	0	0	0	1	0
Fagus grandifolia var. caroliniana (Loud.) Fern. & Rehd.	0	6	8	0	0	0	0	0
Fraxinus americana L.	9	0	0	0	1	0	0	0
Fraxinus pennsylvanica var. subintegerrima (Vahl) Fern.	2	0	0	0	1	0	2	0
Gleditsia triacanthos L.	0	0	0	2	0	0	2	7
Juniperus virginiana L.	6	33	0	9	2	52	1	8
Liquidambar Styraciflua L.	10	28	0	33	0	0	2	8
Lindera Benzoin (L.) Blume	0	1	0	0	0	0	0	0
Morus rubra L.	1	0	0	0	0	0	0	0
Nyssa sylvatica Marsh.	17	12	9	6	10	0	1	1
Parthenocissus quinquefolia (L.) Planch.	3	0	0	0	0	0	0	0
Pinus echinata Mill.	1	301	62	19	58	61	3	18
Platanus occidentalis L.	1	0	0	1	0	0	1	5
Prunus serotina Ehrh.	0	1	0	1	0	0	0	1
Quercus alba L.	18	74	24	21	65	12	8	29
Quercus falcata Michx.	0	1	0	1	0	0	0	4
Quercus lyrata Walt.	0	1	0	0	0	0	0	0
Quercus marilandica Muench.	0	16	18	11	0	0	0	0

TABLE I (Continued)

SPECIES	PAIRS OF CONTRASTING STATIONS							
	1	2	3	12	7	11	5	6
Quercus Muehlenbergii Engelm.	3	0	0	2	9	0	0	0
Quercus rubra var. borealis (Michx.) Farw.	0	0	0	11	4	0	2	0
Quercus stellata Wang.	4	16	0	7	2	18	1	25
Quercus velutina Lam.	12	17	0	0	0	0	0	3
Rhus copallina L.	3	1	0	0	3	3	0	2
Rhus glabra L.	5	0	0	10	0	0	0	0
Rhus Toxicodendron L.	11	0	0	0	0	0	0	0
Robinia Pseudo-Acacia L.	2	0	0	0	1	0	0	0
Sassafras albidum (Nutt.) Nees	0	2	0	0	0	0	0	3
Smilax spp.	0	1	0	1	0	0	0	0
Ulmus alata Michx.	6	5	10	2	0	0	0	4
Ulmus americana L.	10	18	18	1	1	0	4	15
Ulmus rubra Muhl.	4	0	0	0	0	0	0	0
Viburnum prunifolium L.	3	0	0	0	9	0	0	0
Viburnum rufidulum Raf.	0	4	0	8	0	0	2	10
Vitis rotundifolia Michx.	4	8	0	0	9	0	0	0
Vitis spp.	0	0	0	0	0	4	8	0
Xanthoxylum Clava-Herculis L.	0	0	0	0	0	0	9	0

*Scientific names are in accordance with Fernald (3).

diformis, Gleditsia triacanthos, Juniperus virginiana, Quercus rubra var. borealis, Quercus stellata, and Viburnum rufidulum.

An analysis of the species in Stations 7 and 11 revealed that Carya tomentosa, Pinus echinata, and Quercus alba were abundant on both sites. Carya cordiformis was found on Station 11, but was not recorded on Station 7. Acer rubrum and Cornus florida were common species in Station 7, but absent in Station 11.

Vegetation on Stations 5 and 6 was sparse compared with other stations studied. This was attributed to the frequency of sandstone outcrops on Station 5 and to the fact that much of the area of Station 6 was under cultivation. Carya tomentosa was a common representative on both sites. Attention is called to Xanthoxylum Clava-Herculis which was identified on Station 5 and was not encountered on other sites within the study area. Ulmus americana and Pinus echinata on Station 6 were indicative of the old-field type habitat.

The island on which Station 4 was located was temporary and was constantly undergoing change. Species found on the island which were either rare or absent on other sites included Catalpa bignonioides, Quercus nigra, Cephalanthus occidentalis, Hamamelis virginiana, Prunus americana, and Rhus radicans.

Smilax rotundifolia, Rhamnus caroliniana, Salix interior, and Salix caroliniana were found only on Station 8. Other species in this area were similar to those on Station 4. Vegetation of Station 10 was similar to that found on Station 6. Species encountered only on Station 10 included Crataegus Engelmanni, Halesia carolina, and Quercus phellos.

The cliff overlooking the stream which constituted Station 9 exhibited Acer Negundo, Juglans nigra, Quercus prinus, Salix nigra, and Tilia americana, species not found in other stations studied. It is suggested that the presence of these plants on Station 9 was due to the microhabitat evident within the area.

SUMMARY

Field studies were made to determine the variation of species on contrasting sites over a section of land at Longpool on Piney Creek in northern Pope County, Arkansas. The woody species were identified on twelve separate stations within the section and four sets of contrasting stations were compared as to dominant species.

The entire section was classified as oak-hickory type forest. The dominant species on all slopes were Carya tomentosa and Quercus alba, with Ulmus americana, Quercus velutina, Nyssa sylvatica and Diospyros virginiana being important subdominants.

The dominants on the flood plains and sandy sedimentary soils were Pinus echinata, Juniperus virginiana, and Ulmus americana.

A greater variety of species was found on the more permanent sites on the slopes than on the transitory soils of the flood plains.

This was attributed to the difference in age of the two areas, the flood plain being much younger, and to the periodic shifting of the flood plain soils.

The moist, protected ravines exhibited Fagus grandifolia var. caroliniana and Acer rubrum while the contrasting terrains of exposed valleys and slopes were dominated by Quercus spp. and Carya spp.

Specific vegetational communities were evident in certain sites and appeared to be dependent upon the microhabitat.

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A METHOD OF TEACHING BASIC CRYSTALLOGRAPHY TO THE BEGINNING STUDENT

Robert J. Willard
University of Arkansas

The first student encounter with basic crystallography occurs in the sophomore-level course, Mineralogy, in the Geology Department at the University of Arkansas. The study of crystallography at this level consists predominantly of geometrical concepts, which are grouped under the following equivalent names: geometrical crystallography or external crystal morphology or point-group symmetry. Underclassmen generally have little or no background from previous training to meet the challenge of this first encounter. Those students who are most adequately prepared to do so and who most readily grasp the fundamentals of crystallography are those who, at sometime early in their academic pursuits, have completed secondary school or college courses such as plane and spherical trigonometry, descriptive geometry, analytic geometry, engineering drawing, and algebra. The discipline of such courses necessarily stimulates and requires thinking in three dimensions, and with or without suitable background, each student soon discovers that he must master this three-dimensional thinking process.

Although there is no standard outline or procedure followed in the presentation of basic crystallography, according to the most recent textbooks in the field of mineralogy (cf., 1, 4, 5, 6) and to other specialized or advanced texts (e.g., 2, 3, 9), the most successful approach seems to involve the following sequence of concepts, based upon trial and error over three years of teaching.

1. The use of geometric biaxial and triaxial coordinate systems and associated equations for locating points and planes in space.
2. The linear elements of crystallography.
3. Miller and Bravais indices.
4. Law of Rational indices.
5. Law of the Constancy of Interfacial Angles, and use of the Penfield goniometer.
6. The Hauy-Donnay Rule.
7. The concept of symmetry through study of the cube, to be used as a means of introducing the symmetry elements of crystallography.
8. Hermann-Mauguin symbols.
9. The Zone Law.
10. The spherical and stereographic projections.
11. The Law of Symmetry.
12. Holohedral, enantiomorphic, and hemihedral forms, based

upon the concept of the fundamental form.

13. The triaxial crystal systems.

14. The tetra-axial crystal systems.

Discussion of the meaning and use of forms, and the triaxial and tetra-axial crystal systems, is adequately presented in recent textbooks (ref. Literature Cited) and will, therefore, be omitted from this paper.

Some fundamentals of analytic geometry constitute a useful avenue of approach to the linear elements of crystallography. For example, in the two-coordinate system, x and y, one variable is a linear function of the other if both are connected by an equation of the first degree,

$$y = mx + b \quad (1)$$

Any point in this system has the coordinates, $(\pm x, \pm y)$. In the three-coordinate system, x, y, and z, both points and planes may be located by,

a. Coordinates of a point, as $(\pm x, \pm y, \pm z)$.

b. Intercepts of a plane on the reference axes, x, y, and z.

The equation representing the plane is defined in terms of a normal to that plane, providing that the normal passes through the origin of the system. If the direction cosines of the normal are l, m, and n, and if its length is p, then the coordinates of the intersection of the normal with the plane are (lp, mp, np), and the resulting equation,

$$lx + my + nz = p \quad (2)$$

where p is positive, is one of the first degree and represents the form of the equation of a plane (7).

A study of the external morphology of crystals rests basically upon the interrelations of a plane and the point locating a normal or face pole to that plane and drawn through the origin of the reference system of axes (Fig. 1). Emphasis is placed upon the idea that a crystal is a real three-dimensional solid with certain real directions and planes such as edges and crystal faces. These edges between adjacent crystal faces as well as the interfacial angles constitute the linear elements. By referring the linear elements to a system of three or four imaginary axes whose origin is at the center of a crystal, scalar and angular values may be applied to them. Thus, there are

1. Parameters representing intercepts of a crystal plane at some unit length or multiple thereof on each of the reference axes.

2. Axial ratios representing the proportional unit length along each axis, where the b or a_2 crystallographic parameters are set equal to unity, by convention. Thus, the axial ratio in the tetragonal system is represented by a(=1):c, whereas in the orthorhombic system, the ratio is a:b(=1):c.
3. The interaxial angles, α, β, and γ which must be defined in terms of angular values, because they are an essential difference between one crystal system and any other. For example, $\alpha = \beta = \gamma = 90^o$ in the cubic system, whereas $\alpha \neq \beta \neq \gamma \neq 90^o$ in the triclinic system.

According to Wolfe (9), "the linear elements of the crystals of most mineral and chemical substances are unique, and, therefore, serve as determinative physical characteristics."

The student is then exposed to the unreal directions used in the study of crystals as aids in defining, by simpler means, the arrangement and location of the linear elements in space. These are the polar elements. Once a unit face is selected for a given crystal, the parameters of any other face may be related to the parameters of the unit face. To determine these parameters, it is necessary to find the relative slopes of the three lines cutting the three pairs of axial combinations (viz., ab, bc, ac, as in the orthorhombic, or a_1a_2, a_2a_3, a_1a_3, as in the cubic, etc.). Such a procedure is tedious and difficult to do in practice.

The simple and unique answer to this difficulty, as posed to the student, is suggested by the method in analytic geometry of locating a plane by means of a normal to that plane. Thus, the student can verify that a face normal will precisely define the orientation of a crystal plane or face, in terms of the reference axes, if the coordinates of that normal are known.

The coordinates in the triaxial systems are known as Miller indices, while those in the tetra-axial systems are known as Bravais indices. These coordinates are better named, polar coordinates, and are readily determined by a reciprocal relationship. Expressed in elementary form, the index (or coordinate of a face normal) is the reciprocal of the parameter distance (P) of a plane intersecting a reference axis.

$$P = I^{-1} \qquad (3)$$

In a triaxial system with reference axes, a, b, and c (e.g., the orthorhombic), the Miller indices are

$$P_a = I_a^{-1} = h^{-1} \qquad (3a)$$

$$P_b = I_b^{-1} = k^{-1} \qquad (3b)$$

$$P_c = I_c^{-1} = l^{-1} \qquad (3c)$$

In a tetra-axial system with reference axes, a_1, a_2, a_3, and c (e.g., the hexagonal), the Bravais indices are

$$P_{a_1} = I_{a_1}{}^{-1} = h^{-1} \quad (3d)$$

$$P_{a_2} = I_{a_2}{}^{-1} = k^{-1} \quad (3e)$$

$$P_{a_3} = I_{a_3}{}^{-1} = i^{-1} \quad (3f)$$

$$P_c = I_c{}^{-1} = l^{-1} \quad (3g)$$

The general index symbols, {hkl} and {hkil}, represent the general position of polar coordinates in the triaxial and tetra-axial systems, respectively. In the latter case, the correctness of the symbols, in terms of specific values, is dependent upon the solid geometry of a plane and its normal (e.g., 8), satisfying the equation,

$$h + k + i = 0 \quad (4)$$

The student is then admonished about the rationality of index values, according to Hauy's Law (e.g., 3), frequently referred to as the Law of Rational Indices. Conjunctively, Stensen's Law, termed the Law of the Constancy of Interfacial Angles, points out the uniformity and consistency of angular relations, in terms of crystal directions for any given mineral or crystalline material.

Using several quartz crystals of varying habit, the student then measures sets of corresponding interfacial angles with the Penfield arm protractor and goniometer. The validity of Stensen's Law, thus, is readily established. The student is cautioned that the Penfield instrument must lie in the imaginary plane which includes the face poles of any two adjacent faces, and that the desired interfacial angle is the supplement of the angle which is measured directly by the instrument.

A fundamental concept of crystallography, needing precise definition and systematic presentation, is that of symmetry. The general meaning of symmetry is adequately presented in Webster's Collegiate Dictionary:

> Balanced proportions . . ., Correspondence in . . . relative position, of parts that are on opposite sides of a dividing line or median plane.

Through study of the hexahedron or cube, a beginner, with no previous knowledge of crystal symmetry, can acquire a basic understanding of the symmetry elements. Very little encouragement is necessary, even for the mediocre student, and the better students generally will be able to carry on the study in its entirety in a matter of one or two hours. The procedure for locating the 23 symmetry elements of the cube is as follows:

1. Examine the cube and decide how many times it may be divided into two equal parts so that one half appears as if it were the mirror reflection of the other half. There are nine such positions, termed symmetry planes, where this is true.
2. Note that at certain points these planes intersect (e.g., at the center of any side of the cube). Holding the cube at two points opposite one another with the thumb and forefinger, rotate the cube and note that the same type of face is repeated four times in a complete rotation (360^{o}). These two opposing points mark the emergence of an axis of symmetry about which the same type of face or group of faces is repeated four times. This is a four-fold axis. How many four-fold axes can you find?
3. Select a point where three planes intersect (e.g., on any corner of the cube). Placing the thumb and forefinger on two opposing corners, make a complete rotation and note that the same type of face is repeated three times. This is a three-fold axis of symmetry. How many can you find?
4. Select a point where two planes intersect. Make a complete rotation and note that the same type of face is repeated twice. This is a two-fold axis of symmetry. How many can you find?

The location and number of these symmetry elements is thus a matter of discovery. Furthermore, the student is impressed with the fact that a symmetry plane requires a reflection operation, while a symmetry axis requires a rotation operation. The meaning of the remaining symmetry element, that of the center of symmetry, is readily verified in the perfect cube by observing corresponding points, corners, edges, or faces equidistant from an imaginary point at the center of the cube. The various operations associated with symmetry planes, axes, and a center are collectively termed the symmetry operations.

Subsequent to the study of cube symmetry should follow:

1. Types of symmetry axes, 1, $\bar{1}$, 2, 3, $\bar{3}$, 4, $\bar{4}$, 6, $\bar{6}$, with the meaning and application of straight-fold axes versus rotary-inversion axes.
2. Symmetry axis symbols, e.g., ▲ = straight 3-fold axis, △ = 3-fold rotary-inversion axis.
3. Symmetry plane symbol = m, or P.
4. Symmetry center symbol = c.
5. Hermann-Mauguin (HM) symbols, a short-hand method of writing class symmetry, once the elements of symmetry of a given class are understood (cf. 5).

A special problem concerning HM symbols always needs explaining to the beginner. Consider the following classes:

Class	Symmetry	HM Symbols
Hextetrahedral	$4A_3$ $3A_2$ 6P	$\bar{4}$ 3 m
Ditrigonal-dipyramidal	$1A_3$ $3A_2$ 4P	$\bar{6}$ m 2
Trigonal-pyramidal	$1A_3$ 1P	$\bar{6}$
Tetragonal-scalenohedral	$3A_2$ 2P	$\bar{4}$ 2 m

A comparison of the symmetry elements of these four classes with their HM symbols seems to indicate some apparent inconsistency. Thus, in the hextetrahedral class, there are three 2-fold axes, but the HM symbol representing these is $\bar{4}$, a 4-fold axis of rotary inversion. The answer to this and other such apparent inconsistencies lies in an understanding of the function of an even- versus an odd-fold axis of rotary inversion, and crystallographic convention. Two rules clearly portray the symmetry operations of rotary inversion axes (9); namely, that

1. An even fold rotary inversion axis produces the same number of faces as the numerical order of the axis.
2. An odd fold rotary inversion axis produces twice the number of faces as the numerical order of the axis.

In the general form of the class, $\bar{4}$ 3 m, there are six {hkl} faces grouped about one end of each 3-fold axis. The symmetry operation of the $\bar{A}_4$ about each of the three crystallographic axes in the cubic system (i.e., a_1, a_2, a_3) requires that

$$\bar{A}_4 \cdot n\{hkl\} = K$$

$$4 \cdot 6\{hkl\} = 24K$$

where K is the symmetry constant (total maximum permissible faces for a given form in the {hkl} position and for a given class). If each of the three 2-fold axes are regarded as $\bar{A}_4$, then all 24 faces of the hextetrahedron may be produced about each axis in <u>one</u> symmetry operation rather than by straight rotation about the three 2-fold axes. This is crystallographic convention. According to Hurlbut (5), ". . . rotary inversion has been adopted by international agreement," and should therefore be given preference over straight rotation. Its aim is to minimize the symmetry operations required to produce a given form.

The concept of zones is notably difficult for the beginning student to grasp. The progression from a simple crystal face, for example, to the final zone axis requires three-dimensional visualiza-

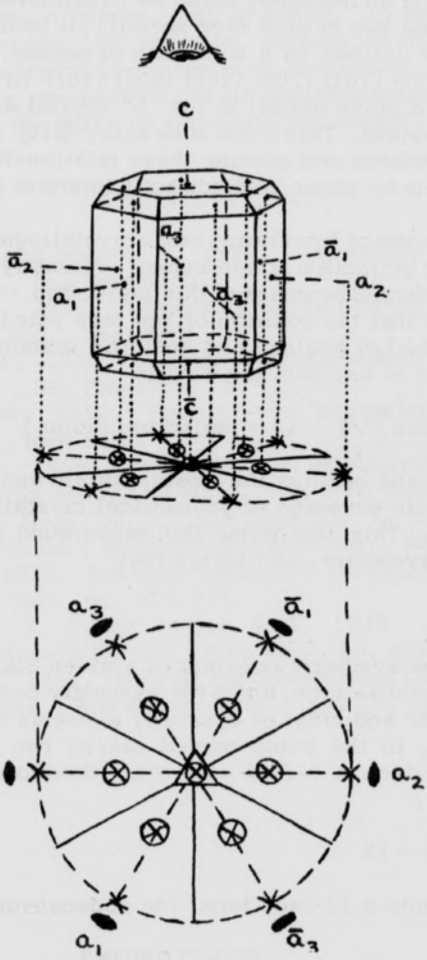

Figure 1. Diagrammatic procedure for establishing the symmetry elements and form positions from a wooden crystal model of corundum, class $\bar{3}$ 2/m. Three forms are illustrated: basal pinacoid, hexagonal prism, and hexagonal dipyramid. By means of the stereographic projection, the plots of face poles are visually approximated by the student.

tion. Briefly, if an imaginary plane be constructed through a crystal so as to include two or more face normals, it becomes a zone plane. It, in turn, is defined by a zone axis or normal. Thus, the faces, (100) (101) (001) ($\bar{1}$01) ($\bar{1}$00) ($\bar{1}0\bar{1}$) (00$\bar{1}$) (10$\bar{1}$) have their face normals lying in a plane normal to the "b" crystal axis (e.g., as in the monoclinic system). This is the zone axis, [010]. With some practice, most students can picture these relationships in their minds, reproduce them on paper, and correctly interpret them from a crystal model.

For purposes of integrating basic crystallographic concepts, the stereographic projection is introduced. Symmetry relations and zones are readily detected by means of this projection. Emphasis is placed upon the fact that the position of any face pole is determined by its phi (ϕ) and rho (ρ) angles, and that the distance (d) from the projection center to any pole position is

$$d = r \cdot \tan \rho/2 \qquad (r = \text{projection radius}) \tag{5}$$

The last and perhaps the most important fundamental concept in this systematic coverage of geometrical crystallography is the Law of Symmetry. This law forms the background for use of the term, point-group symmetry, and states that

$$K = F\Sigma \tag{6}$$

where K is the symmetry constant of a given class, F the number of faces of a specific form, and Σ the symmetry complement or the sum of the number and order of symmetry elements meeting at a certain point. Thus, in the cubic normal class, two planes intersect at (011) and produce a 2-fold axis; Σ is, therefore, 4. Since K is 48 in this class,

$$F = 48/4 = 12$$

(011) represents a 12-face form, the dodecahedron.

CONCLUSIONS

The disciplines implicit in the study of basic crystallography, as outlined herein, require constant application of the three-dimensional thinking process on the part of the student. In a restricted sense, this process and the concepts involved are largely academic, but in a broad and practical sense, they are useful in establishing mental pictures of solid figures. With the attitudes and training thus acquired, the good student reduces his later troubles to a minimum, in such geological subjects as structural geology, structural crystallography, structural petrology, and in allied sciences such as chemistry and physics. Further, he tends to view matter, in general, in terms of its true attribute, that of space. To study aspects of crystalline substances, for example, without an understanding of their natural geometry, is necessarily an incomplete picture. When considered in this perspective, basic crystallography receives its proper meaning in the realm of scientific knowledge.

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APPLICATION OF PALYNOLOGY TO THE STUDY OF TERTIARY ROCKS OF THE COASTAL PLAIN OF ARKANSAS

Eugene L. Jones
Arkansas Polytechnic College

INTRODUCTION

Tertiary rocks representing the Eocene series of the Tertiary system crop out over large areas of the Coastal Plain in Arkansas. Of far lesser areal extent are rocks of the Paleocene series.

The Eocene section in Arkansas has been subdivided into the Wilcox group, lower Eocene; the Claiborne group, middle Eocene; and the Jackson group, upper Eocene in age. The Paleocene series is represented by the Midway group. All of these units are of considerable lateral extent, recognized in other states of the Coastal Plain. All dip generally to the southeast and thicken in the same direction.

Because of a paucity of distinctive fossil zones, and because of sharp vertical and lateral changes in lithology, these Tertiary rocks of the Coastal Plain pose stratigraphic problems. Boundaries between units are vague, often impossible to determine in field work. Subdivisions of the groups into formations, though accomplished in most states, is valid only in local areas. This is well illustrated by the recent work of Gordon, Tracey and Ellis (1958) in the Bauxite producing area of Arkansas. They were able, using lithology as the basis, to subdivide the Wilcox group into three formations. These units, the basal Berger formation, the overlying Saline formation and the upper unit, the Detonti sand, are restricted in areal distribution to parts of Saline and Pulaski Counties.

Problems are magnified in the subsurface where thickness of the Tertiary section increases and lithology changes laterally and vertically. The contact of the Wilcox and Midway groups in the area of outcrop in Arkansas is marked by a distinct unconformity. Down dip, the contact becomes apparently conformable and is impossible to select with certainty either from electric logs or from samples.

Equally acute is the problem of correlation of units from state to state. A prominent zone of Ostrea thirsae is present near the base of the Wilcox group in a number of states. It is often used as a basis for marking the base of the Eocene and for correlation. There is reason to believe that the zone is far from isochronous and is of questionable value in correlation.

E. W. Berry (1916, 1931) conducted studies of the abundant floras represented by leaf impressions in these predominantly continental rocks. His work, now often challenged as to validity, led the author to investigate the application of palynology, the study of spores and pollen, to the stratigraphic problems present in the area.

APPLICATION OF PALYNOLOGY

Spores and pollen grains from plants preserved as fossils in sedimentary rocks can be used in the solution of stratigraphic problems of correlation and age determination in the same general way as the better known and more widely used invertebrate fossil groups. The plant microfossils also have value in the interpretation of paleoenvironmental conditions including climate and geography.

PREVIOUS WORK

Although spore and pollen analysis as a science dates back to 1916 according to Erdtman (1954), the first published account of its use as a stratigraphic tool was by Raistrick and Simpson (1933). They described the use of microspores in the correlation of coals in England. Since that date the use of spores and pollen in correlation has become general. Papers by Wilson (1946, 1959) and Kosanke (1950) illustrate the use of palynology in stratigraphic work in the United States. The application has been primarily to sections of Pennsylvania coal-bearing strata.

In addition to problems of correlation, spore and pollen analysis has been used in the interpretation of paleoclimates as is illustrated by the recent paper by Sears (1955). This application of palynology is of value in archeological as well as geological investigations as is shown in the paper by Wilson (1949).

The density of spores and pollen grains in sediments is also used by oil company palynological laboratories as indicators of former shore lines in directing exploration for oil and gas.

Although the results of palynological studies of Tertiary rocks of the Coastal Plain have not been published, results of investigations in other areas are available for comparison. The pollen from the Eocene Green River beds was described by Wodehouse (1932). Traverse (1935) studied the Brandon lignite, Tertiary in age. Wilson and Webster (1946) described a spore and pollen flora from a coal bed in the Fort Union group. An extensive study of plant microfossils from the Eocene Series in Germany was published by Potonie (1934). Simpson (1936) studied pollen from Tertiary coals in Scotland.

Earlier studies by Berry (1916, 1930) had been made of the Wilcox flora as represented by megascopic plant fossils, leaf impressions in particular.

AREA OF PRESENT STUDY

Outcroppings of Wilcox sediments in Saline County were selected as the section to be studied. The Wilcox in this area has a thick section of laminated dark, lignitic clays and fine to very fine, white sands. This is the Saline formation of Gordon, Tracey and Ellis (1958).

METHOD OF STUDY

Channel samples in 18-inch units were collected from exposures of the laminated Wilcox sediments in Saline County. Sections for sampling were selected to give a composite section representing as much as possible of the total thickness of the unit of laminated sediments.

These samples were then processed in the palynology laboratory at the University of Oklahoma.

The first step in the processing was the disaggregation of the material by crushing with mortar and pestle.

After disaggregation, the samples were immersed in hydrofluoric acid for 48 hours to remove siliceous materials. They were then washed in distilled water to remove excess acid.

The next step was to immerse them in concentrated ammonium hydroxide for 10 minutes and then to wash them in distilled water to remove excess ammonium hydroxide.

To remove additional inorganic debris, each sample was then centrifuged at low speed for 10 minutes in a zinc chloride solution having a density of 1.4, considerably higher than the spores and pollen grains contained in the samples, but lower than the inorganic detritus. The plant microfossils were then decanted from the centrifuge tube and washed to remove excess zinc chloride.

A part of the concentration of plant microfossils from each sample was then mounted on microscope slides for study.

Genera found by examination of the slides were described and their distribution through the section as well as their numerical distribution in each sample was recorded. Results were plotted as graphs and shown in Figure 1.

NATURE OF THE WILCOX MICROFLORA

An examination of the slides revealed at least 60 genera of plants represented by spores and pollen. Of the 60 genera, 10 were spores and the remainder pollen genera. Only one of the pollen types, Pinus, was a Gymnosperm. The others were Angiosperms. In addition to the spore and pollen flora, examples were found of Hystrichospherida. All of these appeared to belong to a single genus, Hystrichosphaeridium.

As shown by the statistics in Figure 1, the dominant element of the flora was Castanea. The density of other genera was quite variable. Common genera of the flora are shown in Plates I and II.

COMPARISON WITH OTHER SPORE AND POLLEN FLORAS

When compared with the floras from the Tertiary of other areas, the plant microfossils of the Wilcox of the Arkansas Coastal Plain were found to be almost the exact equivalent of those described by Potonie (1934). Nomenclature used by Potonie makes the comparison of generic names impossible. Of the 63 genera listed by Wodehouse (1932) from the Green River formation, only seven were found in the Wilcox. Wilson and Webster (1946) listed 15 genera of spores and pollen from a Fort Union coal. Of these, at least six are present in the Wilcox.

COMPARISON WITH THE WILCOX LEAF FLORA

Berry (1931) listed only 12 genera from the leaf impressions from Saline County, Arkansas, compared with some 140 genera for the Wilcox in the entire Coastal Plain. Of the 12, only two were represented in the spore and pollen flora. Ten additional genera represented by spores and pollen from the Saline County area were listed by Berry as being present in the leaf flora in other areas.

ECOLOGICAL SIGNIFICANCE

Berry (1916, 1931) considered the flora of the Wilcox to be tropical or sub-tropical in nature. Sharp (1951) made a series of comparisons of the flora as described by Berry and modified by more recent work with modern floras. He found the greatest correlation with the present flora of eastern Mexico where some 68% of Berry's genera are now present. Sharp noted two genera in the present Mexican flora not found in the lower Eocene of the Coastal Plain, *Pinus* and *Quercus*. These two genera are present in some sections of the laminated sediments of the Wilcox group. It appears, therefore, that the environmental conditions during the lower Eocene in the Coastal Plain of Arkansas are duplicated in eastern Mexico at present, an area that includes the eastern escarpments of the Central and San Cristobal Mesas and the adjoining coastal plain.

SUMMARY AND CONCLUSIONS

A limited study of the spore and pollen flora present in the laminated sediments of the Wilcox group in the Arkansas Coastal Plain indicates that the plant microfossils have stratigraphic and ecological significance.

Because of vertical changes in the nature of the spore and pollen flora, it appears possible to recognize distinct paleontological zones. The distinctive nature of the total flora, as well as individual zones, provides a basis for correlation of the lower Eocene section of Arkansas with other areas.

Further application of palynological studies to other parts of the Tertiary system in the Coastal Plain should lead to a more definite subdivision of the section into stratigraphic units and aid in the solution of boundary problems, both in the surface and subsurface.

A comparison of the spore and pollen flora with that known from leaf impressions showed only minor correlation. This was expectable in view of the work done in other areas, such as that of Wodehouse (1932) on the Green River flora, where similar results were obtained in such a comparison.

The recognition of additional genera of plants through spores and pollen has aided in the interpretation of the lower Eocene depositional environment. Climatically, the area appears to have been comparable to eastern Mexico, an area of mesas and coastal plains.

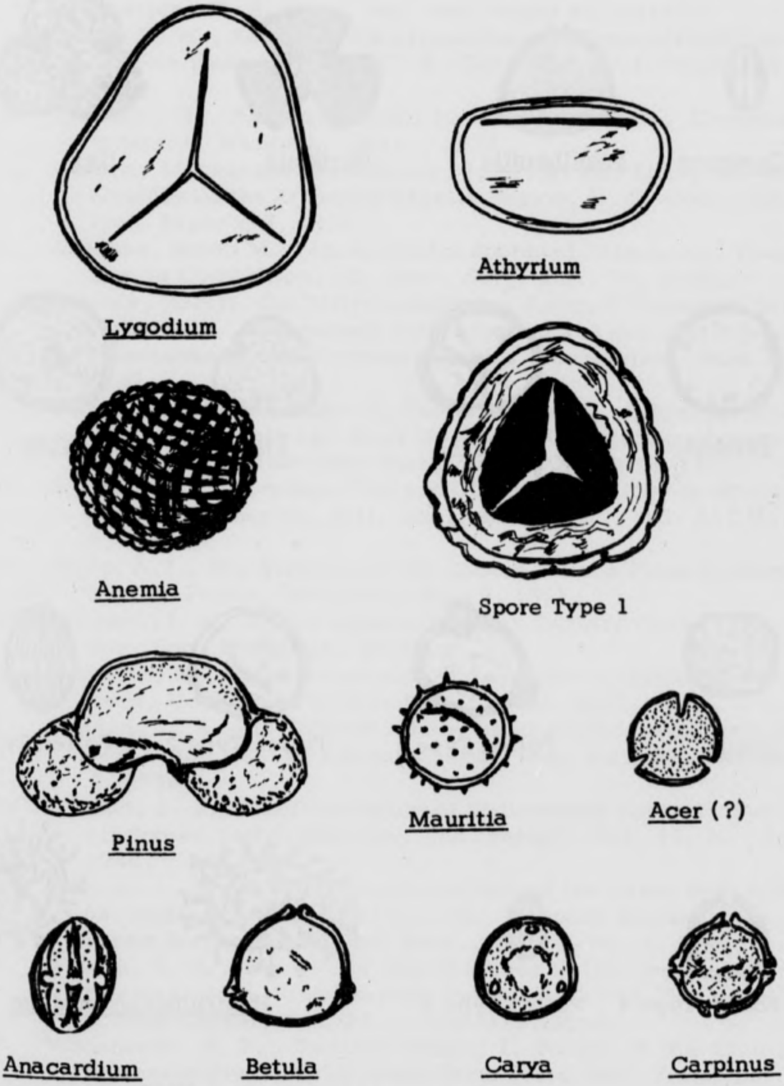
GENUS	DISTRIBUTION EXPRESSED AS PERCENT OF TOTAL FLORA OF EACH SAMPLE		
Lygodium	.5%	.5%	1.4%
Athyrium	.0	.0	.5
Anemia	.5	.0	.2
Spore Type 1	.5	.5	.2
Pinus	.0	.0	10.5
Mauritia	.5	3.1	1.4
Acer	.5	.5	9.9
Anacardium	4.0	6.0	3.5
Betula	3.0	2.1	1.0
Carya	.5	2.1	1.9
Carpinus	.5	.0	.2
Castanea	58.0	51.0	41.0
Engelhardtia	6.2	1.8	3.1
Gordonia	1.0	1.4	4.8
Ilex	5.0	10.0	2.5
Juglans	.0	.7	.0
Nyssa	5.0	1.0	1.0
Typha	.5	1.0	.0
Ulmus	.0	.0	.2
Pollen Type 1	3.0	1.4	1.4
Pollen Type 2	.0	.0	1.1
Pollen Type 3	.0	1.4	.2
Pollen Type 4	1.0	1.4	1.0
Pollen Type 5	6.0	4.0	4.7
Hystrichosphaeridium	.0	2.1	.0
Position in Section	18' above base	12' above base	3' above base

Figure 1. Distribution of genera in Wilcox spore and pollen flora from laminated sediments exposed in road cut on State Highway 35, two miles south of Benton, Arkansas.

GENUS	VERTICAL DISTRIBUTION IN SECTION		
Lygodium	—	—	—
Athyrium	—		
Anemia	—		—
Spore Type 1	—	—	—
Pinus	—		
Mauritia	—	—	—
Acer	—	—	—
Anacardium	—	—	—
Betula	—	—	—
Carya	—	—	—
Carpinus	—	—	—
Castanea	—	—	—
Engelhardtia	—	—	—
Gordonia	—	—	—
Ilex	—	—	—
Juglans		—	
Nyssa	—	—	—
Typha		—	—
Ulmus	—		
Pollen Type 1	—	—	—
Pollen Type 2	—	—	—
Pollen Type 3	—	—	—
Pollen Type 4	—	—	—
Pollen Type 5	—	—	—
Hystrichosphaeridium		—	
Position in Section	3' above base	12' above base	18' above base

Figure 2. Distribution of genera in the Wilcox spore and pollen flora from laminated sediments exposed in road cut on State Highway 35, two miles south of Benton, Arkansas.

TERTIARY SPORES AND POLLEN PLATE I



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TERTIARY SPORES AND POLLEN PLATE II

Magnification of Illustrations X500

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WINTER AND SPRINGTIME: THE PASSING OF A LITERARY GENERATION IN 1901

Kenneth R. Walker
Arkansas Polytechnic College

If any trend was discernible in letters among the elderly literary lights at the turn of the century, it was social progress, tinged with bewilderment and frustration. A general literary pattern is always hard to determine, because as John Borroughs, the famous naturalist, expressed it, "every writer of genius expresses a truth of his own, because he sees things from a particular, individual point of view."[1] The literary production of this elder generation varied from historical novels, such as Lewis Wallace's Ben Hur to books criticizing the current economic conditions, illustrated by William D. Howells' A Traveller From Altruria. Likewise, Yankee humor was best expressed by Samuel L. Clemens' books such as The Adventures of Tom Sawyer and Innocents Abroad.

In addition to keeping step with a changing social scene, the older writers also had the problems of illness and approaching death, and the age-old rivalry with the younger writers who were trying to replace them on the literary stage. In 1901, however, a number of the elderly group still had a firm grasp on their pens. The dean of the ancients was William D. Howells. In 1900 he had acquired the editor's "easy chair" of Harper's Monthly, and from this turret he exercised a wide influence on literary public opinion. Howells' influence, however, had a slightly changing emphasis. In 1886 when he moved from Boston to New York, he had also revised his philosophy. Prior to that time he had written a realistic type of literature with romantic overtones characteristic of Jane Austen and Alphonse Daudet. In New York he moved to the left socially and politically, first to Leo Tolstoy and Thomas Hardy, and then to Henry George and Edward Bellamy. As a result, his writing assumed a new tone. A Traveller from Altruria and Through the Eye of a Needle were illustrative of his changed philosophy. In these novels, Howells portrayed a society harrassed by the irresponsibility of acquisitive capitalism, the evils of industrialism, and the disintegration of traditional standards of morality. His break with the past was philosophical rather than material, but he did set the stage for the younger social reformers like Hamlin Garland, Stephen Crane, Frank Norris, and Jack London.[2]

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[1] Clara Barrus, The Heart of Borrough's Journals (Boston and New York, 1928), 214.

[2] Henry S. Commager, The American Mind: An Interpretation of American Character Since the 1880's (New Haven, Connecticut, 1950), 59-60.

Although Howells in 1901 continued to champion these reform writers, his ardor was cooling in his later years. He was still a socialist but continued to wear a fur-lined overcoat and live in luxury. In 1900 he published Literary Friends and Acquaintances, a reminiscent work, recalling how he had liked Hawthorne, misunderstood Thoreau, and disagreed with Emerson. On November 20, Howells wrote to the noted poet, Thomas B. Aldrich of Boston, that he was always longing for the solitude which the latter described, but he seemed unable to leave New York. Howells confessed that his wife and he had decided that they were too old to live in the country. They had lost their teeth and felt the increasing need of a dentist nearby. The elderly New Yorker added that he was reading Horace E. Scudder's Life of Lowell with a constant dull ache for the days that were no more.

One of Howells' closest friends, Samuel L. Clemens, was living at Riverdale-on-the-Hudson, a short distance from New York. The aged cynic was far enough away to be beyond the reach of all socials he did not wish to attend. Samuel L. Clemens was relatively content among his palisades and steamboats.[3] Howells visited his old friend often, and they had great times denouncing everything, especially the Boer and Filipino Wars. The Harper's Monthly editor said that the former Mississippi River pilot was receiving some hard knocks from people for his righteous fun with President William McKinley's attempt to colonize the Philippines, but was gaining firm friends also. On October 23, both Clemens and Howells were awarded an honorary Doctor of Literature Degree from Yale.[4]

Like Howells, Mark Twain was old; but age, instead of mellowing him, made him increasingly bitter. In one of his last books, The Mysterious Stranger, begun in 1898, Clemens had the hero say that there was no God, no universe, no human race, no earthly life, and no hell. Life was a dream, said the mysterious stranger, grotesque and foolish. Nothing existed but the person, and he was a vagrant, useless, homeless thought wandering forlorn among the empty eternities. The American humorist had reasons for bitterness. His child, "Susy," had died, his wife was an invalid, and he had lost most of his money. To complete his pessimism, he was by na-

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[3] Oscar W. Firkins, William Dean Howells: A Study (Cambridge, Massachusetts, 1924), 17; William D. Howells to Thomas B. Aldrich, November 20, 1901, Mildred Howells, ed., Life in Letters of William Dean Howells (Garden City, New York, 1928, II, 150.

[4] Howells to Miss Aurelia Howells, February 24, 1901; Howells to Samuel L. Clemens, October 15, 1901, Howells, ed., William D. Howells, II, 142, 148.

ture a worrier. Clemens had made a fortune from his writings, but the wealth had evaporated. His dream of becoming a millionaire by a stroke of luck had never forsaken him. Thus, bonanza fever made him a life-long victim to gold bricks and dazzling inventions. He lost hundreds of thousands of dollars on the Paige typesetting machine, and in a publishing firm which went bankrupt under the management of his son-in-law, Charles L. Webster.[5] In order to pay his debts, Clemens had to go on a lecture tour.

As a result of years and worry, Mark Twain in 1901 appeared shockingly old. He had become a small, hesitant, white-haired gentleman. Many of his western qualities had been planed away or softened by quiet city life.[6] As a final indication of Mark Twain's mental depression, he was complaining that when one was young a dollar would buy a hundred exquisite pleasures. But when one became old and had the dollar, one could find nothing worth buying. On this comment, the Bedford, Indiana, Daily Mail remarked that the trouble was not in the dollar but in Mark.[7]

Another dissatisfied, elderly literary man was Henry Adams. A thorough scholar, his best historical effort was an eight-volume work on the administration of Jefferson and Madison. His most controversial studies, Mont-Saint-Michel and Chartres, and The Education of Henry Adams, displayed his disillusionment with the "so-called" progress of civilization. His theories ended in futility. He applied science to history and arrived at the conclusion that culture would eventually be destroyed through the second law of thermo-dynamics, namely, the dissipation of energy. In the thirteenth century, he saw unity; while in the twentieth, he saw multiplicity and ultimate decay. He concluded that the harnessing of natural energy was putting men in chains rather than setting them free. Men in the twentieth century, he said, were being educated by bombs which doubled in number and power each decade.[8]

Traveling in Europe in September 1901, Adams thought that even social customs were declining. Formerly, when he had gone abroad the people on board ship had been sociable and friendly. On this trip, the old cynic complained that the only people he talked to were

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[5]Ralph D. Blumenfeld, In the Days of Bicycles and Bustles: The Diary of R. D. Blumenfeld, 1883-1914 (London, 1930), 168; Albert B. Paine, Mark Twain, A Biography: The Personal and Literary Life of Samuel Langhorne Clemens (New York and London, 1912), III, 1140.

[6]Hamlin Garland, Companions on the Trail: A Literary Chronicle (New York, 1931), 52, 56.

[7]Bedford, Indiana, Daily Mail, September 9, 1901, p. 2, c. 1.

[8]Henry Adams, The Education of Henry Adams: An Autobiography (Boston and New York, 1927), 434-35.

stewards and hotel managers.[9] Like Mark Twain, the fault was probably not to be found in the other passengers, but in him.

The father of the western local color stories, Bret Harte, was also abroad, on an extended visit in London, England. There were several reasons why he lived in England. His residence in London was partly due to the fact that he was able to obtain more for his writings there. Also, he did not wish to live with his wife, and his residence in England gave him an excuse for not being with her.[10] In addition, he liked the soothing effect of the climate. He ate more, worried less, and became a happier "animal." However, Harte's sojourn abroad did not help his writing. His inspiration dried up, and he spent his final years imitating himself in copious fashion. During 1901 Bret Harte suffered from cancer of the throat, but he kept at his work. From his headquarters at Seventy-Four Lancaster Gate, he carried on an ordinary life. His habits were regular and simple. He smoked a lot, drank a little, and took exercise everyday. Occasionally, he would make pilgrimages to Macbeth's country in Scotland and to Charlotte Bronte's home in Yorkshire. Although he belonged to various clubs, the Beefsteak, the Rabelais, and the Kinsmen in his declining years, he frequented only the Royal Thames Yacht Club. When asked why he did not attend the literary clubs, he replied that he only went to a club when he got tired of writing. If he went to a literary club, he had to answer questions on literature. At the Yacht Club, he was not expected to say anything, just listen to yacht conversation. Thus, he could come away feeling refreshed. In May of 1902, far from his native America, he died, at the age of sixty-five, in the home of Madame Arthur Van de Velde at Camberley in Sussex.[11]

The Indiana sage, James Whitcomb Riley, also felt he was suffering from the weight of years. He had two desires. He wanted to build a complete, true book, as a mason would construct a stone wall, and he yearned to be young again. In neither was he successful. Rhymes of Childhood and The Book of Joyous Children were two of his attempts to edit a sterling volume of his poems. But his work was slipshod, and he became a target for the critic. "He has bound together in a book," said the literary expert, "the pebbles and the pearls on one string, and the author seems to have a perverse affec-

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[9] Henry Adams to Elizabeth Cameron, September 28, 1901, Worthington C. Ford, ed., The Letters of Henry Adams (Boston and New York, 1938), II, 355.

[10] They had four children, two boys and two girls.

[11] Henry C. Merwin, The Life of Bret Harte: With Some Account of the California Pioneers (Boston and New York, 1911), 279, 281, 283.

tion for the pebbles."[12]

During 1901 he rested from lecturing and spent his time writing in his home at Indianapolis. He had visions of turning out a complete edition of his works. On September 23, he wrote to Joel C. Harris that if he ever finished the Complete Edition, he would like to have a ten or eleven year holiday with Harris, at which time they would become young again.[13]

In September another elderly Indiana author was in the news. This was General "Lew" Wallace. A request had recently come from Egypt to General Wallace and his publishers for permission to translate Ben Hur into Arabic. Since the Bedouins and their horses played such an important part in its pages, it seemed fitting to the Terre Haute Evening Gazette that this great book should become known to the Arabians. Although the General had written several books after retiring from the army, his greatest fame rested on Ben Hur, published in 1880.[14]

Deep in the heart of the Southland at Atlanta, Georgia, lived Riley's favorite friend, Joel Chandler Harris. In spite of frequent attacks of influenza, Harris was a modest, cheerful fellow. In answer to Howell's request that a group of authors collaborate on a literary set, the Georgian told the literary dean what a poor author he was: "If you think you can give a cornfield hand a showing and you are not afraid to fish a cold dumpling out of the potliquor with your fingers, perhaps I can meet your wishes. . . . You know of course that so far as literary art, I am poverty stricken, and you know too that my style and methods will cause you to pull your hair."[15]

The Southerner's cheerfulness was demonstrated in a letter to Riley on September 30: "Down here we're moseying along towards fall. The roses are fine, and, occasionally, I hear a young mocking bird practicing his tune in the bushes."[16]

During 1901 Harris' major literary enterprise was One Mile to Shady Dale, later rechristened Gabriel Tolliver. Appearing serially

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[12]Marcus Dickey, The Maturity of James Whitcomb Riley: Fortune's Way with the Poet in the Prime of Life and After (Indianapolis, 1922), 337, 341, 382.

[13]James W. Riley to Joel C. Harris, September 23, 1901, William L. Phelps, ed., Letters of James Whitcomb Riley (Indianapolis, 1930), 253.

[14]Terre Haute, Indiana, Evening Gazette, September 12, 1901, p. 6, c. 5.

[15]Joel C. Harris to William D. Howells, June 1, 1900, Julia C. Harris, The Life and Letters of Joel Chandler Harris (Boston and New York, 1918), 451.

[16]Harris to James W. Riley, September 30, 1901, Harris, Joel C. Harris, 460.

in a Philadelphia magazine, Era, during 1901 and 1902, the novel was published in book form in 1902 by the McClure-Phillips Company. The book was dedicated to his dear friend, James W. Riley. Although the setting of the book was in Georgia during the latter half of the nineteenth century, not a single Civil War battle was described in it. The Ku Klux Klan made an appearance but very fleetingly. Gabriel Tolliver was basically an autobiography of Joel C. Harris.[17]

Harris' foremost achievement, his picture of the Georgia Negro, had its origin in 1877, when the Atlanta author was editorial assistant on the Atlanta Constitution. At that time, he had introduced the "Uncle Remus" tales and songs to the Constitution's readers. When asked if any particular Negro had suggested his quaint and philosophic character, he replied: "He was not an invention of my own, but a human syndicate, I might say, of three or four old darkies whom I had known. I just walloped them together in one person and called him 'Uncle Remus.'" As for the stories, they were tales that Harris had heard all his life. He said that he had just collected them so other people might enjoy them. Of these stories gathered over a period of twenty-five years, the "Tar Baby" legend was probably the best loved.[18]

In 1901 the famous New Orleans author of Old Creole Days, George W. Cable, was no longer in the South. To be closer to his literary market, and because of southern resentment to his outspoken criticisms, he had moved to Northampton, Massachusetts. From this headquarters, he travelled extensively and wrote copiously. Early in 1901 he published The Cavalier. Immediately he began work on Bylow Hill, the story of jealousy's disastrous effects, based on an actual medical case. After serial publication in the Atlantic Monthly, this story was brought out in book form by Scribners in 1902. Meanwhile, in August 1901, there appeared in the Century Magazine "Pore Raphael," a sequel to his former "Posson Jone." Cable liked realism, and unlike his Southern contemporary, Joel C. Harris, he was brutal in its portrayal. Many of his characters were overdrawn and his smash endings poor, but he did display the Southern Negro and Creoles well.[19]

The most optimistic writer of the elderly authors, John Fiske, was dead. As if in tribute to his American historical research, he died on July 4, 1901, at East Gloucester, Massachusetts.[20] Although he was a popular lecturer and a lucid, sparkling writer, he was not

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[17] Harris to Riley, April 1, 1901, Harris, Joel C. Harris, 448.

[18] Harris, Joel C. Harris, 144.

[19] Lucy L. Cable Bikle, George W. Cable, His Life and Letters (New York and London, 1928), 249-52; George W. Cable, The Cavalier (New York, 1901), 307-11.

[20] American Historical Review, VII (October, 1901), 187.

a thorough scholar. The historians maintained he was a philosopher, and the philosophers countered that he was a historian. At least, one fact was certain; he was a thorough going evolutionist, who enjoyed explaining the marvelous growth of America in evolutionary terms. Although he talked of a guiding providence and an Anglo-Saxon racial stock that had made the United States great, in the final analysis, he explained these factors as only part of the cosmic validity of science and dynamic natural evolution.[21]

By the turn of the century, the younger writers had as yet been unsuccessful in their attempt to unseat the old literary masters.[22] However, the writings of the younger writers were gaining in general popularity. Winston Churchill's The Crisis, Frank Norris' The Octopus, Hamlin Garland's Her Mountain Lover, and Finley P. Dunne's Mr. Dooley in the Hearts of His Countrymen were high on the best-seller list.[23] Hamlin Garland summed up the situation in a letter to Henry Fuller. He wrote that Howells was an old man and Charles D. Warner already gone. "When Howells and Gilder pass," he continued, "our generation will be the dominant force in letters. We cannot be called 'our younger writers' any longer."[24]

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[21]John Fiske to Henry Holt, December 2,1890, Ethel F. Fisk, ed., The Letters of John Fiske (New York, 1940), 584.

[22]Other elderly authors of note in 1901 included Henry Van Dyke of Princeton, New Jersey; Frank R. Stockton, of Charleston, West Virginia; Thomas B. Aldrich, of Boston; and Joaquin Miller, the Hoosier who had gone to Oakland, California.

[23]Nation, LXXIII (September 7, 1901), 280.

[24]Garland, Companions, 51.

POLITICAL TRENDS IN THE 1959 OFF-YEAR ELECTIONS: THE CASE OF KENTUCKIANA

George C. Roberts
University of Arkansas

The political pulse of the Nation will continue to be revealed by the results of poll-taking and the interpretation of political observers until the election of a President is upon us. Mr. George Gallup has again told us that the Democratic Party enjoys the advantage of electoral support from a majority of potential voters.[1] However, for those skeptical of political observers and for those holding that opinion polls are no substitute for a genuine election, the scattered off-year elections of 1959 offer the best means of checking political trends revealed at the polls midway between the Congressional Elections of 1958 and the 1960 Presidential Election.

These 1959 elections were not of a national type since only state or local officials were chosen by the voters involved. But the American Party System includes both national and state parties, and basically the same electorate that voted in the several states holding elections in November, 1959 will cast the vote in these states in the Presidential Election of 1960.

The November, 1959 elections, while scattered geographically, were concentrated in that part of the United States east of the Mississippi River. Voters in several states participated in the election of local officials; while in New Jersey, Kentucky, Virginia, Mississippi, and Pennsylvania state or legislative officers were chosen. In Pennsylvania, New York, Connecticut, Ohio, and Indiana mayoralty races were widespread. The nature of the election prizes considered along with the state's place in the national party system provides a framework for examining political trends.

What then do the 1959 elections tell us, especially in terms of 1960? There are the customary interpretations offered by the national party chairmen. Democratic Chairman Paul Butler said the elections "demonstrate the vigorous good health of the Democratic Party as it prepares for the momentous campaign of 1960." At the same time Republican Chairman Thruston Morton felt that "Republicans have

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[1] St. Louis Post-Dispatch, November 14, 1959. Gallup reports in this poll that the nation's estimated 102,300,000 voters would probably line up in this manner if registered:

Democrats	56,200,000
Republicans	37,600,000
Undecided	8,500,000

every reason to look forward confidently toward 1960."[2] Party leaders are not expected to give answers other than these; it remains for us to examine the various campaigns, local political environments, and election data to answer our question.

Republican candidate Harold Stassen was defeated for Mayor of Philadelphia by over 200,000 while Democrats won the two Pennsylvania state-wide races for court judges. Republicans claimed gains in Columbus and smaller Ohio cities, while the vote for partisan judges in Cook County (Chicago), Illinois heavily favored local Democrats. Democratic efforts in Connecticut, a state watched for trends, might be described in terms of keeping control of the larger cities by reduced margins in municipal elections. Municipal elections in upstate New York caused little change from the status quo, but caused Republicans to claim support for Governor Nelson Rockefeller's program. Democrats cited advances for their party in New York City. The Democratic-Liberal vote totals in Queens, Bronx, and Richmond counties for local candidates surpassed in many cases the Democratic totals in the 1954 gubernatorial contest won by a Democrat, while 1959 Republican totals here were greatly reduced from 1954. A halting of the state-wide Democratic trend, evident since 1953, was noted in New Jersey legislative races. Democratic Assembly strength dropped eight seats, still leaving the Democrats in control, while a Democratic gain of two Senate seats failed to deliver that body to Democratic control.[3]

In analyzing the vote of these states one must remember that only Pennsylvania had state-wide races, and then only two. When party gains and losses are balanced out it appears that the status quo was generally maintained. It seems advisable to look elsewhere for more definite signs of a political trend. Kentucky and Indiana, the respective homes of Republican National Chairman Thruston Morton (also a United States Senator) and Democratic National Chairman Paul Butler offer this opportunity. The Kentucky election was statewide with the electorate being offered several ballot choices. There were races for governor, lieutenant governor, other state administrative officers, and state legislators. The Indiana elections were of a different nature as no state officers were elected, but every Indiana city elected a mayor. Local factors influence such municipal elections, but the state party organizations conduct campaigns in such a manner that these municipal elections take on the flavor of an ordinary state-wide campaign. In both Kentucky and Indiana the elections had substance insomuch as the prizes were considered

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[2] Louisville Courier-Journal, November 5, 1959.

[3] This election information was taken from the New York Times, the Louisville Courier-Journal, and Richard M. Scammon, America Votes (New York, 1956 and 1958), I and II.

important to the politicians of both states. The Kentucky election, similar to some of the 1958 state elections, saw both parties seeking control of state government and its patronage in anticipation of the 1960 Presidential Election and the local election of a United States Senator. Indiana political leaders were anxious to control city halls and their patronage in anticipation of the 1960 Presidential Election and the election of an entire state ticket headed by a new governor.

Indiana is often regarded as a trend state. President Eisenhower received 57.7 per cent of the national two-party vote in 1956 and 60.1 per cent of the two-party vote of Indiana. The Democratic House candidates secured 56.6 per cent of the national two-party vote in 1958 congressional races while Indiana Democratic candidates for the House secured 53.6 per cent of the state two-party vote. Political shifts in Indiana are swift and devastating. President Eisenhower's 60.1 per cent of Indiana's two-party vote in 1956 was approached when the Democratic candidate for the United States Senate captured 57.0 per cent of the Indiana two-party vote in 1958. The Democratic Party gained forty-seven House seats as a result of the 1958 Congressional Elections. Six seats, or 12.8 per cent of this gain came from Indiana.[4]

Both Indiana and Kentucky exhibit characteristics of two-party or modified two-party states. In the past, Kentucky has been more inclined to vote for Democratic presidential candidates, Indiana for Republicans. However, Kentucky does have centers and years of Republican strength, and Indiana Democrats do win elections: although in the case of the latter, electoral success usually depends on a strong national Democratic trend such as in the early 1930's or in 1958.[5]

The states of Kentucky and Indiana with their 1959 elections seem important to a trend analysis for reasons given above. It will be fruitful to see if political trends established in Kentuckiana during the Eisenhower Era were continued or discontinued in 1959.

Indiana municipal elections, while held in non-presidential and non-congressional years, get involved with national issues. The Republican municipal victories of 1951 were viewed locally as a "set back for Trumanism." Chairman Butler and national Republican figures such as House Minority Leader Charles A. Halleck could not have avoided concern with local elections in their home state. During the course of the Indiana municipal campaign city tax rates were

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[4]This information was secured from the General Election Report of Indiana and Scammon, op. cit.

[5]In the 15 presidential elections since 1900 Kentucky has gone Republican only three times and Indiana has gone Democratic only three times.

cited by Republicans to show that Hoosier Democrats, like national Democrats, were "spenders." The Republican Party in Indiana has for the past ten years campaigned against high governmental spending, socialism, and Walter Reuther. In spite of a landslide defeat for the Republicans in 1958 this theme was generally continued in 1959. Republican State Chairman Robert Matthews spoke in Minneapolis, Minnesota in October and described Social Security in terms of "socialism." Later in the same speech he stated that the Republican Party should strive for the "utter destruction of all socialist schemes."[6] Democratic campaign ads then warned voters, "Don't Let Them Take It Away! . . . Top Republican leaders threaten to end Social Security."[7] On the other hand the Republican candidate for Mayor of Indianapolis said in his newspaper ads, "Make Social Security Stronger . . . Vote for Social Security . . . Vote Republican."[8]

The results of the elections showed that the Democrats had one less mayor and the Republicans fifteen more than after the 1955 elections, the total number of cities having increased and some independents being defeated. The final tally was 71-36 in favor of the Democrats who now controlled twenty-five of the twenty-six largest cities in the state, losing one in this class and gaining Fort Wayne and Lafayette over 1955.[9] The city of Evansville, located in Vanderburgh County which has voted for the winning Presidential candidate since 1896, elected a Democratic mayor. Beginning in 1938, the party winning a majority of the cities had lost them in the next city election. The Democrats reversed this trend by winning majorities in both 1955 and 1959. Not since 1947 and 1948 had Democrats won two sweeping elections in succession. For the long run it may be that the municipal victories following the New Deal type landslide of 1958 for the Democrats will spell an important change in the state political picture; the change not being favorable to the Republican Party.

The Kentucky gubernatorial election has its roots far back in time and Democratic factionalism. The first electoral struggle was in the May, 1959 Democratic Primary. The successful Democratic nominee, Judge Bert Combs, smarting from a 1955 primary loss, defeated Lieutenant Governor Harry Lee Waterfield for the nomination by 33,001 votes. Waterfield had the support of Governor Albert B. (Happy) Chandler who had defeated Combs in the 1955 Primary but could not succeed himself in office. In January, 1959, Wilson Wyatt of Louisville withdrew from the gubernatorial race, announced for

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[6] Louisville Courier-Journal, November 3, 1959.
[7] Indianapolis News, November 3, 1959.
[8] Ibid., November 2, 1959.
[9] Louisville Courier-Journal, November 5, 1959.

lieutenant governor, and joined the Combs forces. During the primary campaign the Combs-Wyatt ticket was accused of subservience to the "Louisville newspaper monopoly" (Courier-Journal) and to former Senator Earle Clements, then Chairman of the Democratic Senatorial Campaign Committee, and his "Texas oil millionaire pals." Harry Lee Waterfield was given a new name by the Combs people, "Happy Lee."

After the primary both Chandler and Waterfield promised support for the Combs-Wyatt ticket. However, by general election time both refused to appear at a rally featuring former President Harry Truman because of Combs' presence. Chandler, an announced Presidential candidate, in effect finally said that he would vote the Democratic ticket but that Combs' election might be the worst thing that could happen to Kentucky. Combs was called a "bolter," a "poor little dunce," the "biggest liar I have encountered in thirty years in politics" and a man who would be "a terrible governor if elected" by Governor Chandler.[10] Kentucky Democrats were mindful of the election of two Republican United States Senators in 1956 and the role that Chandler was supposed to have played by voting for, but not supporting the Democratic nominees. Would factionalism hurt the Democratic Party's chances of victory in 1959?

The Republican candidate for governor, John Robsion, had been defeated for re-election to Congress in 1958 from Kentucky's Third Congressional District (Louisville). A protege of Thruston Morton, Robsion was regarded as a strong candidate in Louisville and in the south-central hill area, his father having once served this section as Congressman. Kentuckians had been known to elect a Republican Governor as a sign of independence such as in 1943.

It would be impossible to assess the efforts that Thruston Morton and Earle Clements put forth to win the Kentucky election. National party spokesmen found their way to the state -- Vice-President Richard Nixon for a National Park dedication in July and former President Harry Truman for a political speech in Paducah, Alben Barkley's home town, towards the close of the campaign. Otherwise the campaign in good Kentucky tradition was colorful but not exactly productive of issue-discussion. Robsion charged that Combs lacked experience, was tied to certain bosses, had no definite program, had made irresponsible fiscal commitments, and would be plagued by party factionalism. Combs replied indirectly by reminding the voters that Robsion had opposed the Kentucky farmer while a Congressman, would give Kentucky divided party government, and would inaugurate a Herbert Hoover type of government by commission as a substitute for government by action.

The election results gave Combs a plurality of 180,093 out of

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[10] Louisville Courier-Journal, October 23, 1959.

853,005 votes cast, the plurality setting a Kentucky record in gubernatorial contests. Wilson Wyatt, former Mayor of Louisville, a founder of Americans for Democratic Action, and a campaign manager for Adlai Stevenson, overcame the prejudices of Kentucky's Bourbon Democracy to secure the biggest plurality ever given a candidate in Kentucky, including Franklin Roosevelt. The Democrats carried all of the other state races and increased their legislative majorities.

Republican National Chairman Morton in his post-election analysis said that in Kentucky "an expected Democratic split did not materialize and the Democrats won the election according to form."[11] However, in 1952 Adlai Stevenson carried Kentucky by only three hundred votes. Then in 1956 Stevenson's percentage of the two-party vote fell to 45.4 and two Republican United States Senators were elected. In the 1959 race for Governor, the next important state-wide election after the 1956 Eisenhower landslide, Combs was able to secure 60.6 per cent of the two-party vote. As a candidate he fared extremely well in traditionally Democratic Western Kentucky (securing 77.9 per cent of the vote in McCracken County for example), and raised the Democratic percentage in Harlan County, a coal-producing area, to an all-time high of 64.6. Combs ran well in the Bluegrass Region, home of Kentucky's Dixiecrats. President Eisenhower captured 61.8 per cent of Fayette County's two-party vote in 1956 while Combs received 57.4 per cent of the vote here in 1959. The larger urban areas of the state, partial to Eisenhower in 1956, were all carried by Combs excepting Jefferson County (Louisville), home of the Republican candidate. The vote shift in these urban counties from 1956 to 1959 was startling. Robsion, the Republican candidate, carried only twenty-seven of one hundred and twenty counties, just holding his own in the Republican Eighth Congressional District. The 1959 state election in Kentucky offered little encouragement to those witnessing a trend in Kentucky politics that was supposed to give the state a "marginal political complexion" with Republicans probably having an advantage in the long run.[12]

Apart from parties and candidates the 1959 elections offer an insight into a national political issue, that of spending. President Eisenhower seized the initiative in 1959 and warned that the Democratic victory of 1958 was not an indication that the people favored the "spenders." Many Democrats in Congress took the President's pronouncement as a true reflection of public opinion. The "spenders"

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[11] Louisville Courier-Journal, November 5, 1959.

[12] These election figures have been taken from Scammon, op. cit., and the Louisville Courier-Journal. For a discussion of the direction of Kentucky politics after the Eisenhower Era see John H. Fenton, Politics In the Border States (New Orleans, 1957).

label did not hurt Indiana Democrats in 1959 in spite of the traditional attachment of the Hoosier to economy. Also, elsewhere in the country there was widespread support of the electorate for new taxes, the retention of school taxes, and bond issues for the amount of $1,400,000,000.[13] Kentucky voters approved the financing of a veteran's bonus after being forewarned that a three per cent sales tax would likely follow.

It is difficult to isolate a national political trend in a nation which has a true national vote only when a President is elected. Congressional elections can hardly be described as being national elections since no election district reaches beyond a state's borders. Our party system like our governmental system is federal in nature. Nevertheless, state and national party systems, state and national party organizations, and state and Presidential elections are invariably intertwined. In the seeds of the 1958 and 1959 elections are the victories and defeats of 1960. A look at the total picture, with emphasis placed on Kentucky and Indiana for reasons mentioned, should not discourage Democratic optimism for 1960 nor encourage Republican hopes.

[13] Louisville Courier-Journal, November 6, 1959.

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