Proceedings of the Arkansas Academy of Science
(Founded 1917)

Volume II

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Thirty-First Annual Meeting, May 2 and 3, 1947
University of Arkansas, School of Medicine
Little Rock, Arkansas

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Price: One Dollar
To Members: Fifty Cents
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Editorial

After five years of turmoil and world strife, we are finally bringing forth this the second volume of the Proceedings. It is not necessary to itemize the numerous difficulties that have made publication so difficult if not impossible within much of this period. Several of these papers were delivered to the Academy in the early days of the struggle and in a way are now out of date but they are here inclosed as a matter of record. Unfortunately not all papers that have been presented to the Academy are available for publication at this time. Several of the members were confident they could get their papers to the editor but have failed to do so. Perhaps some of these can be included in a later issue.

With the return of conditions approaching normalcy, it is to be hoped that the Proceedings may appear with more regularity and that there will be more members and others who will find the Proceedings a favorable medium for publication of their material. Members and others have been very cooperative over the delaying of this issue. It is to be hoped that this volume may in a measure compensate them for their long delay.

Dwight M. Moore
Editor
A REPORT OF THE SECRETARY

The Academy, 1942-45, Incl.
L. B. Ham

Detailed reports of the annual spring meetings of the Arkansas Academy of Science have been sent out to all members. Therefore, only a summary of Academy activities for a more permanent record will be reviewed. Further secretarial information will be found in tabular forms elsewhere. While the period under discussion has never been equaled before in history, the Academy has held meetings each spring, though on a smaller scale. In the meantime new evidences that the people of our part of the country sense the importance of research in industry may be seen in the new research organizations such as the University Bureau of Research, The Southern Association of Science and Industry, The Gulf Southwest Industrial and Agricultural Conference, Inc. and the Midwest Research Institute.

Changes in By-Laws and Constitution

At the spring meeting of 1942 at Monticello, the Academy voted to adopt new amendments, numbers 5, 6 and 7, to the by-laws. The new by-laws are as follows:

5. The fiscal year and the membership year shall be designated as beginning with January 1 and ending with December 31.

6. All officers assume their duties at the beginning of the fiscal year following their election.

7. A person elected to membership within a year holds paid-up membership for the remainder of that fiscal year.

The academy voted also to authorize the president to appoint an auditing committee to examine the Treasurer's and the Secretary's books at the end of the fiscal year. The president was authorized in the spring of 1942 to appoint a membership and a publicity committee.

At a business session of the 1943 Academy session, the Academy voted, after considerable discussion, that a committee be appointed to consider the establishment of an Industrial Commission with a view to listing, tabulating, and correlating, to the extent possible, research work in Arkansas. The executive committee was authorized by vote, also, to handle routine matters in interim between the annual meetings.

The Academy at its spring session in 1944 voted to make the following changes in constitution and by-laws:

1. Article III of the constitution to be reworded to read "persons and organizations" in place of "persons".

2. Addition to amendment to by-laws No. 4 after the year 1942, "and dues of an institution, $10.00 per year, carrying a single membership."

3. Take out Section 2 of Article III and also "two members and the payment of dues" in Section I in constitution and replace with "of the membership committee and payment of dues."
Resolutions

The proposal to approve the Kilgore "Science Mobilization" bill was rejected by the Academy at the spring meeting in 1942. The Academy members preferred organization for concerted action in the war effort and during the post war period. At that time, the Academy members questioned whether the proponents of this bill understood it sufficiently to avoid serious political entanglements and research by bureaucracy from Washington.

Mr. H. L. Winburn, in behalf of the Research Committee, reported the following two resolutions to the Academy at the spring meeting, 1945: namely, that (1) the Academy members undertake independent scientific investigations and report the same to the Academy, (2) the Academy urge the state research program to be conducted at the scientific level in the colleges of the state and under the heads of the departments properly concerned. A general recommendation to the effect that all research programs in the state be coordinated, as far as possible, was made also. The above resolutions of the Research Committee were adopted.

Dr. Roberts introduced, orally at the 1945 spring business session, a resolution to be sent to the President of the United States and to the Arkansas delegation in Congress protesting the drafting of scientific and technical students. The general idea underlying the resolution was adopted by the Academy members. The exact form, which was later sent to the Senators, follows:

We believe that the withdrawal from American Colleges and Universities of almost all young men majoring in the Sciences will soon bring about a very serious shortage of technically trained personnel which may prove fatal to the adequate development of science and industry. More jobs depend upon an expanding industry and an expanding industry depends upon scientific and technical developments.

Further, we do not believe that the present and the near future needs, which are less pressing than formerly, can possibly justify so serious a drain on the future for benefit of the present, even if military victory could be won without technical support at home.

We, therefore, strongly urge that measures be taken at once to correct this dangerous situation.

We suggest such measures as the following:

1. Deferring from draft liability all bona fide science majors so long as they make satisfactory progress in their studies.

2. Deferring science graduates who enter critical occupations, and supervising their placement to best advantage.

3. Discouraging science students from entering the service voluntarily, or leaving their studies for other reasons. (If necessary, draft them, put them in uniform, and return them to their classes.)

4. Returning to the classroom as many as practicable of the science students who are already in service - with or without discharges.

5. Encouraging qualified high school graduates to enter college science courses.
Research Committee

The afternoon session of the 1944 spring meeting in Little Rock was devoted to a round table discussion on "Research in Arkansas." Many of our members have been interested in a more definite organization to promote research in our state. The research institute idea was suggested by some members.

Dr. Roberts spoke at length on the need of some form of organized cooperative research. The rapid growth of the Alabama Institute was cited as an example of what can be done and to illustrate lines along which the academy may well be thinking. He stated that a research institute to be adequate ought not simply to encourage research and find what is being done, but to obtain funds, to subsidize research on industrial problems of the state, to cooperate with various laboratories in arranging for cooperative research programs, to help establish better research library facilities, to patent suitable inventions for the benefit of members, and for licensing to non-members.

The discussion indicated that the members are much interested in the developmental possibilities through research, and are willing and anxious to contribute substantially of their services. Members felt that an enlarged research program spread over the state would aid much to lift the whole tone of educational outlook in the state as well as to raise the level of industrial efficiency in the state.

Mr. L. A. Henry, Engineer, Director of the State Planning Board and Mr. W. M. Shepherd, acting Director of the Arkansas Economic Council made valuable contributions to the discussion. The discussion brought out that there are about 1200 manufacturing and mining industries in the state. The chief function of the various research agencies, so far, has been to bring together the facts. Our guest speakers pointed out that our state's weak industrial situation is due to our vast deficiency in industrial research in the state, and that we have a great untouched field of industrial problems and opportunities for pure research for the development of the state's mineral and agricultural resources.

At the time the program was planned, but few knew anything about the University of Arkansas Bureau of Research which had just recently been established by an act of the 1943 Legislature.

As an immediate result of the round table discussion a Committee on Research was authorized at the business session which followed the round table discussion. This committee was to work with the University Bureau and with the Committee on Surveys and Research headed by Mr. Thomas Jones. The suggestion was made that this committee contact Mr. Jones. The committee is composed of the following members:

Mr. H. L. Winburn - Noloak Pottery
Dr. Byron L. Robinson - University of Arkansas School of Medicine

Other members to be added as needed.

The research committee consisting of the above two members and Dr. Roberts, President of the Academy at that time, held many informal talks. They had luncheon December 15, 1944 with the Arkansas Economic Council in Little Rock at Lafayette Hotel and then held a meeting at 2:30 p.m. After a lengthy discussion, decision on formation of any research organization was postponed until it...
could be determined whether the University Bureau of Research would cover the field and make such an organization unnecessary.

The research committee will award the AAAS research grant as one of its functions. Steps were taken to affiliate with the American Association for the Advancement of Sciences in October 1942. The question of affiliation was placed before the Executive Committee of the AAAS at the December meeting. Affiliation of state academies with the AAAS entitles them to a yearly research grant, the amount depending upon the number of Academy members who are also members of the AAAS. The minimum grant is $25.00. Because of our small membership in the AAAS, we have been awarded the minimum grant of $25.00 since 1943. This is a beginning. There is no reason why much more money from sources, at present unknown, will not become available as fast as the money can be shown to be fruitfully spent. Those who wish to be considered for the AAAS research grant should send a brief abstract of their project to the research committee.

There were no applications for the 1944 grant and none for the 1945 grant up to the present time. The whole amount of a year’s grant, or more than a single year’s grant may be awarded to one grantee.

The research grants must be called for within three years but the three year limit does not include the calendar year 1945. Perhaps we have some Academy members now in a position to undertake some research requiring extra funds not otherwise available. The Academy does not receive the money until the Secretary of the AAAS receives a report stating the name and address of the grantee and the subject of the project to be undertaken.

Junior Academy Discussions

There have been a number of discussions on the formation of a Junior Academy dating even before the war. The Academy voted at the 1942 spring session to have the president-elect appoint a committee to consider the formation of a Junior Academy and report at the next meeting. Plans were launched at the following year’s meeting for organization of such an Academy, with Dr. Wills heading the committee. The war, restricted travel and heavy war time duties have stalled any real headway on the Junior Academy organization. The report of the academy Conference of the AAAS, which held its sixteenth annual session at Cleveland, Ohio, September 11, 1944, contains some very excellent remarks not only on Junior Academy activities, but also on Science Clubs of America activities. Dr. D. M. Moore, our Academy Conference representative, was present at this meeting. A great challenge presents itself in the organization of our young potential science workers.

Concluding Remarks

Abstracts of all papers read before the regular Academy sessions since 1941 will be printed in this volume, if an abstract was received as requested, unless the complete paper is presented for publication. In the latter case, the complete publication will be substituted for the abstract.
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ABSTRACTS OF PAPERS SINCE 1941

26th Annual Meeting May 1-2, 1942.
Arkansas A. & M. College, Monticello, Arkansas

1. The Corpus Allatum of Galleria Mellonella L. T. L. Smith, The College of the Ozarks. 15 minutes. Evidence is at hand to indicate that in Galleria, as has been shown to be the case in many other insects, there are (a) incretory or endocrine substances found in the head region which govern the metamorphosis of the last larval instar into the pupa, (b) critical periods in late larval development beyond which the endocrine actions cannot be interfered with. The structure of the corpus allatum in Galleria is typical of that found in other lepidopterous insects.

2. An Exploratory Study of the Early Effects of Antuitrin-S in Prepubertal Rats. Mrs. E. Z. Burkhart, Clarksville. 15 minutes. Previous work by the author ('39, '42) has shown that, by the use of colchicine, very early responses to single small doses of androgens can be detected in the accessory sex glands of castrated young adult rats. These results suggested a study of the early effects of gonadotropic substances on the accessory sex glands of prepubertal rats. Twenty-day-old rats were injected with 20 R.U. of Antuitrin-S. Uninjected animals served as controls. All the rats received 0.1 mg. of colchicine per 100 grams of body weight approximately six hours before sacrifice. The animals were sacrificed in pairs (one control and one which had received Antuitrin-S) at intervals from 13 to 44 hours after injection.

* All Academy sessions were held in the spring, preferably the last week in April, otherwise the first week in May. All yearly elected officers serve the following calendar year.
The seminal vesicles and the ventral prostates of all control animals contained varying numbers of mitotic cells. The number was significantly increased by the Antuitrin-S in the seminal vesicle at 28 hours and thereafter. The ventral prostate responded more slowly; a slight increase was evident at 35 hours and marked increase at 43 hours and 44 hours. Increased mitotic activity is an indicator of early gonadotropic activity in prepubertal rats.

3. **Notes on the Herpetology of Clay and Greene Counties, Arkansas.** M. W. Parker, Northwestern University. (Read by D. M. Moore). 15 minutes.

4. **The Largest Sassafras in Arkansas.** D. M. Moore, University of Arkansas. 5 minutes. Sassafras tree near Bentonville is here presented as a candidate for the largest Sassafras in Arkansas.  
   - Total Height: 56 feet  
   - Estimated Age: 130 years  
   - Diameter, B. H.: 45 inches  
   - Diameter, one foot from the ground: 58.9 inches  
   A challenge is issued for authentic data on any larger than this.

5. **Doubtful Arkansas Plants.** D. Demarse, Arkansas A. & M. College. 7 minutes. A list of about sixty names from the Branner and Coville list which are doubtful as occurring in this state. Some are excluded on range and others on synonymy. It is much more difficult to throw a plant out of these old lists than it is to add a new one.

6. **Orchids of Arkansas.** Illustrated. D. M. Moore, University of Arkansas. 15 minutes. Orchids are essentially tropical plants with only about 15% of the 15,000 known species occurring in temperate regions. Of these, about 30 occur in Arkansas. These were listed and briefly described.

7. **Leaf Oils of Arkansas Gymnosperms, I. Juniperus Mexicana.** D. M. Moore, University of Arkansas. 12 minutes. Juniperus mexicana, the Ozark White Cedar, has been pointed out previously to be notably free from rusts. The difference in the odor of the crushed leaves has suggested that the difference might be due to the different oils present in the leaves. A preliminary examination of the leaf oils disclosed the following:

   - Steam extraction of green leaves yields a clear, slightly yellow oil with a rich aromatic odor somewhat resembling that of turpentine. At the same time a clear, colorless material, distinctly resembling camphor in appearance and odor, crystallized in the condenser. Fractional distillation of the oil gave a series of fractions varying in color, odor, and consistency. Specimens of the fractions were displayed.

8. **Suppression of Crystallization in Paraffin for Embedding.** F. Dickey, Arkansas A. & M. College. 12 minutes.

9. **Vapor Pressures II, Nitroparaffins.** D. Coleman. 12 minutes.

10. **Some Studies on the Thermodynamics of Solutions.** C.F. Bjork, John Brown University. 15 minutes. The present work was
conducted by W. G. Eversole and C. F. Bjork in the Physical Chemistry laboratory at the State U. Of Iowa. Since the change in free energy may be considered as the driving force in a chemical reaction the authors felt that it might prove interesting to conduct a few investigations pertaining to it.

Vapor pressure measurements were made on aqueous potassium nitrate solutions. Geometric mean activities of ions were calculated. The free energies of dilution of both solvent and solute were determined. Finally an empirical equation was derived which showed the relationship between the actual composition of the solution and its volume. This facilitated the calculation of partial molal volumes.


15. Some Trends and Problems in Present Day Teaching of Secondary Physics. L. B. Ham, U. Of Ark. 15 minutes. Broadening the educational base in our school system, and the rapid development in physics have brought unforeseen problems in the conduct of Physical Science in the secondary schools. Physicists feel that many of the resulting problems can be solved only by cooperative action of leaders in the various scientific fields and in the educational field. Moreover, the resulting march of scientific progress, as far as physics is concerned, in upsetting the established social and economic order is not sufficiently recognized by the social science worker so that balanced coordination between physical science, social science and the economic order can be established. The march of science presents our society with a continuously changing social order.


27th Annual Meeting May 1, 1943
University of Arkansas School of Medicine, Little Rock, Arkansas

1. Treatment of Cancer by Radiation. J. S. Wilson, M. D., Mack Wilson Hospital, Monticello. 15 minutes. After discussing the cancer problem from the standpoint of human waste and of suffering and the need of education, both to encourage prompt application for treatment and to discourage reliance on 'quacks', the author takes up the types of cancer and their treatment. The history and present use of radiations (both those from radium and the X-rays) in cancer treatment are particularly emphasized.


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4. Inherited Poliomyelitis. Dr. Erwin, Henderson State Teachers College, Arkadelphia.

5. Some Aspects of Arkansas Science in Service for the War Emergency. D. M. Moore, University of Arkansas, Fayetteville. 10 minutes. Arkansas Science and scientists are contributing much and have potentialities for far greater contributions. Some of these in various fields—especially botanical—are pointed out.


28th Annual Meeting May 6, 1944.

University of Arkansas School of Medicine, Little Rock, Arkansas

1. Notes on the Nesting and Incubation of the Eastern Red-wing (A. P. Phoeniceus). H. N. Marvin and Margaret Banta Marvin. U. of Arkansas, School of Medicine. The topography of a small marsh on Long Island, N. Y. made possible a rather detailed study of ten Red-wing nests. The resident male Red-wings arrived March 8, and nesting began May 10, 1942. The first eggs were laid one to five days after the nests were completed, followed by one egg each day for the next three days. Incubation began with the laying of the third egg and usually resulted in three eggs hatching on the fourteenth and one egg on the fifteenth day after the first egg was laid. Removal of eggs from one nest failed to increase the number of eggs laid, and the addition of eggs to one nest did not stop laying. All forty eggs hatched and all young lived to leave the nest. It was suggested that the later in the season the eggs hatched the less time the young remained in the nest. The male Red-wing is polygamous and very sharp territorial limits are observed among them. The males were not disturbed by nesting mallards and warblers but they were greatly excited when their territories were invaded by crows.

2. Blood Cells of Reptiles and Birds Compared to Those of Mammals. D. L. Ryerson, U. of Arkansas School of Medicine (Anatomy Department). While the red blood corpuscles of mammals lack nuclei, those of other vertebrates are true nucleated cells. These true cells possess mitochondria, Golgi material during development, and bodies staining with neutral red dye.

White blood cells of birds may be classified in the same groups that are found in mammals except that the place of the mammalian blood platelet is taken by true cells (thrombocytes). The leucocytes of turtles are similar to those of birds. Snakes and lizards, with only one recorded exception, do not possess cells which are counterparts of true eosinophiles of turtles, birds, and mammals.

Laboratory methods of studying blood cells, such as total cell counts, smears, and supravitaly stained living cells, will be considered briefly.

3. A Pedigree of Sex-linked Recessive Peroneal Atrophy. W. G. Ervin. State Teachers College. Sex-linked peroneal atrophy is characterized by the inability to support weight on the heels, a gradual atrophy of the calf of the leg, severe pain
after prolonged use of the feet, and a marked reduction of efficiency in the use of the hands and fingers. The trait first becomes evident at about the fifteenth year and gradually grows worse. Complete disability seems to vary with individuals, but occurs in this family history quite late in life. This pedigree includes 7 generations and 78 individuals. A total of 7 affected males occur in generation II, IV and VI. The observed ratio of affected and normal males fits the expected ratio for a sex-linked recessive trait.


5. Some Exceptional Forms of Quartz. H. E. Wheeler, Arkansas Geological Survey. Silicon dioxide, the most abundant compound in Nature constitutes 60% of the lithosphere, and free quartz forms not less than 12% of the earth's crust. The various forms of quartz number more than 200.

Taking the temperature and optical properties of quartz into consideration, six distinct types are recognized, - the alpha and beta modifications of Quartz, tridymite, and cristobalite.

Quartz has its origin by sublimation, fusion, or solution, a clear understanding of which enables us to interpret, many of the forms in which the mineral is found in nature.

Crystal habit, which sets us forth on delightful journeys through an infinitely varied territory, is specifically illustrated by two rare forms in Arkansas, cubic and exfoliated quartz. Certain other types are presented.

Inclusions in quartz list many minerals, some gases, and liquids, a few of which are not yet identified. Pseudomorphic forms have an intriguing interest as well as the several types of twinning.

Pertinent economic interest in quartz crystals center on their piezoelectrical nature and predicts for Arkansas an important development of her resources in the manufacture of radio oscillators and other scientific materials.

29th Annual Meeting April 28, 1945.
University of Arkansas School of Medicine, Little Rock, Arkansas


2. Some Ceramic Properties of Certain Pulaski and Saline County Clays. W. E. Crockett, Niloak Company, Little Rock. Three typical clay types, outlined by Tracy in a 1944 United States Geological Survey publication were analyzed for ceramic properties. The desired data were correlated with possible industrial applications.

3. Private Industrial Research Programs. W. L. Belvin, Bureau of Research, University of Arkansas. The paper presented covered Private Industrial Research Programs. It dealt with the nature of industrial research, industrial research as a resource, costs of industrial research, industrial research for the small enterprise, how private industry uses public research agencies, economic and commercial research and something of which the future holds for continued research programs. It
was pointed out that some of the reasons for the growth in industrial research are (1) the growing realization by industrialists and investors that research pays, (2) the pressure of competition which supplies an incentive to develop new and improved methods and products, (3) the desire for expansion and diversification of products and (4) new discoveries and inventions.


5. Inheritance of Susceptibility to Caries in Albino Rats (Rattus Norvegicus). H. R. Hunt, Michigan State College, C. A.Hoppert, Michigan State College, and W. G. Erwin, Henderson State Teachers College. The two objectives at the outset of this investigation were: (1) to determine whether there is an inheritance factor in the development of dental caries in the albino rat; and (2) if there is such a factor, to discover, if possible, the number of gene pairs involved and the genetic and physiological effects of each gene. The inheritance factor has been demonstrated. The second objective is yet to be attained. A cariogenic diet provided an essential tool for the study. The most susceptible and the most resistant offspring of a group of rats from several sources were selected to start the susceptible and resistant lines respectively. These two lines were developed by phenotypic selection, brother x sister inbreeding, and progeny testing of breeders.

The susceptible line is now in the 12th generation and the resistant line is in the 7th. The average time required for the individuals of the 12th generation susceptibles to develop caries, after being placed on the caries diet, was 24 days, and for the 7th generation resistsants, 245 days. This conclusively proves that heredity is a factor in susceptibility to dental caries in rats. There are reasons for believing that multiple factors are responsible for this difference, but further experimental work is required to test this hypothesis.

6. Arkansas "Weeds" as Industrial Raw Material. D. M. Moore, University of Arkansas. Possibilities of the use of floss from milkweed were discussed and accompanied by Kodachrome slides. An account of the program to collect this floss for use by the navy was presented. Enough floss for making more than one million life jackets was reported. Other possibilities were explored and suggested.
MEMBERS OF THE ARKANSAS ACADEMY OF SCIENCE

The following list includes a few former members who are still in the armed services or in other war connected activities.

Abbott, C. E., 1908 N St., N. W., Washington, D. C.
Amos, Mrs. Esther, Niloak Company, 1709 E. 9th St., Little Rock
Anderson, R. J., Rooms 443-447, State Capitol, Little Rock
Armstrong, Miss Ruth M., 1106 N. 14th St., Ft. Smith
Atchley, R. M., 2716 Cedar St., Little Rock
Austin, R. H., Arkansas State College, Jonesboro

Baker, J. P., 1804 West 29th St., Pine Bluff
Banks, J., College of Medicine, University of Arkansas
Basham, Mrs. Ernestine Hogan, Clarksville, Arkansas
Batchelor, H. B., Siloam Springs, Box 96
Battey, Miss Zilpah C., University of Arkansas
Beach, I. T., College of the Ozarks, Clarksville
Bogan, H. L., 2909 W. Capitol, Little Rock
Basford, Mrs. Adelphia Meyer, Harding College, Searcy
Buhlis, R., Box 1012, Little Rock
Burkhart, Mrs. B. LeRoy, 311 Hill St., Clarksville

Collins, Dr. D. S., 214 Bayles St., Hot Springs National Park
Cook, D. L., 1515 Wright St., Siloam Springs
Crockett, W. E., Niloak Company, Little Rock

Demaree, D., State A. & M. College, Monticello
Dennison, Miss Maggie M., Henderson State Teachers College, (Deceased).
Erwin, W. G., Northwestern State College, Natchitoches, Louisiana

Hackney, J. C., A. & M. College, Monticello
Hale, H., University of Arkansas, Fayetteville
Hall, C. J., Agri. Col., University of Arkansas, Fayetteville
Ham, L. B., University of Arkansas, Fayetteville
Harding, A. M., University of Arkansas, Fayetteville
Hartsoe, Miss Inez, Sr. High School, Little Rock
Henbest, W. N., College Avenue, Fayetteville
Henbest, O. J., 601 Forrest, Fayetteville
Hobgood, W. C., A. & M. College, Monticello
Horlacher, W. R., University of Arkansas, Fayetteville
Horsfall, W. R., University of Arkansas, Fayetteville
Hyman, H., Henderson State Teachers College, Arkadelphia
Keller, J. B., Spartan School of Aeronautics, Tulsa, Okla.
Klk, M. C., University of Arkansas, Fayetteville
Krantiger, J. T., College of the Ozarks, Clarksville

Lane, H. I., Hendrix College, Conway
Lawson, M., Russellville
Logg, Miss Fannie Carroll, 801 N. Washington, Forrest City

Mackey, Mrs. Johnnie Mae, Jr. High, Hot Springs
Matthew, H. V., Arkadelphia
Miles, J. H., Box 70, Searcy
Moffatt, W., Navy
Moore, D. M., University of Arkansas, Fayetteville
Moore, Miss Jewel, Box 355, Hot Springs
Mundie, J. R., Ouachita College, Arkadelphia
Munn, W. C., A. & M. College, Magnolia
McGinnis, J. C., A. & M. College, Monticello
McHenry, M. J., Hendrix College, Conway
Pape, Miss Mary, Little Rock Junior College
Parker, J. P.
Pierce, Miss Edith Ann, 308 Charles Street, Little Rock
Porter, L., University of Arkansas, Fayetteville
Provine, E. A., Ouachita College, Arkadelphia
Pryor, J. E., Harding College, Searcy

Ratekin, Miss Eula, 501 N. 15th St., Ft. Smith
Reed, C. T., A. & M. College, Monticello
Rhodes, R. C., 1126 Clifton Rd., N. E., Atlanta, Georgia
Roberts, L. B., Huntingdon College, Montgomery, Alabama
Robinette, C. V., State Teachers College, Conway
Robinson, B. L., School of Medicine, Little Rock
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NOTES ON THE HERPETOLOGY OF CLAY AND GREENE COUNTIES, ARKANSAS

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The collecting of snakes in Greene County, Arkansas, was started in 1938, during residence at Paragould, and was discontinued with removal to Memphis, Tennessee, in July, 1934. The amphibians and other reptiles received little attention by the author prior to 1933. Some notes and specimens for Clay County secured on several short summer trips to the Black River east of Corning during 1932 and 1933 are well supplemented by records for Greenway obtained by Dr. S. E. Meek. The results of Julius Hurter’s work at Paragould are included as published in Hurter and Strecken (1909), in which is also a list of Meek’s specimens. Schwarz (1938) gives records by counties, while Burt (1935) lists a few species from the region. Dellinger and Black (1938) and Black and Dellinger (1938) include published records and museum specimens in two state lists. Parker (1939) incidentally lists several species in another report, and a few species have been included individually in other papers.

Meek’s collection in the Field Museum of Natural History has been examined by the author, but Hurter’s specimens have not been located. Some of the material collected by the author are in the Museum of Zoology of the University of Michigan, others are in the United States National Museum, and a few are in the Field Museum of Natural History and the Chicago Academy of Sciences, but most of the material remains in the author’s collection. Specimens in museums are indicated by the following abbreviations: AUM (Arkansas University Museum); CAS (California Academy of Science); FMNH (Field Museum of Natural History); UMMZ (University of Michigan Museum of Zoology); USNM (United States National Museum); and SDSNH (Museum of the San Diego Society of Natural History). No specimens of Lampropeltis calligaster, Matrix cyclopion cyclopion, or Matrix grahamii from Clay or Greene Counties, Arkansas, have been examined by the author.

Clay County is the northeasternmost county of Arkansas, and Greene County lies just southward. The plan of the general topography is rather simple. From the northeastern corner of Clay County, a low range of outlying hills from the Ozarks, Crowley’s Ridge, extends south-southwest through the southwesterly corner of Greene County. The relief is nowhere much more than 200 feet, with very few steep declivities. The surface soil of the hills is generally clayey, but gravel deposits are fairly numerous. There are few large boulders and no extensive exposed bed rock. East of the border of Crowley’s Ridge at Paragould, there are eight miles of level land to the St. Francis River, which is the eastern border of both counties. In Greene County, the same conditions exist west of Crowley’s Ridge, where Cache River bounds the lower half of the county, but the river lies more eastward in Clay County. West of Cache River and paralleling it at a distance of about ten miles, Black River flows southwest to the southwestern corner of Clay County. These three rivers are all generally slow-flowing and have mud or sand bottoms. Black River is largest; the other two are bordered, especially in the south, with drainage ditches of varying size and efficiency.

Crowley’s Ridge in the heights is timbered with pine and scattering growths of Juniperus. The lower hills and the lowlands away from the rivers are partly deciduous-wooded, with oak and hickory predominating, but deforestation is well under way. There is much land under cultivation or recently deserted or cleared, and these conditions are becoming increasingly evident even in the
hills. Near the waterways are willow and cypress forests which are being slowly removed. Several small, irregular lakes are the remains of old river channels.

The author is deeply indebted to a number of friends who live in Greene County for specimens they have secured and for other assistance at various times. To Dr. Howard K. Gloyd, many thanks are due for identification of several species, for advice during the work, and for criticism of the manuscript. Mr. Karl P. Schmidt has kindly supplied a revised list of the Meek collection from Greenway, Clay County, in the Field Museum of Natural History.

LIST OF SPECIES

AMPHIBIANS

1. *Necturus maculosus* (Rafinesque). Mudpuppy or Water-dog.

**GREENE COUNTY:** (Viosca, 1937).

The mudpuppy was collected only in a brook in the wooded hills 2-3 miles northwest of Paragould. On June 20, 1934, about ten eggs were discovered under a small log imbedded in the mucky bottom of the brook. The eggs hatched through the next few days. Fishermen reported taking several specimens on trot lines in the St. Francis River east of Paragould.

Black and Dellingier's (1938) record for Craighead County, Arkansas, is doubtless based on the author's Greene County specimens mapped by Viosca.


**CLAY COUNTY:** Greenway (Hurter and Strecker, 1909), FMNH (1).

**GREENE COUNTY.**

A specimen was seined in a ditch by the highway at Black River, 2 miles east of Corning; while in Greene County this salamander has been found in streams and sloughs of both the St. Francis and the Cache River lowlands. In April, 1931, a large specimen taken in backwaters of the St. Francis River east of Paragould contained a great number of small and medium sized crayfish. Several instances of the horn snake (*Farancia abacura reinwardtii*) feeding upon these salamanders were reported by friends. It was noted that the horn snake and Amphiuma were always found in the same environment.


**GREENE COUNTY:** Paragould, UMMZ (1).

The newt was collected only in 1934. It was found in and about wooded ponds within five miles north, east, and southeast of Paragould. The land form was found in early June.

A male and a female taken in the same pool on March 5th and kept in a small aquarium clasped most of the afternoon of March 26th. The next day they floated near the top of the water and clasped vigorously. This continued on March 27th, with the two facing in opposite directions and with anals approximated. Several
eggs were noted later, mostly on the sides of the jar rather than on the few weeds placed in the water. The eggs failed to hatch.

4. Ambystoma maculatum (Shaw). The spotted salamander.

CLAY COUNTY: Greenway (Hurter and Strecker, 1909), FMNH (2).

GREENE COUNTY: 3 miles east of Paragould, UMMZ (1) (Black and Dellinger, 1938).

One specimen was collected in lowland woods near the Black River 2 miles east of Corning. This species has been taken in a number of places in Greene County, but in no great quantities. It was found only in wooded lowlands, in logs or under pieces of wood in damp places. Few were found in the western half of the county.

5. Ambystoma opacum (Gravenhorst). The Marbled Salamander.

CLAY COUNTY: Greenway (Hurter and Strecker, 1909), FMNH (5); 22 miles north of Paragould, UMMZ (4) (listed as in Greene County in Black and Dellinger, 1938).

GREENE COUNTY: Paragould (Hurter and Strecker, 1909); 3 miles east of Paragould, UMMZ (4) (Black and Dellinger, 1938); 4 miles southeast of Paragould (Burt, 1935), FMNH (9); 14 miles west-northwest of Paragould, UMMZ (2); 17 miles northwest of Paragould, FMNH (6); 32 miles east of Paragould, UMMZ (2). A few specimens have been taken in wooded lowlands near the Black River 2 miles east of Corning. In Greene County this was generally the most abundant salamander. Like A. maculatum, it was found under logs or other debris in wooded lowlands. Specimens were seldom found near the rivers and were always rare in the river bottoms.


CLAY COUNTY: Greenway, FMNH (2).

Although Hurter and Strecker (1909) did not record these specimens, they were apparently a part of Meek’s collection, having similar tags and data.

7. Ambystoma texanum (Matthes). The Texas Salamander.

CLAY COUNTY: Greenway (Hurter and Strecker, 1909, listed as A. jeffersonianum, FMNH (2); 2 miles east of Corning, UMMZ (1).

GREENE COUNTY: 3 miles east of Paragould, UMMZ (2) (Black and Dellinger, 1938).

Specimens have been taken in wooded lowlands at Black River 2 miles east of Corning. The species was quite common in some localities of Greene County. It was found with A. maculatum and A. opacum, but was relatively more abundant near the rivers. Particularly in the Cache River bottoms, it seemed to favor a habitat slightly different from that of the other two species, being found in forest floors which did not have nearly so deep a humus layer nor so much undergrowth or down timber. Sawn planks lying on the ground were a favored concealment.

8. Siren intermedia Le Conte. The Two-legged Dwarf Eel, or Dwarf Siren.
CLAY COUNTY: Greenway (listed as S. lacertina in Hurter and Strecker, 1909), FMNH (1).

GREENE COUNTY: Paragould, UMMZ (1); Marmaduke, AUM (1) (listed as S. lacertina in Black and Delling, 1938).

A specimen collected near the Black River two miles east of Corning seemed identical with Greene County S. intermedia. East of Paragould, these animals were found in small woodland ponds with leafy bottoms.


CLAY COUNTY: Greenway (Hurter and Strecker, 1909), FMNH (1).


GREENE COUNTY: 2 miles northwest of Paragould, UMMZ (1).

This record, (based on a rather small specimen) is included with some hesitation, as the call of this toad was not noted in northeastern Arkansas by the author. However, the species probably occurs there.


CLAY COUNTY: Greenway (listed as Bufo americanus in Hurter and Strecker, 1909), FMNH (12); near Corning, UMMZ (5) (Black and Delling, 1938); 22 miles north of Paragould, UMMZ (1) (listed as in Greene County in Black and Delling, 1938).

GREENE COUNTY: Cache River bottoms, MVZ (2); Bolton, MVZ (2); near Paragould, UMMZ (1) (all in Black and Delling, 1938); 8 miles east of Paragould, USNM (1) (Burt, 1935); 17 miles northwest of Paragould, UMMZ (1); 13 miles west-northwest of Paragould, UMMZ (1); just east of Paragould, UMMZ (1). A number of specimens have been taken east of Corning, a few near Knobel, and several in the eastern end of Clay County.

This is an abundant animal throughout Greene County, probably found most commonly in the lowlands near the hills. In 1933 and 1934, the toads first appeared about the first of April and started breeding in less than a week.


GREENE COUNTY: Paragould (Hurter and Strecker, 1909); 4 miles northwest of Beech Grove, UMMZ (3).

The cricket frog is fairly common near the Black River 2 miles east of Corning, especially about the edges of woods ponds. It is common in the bottom lands near the rivers of Greene County, being found most often along the wooded shores of lakes, ponds and sloughs. Calls were first noted about the middle of April in 1934, but the cricket frogs were doubtless active before that date.


GREENE COUNTY: 5 miles southwest of Paragould, USNM (4) (Burt, 1935); near Paragould, UMMZ (4) (Black and Delling, 1938); just north of Paragould, UMMZ (14).
During the early spring, this little frog was found very abundantly in the hills and nearby lowlands within a fifteen mile radius of Paragould. The species appeared during the first week of March, in 1934, started egg-laying in a week, and were found often for about a month and a half.


**CLAY COUNTY:** Greenway (listed as *Hyla squirella* in Hurter and Strecker, 1909), FMNH (1).

In comparison with several Mississippi specimens and a series of Texas and Oklahoma *P. streckeri* in the Field Museum of Natural History, this specimen is somewhat anomalous. It is a female, noticeably larger than the *streckeri* and considerably larger than the Mississippi specimens of *ornata*. However, the relatively long hind legs and the vomerine teeth situated between the internal nares ally it with the latter species. In view of the comparative paucity of collections from the region just west of the Mississippi River, it may well be that the two forms intergrade.


**GREENE COUNTY:** 17 miles northwest of Paragould, UMMZ (1).

A few specimens have been taken in the St. Francis River bottoms and in the lowlands east of Paragould. Some were congregated about a pool near the Cache River, northwest of Paragould, on June 13, 1934.


**GREENE COUNTY:**

The published record for Clay County (Greenway, Hurter and Strecker, 1909) is doubtless based on Dr. Meek's "*Hyla pickeringii*" which were reidentified as *Hyla versicolor* before being discarded by the Field Museum of Natural History. However, *Hyla crucifer* undoubtedly occurs throughout the county. In Greene County, it was found fairly commonly in spring in much the same places as *Pseudacris n. triseriata*, and emerged nearly as early in the spring. Specimens were also taken in the forested bottom lands of the St. Francis and Cache Rivers.


**CLAY COUNTY:** Greenway (listed as *Hyla pickeringii* in Hurter and Strecker, 1909; and as *Hyla crucifer* in Black and Dellinger, 1938).

**GREENE COUNTY:** 17 miles northwest of Paragould, UMMZ (1).

A few specimens have been found along the banks of the Black River 2 miles east of Corning. On the night of June 13, 1934, the tree toads were mating in a pond near the Cache River in northwestern Greene County. Specimens have also been found in the St. Francis River bottoms east of Paragould.


**CLAY COUNTY:** 1 mile east of Corning, UMMZ (1) (Black and Dellinger, 1938); Greenway, FMNH (2).
GREENE COUNTY: 2 miles west (?) of Paragould, UMMZ (1); Cache River, USNM (1) (both in Black and Dellinger, 1938).

The bullfrog was found to be common about the Black River 2 miles east of Corning and on the Little River near Knobel. It was a common stream and pond frog in Greene County. Besides inhabiting sloughs and rivers, it was found in sandy streams that contained few or no other frogs. The half-grown specimens came out in the spring with Rana pipsiens, just a few days later than Pseudacris n. triseriata and Hyla crucifer appeared. Adults were not collected before the middle of March.


CLAY COUNTY: 2 miles east of Corning, UMMZ (1) (Black and Dellinger, 1938).

GREENE COUNTY: Paragould (Hurter and Strecker, 1909); 3 miles east of Paragould, UMMZ (2) (given as 2 miles west of Paragould in Black and Dellinger, 1938).

The green frog was fairly common near the Black River 2 miles east of Corning. In Greene County, this frog was plentiful only in a few woodland streams, ponds and swamps with muddy or mucky bottoms. Specimens were taken in both hills and lowlands.

20. Rana palustris (Le Conte). The Pickerel Frog.

GREENE COUNTY: 15 miles west-northwest of Paragould, UMMZ (1).

In addition to the above record, specimens have been taken near the St. Francis River east of Paragould, in brooks in the wooded hills 8 miles west of Paragould, and in the Cache River lowlands south of Beech Grove.


CLAY COUNTY: Greenway (Hurter and Strecker, 1909), FMNH (1); 1 mile northeast of Latto (Burt, 1935), FMNH (1); 4 miles west of McDougal (Burt, 1936); 1 mile east of Corning, UMMZ (6) (listed as R. sphenoecephala in Black and Dellinger, 1938); 2 miles east of Corning, UMMZ (4) (listed as R. sphenoecephala in Black and Dellinger, 1938); 22 miles north of Paragould, UMMZ (8) (listed as R. sphenoecephala in Greene County in Black and Dellinger, 1938).

GREENE COUNTY: 10 miles southeast of Paragould (Burt, 1935); 5 miles east of Paragould, UMMZ (4) (listed as R. sphenoecephala in Black and Dellinger, 1938); Cache River, USNM (2) (Black and Dellinger, 1938).

The leopard frog was abundant in the vicinity of Black River 2 miles east of Corning. It was common in a variety of habitats in both hills and lowlands of Greene County. In 1934, eggs were first found on March 13th and transforming young on May 1st.


CLAY COUNTY: Greenway (Hurter and Strecker, 1909), FMNH (4); 2 miles east of Corning, UMMZ (1); Greenway, CAS (1); 22 miles north of Paragould, UMMZ (1) (listed as in Greene County in Black and Dellinger, 1938).

GREENE COUNTY: 3½ miles southeast of Paragould, UMMZ (2) (Black and Dellinger, 1938); 3 miles south-southeast of Paragould,
This species has been found in stumps in forests along the Black River 2 miles east of Corning. A considerable number has been found under stones and boards about ponds in the hills southwest of Paragould. Some were also found under stumps and logs in or near woods in the lowlands east of Paragould.

REPTILES


**CLAY COUNTY:** Greenway (Hurter and Strecker, 1909), FMNH (3); near Corning, UMMZ (1).  

**GREENE COUNTY:** Paragould (Hurter and Strecker, 1909); 3½ miles east of Paragould, UMMZ (2); near Paragould, UMMZ (1).  

A very few specimens have been taken in forests near the Black River 2 miles east of Corning. In Greene County, it is a rather common lizard in the wooded hills, but is less abundant in the lowlands and is rare in the river bottoms.


**GREENE COUNTY:** 6½ miles southwest of Paragould, UMMZ (1) (given as 6½ mi. N. W. Paragould in Dellinger and Black, 1938).  

Several specimens were seen in the sandy lowlands between Black River and Corning. Specimens have been collected only in the hills near Village Creek, 5 to 8 miles southwest of Paragould.


**CLAY COUNTY:** 1 mile east of Corning, UMMZ (1) (Dellinger and Black, 1938).  

**GREENE COUNTY:** Paragould (Hurter and Strecker, 1909); 10 miles southeast of Paragould, USNM (1) (Burt, 1935); 3½ miles southeast of Paragould, UMMZ (1).  

In Greene County, this is a common lizard in the deciduous-wooded hills and in the bottoms along the rivers, and is even more abundant in the lowland forests between these two regions.


**GREENE COUNTY:** 10 miles southwest of Paragould, USNM (3) (Burt, 1935); 3½ miles southeast of Paragould, UMMZ (1); 14½ miles west-northwest of Paragould, UMMZ (2).  

Published records for Greenway (Hurter and Strecker, 1909; etc.) are based on specimens of *E. laticeps*. The author took a number of specimens of *fasciatus* along the Black River 2 miles east of Corning. This skink was found to be abundant throughout Greene County, particularly in the lowlands near watercourses. It was not restricted so much to forests as *Sceloporus* and *Leiolopisma*, but showed a greater tendency to burrow in rotten logs. Tall,
dead stumps were a favored habitat for this species and E. laticeps.


CLAY COUNTY: Greenway (listed as Plesiophis quinquelineatus in Hurter and Strecker, 1909; and as Eumeces fasciatus in Dellinger and Black, 1938; and Schwartd, 1938), FMNH (1); 22 miles east of Corning, UMMZ (1) (Dellinger and Black, 1938).

GREENE COUNTY:
As identified by the greater spread and softer color of head and the greater size, this species was found occasionally in the lowlands and lower hills near Paragould. It was not very common. A young specimen was taken under bark on a log in woods 5 miles south-southeast of Paragould on April 11, 1934.

28. Carphophis amoena vermis (Kennicott). Worm snake.

GREENE COUNTY: 3± miles east of Paragould, UMMZ (1).

The specimen listed above was found under the bark of a fallen sapling in a lowland forest.

29. Farancia abacura reinwardtii (Schlegel). Red-bellied Snake.

CLAY COUNTY: Greenway (Hurter and Strecker, 1909), FMNH (1); Reecter, USNM (1) (Dellinger and Black, 1938); 22 miles north of Paragould (Smith, 1933), UMMZ (1) (listed as in Greene County in Dellinger and Black, 1938).

GREENE COUNTY: 10 miles southeast of Paragould (Burt, 1935); 2± miles southeast of Paragould, UMMZ (1) (Dellinger and Black, 1938).

A specimen with only the posterior third of the body exposed was found in a pile of dead sticks and leaves at the edge of a woods pond east of Black River 2 miles east of Corning. From the St. Francis River west nearly to Paragould, specimens were found occasionally in swampy regions, where friends observed its feeding upon Amphiuma on several occasions.


CLAY COUNTY: Greenway (Hurter and Strecker, 1909), FMNH (1).

31. Heterodon contortrix (Linnaé). Hog-nose Snake or Puff Adder.

CLAY COUNTY: Greenway (Hurter and Strecker, 1909), FMNH (2); Greenway, CAS (1) (Dellinger and Black, 1938).

GREENE COUNTY:
These snakes were common in the sandy and gravelly localities of Greene County, particularly in and near the hills, where the black phase was as abundant as the spotted phase. The hog-nose snake seemed to come out of hibernation slightly earlier in the year than any other snake. For example, two specimens were found on a cold, cloudy day in early March, 1928, at least a week before any other species were observed.

**CLAY COUNTY:** Greenway (Hurter and Strecker, 1909), FMNH (2).

**GREENE COUNTY:** 1½ miles northwest of Paragould, UMMZ (1); 3¼ miles southwest of Paragould, UMMZ (4) ("Paragould", Dellinger and Black, 1938); near Paragould, UMMZ (3).

This snake was abundant near Paragould in 1928 and 1929, but was found in smaller numbers in succeeding years. The usual habitat was wooded and brushy places in and near the lower hills.

33. *Coluber constrictor constrictor* (Linne'). American Black Snake or Eastern Blue Racer.

**CLAY COUNTY:** Greenway (Hurter and Strecker, 1909) (listed as *C. c. flaviventris* in Schwartz, 1938), FMNH (3).

**GREENE COUNTY:** 3 miles east of Paragould, UMMZ (1) (listed as *C. c. flaviventris* from Paragould in Dellinger and Black, 1938); Paragould, UMMZ (1); 2 miles northwest of Paragould, UMMZ (2); 9½ miles west of Paragould, UMMZ (1) (all in Dellinger and Black, 1938).

The blacksnake was abundant and well-known in the vicinity of Paragould, where it was often found near and in the hills, in fields and thinly-wooded regions. During the first two years of collecting near Paragould, the author observed several specimens which approached the western *C. c. flaviventris* in coloration, but none was preserved.


**CLAY COUNTY:** Greenway (listed as *Coluber guttatus* by Hurter and Strecker, 1909; as *Elaphe guttata* by Schwartz, 1938, and as *Elaphe laeta* by Dellinger and Black, 1938. Cf. Evans, 1940), FMNH (3).

**GREENE COUNTY:** 5 miles northeast of Paragould, UMMZ (1); 8 miles south of Paragould, UMMZ (2); 16 miles northwest of Paragould, UMMZ (1); 3½ miles southeast of Paragould, UMMZ (1) (listed as *E. o. confinis*), (all in Dellinger and Black, 1938).

Several specimens have been taken on the wooded banks of Black River 2 miles east of Corning. Unlike the chicken snakes of eastern Greene County, these adults showed little or no approach to the pattern of *E. o. confinis*. This was apparently the most uniformly distributed snake of Greene County. Specimens were taken from the tops of the highest hills to the wooded shores of St. Francis and Cache Rivers, but were seldom found away from forests.


**CLAY COUNTY:** Greenway (Hurter and Strecker, 1909).

Although no specimens have been located, there seems no particular reason to doubt the record given above.

36. *Lampropeltis getulus holbrooki* (Stejneger). King Snake or Salt and Pepper King Snake.

**CLAY COUNTY:** Greenway (Blanchard, 1921), FMNH (1).

**GREENE COUNTY:** 4 miles southeast of Paragould, UMMZ (1); 3½ miles south of Paragould, UMMZ (1); 16 miles northwest of Paragould,
Several specimens were taken near the Black River 2 miles east of Corning. In Greene County, this common snake was usually found near pond, slough, swamp, or stream, and never at any great distance from forests. The juveniles, particularly, were often found under bark on logs or burrowing in rotten logs. The species was found over nearly as wide a range of terrain as Elaphe o. obsoleta, but was not so plentiful on the higher hills and in the immediate proximity of rivers.

37. Lampropeltis triangulum syspila (Cope). The House King Snake.

GREENE COUNTY: 3½ miles southeast of Paragould, UMMZ (1) (Dellinger and Black, 1938).

38. Cemophora coccinea (Blumenbach). The Scarlet Snake.

GREENE COUNTY: 3½ miles southwest of Paragould, UMMZ (1) (given as 3½ mi. S. E. Paragould in Dellinger and Black, 1938).

The above specimen was found in a tiny crevice twelve feet underground when a section of gravel pit bank was pried away by workmen. This was in a hilly area with some woods nearby.


GREENE COUNTY: Paragould (Hurter and Strecker, 1909).


CLAY COUNTY: 1 mile east of Corning, UMMZ (1); 22 miles north of Paragould (listed as in Greene County in Dellinger and Black, 1938), UMMZ (1); 2 miles east of Corning, UMMZ (1), (all in Dellinger and Black, 1938).

GREENE COUNTY: Paragould, UMMZ (16); 3½ miles southeast of Paragould, UMMZ (1); 3 miles east of Paragould (listed as 2 mi. W. Paragould in Dellinger and Black, 1938), UMMZ (2), ("Paragould, 23 MU; 10 mi. S. E. Paragould, (Burt, 1935) 1 USNM; S. Marmaduke, 1 MU" in Dellinger and Black, 1938).

This species was found to be fairly common near the Black River 2 miles east of Corning. Several were observed on the Little River near Knobel. Although it was one of the more common water snakes in Greene County, this species was never found in numbers at all comparable to N. r. rhombifera. It was, however, found in a greater variety of aquatic habitats and showed a greater tendency to roam from the immediate vicinity of water than the other species of Natrix.

41. Natrix erythrogaster transversa (Hallowell). Transverse Copper-belly.

GREENE COUNTY: Paragould, UMMZ (1).

One specimen which seems assignable to this subspecies was taken on a road ditch near the Black River 2 miles east of Corning.
42. **Natrix fasciata confluens** (Blanchard). Banded Water Snake.

**CLAY COUNTY:** Greenway (listed as *Tropidonotus s. sipedon* in Hurter and Strecker, 1909), FMNH (2).

**GREENE COUNTY:** 10 miles southeast of Paragould (Burt, 1935); near Paragould, UMMZ (1); 3 miles east of Paragould (listed as 2 ml. W. Paragould in Dellinger and Black, 1938), UMMZ (1); 3 miles southeast of Paragould, UMMZ (1); (all in Dellinger and Black, 1938).

Specimens have been taken in the vicinity of Black River 2 miles east of Corning. A commonly-occurring snake, it was more often found in colonies than the other water snakes of Greene County.

43. **Natrix grahamii** (Baird and Girard). Graham’s Water Snake.

**GREENE COUNTY:** Paragould (Hurter and Strecker, 1909).

44. **Natrix rhombifera rhombifera** (Hallowell). Diamond-backed Water Snake.

**CLAY COUNTY:** 2 miles east of Corning, UMMZ (1) (Dellinger and Black, 1938).

**GREENE COUNTY:** Paragould (Hurter and Strecker, 1909); 1 mile northwest of Paragould, UMMZ (1); 3 miles east of Paragould (given as 2 ml. W. Paragould in Dellinger and Black, 1936), UMMZ (9); 3½ miles southeast of Paragould, UMMZ (1); just east of Paragould, UMMZ (1); ("near Paragould, 7 mi." in Dellinger and Black, 1938).

This was the most common water snake near the Black River 2 miles east of Corning, and also throughout Greene County. It stayed close to water; but surprisingly large snakes were found on very small streams and ditches.

45. **Storeria dekayi** (Holbrook). Dekay’s Snake; Brown Snake; Ground Snake.

**GREENE COUNTY:** 3½ miles southeast of Paragould, UMMZ (1) (Dellinger and Black, 1938).

46. **Ha Idea striatula** (Linne). The Ground Snake or Brown Snake; Worm Snake.

**GREENE COUNTY:** 3½ miles southeast of Paragould, UMMZ (1) (Dellinger and Black, 1938).

A gravid female was found under a large plank on the bank of Black River 2 miles east of Corning on May 27, 1934. A second Greene County specimen has been taken in the wooded lowlands near Stanford.

47. **Thamnophis sauritus proximus** (Say). The Ribbon Snake.

**CLAY COUNTY:** Greenway (Ruthven, 1908), FMNH (1); 1 mile east of Corning, UMMZ (1); 22 miles north of Paragould, UMMZ (1), (all in Dellinger and Black, 1938, latter listed as in Greene County.)

http://scholarworks.uark.edu/jaas/vol2/iss1/1
GREENE COUNTY: 4 miles southeast of Paragould, UMMZ (1); Paragould, UMMZ (1), (both in Dellinger and Black, 1938).

Specimens have been taken on the Black River 2 miles east of Corning. In Greene County, this common species was usually, but not always, found in the vicinity of water. It was most abundant in swampy areas near the river bottoms.

48. Agkistrodon mokasen mokasen (Beauvois) Copperhead.

CLAY COUNTY: Greenway (Hurter and Strecker, 1909).

GREENE COUNTY: Paragould, UMMZ (1); 4 miles southeast of Paragould, UMMZ (1); near Paragould, UMMZ (1), ("Paragould, 1 MU" in Dellinger and Black, 1938).

Dellinger and Black (1938) list a specimen in the Field Museum of Natural History, but this cannot now be located. However, there is very little doubt that the copperhead occurs in Clay County. It is a common snake in the wooded hills and lowlands of Greene County, though the continued deforestation has considerably reduced the number in recent years. In the lumbering of a small area in the hills west of Paragould, over fifty were reported killed during two months of the autumn of 1933. Some of the farmers called the snakes "ground rattlers".

49. Agkistrodon piscivorus (Lacepede). Cottonmouth or Water Moccasin.

CLAY COUNTY: 1 mile east of Corning, UMMZ (1); 22 miles north of Paragould, UMMZ (1), (both in Dellinger and Black, 1938, latter listed as in Greene County).

GREENE COUNTY: Paragould (Hurter and Strecker, 1909); 3½ miles southeast of Paragould, UMMZ (1); 3 miles east of Paragould (listed as 2 miles west of Paragould in Dellinger and Black, 1938), UMMZ (2), (all in Dellinger and Black, 1938); Paragould, UMMZ (3).

Specimens have been taken in the Little River near Knobel. The moccasin was reported by residents, but not found by the author, at the Black River 2 miles east of Corning. In Greene County, this was a fairly common snake along all the watercourses except in the hills, but the harmless water snakes were considerably in the majority.

50. Crotalus horridus atricaudatus (Latreille). Banded or Timber Rattlesnake.

GREENE COUNTY: Paragould (Hurter and Strecker, 1909).

The rattlesnake has been rare for the past 25 years, though it was apparently quite common in the early settlement period. It is yet reported fairly common in some of the timber slashes east of the Cache River, and occasional specimens are still found in the hills north of Paragould. A specimen caught north of Paragould early in 1934 showed in coloration a distinct leaning toward the northern subspecies.

Throughout the author's residence at Paragould, no reports were received of more than one kind of large or medium-sized rattlesnake occurring or having occurred there in the past; and it is partly for this reason that the record of Crotalus atrix in Clay County (Perkins and Lentz, 1934) is not admitted. Dellinger and

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Journal of the Arkansas Academy of Science, Vol. 2 [1947], Art. 1

Published by Arkansas Academy of Science, 1947
Black (1938) list a specimen of C. atrox from Piggott in the San Diego Society of Natural History Museum, but the museum has no record of such a specimen.


**CLAY COUNTY:** 1 mile east of Corning, UMMZ (1) (Dellinger and Black, 1938).

**GREENE COUNTY:** 16 miles northwest of Paragould, UMMZ (1); 7½ miles southeast of Paragould, UMMZ (5); 3 miles northwest of Paragould, UMMZ (1), (all in Dellinger and Black, 1938).

Specimens have been taken along the Black River and in woodland ponds, 2 miles east of Corning. This is an abundant turtle in eastern Greene County, and some were also collected in the Cache River region of the western half of the county.

52. *Kinosternon subrubrum hippocrepis* (Lacépède). The Louisiana Mud Turtle.

**GREENE COUNTY:** 3 miles northwest of Beech Grove, UMMZ (1) (Dellinger and Black, 1938); 1 mile northeast of Paragould, USNM (1); 5 miles east of Paragould, USNM (1); 4 miles southeast of Paragould, USNM (1).

The mud turtle seemed somewhat less abundant than the preceding species, but it was more uniformly distributed. The subspecific classification is primarily on the basis of head striping.


**CLAY COUNTY:** Greenway, AUM (1) (Hurter and Strecker, 1909).

**GREENE COUNTY:** St. Francis River, near Paragould, AUM (1) (Dellinger and Black, 1938).

A skull was found at the Black River 2 miles east of Corning. In the spring of 1926, two specimens were taken in nets in the Lake Ditch, 7 miles east of Paragould. They weighed 121 and 64 pounds, respectively. There is a reliable report of a 160 pound specimen from the same locality.


**GREENE COUNTY:** Paragould (Hurter and Strecker, 1909); 3 miles northwest of Paragould, UMMZ (1) (Dellinger and Black, 1938).

This a fairly common turtle in Greene County. It often wanders into flood pools during spring, and travels up small ditches that are far removed from any sizeable body of water.

55. *Terrapene carolina triunguis* (Agassiz). Box Turtle.

**GREENE COUNTY:** ½ mile southeast of Paragould, UMMZ (3); 6 miles southwest of Paragould, UMMZ (2); 3 miles northwest of Paragould, UMMZ (1) (all in Dellinger and Black, 1938); 10 miles north-northwest of Paragould, UMMZ (1); 5 miles north of Paragould, USNM (4).

The box turtle was often found in wooded valleys and nearby lowlands in the vicinity of Paragould. Of seven specimens taken from a small brook in the hills seven miles southwest of Paragould,
two had four claws on each hind foot. No others exhibited this variation.


**GREENE COUNTY:** 18 miles northwest of Paragould, USNM (1).

This turtle was fairly common in the Black River 2 miles east of Corning. Specimens have been observed in eastern Greene County, but have been collected only in the Cache River northwest of Paragould.


**GREENE COUNTY:** Paragould (Hurter and Strecker, 1909).

In addition to the literature record, the painted turtle has been taken in Eight-mile Creek at Paragould, and in the Cache River.


**GREENE COUNTY:** 18 miles northwest of Paragould, USNM (1).

The above-listed example was quite similar to specimens from western Tennessee.


**CLAY COUNTY:** Greenway (Hurter and Strecker, 1909), FMNH (1); "Corning, 1 USNM" (Dellinger and Black, 1938).

**GREENE COUNTY:** Paragould (Hurter and Strecker, 1909); 2 miles south-southeast of Paragould, UMMZ (1) (Dellinger and Black, 1938); Eight-mile Creek 31/2 miles southeast of Paragould, UMMZ (4); 7 3/4 miles east of Paragould, USNM (1); 18 miles northwest of Paragould, USNM (3); 31/2 miles southeast of Paragould, USNM (1).

This species was abundant at the Black River 2 miles east of Corning. In Greene County, it was abundant in the larger, slow-flowing and motionless bodies of water.

60. *Amyda spinifera spinifera* (Le Sueur). The Northern Soft-Shelled Turtle.

**CLAY COUNTY:** "Clay County", UMMZ (1) (Dellinger and Black, 1938).

**GREENE COUNTY:** 18 miles northwest of Paragould, USNM (1).

A large specimen was taken from the Black River 2 miles east of Corning, where the species was apparently abundant. Some of the specimens observed may have been *A. mutica*, but none of this species was captured. In Greene County, the soft-shelled turtle was fairly common in lowland streams.
Eliminations From And Additions To The Published Record

ADDITIONS.

No published records for either Clay County or Greene County, Arkansas, have been found for the following species recorded in this paper:

- *Triturus viridescens louisianensis* (Wolterstorff).
- *Ambystoma talpoideum* (Holbrook).
- *Pseudacris ornata* (Holbrook).
- *Hyla cinerea cinerea* (Schneider).
- *Hyla versicolor versicolor* (Le Conte).
- *Rana palustris* (Le Conte).
- *Carphophis amoena vermis* (Kennicott).
- *Graptemys pseudogeographica pseudogeographica* (Gray).
- *Pseudemys floridana hieroglyphica* (Holbrook).

ELIMINATIONS.

- "*Ambystoma jeffersonianum* Green" (Hurter and Strecker, 1909). Two specimens of the Meek collection in the Field Museum of Natural History, early label *Amblystoma microstomum*, are *Ambystoma texanum* (Matthes).
- "*Ambystoma tigrinum* (Green)" (Parker, 1939). The correct locality record for this specimen is Fayetteville, Arkansas.
- "*Siren lacertina* (Linne)." (Hurter and Strecker, 1909). A single Meek specimen in the Field Museum of Natural History has 35 costal grooves and a length of 62 inches. It is *Siren intermedia* (Le Conte).
- "*Hyla squirola* (Daudin)" (Hurter and Strecker, 1909). A single Meek specimen in the Field Museum of Natural History is labeled *Hyla squirola* but is here assigned to *Pseudacris ornata* (Holbrook).
- "*Rana sphenocephala* (Cope)" (Black and Dellinger, 1938). All the spotted leopard frogs of this region are conspecific, and for them the name *Rana pipiens* (Schreber) seems most applicable.
- "*Coluber constrictor flaviventris* (Say): (Schwardt, 1938). Of the numerous blacksnakes examined, none showed a preponderance of *C. c. flaviventris* characteristics in both coloration and scutellation; consequently all specimens are considered to be *Coluber c. constrictor* (Linne).
- "*Coluber guttatus* (Linne)." (Hurter and Strecker, 1909; in Dellinger and Black, 1938). As Evans (1940) has pointed out, this is a juvenile *Elaphe o. obsoleta* (Say).
- "*Tropidonotus sipedon sipedon* (Linne)." (Hurter and Strecker, 1909). Dr. Meek's specimens in the Field Museum of Natural History are *Natrix fasciata confluens* (Blanchard).
Literature Cited


HOW SHOULD SCIENCE BE TAUGHT TO AID IN OUR PRESENT EMERGENCY

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Our present national emergency in defense and all-out effort of warfare has greatly emphasized the need of men and women thoroughly trained in mathematics and science. There can be no doubt that we live in a highly developed and specialized scientific world. In view of this fact, it is more than ever necessary that citizens understand the basic principles of science involved in their environment. The mathematics and science courses of our secondary schools and colleges if properly taught, can contribute much to the civic and national welfare. I do not wish to be presumptuous in suggesting that there are only certain methods by which science classes may be taught and that your present methods of teaching are entirely wrong. However, I do wish to urge that our science teaching become definitely functional and practical for the students so that they may make use of their science experiences both now and in the future. The content of our science courses should be thoroughly scrutinized with the view of including only the subject matter which is essential to the needs of our students. This may make necessary the elimination of certain material which we have long thought of as essential and the substitution of new material. Also, possibly it means spending a longer period of time on a smaller amount of subject matter in order to insure thoroughness as well as practicality.

I wish to suggest that in the three commonly taught science classes of the high school that more emphasis be placed on participation in learning activities dealing with things vital to the student in relation to his own life and to his community. Such activities should be of greater value than the mere learning and memorizing of facts from textbooks. Those following me on this program are going to discuss certain specific phases concerning individual science subjects. Therefore, I shall confine this discussion, particularly, to general phases of General Science, Biology, and Chemistry.

By far the greater number of students of the secondary schools receive instruction in General Science. Its popularity has steadily increased as a requirement of secondary curricula. There are so many varied subjects in this general field to be considered that it becomes a difficult problem to make the selection of material which is vital. It seems that most certainly an elementary consideration of atomic structure of matter is a necessity since matter is the basic component of our environment. So much of our recent progress in Physical Science has resulted from a better understanding of the nature of matter. This particular phase may not have such intimate connection with the individual student but will be a necessary part of his equipment to understand intelligently modern scientific discoveries and recent articles, even though they are popular articles.

At the present time much emphasis is being placed upon health, nutrition, physical fitness, and in First Aid as matters in which every citizen can not only help himself but serve his country. Such things as active community projects dealing with these problems may be sponsored and engaged in by the students, which will be much greater in value than mere knowledge and learning of certain rules of health. I well realize that this subject matter is not the sole concern of the students of General Science but is also the concern of all students or members of the community and is likewise to be considered in the teaching of Biology, Physical Education, and other subject matter. In fact, well organized school
and community projects built around these interests will serve more in the teaching of the particular materials if students actually are a part of such a program.

Aeronautics and aviation are increasingly important in the consideration of the life of the individual and of the nation. I recently heard a man from the Civil Aeronautics Authority and the Office of Education, at North Central Association meetings urging that we make our students airminded by our various teaching devices, meteorology, navigation, mechanics, and astronomy, which are ordinarily considered in General Science, are of extreme importance in aviation navigation. Again active participation in projects is far better than mere textbook learning. Of great importance to young men and in many cases to young women is an understanding of the principles of the gasoline engine and the principles of aeronautics. Natural interests can be easily capitalized upon in the teaching of these matters in General Science. Further, in our present mechanical and electrical world a very valuable field of study is that of home mechanics, which is important for both boys and girls.

We should not neglect the study of the conservation of our natural resources in the study of any of our sciences. Particularly at this time with such large demands being placed on our natural resources and a shortage of essential war materials, it is easy to teach and install the ideas and ideals of conservation of our natural resources. The campaigns for saving various scrap materials have been of great value in teaching conservation if properly used. Such attitudes must not be considered merely as temporary measures but something which is essential for the further development of our national and personal welfare.

In addition to the necessity of the teaching of certain of the above mentioned subjects in Biology there are still other important considerations. Most certainly, conservation of natural resources, health and the teaching of human physiology through First Aid cannot be neglected. Attention should be given to the present through well-planned activities, even such as growing a "Victory Garden"; as teaching the factors which influence plant growth and development. Likewise the care of livestock and pets may well illustrate and be used in the discussion of the fundamental principles of reproduction and nutrition of animals. Likewise there is need for consideration of the laws of heredity by practical activities such as records from pedigreed livestock, tracing one's own ancestors and the social problems concerned with the so-called superior and pure races of the world.

Some have experienced the fear that the teaching of only the practical aspects of biology (or any science) would lead to failure on the part of the teacher to give a thorough course in the subject. (Riddle '42). Possibly we need to realize that it is not the object of secondary science subjects to prepare solely professional scientists. We should not lose sight of the possibility of better teaching of fundamental principles through practical activities and applications. Projects and other participation activities are creating an interest on the part of the students to find out details concerning phenomena. Surely that is better than superimposing the enthusiasm of a teacher and forceful study of principles for the sake of knowledge alone.

Finally, let us consider the teaching of chemistry in our secondary schools. The principles and laws of chemistry have come to play an important role in the everyday activities and lives of all. Nevertheless, it seems that the learning of many symbols,
formulas, equations, and mathematical computations becomes extremely distasteful to the beginning chemistry student. It is true that these, when taught from a pure memory standpoint, become a hard and difficult chore for students to do and it is difficult to create an interest in the work. Here again, possibly we are over-emphasizing the mastery of knowledge which is a part of the equipment needed for a chemist. Such a knowledge is indeed necessary for a successful working basis using chemistry in the field of industry and other pursuits of life having a chemical basis. Usually, young students are deeply interested in the common everyday elements and their properties. Possibly, more attention is needed for a descriptive chemistry rather than a lot of emphasis on theoretical chemistry which the majority of these students will not be able to master or have any need of later in life. Very successfully, many instructors have made use of the testing of consumer products and the preparation of various drugs and cosmetics in high school chemistry classes which have been of definite value to the pupils working with them. At the same time many fundamental chemical principles and laws have been learned. Perhaps we can give a knowledge of the fundamentals ordinarily taught by using these particular terms and symbols in our discussion of the problems and definitely relating them to the interests and activities of the students. The associative powers of the memory will help much in remembering these fundamentals when it can be connected with practical applications. Also, we had best provide for the individual interests and vocational choices and aptitudes of our students by challenging them with a more detailed study of certain principles which they will eagerly master than study from the textbook with certain page to page assignments.

In conclusion, we probably do not need to teach science in a greatly different manner during the time of war than during the time of peace. It is true probably that our present emergency has helped us to emphasize the need of practical applications and securing a more definitely embedded knowledge of scientific principles and fundamentals which may be necessary for the life of the students both at the present and in the future. May we use basic principles and methods of presentation with an active participation of the student in learning activities which will develop a scientific attitude and teach scientific principles!

Army and Navy, 1942. - Various publications especially folder by Navy as to education required for definite branches of service.

Riddle, Oscar, Editor.
OBJECTIVITY IN BIOLOGY

Cyril E. Abbott, Harding College, Searcy

When I was an undergraduate I once had a conversation with a graduate student who was experimenting on rats. During the course of our discussion I pointed out the evidence that had been accumulating that the orientation of Hymenoptera depends upon visual memory. "Well", said my companion with some scorn, "I have always considered such explanations anthropomorphic". When I asked him to supply an explanation of his own, he said, "It is probably kinesthetic". I thought at the time that, had the young man been more familiar with wasps and less exclusively concerned with rats, he might have reached a different conclusion. And besides, his statement did not, from his standpoint, eliminate what he called "anthropomorphism", since even in falling back upon kinesthesia the explanation would be incomplete without the postulation of some kind of memory.

The history of biology is very largely a history of attempts to eliminate superstition and folklore. Even so good a naturalist as Romanes was a romanticist. We are probably in agreement that romanticism, anecdotalism, and metaphysical teleology are out of place in the laboratory. The extreme mechanists cannot be blamed for taking exception to some of the sentimental trash that has come out in print concerning biological processes. Attempts to purge biology of humanistic and even supernatural impediments have resulted in many casualties on both sides. Some of us can still remember the "unnatural history" we read in our childhood.

Today we have exchanged those traveler's anecdotes for what is called "ecology", and the ecologists are so afraid of being thought unscientific that they have invented their own barbarous jargon which no one can understand. And for the past few years a battle has been waged in education between the advocates of "nature study" and the "objectivists". The former claim that, considering the nature of child psychology, it is impossible to teach elementary pupils science impersonally and objectively; the latter that unless science is taught objectively it is not science.

It seems to me that the question of objectivity is relative. No experimental result, even in chemistry or physics, is absolute; and certainly the arguments between students concerning the significance of results indicate that interpretation is not.

Nor dare we conclude that, because we can apply physical and chemical measurements to biological phenomena, vital processes can be explained only on the basis of physical and chemical concepts. Physical concepts are themselves in a state of flux. Twenty-five years ago all physical phenomena were referred to the concepts of conservation of matter and of energy; today, if electronic physics has demonstrated anything, it is that we have no absolute definitions for either matter or energy, and that causality is comprehensible only on a statistical basis. Even the "laws" of Boyle and Arrhenius are still undergoing modification.

For the so-called "laws" of science are not edicts from the Creator. They are generalizations from experience - an experience ever changing but never perfect. Objectivity, even in physics and chemistry is a goal never quite achieved.

"Ah, but a man's reach should exceed his grasp,
"Or what's a Heaven for?"
In writing that, Browning came close to feeling truly the scientific spirit. Indeed it would be a dull world for all of us were the universe so ordered that the predictability of all phenomena in all their phases was completely within our grasp. And it is just as well, perhaps, that no science is ever likely to be a finished product.

We are so used to generalizations in science, and so familiar with reliable predictions based upon such generalizations, that we often overlook the fact that generalizations are merely approximations. If we are not careful this is likely to lead to oversimplification of problems. Now oversimplification is a dangerous technique in biology. The Law of Parsimony is admissible only if and when it does not lead us astray. Indeed the history of biology is littered with the derelicts which ran upon this Charybdis in an effort to escape the Scylla of confusion. One need only recall Haekel's "Biogenetic Law", Loeb's "Forced Movements", and Watson's interpretation of thought as speech movements; or, to go further back, spontaneous generation and epigenesis.

We must also avoid the conviction that we have explained a process by inventing a name for it. Ecology is filled with meaningless jargon. So is physiology. Who dares attempt giving a satisfactory explanation of "instinct", "chemotropism", or "differential sensitiveness"? Physiologists are now inclined to regard reflexes with suspicion. Is there any real need to substitute the word "chemotropism" for "olfaction" or "photo-sensitivity" for "vision"? Does not the employment of such peculiar terms lead to confusion?

The Mechanists, especially Jacques Loeb, introduced such terms to avoid what they considered metaphysical interpretations of natural phenomena. But in so doing they committed an error and an oversight: the error was to suppose that a term applied to the behavior of a few species of organisms necessarily applies to that of all others; and the oversight was that no matter how careful one may be to define a term, others are bound to use it differently. Hence the multiplication of terms often confuses rather than clarifies the issue.

Behavior is too elusive to yield itself to simple generalizations for a variety of phenomena exhibited by a wide range of organisms in various circumstances. Does one suppose, for example, that the behavior of a hungry man entering a restaurant duplicates that of phagocytes attracted to an area of inflammation? Apparently some do, for as late as 1925, one psychologist referred to the attraction between the sexes in human beings as "erotropism"—on the assumption, presumably, that the reactions of adult human beings duplicate the behavior of the kind of germ cells they contain.

To be sure, all living processes are based upon certain common chemical and physical principles. But to admit this is very different from insisting that by substituting a few chemical equations, mathematical formulae, and physical constants for the organism we have adequately described it. We cannot even explain the simplest physiological process by such juggling. It is not to be wondered at that not long ago a biochemist prefaced his book on blood chemistry with the challenging assertion: "This work is teleological". Nor did one find in the book any speculative discussion on the nature of the Deity or the immortality of the soul. Apparently all the author intended to imply is that the chemistry of the blood is self-regulatory.
It is this self-regulation that distinguishes the living organism from non-living systems; making it impossible to adequately describe the former on a basis of chemistry and physics alone. To refer to man, as Herrick has done, as "The Thinking Machine", is, biologically speaking, a contradiction of terms. A machine does not think - that is why, by definition, it is a machine. No organism is "automatic" in the sense that it exhibits invariant behavior. Indeed, Goldstein, in his recent book "The Organism" insists that a living system never reacts except as a whole. Even Sherrington is careful to point out that the scratch reflex of dogs is not a single reflex, nor does its initiation always depend upon a single stimulus.

Even the mechanism occasionally admit that one cannot define an organism by its parts, nor its behavior as a mere system of reflexes. Bethe, for example, states that the adjustment of the simplest organism after injury is an adjustment of the whole organism and proportional to the injury. It is true that he attempts to define this mechanistically; although in that he is not entirely successful.

Not only does every organism differ from every other; variation in adaptive behavior may be observed even in organs. Recently I have been observing the pulsation of immature ovaries in Lucilia sericata Meig. The rate may vary from one pulsation in thirty seconds to one per second. Sometimes, when a fly is opened, the ovaries pulsate feebly for a few seconds and then stop; yet often, under what appears to be identical conditions, they pulsate for hours, and even do so when kept in vitro in Ringer's Solution. The same kind of stimulus may, in one case accelerate pulsation; at another time it may entirely inhibit it. Or it may stop one ovary and accelerate the motion in the other. Although eserine generally accelerates the action, it may inhibit it in one or both organs. It may stop the organ in either a contracted or relaxed position. Similar variations are observed when acetylcholine is used, either alone or in conjunction with eserine. Nicotine may stimulate the ovary to pulsate rapidly for several minutes and then stop, but quite as often it slows the rate of pulsation, which then continues several hours. Heat and concentrated salt solutions generally increase the rate of pulsation, but they may inhibit it entirely or in part.

Similar results are obtained in the case of the digestive system. Seldom, in two consecutive specimens, are corresponding sections of the gut active. The addition of warm water may initiate pulsation in the rectal sack, mid-intestine, or crop - or it may have no effect whatever.

No doubt the activities of the whole organism are, in general, adaptive, but this adaptiveness varies qualitatively as well as quantitatively. A fly recovering from the toxic effects of eserine may recover in a variety of ways: the wings may become active first, or the legs; or both may become active at the same moment. Poisoning from strychnine sometimes has a symptomology resembling that of eserine; or the symptomology may differ markedly in the two cases. And this is as true of the frogs as of flies.

One of the most difficult of scientific techniques is to determine whether one is dealing with a result or a conclusion. It is, strange as it may seem, difficult to draw a distinct line between observation and meditation. All one can do is to apply cautious logic to the problem. The best interpretations often come, not by a slavish regard for results, but through a careful selection of the most significant results. We must be careful, of
course, not to draw conclusions from insufficient data. Neither can we afford to ignore statistical probability. We cannot, as one worker is said to have done, draw conclusions from four cases in a hundred; that is if all of the cases were carried on under essentially similar conditions. We can reduce both labor and the margin of error by making certain that our experiments are as carefully controlled as conditions will permit.

The most efficient experimentalist is the one who observes with an open mind; who, without bias, experiments, not to substantiate a prejudice, but to establish a fact. If one must generalize, let him generalize as if he were the first and last observer in existence, uninfluenced by preconceptions. It is difficult to do this, but it is the only way to avoid the mistake the mechanist himself makes when he accuses the Medieval Scholastic of doing the same thing: that of trying to demonstrate only what one wishes to prove. Deterministic mechanism may be quite as much of a religion as Calvinism; in spite of their contrary conclusions, both are based upon the same system of metaphysics. And metaphysics, though valuable elsewhere, is out of place in a laboratory. The advice which Francis Bacon applied to readers, applies equally to the laboratory experimentation. "Read", he advised, "not to accept, nor to refute; but to weigh and consider."

References


OVARIAN PULSATIION AND ALLIED PHENOMENA IN LUCILIA SERIGATA MEIG.

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On opening the abdominal cavity of a living, female fly with undeveloped ova, one generally finds the ovaries contracting rhythmically. Contraction chiefly involves the calyces, for contraction of the ovarioles is spasmodic and ephemeral, and the oviducts contract only occasionally, usually as the result of mechanical stimulation.

This pulsation, though affected by stimuli external to the organs, is more or less independent of them, for the ovaries often continue this action for hours in Ringer’s solution, even when separated from the body of the insect. Moreover if, for any reason, ovaries which have been left for some hours have ceased to pulsate, the addition of warm (30°C.) Ringer’s will often initiate pulsation for several hours longer.

The ovaries are seldom motionless in a freshly dissected specimen, but sometimes pulsate feebly and soon stop, apparently as a result of the shock of operation. In such cases any one of a variety of stimuli may initiate pulsation. Crystals of ordinary table salt dropped upon them will often have this effect; so too, will sugar, although it is less effective. Mechanical stimuli initiate pulsation; even a stream of liquid passed over the organs often having that effect. But, with the specimens I used, no single stimulus invariably produced the same result—excepting eserine and acetylcholine bromide, the effects of which will be described later in this paper. Occasionally none of the stimuli, singly or together, had any observable result upon pulsation.

There is no evident consistency in the rate, vigor, or synchrony of ovarian pulsation. Even in a single specimen the two ovaries seldom contracted at the same rate, although it was not unusual for them to do so alternately. Contraction often appeared to take place simultaneously in the entire ovary; at other times a visible wave of contraction passed from the margins inward toward the center, which became briefly elevated, so that the surface of the organ was momentarily convex. Less frequently a wave of contraction passed from the cephalic margin of the organ toward the oviduct. Cases of incomplete contraction were also observed: In such cases the margins of the organ were active, while the rest of the body was motionless.

The period of contraction varied from 0.8 seconds to nearly a minute, depending upon the specimen and circumstances. In some cases the rate increased or decreased without apparent cause. Some specimens exhibited an increase in both rate and vigor for a time and then gradually slowed and finally stopped.

Contraction of individual ovarioles was observed only a few times and then only in fresh specimens. Each acts independently of the others. A wave of constriction passes from the free end of the organ to the calyx. The oviducts contract occasionally, generally by shortening of the tube. Erratic contractions of the accessory glands and spermathecal ducts also occur. Contractions of the latter may bring the reservoirs in contact with one another in a way which suggests a boxer striking his fists together.

Pulsations of the ovarian calyces appear never to occur in flies with matured ova; nor is any movement of the reproductive ducts evident in such specimens. Movements which produce descent of the ova must occur, but perhaps are inhibited in dissected
specimens. The close packing of the ova and consequent limitation of free space in such specimens must, however, limit internal movements; it is difficult to understand how pulsation could take place under such circumstances.

In considering the effects of eserine and acetylcholine upon ovarian pulsation it is necessary to point out that the experimental results obtained upon other organisms with the aforementioned substances have not been entirely consistent. A number of students have pointed out that acetylcholine, although it raises the blood pressure, also produces vasodilation. Heilbrunn has summarized the results of the studies on the action of the drug, and the few references I have studied in detail support his conclusions that the action of acetylcholine varies with different organisms and under different circumstances. Interpretations also differ as to the effect that acetylcholine has upon various invertebrates. Thus, while Beauvallet maintains that its action on the gut of molluscs is similar to the results obtained with the gut of vertebrates, Roeder (1939), in experimenting on the central nervous system of insects, concludes that injected acetylcholine, even in the presence of eserine has little effect upon the behavior of the experimental animal. He emphasizes the fact that the effect of eserine alone may result from a cholinergic condition brought about by inhibition of the esterase action of the tissues on acetylcholine normally produced. He did find that acetylcholine produces increased impulse discharges in isolated insect nerve.

Thus it is difficult to decide whether the effects of eserine result from the action of the drug directly or to suppression of the organic esters which act upon acetylcholine. Be that as it may, when eserine is added to the Ringer’s solution in which living fly ovaries are kept there is usually an increase in the vigor and rhythm of contraction. A higher concentration of the drug inhibits all movement; the ovaries remaining strongly contracted.

(Similar effects, by the way, may be observed on the activities of the gut). On the other hand, acetylcholine alone seems to reduce both the speed and rhythm of contraction, and in excessive amounts produces a condition of permanent relaxation and stasis. Pulsation is most nearly normal, though increased, when eserine and acetylcholine are applied together. The results of these observations appear in the accompanying table.
## Table I. Effects of Eserine and Acetylcholine Hydrobromide on Ovarian Pulsation in Lucilia

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Acetylcholine</th>
<th>Specimen</th>
<th>Eserine</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Rate of pulsation increased; arrhythmic, with partial relaxation.</td>
<td>1</td>
<td>Intermittent, irregular pulsations becoming rhythmic and strong.</td>
</tr>
<tr>
<td>2</td>
<td>Pulsation initiated in motionless organs; period of relaxation longer than that of contraction.</td>
<td>2</td>
<td>Pulsations irregular but intensified.</td>
</tr>
<tr>
<td>3</td>
<td>Pulsation in one ovary only. Partial relaxation of active organ.</td>
<td>3</td>
<td>Contractions of right ovary complete; left relaxed and motionless.</td>
</tr>
<tr>
<td>4</td>
<td>Organs relaxed and motionless excepting at margins.</td>
<td>4</td>
<td>With acetylcholine, slight acceleration and complete contraction.</td>
</tr>
<tr>
<td>5</td>
<td>Pulsations slow and incomplete, but slowly accelerating.</td>
<td>5</td>
<td>Pulsations resumed which had stopped under acetylcholine.</td>
</tr>
<tr>
<td>6</td>
<td>Right ovary arrhythmic and partially relaxed; left rhythmic and vigorous.</td>
<td>6</td>
<td>Pulsation feeble. Finally stopped with ovaries contracted.</td>
</tr>
<tr>
<td>7</td>
<td>Ovaries motionless in relaxed position.</td>
<td>7</td>
<td>With acetylcholine, pulsations initiated from stasis.</td>
</tr>
<tr>
<td>8</td>
<td>Pulsations slower after eserine.</td>
<td>8</td>
<td>Results negative.</td>
</tr>
<tr>
<td>9</td>
<td>Slower after eserine; intervening periods of inactivity in relaxed condition.</td>
<td>9</td>
<td>Pulsations slower but more complete.</td>
</tr>
<tr>
<td>10</td>
<td>Pulsations slower after eserine with partial relaxation.</td>
<td>10</td>
<td>Ovaries stopped in contracted position. Solution very concentrated.</td>
</tr>
</tbody>
</table>

The function, if any, of ovarian pulsation, is not clear. Each ovary is richly supplied with tracheal branches from two adjacent spiracles. This suggests that the organ requires a relatively large amount of oxygen, and it may be that pulsation increases its diffusion. On the other hand, it may be that pulsation has no significance beyond the fact that automatic contractility is an inherent property of the calyx tissue.

### References

THE USE OF LIVING THINGS IN TEACHING GENERAL SCIENCE AND HIGH SCHOOL BIOLOGY

Mildred R. Pool, John Brown University, Siloam Springs

There is a tendency for busy high school biology teachers to rely on teaching materials as suggested in text-books or work-books. This is an excellent procedure in most cases, for the specimens suggested are usually generalized and selected because they illustrate the particular principle being discussed. However, many times in order to follow these suggestions, it is necessary either to use preserved materials entirely strange to the pupil, or perhaps they are not available at all, and the teacher has to resort to pictures, reference book and chart work. Not that these mentioned do not have advantages, they do. But why follow such humdrum methods? Why not use the living organisms of your particular locality to illustrate the principles of biology or to give a broad survey of living things as most courses of general science demand?

Such a program is possible, irrespective of the type of flora and fauna characteristic of your locality. And such a program offers many teaching and learning advantages. It is accepted by all that the average person retains much more knowledge of a thing if that object under consideration is actually seen, perhaps handled, than if it is only read about. For example: Boys and girls may be told about the lowly liverworts, the life habits, form and size which doesn't mean much, for each student has his own concept of the word "small". If you show them preserved material, you get across to them the right idea of form and size, but they remember it as colorless in a museum jar or a watch glass. But what boy or girl wouldn't remember Marchantia if, on a field trip, it were pointed out to them as it covered a rock or a portion of a rock in the cool shade beside a sparkling rippling stream? They might forget and call it a moss, but would that miss the real relationship so dreadfully far? If questions are allowed to arise from the student's natural curiosity concerning the behavior and actions of an animal they are watching in the field or in the laboratory, the answers are very important to that student's mind and make a vivid impression, much more so than if the class is told to look at the animal or plant in the specimen jars, or set up under a microscope.

All high school teachers are familiar with the complaint that "Mrs. So-and-So's class is so boring" or "they just hate to go to some class because it's the same thing day in and day out, never anything new". Such a complaint is rarely heard and could not be fairly made where the teacher is fulfilling the definition of "Biology".

When students realize there is present in their own surroundings a great variety of interesting things, just for the looking, they will become more observant, a trait that will not only aid them in further scientific studies, but carried on into other fields contributes to a happy and full life.

There is much in the behavior of plants and animals that can be applied to human existence. The very way in which plants and animals live together, each in its own niche, yet depending on another individual for some one thing, and it, in turn, helping something else, is so similar to our own concept of a community (man-made). The persistence of some animals, the industry of others, the neatness of another, and many additional traits can be noted. Parallelism can be drawn that will aid adolescents in
adjusting themselves to society in formulating a philosophy of
life and give them a better understanding of their environment.
This in turn helps to develop a feeling of self-confidence and
security.

Plants and animals may be studied in their natural habitats
by the students themselves, on well organized and well-planned
field trips. This does take careful previous planning, in order
that the organisms you find will coincide with the forms being
studied. It is not necessary for a field trip to be long and
tiresome, involving many details and instructions. A trip to the
edge of the school yard to see an ant hill, or a bird’s nest will
be just as profitable, if those are the things you are studying,
as a trip ten miles in length. In this instance, the project
method of teaching has a great many things in its favor. Then
you can fit the course to meet the conditions of the environment.
However, there are many specimens that can be reared quite success-
fully in the laboratory, but again, that requires extra work and
care.

In fairness to the subject at hand, we should see both the
advantages and disadvantages, and it seems to me that all the dis-
advantages can be summed up in the statement, "that it requires
careful planning and a reasonable amount of initiative on the part
of the teacher". But if the teacher is interested in his or her
job and the challenges presented, no amount of work will deter him
or her in gaining the proper objectives.

As a summary of this paper, it is my opinion that any course
punctuated with observations and experiments with real live sub-
jects can become as fascinating and as intriguing as life itself.
A COMPARISON BETWEEN THE REDUCING ACTION OF MONOSACCHARIDE SUGARS AND THEIR EFFICACY IN SUPPORTING THE LIFE OF LUCILIA SERICATA MEIG.

C. E. Abbott, Harding College, Searcy

Neither the materials nor the techniques presented in this paper are wholly original. Only the method of comparison and the exact chemical methods can make any claim to originality; the results, and the conclusions one may draw from them, might well have been predicted from results obtained by many students in various ways, as will appear from the brief outline which follows.

In 1927, Bertolf reared honey bee larvae on pure sugars. He found that, so far as the monosaccharide hexoses are concerned, fructose, glucose, and galactose support life in the order given. Fraenkel (1936) found that the adults of Calliphora erythrocephala survive equally well on all three of the sugars named and several others also; a situation which certainly does not obtain in the case of Lucilia sericata. Loofer (1935) found that the protozoan, Chlorella eucharum, exhibits an acceleration of growth in the presence of both fructose and galactose but for some reason glucose has less effect.

Much evidence indicates that fructose is a highly efficient nutrient for many animals. Thus Rowe, McManus, and Plummer (1935) found that, as concerns the ovarian function in young women, there is a much greater tolerance for fructose than for galactose. This is in line with the clinical use of fructose for diabetics.

Weinbach and Calvin (1935) found that the relative reducing power of the monosaccharides is fructose, glucose, galactose, in the order given, and Watchorn and Holmes (1931) had previously demonstrated that fructose is effective in reducing the production of urea by embryonic kidneys, although the effect of galactose in this respect, is irregular, and xylose has no inhibiting effect. Apparently the effect of glucose was not tested.

This outline is by no means a complete account of this most interesting problem. For such a review the reader is referred to Traeger’s (1941) excellent discussion, and to the more recent texts on biochemistry.

The adult "greenbottle" fly, Lucilia sericata is incapable of surviving upon pure proteins, and evidently depends upon those ingested in the larval state. The chief function of protein ingested by adult flies is the formation of eggs: without it, eggs do not develop. On the other hand, Lucilia survives for varying periods of time on pure carbohydrates; especially sugars. The sugar most effective in prolonging life is fructose, which, in pure form, enables 70% of the flies to survive 33 days. On a diet of concentrated glucose flies live about 29 days; while galactose supports life no more than 14 days at most. I cannot agree with Crow (1932) who maintains that this species may live from 6 to 8 days on water alone; repeated experiments under widely varying conditions always brought 100% mortality no later than the fifth day.

When fed sugars in molar dilutions, the time of survival depends in part, of course, upon the dilution of the sugar, but it is also a function of the species of sugar; so that if the same molar concentration of two different sugars is employed in feeding two different groups of flies, there is still a divergence between them as concerns the duration of life. Moreover this divergence...
becomes greater as the molar concentration increases, as is illustrated in Table I.

### Table I Survival of Lucilia on Monosaccharides

<table>
<thead>
<tr>
<th>Molar Conc.</th>
<th>Fructose</th>
<th>Glucose</th>
<th>Galactose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/64</td>
<td>7.0</td>
<td>6.0</td>
<td>6.0</td>
</tr>
<tr>
<td>1/48</td>
<td>7.5</td>
<td>7.0</td>
<td>6.5</td>
</tr>
<tr>
<td>1/32</td>
<td>10.5</td>
<td>9.5</td>
<td>7.5</td>
</tr>
<tr>
<td>1/24</td>
<td>14.0</td>
<td>13.0</td>
<td>9.0</td>
</tr>
<tr>
<td>1/16</td>
<td>20.0</td>
<td>18.5</td>
<td>11.0</td>
</tr>
<tr>
<td>1/8</td>
<td>29.0</td>
<td>27.0</td>
<td>14.0</td>
</tr>
</tbody>
</table>

Since fructose, glucose, and galactose all reduce alkaline cupric sulphate solutions, one would naturally expect them to have a similar effect upon respiratory enzymes and pigments, and upon any substance which has the properties of such enzymes and pigments. Methylene blue, an efficient hydrogen acceptor, is one such substance. It oxidizes fructose very rapidly, glucose somewhat more slowly, while galactose requires a considerable time for oxidation. The reactions are more or less reversible, especially in the presence of free oxygen. Nearly four times as much glucose (20.08 mgs.) as fructose (5.94 mgs.) is required to reduce equivalent quantities of methylene blue in a given time.

In order to obtain a reliable comparison of the reducing action of the three sugars, a given unit of methylene blue solution was mixed with a measured quantity of sugar of known concentration, and the time required for reduction at constant temperature carefully recorded. This was repeated with each sugar, and in order to make the comparison more complete, several "standard" concentrations of the sugars were used. Preliminary tests indicated that the most desirable concentrations were molar dilutions: .02, .04, .06, .08, and .10. In practice, 5 ml. of each was added to five marked test tubes. To each tube 10 ml. of the dye was then quickly added, and the tubes simultaneously immersed in a water bath of 40°C.

The stock solution used in the tests was made by dissolving 0.00047 gms. of the dye in 500 ml. of water to which 1.0 gm. of sodium hydroxide had been added. Methylene blue is reduced only in alkaline solution. It is usually comparatively easy to time the reduction of methylene blue because the color disappears rapidly and completely. The results of the tests are given in the following table.

### Table II Reduction of Methylene Blue by Monosaccharides

<table>
<thead>
<tr>
<th>Molar Conc.</th>
<th>Fructose</th>
<th>Glucose</th>
<th>Galactose</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.02</td>
<td>8.0</td>
<td>13.0</td>
<td>18.0</td>
</tr>
<tr>
<td>0.04</td>
<td>6.0</td>
<td>8.0</td>
<td>12.0</td>
</tr>
<tr>
<td>0.06</td>
<td>5.0</td>
<td>5.0</td>
<td>7.0</td>
</tr>
<tr>
<td>0.08</td>
<td>4.5</td>
<td>4.0</td>
<td>6.0</td>
</tr>
<tr>
<td>0.10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
One should notice that difference in reduction time for different sugars is much greater at very low concentrations than it is in solutions containing the sugar in more concentrated form. The significance of this is not entirely evident, but it seems to be characteristic, because it appears consistently, even when substances other than methylene blue are used. This is indicated on Table III, which consists of data relative to the reduction of haemoglobin.

**Table III Reduction of Haemoglobin by Monosaccharides**

<table>
<thead>
<tr>
<th>Nolar Conc.</th>
<th>Fructose (Minutes)</th>
<th>Glucose (Minutes)</th>
<th>Galactose (Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.02</td>
<td>14.0</td>
<td>16.0</td>
<td>20.0</td>
</tr>
<tr>
<td>0.04</td>
<td>9.0</td>
<td>10.0</td>
<td>12.0</td>
</tr>
<tr>
<td>0.06</td>
<td>7.0</td>
<td>7.5</td>
<td>9.0</td>
</tr>
<tr>
<td>0.08</td>
<td>6.0</td>
<td>6.5</td>
<td>7.0</td>
</tr>
<tr>
<td>0.10</td>
<td>5.0</td>
<td>5.0</td>
<td>6.0</td>
</tr>
</tbody>
</table>

The haemoglobin solution was prepared by dissolving in 500 ml. of water 1.0 gm. of dry, powdered haemoglobin and 1.0 gm. of sodium hydroxide. The preparation was filtered before use. The reduction of haemoglobin is more difficult to observe because the change in color is from a yellow amber to a cherry red, and the change is often so gradual that it is difficult to determine the time at which reduction begins and whether or not it has been completed. Only by repeating the experiments many times could reliable conclusions be made as to the reduction time.

Peptone, gelatine and egg albumin did not reduce either methylene blue or haemoglobin, even when the solutions were heated to the boiling point and then allowed to stand for twenty-four hours.

All of the evidence presented seems to indicate that there is a close relationship between the ease with which a carbohydrate is oxidized in the animal body and its ability to support the life of the organism. That this is likewise related to the fact that proteins are not oxidized readily seems probable. Of course the only way one could finally determine whether or not the oxidation of carbohydrates "spares protein" in proportion to the ease with which a given carbohydrate is oxidized would be to run nitrogen determinations on flies fed specific sugars. Apparently this has not been done. Evidently Lucilia lacks the chemical machinery for converting ingested proteins into materials which are easily oxidized.

One conclusion seems inevitable: there is no direct relationship between the ease with which a sugar is oxidized and its chemical relationship to other sugars. Glucose and galactose are stereoisomeric aldoses, yet they are not oxidized with anything like equal speed, either in vitro or in the animal body. On the other hand fructose, which is a ketose sugar, is oxidized more easily than either of them.
Literature Cited

NOTES ON THE BEHAVIOR OF A CORAL SNAKE IN CAPTIVITY

C. E. Abbott, Harding College, Searcy

During the month of December, 1942, I received from Louisiana, a living male specimen of Micrurus fulvius. Although I was entirely unfamiliar with the species, efforts were made to apply what knowledge I had of snakes as a group to maintaining it alive in captivity. It was kept in a large battery jar with a screen top. A layer of sand covered the bottom of the jar, and a small preparation dish therein was kept filled with water.

Efforts to induce the reptile to feed were fruitless. Small frogs, meal worms (Tenebrio molitor) and milk were all ignored. Ditmars states that it is almost impossible to induce Micrurus to feed in captivity, adding that in natural surroundings the snake lives largely upon lizards. But I had no lizards, and the snake died, after three months, no doubt because it had eaten nothing.

Ditmars also states that the coral snake in captivity has a tendency to immerse itself in water. This my specimen did upon numerous occasions. The laboratory, though much warmer than the air outside of the building, was far from tropical. The cup of water in which the snake was in the habit of coiling was five to seven degrees (centigrade) warmer than the surrounding air. It is possible that the snake, being a subtropical animal, entered the water for warmth, although this may not be a complete explanation of this behavior.

The animal had a habit of elevating its body a third of its length to sway from side to side like a cobra. It also "leaned" against the wall of the jar when so elevated, sometimes remaining in that position for an hour. Since the animal had to maintain this position chiefly by muscular tension, it must be capable of remarkably intense and enduring muscular tonus.

Although I handled the specimen many times (with gloves, of course), it never offered to bite, excepting on one or two occasions, as the result of being inadvertently pinched.

The coloration of the species is said to vary considerably, in spite of a fundamental pattern. This specimen was nearly black, since the scales in the "orange" areas were orange only at the margins. The belly was distinctly coral-colored.

The snake was etherized once, in order that it might be photographed. It did not seem to suffer any permanent inconvenience from the treatment. But it evidently noticed the "smells" we generated in the laboratory, for every time we did so the snake buried its head in the sand or immersed it in the cup of water. The same behavior was sometimes observed when there was an unusual amount of noise in the room. Snakes are said to be hard of hearing, but this one may have felt vibration through the table on which the cage was kept. There can be no doubt that snakes resting on the ground perceive footfalls through vibration.
SUGGESTIONS FOR THE PLACEMENT OF CONSERVATION IN THE CURRICULUM OF SECONDARY SCHOOLS IN ARKANSAS

Irvin A. Wills, John Brown University, Siloam Springs

Many have interpreted the Arkansas state law requiring the teaching of conservation in secondary schools as making mandatory the offering of a separate course in conservation of a half unit or unit credit. The author believes, in accordance with the philosophy of instruction advocated by Bulletin No. 11, Arkansas Cooperative Program to Improve Instruction, entitled "Nature Study and Conservation" (Secondary Section), that such conservation instruction is best given as units in already existing secondary subject matter. May I quote from the above mentioned bulletin which reads as follows: "On the secondary school level, it is recommended that a minimum of one unit in conservation be offered each year. These units should be selected in such a way that at the end of six years a pupil will have had an opportunity for worthwhile experiences in each of the major areas of conservation. The type of unit offered each year by a school will depend upon the program in effect in that particular school. The administrator should be responsible for outlining a program which will conform to this suggestion." Such a plan does not crowd the curriculum with an extra subject matter course. Further, the teaching of conservation as units in already existing subject matter brings out its true relationship to such subjects and adds interest and practical value to such courses in which it is included.

As indicated by the Arkansas Bulletin, mentioned above, a definite plan of arrangement of units in conservation to be taught in the various subject matter fields rests upon the administrator to work out. However, many administrators, because of lack of time, have not given the matter serious consideration and have supposed it easier to administer a separate course. Personally, I believe it is a responsibility of both the principal and the staff of science and social science teachers to work out a plan to fit the local situation. I wish to offer a suggested plan which might be followed, at least in generalities, the details of such to be completed according to local situations.

In the seventh grade, I recommend that a unit dealing with the recreational resources be included in the study of Arkansas History. Such a unit as given by the Arkansas Bulletin entitled "Recreation or Wreck-creation", pp. 104-114, might be used. In certain school systems, the state adopted text, Paths to Conservation is used. In connection with this text, a unit in wildlife conservation can be most readily developed and used in the seventh grade science or other similar subject matter course.

The conservation instruction for the eighth grade may be well given in either general science or social science. Some, however, may wish to include this instruction in agriculture or home economics, if such are offered. Particularly suited to this grade level is a unit in soil conservation. Again, our Arkansas Bulletin gives many suggestions for the development of such a unit; one at the junior high school level and one at the senior high school level.

Most high school students in the ninth grade take general science and units dealing with water resources and mineral resources might be readily used in this subject. Of course, there is nothing to prevent the use of a unit in soil conservation if such a plan is better adapted locally.
In most high schools, biology is taught in the tenth grade and in many schools, it is a required subject. The natural place for the teaching of units dealing with the conservation of our forests and conservation of plant and animal life is in biology. Therefore, these units might be well given in high school biology. A unit, however, on conservation of forests might be just as readily included in the social studies for tenth grade if the biology is not required of all students and social science is required.

When we consider the curriculum of the eleventh and twelveth grades, we find that except for English and American History, there is not a required science or social science subject. Thus, it is suggested that the most of the conservation instruction required for all high school students be given previous to the eleventh and twelveth grades. This does not, however, mean that no consideration should be made of conservation or any units of such taught at the eleventh and twelveth grade level. In fact, there are many opportunities for the presentation of conservation units in the subjects of chemistry, physics, American History, Economics, Government, and others. Most assuredly, schools offering agriculture and home economics can well include units of conservation in these subjects. I would, however, warn against the danger of duplicating the instruction and activities carried out in the preceding units of lower grade level. This emphasizes the definite need for a well thought out and cooperative plan of conservation instruction by the instructors of the various related subjects in the junior high and senior high grades.

Some may contend that subject matter courses are already "loaded" to capacity with material to be presented and that there is no room for units of conservation. Increasingly, our courses are crowded and we have inadequate time to cover everything. However, it is much better to cover thoroughly less material which will have fundamental and practical value. Conservation units are certainly fundamental and may be very practical if taught properly. These units may be of various lengths and certainly should be less than five or six weeks in length. Probably, two or three weeks is sufficient time for developing most units.

May I warn against the use of just merely textual material in the giving of conservation instruction? There are so many practical and worthwhile activities which may be participated in by the students which will also call for the use of the community as a laboratory in order to work them out. This will create interest among the people in such projects and bring about a community consciousness of conservation projects, which should lead to definite steps for the solving of these problems by community action.

Finally, I should like to offer criticisms of the plan of giving conservation instruction in a single course required of all students to take. It may be easier to administer, but it will certainly not accomplish the results of the cooperative plan outlined above. The teaching of conservation as a single subject is not likely to promote interest among the students which will be carried over into worthwhile activities in the community. They think of it as merely another subject to be taken and it becomes largely a textbook course rather than one of activities participated in by the various pupils.

We certainly all agree that the Arkansas law requiring the teaching of conservation is a valuable one. But the value largely depends upon the manner in which such instruction is given. I believe that the plan which I have advocated will more nearly carry out the intents of its author than the teaching of conservation textbook facts.
CALYCANTHINE. DISTILLATION WITH ZINC DUST.

Irving T. Beach, College of the Ozarks, Clarksville
(Paper presented at the 1940 meeting of the Academy)

The alkaloid, calycanthine, was first obtained by Eccles (1) from Calycanthus glaucus. It was also studied by Gordin (2). The molecular formula was established by Spaeth (3) as C_{22}H_{28}N_{4}, who also prepared a dimethyldiide.

The work to be reported here was started at Cornell University under the direction of the late Professor George Barger of Edinburgh. The source material was the seeds of C. floridus obtained from North Carolina. The extraction followed the usual method. The ground seeds were first extracted with ether to remove fats and then with ethyl alcohol. Concentration of the alcoholic extract and precipitation with ammonia gave a crude base in a 1.4% yield.

The bulk of the extraction was carried out by the Parke-Davis Co., through the courtesy of Dr. Oliver Kamm. The alcoholic concentrate which they returned was a dark viscous mass. The method of purification found most satisfactory was to dissolve this material in glacial acetic acid and pour the solution into a large volume of water. This treatment precipitated certain non-alkaloidal impurities in filterable form. After filtration the base was fractionally precipitated with ammonia. This product was still dark colored and amorphous. After drying, it was dissolved in acetone and precipitated as sulfate by means of concentrated sulfuric acid in acetone. The salt was reconverted to the base which was finally recrystallized from absolute alcohol. It had a melting point of 245° C., the figure given by Spaeth.

Distillation of the pure base with zinc dust yielded a volatile product which proved to be ammonia, and an oil. The oil was separated into a basic and a non-basic fraction. The first was identified as epidendrine by comparison with a sample of that base obtained by distilling cinchonine over litharge, the method described by Hoogeboom. The two samples gave sulfates which had the same melting point, and a mixed melting point showed no depression.

The non-basic fraction was characterized by a violently unpleasant odor typical of the indoles. It was identified as 1,5-dimethylindole by comparison with a synthetic product made from methylphosphonyldrazine and propionic aldehyde. Mixed melting point determinations of the picrates showed no depression.

While zinc dust distillation is admittedly drastic, and might lead to deepseated reactions, some conclusions may be drawn regarding the constitution of the alkaloid. If we assume that the lepidine and the dimethylindole represent two fragments of the calycanthine molecule, all but two carbons and two nitrogens are accounted for. If we make the further assumption that the indole residue represents a carboline group, as is often the case in alkaloids, then there is but one nitrogen atom unaccounted for. In correspondence with the author of this paper, Professor Barger proposed a formula to meet these requirements. The point of attachment of the two fragments was suggested by analogy with two other alkaloids, evodiamine, and rutecarpine. This formula is shown on following page.
Experimental

Zinc Dust Distillation. Five grams of the pure base was mixed with 100 grams of zinc dust and heated in a pyrex test tube on a metal bath at 400° to 500° C. The distillate was collected, and the uncondensed gases passed through dilute hydrochloric acid. This acid solution was examined according to the method described in Allen's Commercial Organic analysis (VI, 18) and found to contain only ammonium chloride.

The oily distillate was treated with dilute hydrochloric acid to remove basic constituents, and then extracted with ether. Evaporation of the dried ether extract yielded a yellow oil having an indole-like odor. This oil was distilled under reduced pressure. At 2 mm. it boiled at 130-132° C. The picrate was prepared by dissolving the oil in dry ether and adding an ether solution of picric acid. To induce crystallization it was found necessary to add petroleum ether and cool to -15°. Red crystals were obtained which melted at 137.5° (sealed tube). 1,3-Dimethylindole was synthesized by the method of Degan (4). The picrate was made in the same manner as described above, and found to melt at 138°. The melting point of a mixture of the two samples was 137.5°.

The acid solution containing the basic fraction was made alkaline and subjected to steam distillation. The distillate was extracted with ether. The other extract was dried with potassium carbonate and the solvent evaporated. A yellow viscous oil with a quinoline-like odor remained. A boiling point determination gave 232°. A sulfate of the base was prepared by adding a solution of concentrated sulfuric acid in absolute alcohol to an ether solution of the base. The sulfate was recrystallized from absolute alcohol. The melting point was 219°. Some lepidine was prepared by the method of Hoogeboom (5). The sulfate, prepared and purified as just described, melted at 219°. A mixture of the two samples also gave 219°.

(1) Proc. Amer. Pharm. Assoc. 84, 382 (1888).
(2) Jour. Am. Chem. Soc. 27, 144, 1418 (1905); 31, 1305 (1909); 33, 1625 (1911).
A NOTE ON THE OCCURRENCE OF D-MANNITOL IN THE NATIVE PERSIMMON

Iving T. Beach, College of the Osarks, Clarksville

The literature records very little work on the constituents of the native persimmon, Diospyros Virginiana L. The Japanese persimmon, D. kaki L., has received more attention. In 1929 Matoe Iwata (1) noted the presence of D-mannitol in that fruit.

For the present investigation about sixteen kilograms of ripe fruit was used. After the addition of an equal volume of water the mixture was allowed to ferment, and then the pulp partly separated through cheesecloth. Distillation of the liquor yielded the equivalent of 284 ml. 100% alcohol. The undistilled liquor was filtered to remove the remainder of the pulp, and the distillation continued. The distillate which came off at 100° C. was acid to litmus. A Declaux determination showed the acid constituent to be acetic. The liquid in the distilling flask developed a deep red color and as it became concentrated a chocolate-brown material separated. The heating was interrupted from time to time to filter off this material. Finally the precipitation of this substance ceased and a colorless crystalline precipitate appeared. The concentration was continued, with occasional removal of the crystalline product, until the residue was a dark brown viscous material having an acid reaction. The crystals were readily purified by recrystallization from hot 50% alcohol. They agreed in melting point with the value for mannitol (166° C.) and gave the tests described for that substance by Millikan. The yield was about 150 grams purified product, or almost 1%.

Mannitol was the only constituent positively identified. The chocolate colored insoluble product is possibly a phlobaphene resulting from the tannin in the fruit. This behavior is characteristic of one class of tannins.

SIMPLE IGNITION FURNACES
L. B. Roberts & J. C. Hackney, Arkansas A. & M. College, Monticello

Ignition furnaces which give performance comparable to a blast burner may be easily constructed from simple and economical materials. The first type described uses an ordinary bunsen burner, and the second uses an open jet flame from a blow-pipe or a glass jet.

To construct the first type, the materials needed are one "tin" can of approximately one quart capacity, or smaller, and one pipe-stem triangle. The top of the can is removed entirely. A hole is made in the bottom of the can by making two diagonal cuts, and bending the points in. This hole should be large enough to admit the top of a bunsen burner and leave sufficient opening for draft. The triangle is mounted about the middle of the can by pushing the wires through three equidistant holes punched in the side of the can. This furnace is mounted on an iron ring so that the top of the bunsen burner is just inside the opening of the can.

The second type of furnace is just like the first, except that an additional single piece of pipe-stem is mounted about an inch and a half below the triangle. The purpose of this is to break the flow of gases, and allow the flame to strike the bottom of a crucible when held on the triangle. Otherwise, a mixture of cold gases would strike the bottom of the crucible. The open jet (either a metal blow-pipe or a home-made glass jet) is mounted about two or three inches below the bottom of the furnace. The air-gas mixture is adjusted by raising and lowering the jet. A completely sootless flame is easily produced by proper adjustment.

After ten minutes operation of the first type furnace, a temperature of between 801° and 880° C. was produced within the crucible. This was determined by the fact that sodium chloride (melting point 801° C) melted, and sodium pyrophosphate (m.p. 880° C) did not melt. With the open jet furnace, sodium pyrophosphate melted within ten minutes, while potassium carbonate (m.p. 891° C) did not melt. Actual temperatures obtained would be expected to vary with the type of gas, size of opening in the jet, and the air-gas ratio.

The open jet furnace has been used successfully in place of a blast burner for such ignitions as the gravimetric determination of iron as Fe₂O₃. The bunsen burner furnace has some tendency to sooting unless an unusually large amount of air is admitted to the burner. A higher temperature can be obtained by insulating the furnace with asbestos, or covering it very loosely. Covering the furnace also produces more uniform heating.

Advantages of both types of furnaces are: nominal cost of materials; ease of construction and operation; uniformity of heating; and wide range of temperatures attainable.
SPECIFIC GRAVITIES AND FLUIDITY FACTORS OF GLAZE SLIPS

E. S. Amos, Niloak Company, Little Rock

Introduction

Early this year an order restricting the use of lead-bearing chemicals was issued by the War Production Board, reducing the amount allowed the ceramic industries to 50% of 1944 consumption. This shortage necessitated the immediate reduction in the lead content of several glazes.

At about this same time changed body composition and plant process required adjustments in the glaze composition and application.

The laboratory began the investigation of these problems: First - to determine the changes necessary in the chemical composition of the glazes (because of the lead order and also the new body). Second - to determine the best methods of application of these new glazes to the new body. And, third, to establish control methods for plant use to insure satisfactory and consistent results.

Preliminary Laboratory Work

The formulae were re-calculated and the lead content was reduced. The glaze slip is a suspension of clays, feldspar, whiting, white lead, flint, aluminum hydrate, coloring oxides and other glass forming materials in water. The slip was milled and applied by dipping, to small cones cast of the new body. These prepared pieces were fired through the laboratory kiln with a simulative fire, approximating conditions in the commercial kilns. These preliminary investigations resulted in glazes maturing at required temperatures. The colors were developed and the surface textures adjusted.

Early Plant Experiments

The new processes were then tested at the plant. Batches of the new glazes were ground with normal plant procedure, and casts were prepared for fire. The glazes matured, and the colors and textures were good, but several glaze faults developed. Some pieces exhibited crawling, a fault characterized by shrinkage of the glaze at various spots on the body, leaving naked zones with rounded edges. Some revealed body scars and blisters where the walls of the ware had split slightly. With these problems in view, laboratory investigation was resumed.

Further Laboratory Investigation

Crawling starts at the beginning of fire, revealing lack of compatibility between the raw glaze and body. The glaze coating dries rapidly during this period and is likely to crack and shrink prior to melting. If the glaze is not extremely fluid in the molten state, the cracks will not heal. Rather, the surface tension of the glaze causes the broken edges to roll back still further, leaving the surface of the body bare.

Crawling can develop, too, if the surface of the body is dusty when the glaze is applied. Like other liquids, the molten glass will not cling to a surface which it cannot wet, and will recede from the dust covered areas.
Since proper precautions against dust were observed, the trouble was considered to lie in the glaze film itself. In this particular instance, due to material restrictions, it was more feasible to increase the strength of the raw glaze film than to increase the fluidity of the molten glaze. The bonding agents used in the glaze are normally ball clays, such clays showing a maximum subdivision and the highest degree of plasticity, possessing a great bonding power and toughness in the unfired state and vitrifying at comparatively low temperatures as compared to the kaolins. The indicated increase in the glaze eliminated the crawling.

The phenomenon of wall splitting was more difficult to control. An extensive search of ceramic literature failed to reveal much of real help. It did, however, support our own observation that the fault arose during application and was caused both by the condition of the ware and that of the glaze slip.

The work was carried out with unfired ware, which had lost its plasticity due to drying and also a great deal of the toughness and strength imparted by the plastic clay. Addition of water does not restore these properties, but weakens the body.

When an excess of water from the glaze was absorbed, saturating the surface of the ware, it divided the walls into strata. The swelling of the outside layer caused it to rise and finally to burst outward, leaving a star shaped tear which was further aggravated by the stresses of firing.

Investigation of the Effect of Moisture in the Ware

The effect of various water contents of the ware was first investigated. Normal glaze, milled with water containing no electrolyte, and thinned with water to dipping consistency, was applied to pieces of ware leather hard (containing 10% moisture), air dry (6% moisture), bone dry (4% moisture), and dry.

Tests were made on ware in these conditions with 5-, 10-, and 15-second immersions. The leather hard ware, already containing 10% water, had a low receptivity value. That is, it did not quickly absorb further water into its surface. The receptivity value is a measure of the amount of water absorbed per unit area per unit time, and influences the glaze thickness on dipping. The surface of the ware in this condition failed to absorb water fast enough to give a proper thickness of glaze. Increasing the immersion time beyond practical limits only caused enough water to be taken up to bring about wall splitting.

The air dry and bone dry tests gave similar results. The R value here was considerably greater and consequently water was absorbed more rapidly and a thicker deposition resulted. Still too much water was absorbed in normal dipping time, to give good results.

The glaze was deposited on the dry ware too rapidly, building up an extremely thick coating during a very short immersion. The R value of the dry ware was extremely high, and again the excess water caused wall splitting.
Since control of the moisture content of the body did not show promise, attention was directed to the glaze slip itself.

**INVESTIGATION OF FLUIDITY FACTORS IN GLAZE SLIPS**

The problems here appear to be control of the following factors through control of the slip consistency:

1. the weight of glaze deposited per unit area per unit time (coherence value)
2. the character of the deposition
3. the quantity of water absorbed per unit weight of the deposition (controlled by water content of the glaze and receptivity of the ware).

The three factors were found to be so closely related that it is impractical to separate them for discussion. They were in turn influenced by the particle size, fluidity, pH value, and specific gravity of the slip.

A glaze which showed poor behavior in respect to wall splitting was chosen as the basis for the tests.

The effect of particle size was investigated. Studies of the dipping behavior of the glaze milled for varying lengths of time with no electrolyte addition showed that the milling time affected glaze consistency, dipping characteristics, fluidity and pH value. Until the glaze reached the optimum particle size distribution, its characteristics improved, dipping nicely with a good fluidity, drying rapidly and having a good smooth texture. Further increase in grinding time resulted in the glaze becoming quite viscous and in the tendency toward poor drainage, slow drying and severe cracking on drying, which became progressively worse with further reduction of particle size. The fluidity of the slip decreased rapidly and the amount of glaze adhering to the surface per unit time increased. The pH value increased as the particle size became smaller. The glaze dried slowly because of the clogging of pores by the fine particles, thus reducing the capillary action.

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**TYPICAL CURVES SHOWING WORKING PROPERTIES AS A FUNCTION OF PARTICLE SIZE**

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Published by Arkansas Academy of Science, 1947
The fluidity of the slip was found to change with age. On standing, thinning was pronounced, and might be explained by progressive solution of the salts, resulting in increased alkalinity.

The addition of an electrolyte to the glaze slip produced definite changes in its behavior. "N" Brand sodium silicate was chosen and added to the mill batch in order to accelerate its action. The water content was cut to about 75% of that formerly used, resulting in a slip of high specific gravity. Thus the specific gravity could be held fairly constant, while the fluidity could be varied from a heavy paste at one extreme, to a watery consistency at the other extremes.

Starting with a five drop addition of the reagent, we increased it at five drop intervals to 40. The following results were gained:

<table>
<thead>
<tr>
<th>Drops</th>
<th>Glaze Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Too viscous. Deposition too thick. Poor draining, slow drying and cracks on drying.</td>
</tr>
<tr>
<td>10</td>
<td>Still too viscous, with poor draining, slow drying.</td>
</tr>
<tr>
<td>15</td>
<td>A little too viscous, dips fairly well, dries a little faster, no cracks.</td>
</tr>
<tr>
<td>20</td>
<td>Dips well, drains well giving a uniform coating, dries rapidly, strong smooth feel.</td>
</tr>
<tr>
<td>25</td>
<td>Dips well. A little too fluid, dries a little too rapidly. Grainy feel.</td>
</tr>
<tr>
<td>30</td>
<td>Dips well but too fluid. Curtains (dried before smoothing out well). Grainy feel.</td>
</tr>
</tbody>
</table>

Working above the optimum silicate content, it was found that fairly satisfactory physical dipping characteristics could be regained by adding acetic acid. This apparently caused the formation of a gel which retarded the drying rate and thus reduced curtaining. The glaze coating, although it appeared thick enough in the raw state because of the gel-like character, was still far too thin on firing. Therefore, silicate alone was indicated for plant use.

**Plant Control Procedure**

Since the glaze preparation at the plant is carried out in close co-operation with the laboratory, most of the control work was instituted during this operation. The changes in clay content were made here. The optimum time schedule for milling each separate glaze was determined and put into effect. The initial water was measured, and the accurately measured silicate was added to the batch. These factors, which were the variables throughout the tests, were now set values when the glaze was delivered to the dippers. All that remains is to thin the slip slightly with water.
to bring it to the specific gravity specified for each separate glaze and each size ware, calculated simply from the weight in grams of 1000 cc of the slip, and to select air dry ware for dipping. Some of the dippers become quite skilled at judging a glaze by the feel, but all are required to make the weight test several times during the dipping period to insure proper control.

Some of the glazes require an ageing period of 24 to 48 hours before dipping. These are ground ahead of the dipping schedule and stored under the supervision of the dipper who records the time of delivery and then waits for the specified time before using the glaze.

With these controls being conscientiously used in the plant, glaze troubles have been reduced and ware quality improved.
ECONOMIC IMPORTANCE OF THE ARKANSAS DEER HERD

Roy Wood, Coordinator - Pittman-Robertson Program
Arkansas Game and Fish Commission, Little Rock

History of the Whitetail

In the history of the North American Continent, the wildlife with which our country was so bountifully blessed, played a major role in the development of this "new world". It was the wild turkey in the New England states that helped to prevent the early pilgrim from starving, and the American elk or "Wapiti" which supplied both food and clothing to the early pioneer of the Appalachians. In the great plains region of the west, the American bison or buffalo provided furs for warmth and food for sustenance to an army of workers that built our railroads and pushed our civilization westward. It was the beaver in the northwest, just as much as gold in California, that lured deep into the wild beyond our early trappers and traders who blazed new trails for settlement.

Of equal significance in the history of our country, and particularly Arkansas, was the whitetail deer which once ranged from the Atlantic seaboard west to the Rocky Mountains and from the Gulf of Mexico north to the provinces of Canada. The deer furnished the pioneers with venison as one of their principal sources of food and buckskin for their garments. Hunting of the whitetail taught our forefathers woodcraft and rifle marksmanship.

From the notes of Lt. Wilkinson, who with three companions in 1807, descended the Arkansas in two canoes, we receive some idea as to the abundance of deer and the big game in this state. He wrote "of the presence and abundance of game found on this journey, particularly on the upper portion of the river, - - - the borders of the Arkansas river may be termed the paradise of our territory for the wandering savages. Of all the countries ever visited by the footsteps of civilized man there never was one, probably, that produced game in greater abundance, and, I believe there are buffalo, deer, elk, and bear sufficient on the banks of the Arkansas alone, if used without waste, to feed all the savages in the United States territories one century".

The exploitation of this wildlife is an old story which has been retold many times. With the settlement of the country and the development of railroads, hunting became a sport rather than a necessary means of procuring food. Then market hunting began in earnest. The elk and buffalo were entirely exterminated, the bear reduced to but a few individuals, and the deer depleted to a remnant of their former abundance.

The low ebb of the deer population in Arkansas was reached during the period from 1920 to 1930, at which time the herd numbered less than 1,000. These deer were distributed in small and widely scattered bands seeking refuge in the rugged fastness of our highlands, the extension forests of our coastal plains, or in the deep bottom lands of our delta.

Restoration

The turning point in the population trend of our deer herd dates from the establishment of our first federal big game refuge in the Sylamore District of the Ozark National Forest in 1926 and
the first state game refuge in 1927. Today, Arkansas is served by twenty-seven state big game refuges comprising an area of over 470,000 acres, nine federal refuges comprising 143,000 acres under the direction of the U.S. Forest Service in cooperation with the State Game and Fish Commission, and two wildlife refuges consisting of 134,000 acres under the supervision of the United States Fish and Wildlife Service.

This represents a total refuge area of over 747,000 acres exclusive of state parks, federal ordnance plants, war training areas, and other federally owned lands upon which hunting is restricted.

The first of our big game refuges were established in areas where a small remnant of the original herd existed and which served as breeding stock. In more recent years, however, as our restoration program advanced, the refuges have been established in areas extremely suitable for deer production but on lands where there were no deer or where the breeding stock was inadequate. This problem is being met by an intensive stocking program. At the date of this writing (April, 1945) a total of 779 deer have been planted during the past four years.

**Present Population**

The estimated population of our deer herd, today is approximately 33,565 head. The distribution, abundance, kill, and hunting pressure in 1944 is shown in the following table.

<table>
<thead>
<tr>
<th>Region</th>
<th>Population</th>
<th>Kill</th>
<th>Hunters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ozark Mountain</td>
<td>11,375</td>
<td>532</td>
<td>6,422</td>
</tr>
<tr>
<td>Delta</td>
<td>8,485</td>
<td>228</td>
<td>2,485</td>
</tr>
<tr>
<td>Ouachita Mountain</td>
<td>6,225</td>
<td>397</td>
<td>2,795</td>
</tr>
<tr>
<td>Coastal Plains</td>
<td>7,480</td>
<td>399</td>
<td>2,298</td>
</tr>
<tr>
<td>Arkansas (total)</td>
<td>33,565</td>
<td>1,606</td>
<td>14,000</td>
</tr>
</tbody>
</table>

From this table it may be seen that the deer are somewhat evenly divided in the four major game regions of the State. Actually there are some deer in 66 of the 75 counties in the state although the bulk of the population is located in a few centers such as the herds in the Sylamore District (Stone and Baxter Counties), Desha & Chicot Counties, Grant, Dallas, Howard, Ashley, Perry and Polk Counties.

**Economic Importance**

The actual value of the deer in the state of Arkansas may be figured at the rate of $50.00 per head or a total of $1,678,250.00 (Actually, the deer purchased from the Sandhill Game Farm in Wisconsin cost us $60.00 per head). This is an increase of $1,628,250.00 over the original stock valued at $50,000 represented by 1,000 head of deer. Each year since 1927 we have been paid dividends in the form of sport and deer bagged.
Last year during the 12 day (1944) season of two periods (six days each) approximately 14,000 hunters went to the field in the pursuit of the Whitetail and bagged 1,606 deer valued at $80,300.00.

For the privilege of hunting each of the 13,800 resident sportsmen held a $1.50 hunting license and each of the 200 non-resident sportsmen possessed a $25.00 license. The sum total of these licenses was $25,700.00. This money is paid into the general game protection fund and used in maintaining and promoting our game restoration program.

The recreational and esthetic values of Arkansas' Whitetails cannot be overlooked. A hunter goes to the deer woods and feels rewarded if he gets sight of the animal.

Deer hunting as an outdoor sport is exhilarating, supplying exercise and escape to an army of sportsmen.

Indirectly, Arkansas benefits from the expenses incurred by the hunter in making his trip. He first procures a gun for which he must buy shells. To many sportsmen the proper attire is important so he fits himself in hunting clothes of special design. Then there's the "grub" to be bought for camp, and camping equipment plus operational expenses on his car. If he owns any of the 3,500 deer dogs in the state there will be dog food to buy. Guide service is engaged by a few who are not familiar with the country. Then there's the liquor bill too, which seems indispensable to a few. All in all, the average deer hunter spends at least $40.00 on his sport which enriches his fellow man by the same amount. Thus it may be figured that over $560,000.00 was spent by the Arkansas deer hunters in hunting deer last season.

Future of the Whitetail

And what of the future of deer hunting in Arkansas? There are approximately 33,744,000 acres of land in this State. Of this 75% is in forest of which approximately 16,000,000 acres represents either actual or potential deer range. This is enough territory for more than 320,000 Whitetails based on an estimate of only one deer to every fifty acres. This population would sustain a kill of at least 50,000 deer annually affording sport for more than 100,000 hunters.

An analysis of the economic significance of such potential deer population is shown in the table below:

| Table II |
|-----------------|-----------------|
| Stock Value:    | 320,000 deer @ 50.00 $16,000,000.00 |
| Annual Dividend| 50,000 deer @ 50.00 $2,500,000.00 |
| (Seasonal Kill) |                               |
| License fees paid to game protection fund |                               |
| (a) 95,000 resident licenses @ $1.50 | $142,500.00 |
| (b) 5,000 non-resident licenses @ $25.00 | $125,000.00 |
| Total License Sales | $267,500.00 |

Indirect Value to State through purchase of guns, shells, food, gas, hunting equipment, etc.: 100,000 hunters @ $40.00 per head $4,000,000.00
Is this actually possible? Permit me to refer to records compiled on the Sylamore herd which disclose a deer kill of 21 in 1927 and 463 in 1944 and an increase in the number of hunters from 80 in 1935 to 5,000 in 1944. The Sylamore district comprises a gross acreage of only about 170,000 acres. The deer herd in this district is estimated to number from 4,000 to 8,000. As indicated previously in this paper there are 16,000,000 acres of actual or potential deer range in the State.

As further evidence we need only to refer to the statistics presented by the States and recorded by the Fish and Wildlife Service in their research report #8 entitled, "Big Game Resources of the United States". From this report the following table is prepared showing whitetail deer population estimates and kill in leading deer states.

**Table III**

<table>
<thead>
<tr>
<th>State</th>
<th>Deer Population Estimate, 1942</th>
<th>Deer Kill - 1942</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pennsylvania</td>
<td>750,000</td>
<td>27,770</td>
</tr>
<tr>
<td>2. Michigan</td>
<td>734,000</td>
<td>75,736</td>
</tr>
<tr>
<td>3. Wisconsin</td>
<td>604,625</td>
<td>40,000</td>
</tr>
<tr>
<td>4. Minnesota</td>
<td>472,503</td>
<td>76,806</td>
</tr>
<tr>
<td>5. New York</td>
<td>300,060</td>
<td>13,740</td>
</tr>
</tbody>
</table>

The foundation of a great deer herd has been laid. Public cooperation is needed in the protection of the deer we now have. At the present rate of increase we may expect to achieve our objective of 320,000 deer by 1960.
FURTHER NOTES ON ARKANSAS PTERIDOPHYTES
Dwight M. Moore, University of Arkansas

Since the publication of the list of Arkansas Pteridophytes, several interesting collections have been made which will throw further light upon the Pteridophytes of Arkansas.

Pilularia americana A. Br. had been reported as having been collected near Ft. Smith in 1819. Herbarium sheets of this collection have been examined in the herbaria of the Missouri Botanical Garden and the Philadelphia Academy of Science. Since that time, it has apparently entirely escaped the eyes of collectors. Early in September, 1942, while the writer was investigating the vegetation of Pine Lake on Petit Jean Mountain, a large quantity of this obscure plant was discovered. The growth covered hundreds of square feet of what had been the bottom of shallow portions of this lake. At the time of discovery the lake level had been lowered 15 or 16 inches from the normal level, which exposed certain parts of the area covered by Pilularia, but left other portions still submerged. The first spot discovered was probably 5 x 30 feet in size, but continued observation disclosed many larger areas densely matted with this plant.

This discovery raises several interesting questions. How could such a large amount of this plant become so well established in the short period of five or six years since the lake was established? What were the means of translocation to this point? Where did it originate? Pine Lake was formed by the building of a dam in the recreation area in about 1935 or 1936. At the time of the collection here reported, typical aquatic vegetation had developed in all of the flooded areas, and zonation at the margins was quite evident. In his book, The Fern Allies of North America Clute states of Pilularia, "It is seldom found in standing water." Yet, in the present instance this plant had become well established in water more than one foot deep and became evident only when the level of the lake was lowered. This may be a clue to the reason the plant has escaped notice for so long a period here and elsewhere.

In the previous paper on Arkansas Pteridophyta, the Silvery Spleenwort (Athyrium thelypteroides (Michx.) Desv. was omitted from the Arkansas list because it was not supported by any authentic material. In the spring of 1942 the writer discovered a good colony of this attractive fern on Magazine Mountain, but it was too young to show fertile fronds. Later in the summer, however, collections of this fern in good fruiting condition were made. This, then, is one further addition to the list of Arkansas Pteridophytes.

Marsilea vestita, Hook & Grev., was previously reported from only one definite locality near Monticello. Since that time it has been reported by Dr. Delcie Demaree of Monticello A. & M. College, growing in considerable quantities in the vicinity of Arkansas Post, Arkansas County. In all probability this little plant may be found in many other similar localities in the southern part of the state.

Until recently, Equisetum arvense L. has been reported from only one small station in Washington County. More recently it has been reported by Dr. Demaree from St. Francis County, and the writer has found it along North Sylamore Creek in Stone County. It is surprising that this plant of such wide distribution elsewhere has not been discovered more generally in Arkansas.

Another fern, *Anchistea virginica* (L.) Presl, was reported by Nuttall (5) in "swamps of southern Arkansas", but at the time of publication of the previous list, collectors had failed to include any specimens in material studied. The writer had found no fruiting material and vegetative features were not sufficiently considered. During the last several years, this fern has been collected in good fruiting condition in several localities from Bog Springs, Polk County; Hot Springs, Garland County; Bryant, Saline County; and near Junction City in Union County.

Still another fern which has eluded collectors for the past quarter of a century or more is the Pinnatifid Spleenwort (*Asplenium pinnatifidum*, Nutt.). This had been reported by Lesquereux (4) and Harvey (6), as on "limestone cliffs, in northwest Arkansas", and some of their specimens may be found in some of the larger herbaria. This fern in almost all of its range is found on sandstone rather than limestone, and the report of its occurrence on limestone seemed incredible. About 1941, a collection made by Weldon Larimore on Pea Ridge was found to contain a specimen of this fern and a visit to that locality disclosed an abundance of the fern growing on the sandstone of the ridge above heavier strata of limestone. This station, then, confirms the presence of this species in Arkansas, but must lead to a change in the reported habitat in regard to type of cliffs.

While examining this station, an interesting specimen was found growing between plants of *A. pinnatifidum* and *A. platyneuron*. This specimen had some features resembling each of the other two species, suggesting the probable hybrid origin of this specimen. It was reported at the meeting of the American Fern Society in St. Louis, March 1946, and some discussion as to whether that specimen could be a hybrid between the two putative plants mentioned, or whether one parent was *Camptosorus rhizophyllus*. At the time of discovery, none of this latter species was observed within a half-mile of the station. Later, another plant bearing the same characters as the hybrid already mentioned was found at another station on Pea Ridge, also growing close to specimens of the two species of *Asplenium*. Again, there was no *Camptosorus rhizophyllus* nearer than 300 yards. This seems, then, to be a good specimen of a hybrid between *A. pinnatifidum* and *A. platyneuron*. On this assumption it may be included in the list of Arkansas Pteridophyta under the accepted name, Stotler's Spleenwort (*Asplenium stotleri*-Wherry). The report of these new stations confirms and enlarges previous reports and brings the total number of species, varieties, and hybrids of Arkansas Pteridophytes to 69.

References: