

one square foot openings. Short segments of 1/2 inch (I. D.) brass tubing were soldered at each corner of the frames to receive 3/8 inch iron "tee" pins (30 inches long) used in anchoring the nets. The net bags were 30 inches long and constructed of Nitex (trade mark of Tobler, Ernst and Trabor, Inc., New York) #253 with nylon taped seams. Bags were attached to frames with heavy muslin.

DISCUSSION

Adults of certain terrestrial and aquatic species not easily or frequently taken with conventional collecting gear were captured in these drift nets. These adult forms are accidentally introduced into flowing water and become a part of allochthonous drift. Most often such drift species are small, weak flying or apterous creatures, readily swept by water currents into the drift nets. Families containing diminutive species so collected are listed in Table I.

JOURNAL OF THE TENNESSEE ACADEMY OF SCIENCE

VOLUME 49, NUMBER 3, JULY, 1974

DISTRIBUTION OF CHIROPTERA IN WESTERN TENNESSEE

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ABSTRACT

A survey was conducted from April 1968 through January 1969 to determine the distribution of bats in western Tennessee, an area of approximately 11,000 square miles between the Mississippi and Tennessee Rivers. Twelve species representing seven genera were recorded. They were: *Myotis lucifugus*, *M. austroriparius*, *M. grisescens*, *M. keenii*, *M. sodalis*, *Lasiurus noctivagus*, *Pipistrellus subflavus*, *Eptesicus fuscus*, *Lasiurus borealis*, *L. cinereus*, *Nycticeius humeralis* and *Plecotus rafinesquii*.

INTRODUCTION

From April 1968 through January 1969 we conducted a survey of the Chiroptera of western Tennessee, an area of approximately 11,000 square miles including all or part of 21 counties between the Mississippi and Tennessee Rivers. We recorded 12 species of bats from the area. Prior to our study only four species had been reported from western Tennessee. Kellogg (1939) reported *Pipistrellus subflavus subflavus*, *Lasiurus borealis borealis*, and *Nycticeius humeralis humeralis* from Ben-

I feel the drift net method of collecting, herein described, can be used to advantage by entomologists. By having nets completely blocking a riffle and permitting the nets to remain in the riffle for longer periods, a greater quantity and variety of adult forms may be expected. Time in which the net may be employed for sampling is governed by the amount of stream detritus and vegetative material which clogs and reduces the efficiency of these nets. Net dimensions may be modified to fit individual needs; the device described herein is convenient to handle and effectively samples water depths in many riffles.

LITERATURE CITED

Waters, T. F. 1962. Diurnal periodicity in the drift of stream invertebrates. *Ecology* 43(2):316-320.

ton and Shelby Counties. Calhoun (1941) reported these same species from Obion County. Goodpaster and Hoffmeister (1952) reported *P. s. subflavus* from Lake and Obion Counties, *L. b. borealis* from Lake County, and *Corynorhinus macrotus* (= *Plecotus rafinesquii*) from Obion County. In addition, LaVal (1970) reported *Myotis austroriparius* from western Tennessee after Graves (1969). Localities for specimens collected by Graves are published for the first time in this paper. Prior to LaVal's paper there was only one published record of *M. austroriparius* from the entire state, a specimen collected from a cave in Grainger County in eastern Tennessee in 1911 (Bole, 1943). Lowery (1943), however, examined the specimen and asserted definitely that it was not *M. austroriparius*, but actually *M. lucifugus*.

MATERIALS AND METHODS

Our primary collecting technique was mist-netting over watercourses and stock ponds. Most of the collecting was done from early June through October 1968. Dates herein referred to occurred within that period unless otherwise indicated. Virtually all the ponds were in pastureland near human habitation, while watercourse sites were typically in secluded, forested areas and

varied in width from 15 to 60 ft. For the most part, ponds were netted from 3 June through 7 July, small watercourses (< 30 ft) from 27 June through 24 August, and larger watercourses from 14 August through 5 October. Nets were positioned with the lowest strand slightly above the water's surface and checked periodically between dusk and 2300-2400 hours. They were usually left up overnight. One to three nets per site were used at 16 pond and 34 watercourse sites. A few specimens were also collected with a shotgun, and, during the summer, abandoned buildings were examined for signs of bats. We attempted collections in all western Tennessee counties except Lake and Crockett. After collecting two or three individuals of a species from a site, we usually banded (#2 U. S. Fish and Wildlife Service aluminum bat bands) and released any additional individuals to possibly gain some knowledge of movements.

Although caves are numerous east of the study area in central and eastern Tennessee, only five caves, all in extreme eastern or southern Decatur County near the Tennessee River, have been reported from the study area (Barr, 1961). We checked these caves periodically and netted the entrances to three at least once each during the period of 27 June through 25 October.

We also incorporated into our study 158 specimens or records of specimens in the Memphis State University Museum of Zoology (MSUMZ). The Memphis Branch Laboratory (MBL) of the Tennessee Department of Public Health had donated approximately 150 specimens to the MSUMZ, most of which were kept and preserved in alcohol after identification. The exact collecting locality was unknown for some MBL bats and is listed herein as the appropriate county seat unless otherwise known. It is reasonable to assume that most MBL bats were collected in areas near human habitation. In this report, locations where only MBL bats were obtained are indicated by (*). Locations where MBL bats as well as other bats were captured are indicated by (**). We distinguished young bats on the basis of juvenile pelage and lack of noticeable toothwear. For specimens preserved in alcohol, we used size as the age criterion.

RESULTS AND DISCUSSION

Myotis lucifugus lucifugus (Le Conte): *Decatur Co.*, Featherfoot Cave, 1 mi. N. Perryville, 1. A male was netted on 29 August.

Myotis austroriparius (Rhoads): *Carroll Co.*, 5 mi. N. Huntingdon, 3, 6 mi. E. Milan, 3; *Chester Co.*, 4 mi. N. Enville, 1, 3 mi. N. Henderson 13; *Decatur Co.*, Featherfoot Cave, 1 mi. N. Perryville, 1; *Gibson Co.*, 1 mi. S. Eaton, 5, 1 mi. W. Humboldt, 2, 1/2 mi. E. Rutherford, 7; *Hardeman Co.*, 2 mi. E. Saulsbury, 2, 2 mi. SE Whiteville, 10; *Hardin Co.*, 2 mi. S. Shiloh, 1; *Haywood Co.*, 2 mi. N. Belle Eagle, 14; *Henderson Co.*, 5 mi. SW Chapel Hill, 7, Wildersville, 1; *Henry Co.*, 4 mi. NE Paris 3; *Lauderdale Co.*, 5 mi. W. Glimp, 4; *Madison Co.*, 1/2 mi. W. Jackson, 3; *McNairy Co.*, 10 mi. W. Ramer, 2; *Obion Co.*, Lasater's Corner, 5 mi. W. Hornbeak, 1; *Weakley Co.*, 5 mi. E. Greenfield, 7, 1 mi. N. Latham, 1.

Between 29 June and 26 October, we captured 35 male and 56 female *M. austroriparius* from 21 collecting sites in 14 of the 21 western Tennessee counties. LaVal (1967a) obtained a similar (35:53) ratio for this species in other parts of the southeastern United States. With the exception of one individual from Featherfoot Cave, all specimens were captured over watercourses in forested areas. Sites producing the greatest numbers of bats were over watercourses approximately 30 to 60 ft wide in bottomland hardwood forest. Unfortunately, this type of habitat was not sampled prior to 29 July; only seven *M. austrori-*

parius were taken before that date. The specimen from Featherfoot Cave was netted on 29 August. Seventeen adult males, 31 adult females, six young males, and one young female were kept as study specimens. The remainder, 12 males and 24 females, were banded and released; presumably they were all adults. The young were collected between 29 July and 5 August. A lactating female was taken on 8 July.

The high degree of color variation in this species has been analyzed by LaVal (1967b, 1970). In reporting on our data, he stated that "Graves (1969) found the same trends in sexual dimorphism that I noted farther to the south." These data are presented in Table 1, where collection of *M. austroriparius* is broken down into two time periods for temporal analysis of color variation. No bats of this species were collected in the intervening period.

TABLE 1: Numbers of MYOTIS AUSTRORIPARIUS examined by sex, color group, and capture period

Color Category	29 June-5 August		14 August-26 October	
	Male	Female	Male	Female
A & B	2	18 (2)*	1	0 (1)*
C & D	1	0	9 (9)*	5 (11)*
X	0	2	4 (1)*	6 (1)*

*Numbers in parentheses indicate additional bats in each category which were banded and released.

The color categories in this table are roughly equivalent to LaVal's. The additional X category corresponds to bats that had dorsal pelage coloration characteristics of categories C and D, but patches of ventral fur characteristic of categories A and B. The patches varied in size from about 1 cm² to the entire venter and suggested a seasonal molt. According to LaVal (1970) lighter categories of pelage coloration (A and B) may be due to a higher degree of bleaching in roosts with greater ammonia concentrations. If this is so, females would tend to be lighter than males if they had more communal roosting habits. LaVal (1970) reported females to be more colonial than males in Florida and Louisiana. After molting, all individuals would again have dark pelage. LaVal (1970) hypothesized that the time of molt in males and females is different, but our data do not support this hypothesis. All of our X category bats were collected from 31 July through 1 September, and the ratio of males to females was similar to that of our entire adult sample.

Myotis grisescens (Howell): *Decatur Co.*, Baugus Cave 1 mi. N. Jeannette, 1, Lick Creek, 1 mi. N. Jeannette, 1, 11 mi. S. Decaturville, 1, Featherfoot Cave, 1 mi. N. Perryville, 708, Swallow Bluff Cave, 4 mi. E. Saltillo, 1; *Hardeman Co.*, 2 mi. SE Whiteville, 1. A colony of this species was discovered in Featherfoot Cave, where we banded and released a total of

155 males and 533 females on 29 August and 1, 3, 14, and 15 September. Sex ratios remained relatively constant throughout this period. We estimated the population to be 3,500. The colony was inaccessible by day, emerging at dusk. No mass movements of *M. grisescens* into the cave were noted although such might have occurred in the early morning hours. Considerable transitory movement was suggested by the small number of recaptures. Only eight of the total 688 banded were recaptured at the cave. On 4 October the population was estimated to be 650 bats. Of approximately 150 individuals examined, 75% were males.

Movement from the cave was further demonstrated by recoveries of banded individuals at other localities all outside western Tennessee. Two males were captured at Alexander Cave, Perry County, Tennessee, on 19 September. Two females were recovered in the spring of 1969, one at Tobaccoport Cave, Stewart County, Tennessee, and one at Bellamy Cave, Montgomery County, Tennessee. Females were also recovered in Lawrenceburg, Lawrence County, Tennessee, on 28 April 1969, in northeastern Limestone County, Alabama, on 2 May 1969, near the Gunterville Lock and Dam on the Tennessee River in Marshall County, Alabama, on 11 May 1969, and at Blanchard Springs Caverns, Stone County, Arkansas, on 10 November 1972. Respective distances and directions to these localities are 23 mi. NE, 72 mi. N, 70 mi. NNE, 49 mi. SE, 80 mi. SE, 125 mi. SE, and 250 mi. WNW. A male taken from Featherfoot Cave on 4 October 1968 escaped at Memphis, Tennessee, during a celestial orientation experiment and was recovered in the vicinity of Featherfoot Cave on 18 March 1969, having returned a distance of 113 miles.

We captured three other *M. grisescens* over streams in wooded areas. One, a male, was captured in Hardeman County, approximately 50 miles from the nearest cave known to the authors. Another a lactating female, was taken on 21 July. Approximately 15 miles east of the study area, W. T. Lawhon, Jr. (1969), observed parturition in a cluster of this species in Alexander Cave, Perry County, Tennessee, on 3 June. Five hibernating individuals were found in western Tennessee caves during April and November.

Myotis keenii septentrionalis (Trouessart): Decatur Co., Baugus Cave, 1 mi. N. Jeannette, 1, Featherfoot Cave, 1 mi. N Perryville 3. All individuals collected were males. They were netted at Baugus Cave on 27 June and Featherfoot Cave on 1 and 3 September.

Myotis sodalis Miller and Allen: Shelby Co., Memphis*, 1. A male was collected on 26 September.

Lasiurus noctivagus (Le Conte): Shelby Co., Memphis*, 1. A male with large, scrotal testes was collected on 8 September 1967.

Pipistrellus subflavus subflavus (F. Cuvier): Carroll Co., 3 mi. N Yuma, 1; Chester Co., 1 mi. N Henderson, 1; Decatur Co., Baugus Cave 1 mi. N. Jeannette, 5, Featherfoot Cave, 1 mi. N Perryville, 16, River Cave, 1 mi. N Perryville, 1, Swallow Bluff Cave, 4

mi. E Saltillo, 3; Gibson Co., ½ mi. E Rutherford, 1; Haywood Co., 2 mi. N. Belle Eagle, 1; Henderson Co., 5 mi. SW Chapel Hill, 2; Shelby Co., Memphis*, 4; Tipton Co., Covington*, 1. Goodpaster and Hoffmeister (1952) reported this species as common in the Reelfoot Lake region of northwestern Tennessee. We took eight (three males, five females) torpid *P. s. subflavus* from four caves in early April. Four other inactive individuals were observed at that time and a hibernating male was taken in late November.

Only one *P. s. subflavus* was found in a cave during the summer and early autumn. However, we netted 13 males and two females at the entrance to Featherfoot Cave on 29 August and 1, 3, and 14 September. Of 10 males banded and released there on 1 and 3 September, none was recaptured, suggesting that these bats may have been transients. Four females and one male were netted over large watercourses in bottomland hardwood forest from 29 July through 19 September. One male was shot over a field in Carroll County.

Eptesicus fuscus fuscus (Palisot de Beauvois): Decatur Co., Featherfoot Cave, 1 mi. N Perryville, 8; Shelby Co., Memphis*, 3. Seven males, all with scrotal testes (9-10 mm), were netted at Featherfoot Cave on 29 August. While visiting this same cave on a warm night on 22 January, we heard faint, intermittent, high-pitched squeaks, which were traced to a slightly torpid female in a crevice a short distance from the entrance. Similar squeaks were heard from a vertical fissure in a nearby rock bluff. A short time later, active bats, presumably *E. f. fuscus*, were observed in nearby River Cave. MBL specimens were collected in August 1965 and August and September 1966.

Lasiurus borealis borealis (Müller): Benton Co., 4 mi. SE Holladay, 1; Carroll Co., 5 mi. N Huntingdon, 2, 6 mi. E Milan, 6; Chester Co., 1 mi. N Henderson, 2; Decatur Co., Featherfoot Cave, 1 mi. N Perryville, 2, Lick Creek, 1 mi. N. Jeannette, 15, 3 mi. S Jeannette, 1; Dyer Co., Dyersburg*, 1, 3 mi. W Fowlkes, 1, 8 mi. NW Newbern, 9; Fayette Co., Braden, 2, 2 mi. E Collierville, 3, Galloway, 3, 2 mi. NW Warren, 3; Gibson Co., 1 mi. S Eaton, 1, 1 mi. W Humboldt, 5, ½ mi. E Rutherford, 2; Hardin Co., Pickwick Dam Park, 1, 1½ mi. W Saltillo, 1; Haywood Co., 2 mi. N Belle Eagle, 2; Henderson Co., 5 mi. SW Chapel Hill, 15; Henry Co., 8 mi. N Cottage Grove, 8, 4 mi. NE Paris, 1; Lauderdale Co., 4 mi. W Central, 1, 3 mi. N Edith, 2, 5 mi. W Glimp, 3; McNairy Co. 10 mi. W Ramer, 1; Obion Co., 1 mi. W Elbridge, 1, 1 mi. W Hornbeak, 3; Shelby Co., 1 mi. NE Arlington, 1, Memphis**, 89, Shelby Forest State Park, 3, Millington*, 2; Tipton Co., Bride, 2, Covington*, 8, Garland, 1, Mason*, 1; Weakley Co., 5 mi. E Greenfield, 5, 1 mi. N Latham, 6.

We found this species to be the most common bat in western Tennessee. Forty-nine males and 66 females were captured at 39 localities from 6 June through 13 October. A few of these were netted at Featherfoot Cave or shot elsewhere. The remainder were netted over ponds and watercourses in open to

densely forested areas. We noted no particular habitat preference, although local concentrations were evident over watercourses in forested areas. The MBL furnished 88 specimens from Shelby County. On 6 June, we captured two females, each with three large fetuses. Seven lactating females were taken from that time through 8 July.

Lasiurus cinereus cinereus (Palisot de Beauvois): Dyer Co., Dyersburg*, 1; Shelby Co., Memphis**, 35. The MBL obtained a total of 34 bats of this species in 1965, 1966, 1967, and 1968 during the months of April, June, July, and August. We categorized five of these as young because of small size, indicating a resident summer population in western Tennessee. Young bats had a mean forearm length of 34.4 mm (21-48). The mean forearm length of three adult males was 51.33 mm (50-53), and for eight adult females 56.0 mm (53-58). Another adult individual was obtained from the side of a dwelling on 16 December.

Nycticeius humeralis humeralis (Rafinesque): Carroll Co., 5 mi. N Huntingdon, 1; Decatur Co., 10 mi. S Decaturville, 1; Dyer Co., Dyersburg*, 1; Hardeman Co., Bolivar*, 1; Hardin Co., ½ mi. W Saltillo, 1, 2 mi. S Shiloh, 2; Henderson Co., 5 mi. SW Chapel Hill, 2; Obion Co., 5 mi. W Hornbeak, 2; Shelby Co., Memphis*, 17, Millington*, 1; Tipton Co., Covington*, 1, 9 mi. SW Giltedge, 1. This species was captured from 9 July until 24 August. We netted nine males and one female, mostly over small streams in areas with sparse to dense forest cover. The female was lactating and was obtained on 9 July. Records of the MBL suggest that this species is more numerous in western Tennessee than indicated by field captures. That agency obtained 21 *N. h. humeralis* from 1965 through 1968. Thirteen of these were collected in the month of October, suggesting a fall migration.

Plecotus rafinesquii rafinesquii (Lesson): Gibson Co., 1 mi. S Eaton, 3; Obion Co., 1 mi. W Hornbeak, 2; Shelby Co., Memphis*, 1. We discovered three or four of these bats in the attic of a large vacant house atop a bluff in Obion County. A young male was taken by placing a mist net in the attic. A small mummified *P. r. rafinesquii* was found on the floor, indicating use of the site as a nursery colony. On 18 September, an adult male, an adult female, and a young male were netted almost simultaneously at 2000 over a 40 ft wide creek in bottomland and hardwood forest. The adult male had large, scrotal testes.

ACKNOWLEDGMENT

Appreciation is expressed to Dr(s). Alfred E. Perry, Wayne H. Davis, Donald F. Hoffmeister and George H. Lowery, Jr., for assistance in the identification of certain specimens and for use of valuable reference material and specimens. Appreciation is also extended to Mr. Claude M. Ward for advice on netting bats, to Mr. William M. Arnold, Jr., of the Tennessee Department of Public Health for furnishing valuable specimens, and to a number of graduate students who assisted in the field work. This work was supported in part by a grant from the Memphis State University Faculty Research Fund.

LITERATURE CITED

- Barr, T. C., Jr. 1961. Caves of Tennessee. Tennessee Dep. of Conserv. and Com., Geol. Div. Bull. 64. 567 p.
 Bole, B. P., Jr. 1943. *Myotis austroriparius* in Tennessee. J. Mamm. 24:403.
 Calhoun, J. B. 1941. Distribution and food habits of mammals in the vicinity of the Reelfoot Lake Biological Station. J. Tenn. Acad. Sci. 6:177-225.
 Goodpaster, W. W. and D. F. Hoffmeister. 1952. Notes on the mammals of western Tennessee. J. Mamm. 33:362-371.
 Graves, F. F., Jr. 1969. A survey of the Chiroptera of West Tennessee. Unpub. Thesis. Memphis State Univ., Memphis, Tennessee. 71 p.
 Kellogg, R. 1939. Annotated list of Tennessee mammals. Proc. U. S. Nat. Mus. 86:245-303.
 LaVal, R. K. 1967a. Records of bats from the southeastern United States, J. Mamm. 48:645-648.
 ———. 1967b. Intraspecific variation, life history, and distribution of the bat *Myotis austroriparius* (Rhoads). Unpub. Thesis. Louisiana State Univ., Baton Rouge. 76 p.
 ———. 1970. Intraspecific relationships of bats of the species *Myotis austroriparius*. J. Mamm. 51:542-552.
 Lawhon, W. T., Jr. 1969. Ecology of Alexander Cave, Perry County, Tennessee. Unpub. Thesis. Memphis State Univ., Memphis, Tennessee. 33 p.
 Lowery, G. H., Jr. 1943. Check-list of the mammals of Louisiana and adjacent waters. Occas. Papers Mus. Zool., Louisiana State Univ. 13:213-257.

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BOOK REVIEW

Biology, A Search for Order in Complexity. Developed by the Creation Research Society. Editors: Moore, John N. and Slusher, Harold Schultz. Zondervan Publishing House, Grand Rapids, Michigan. 1970. Reviewed by Arthur W. Jones, Professor of Zoology, The University of Tennessee, Knoxville.

The probability that this book is the only published work that would be considered suitable for use in the public schools in the states of Tennessee, Georgia, Washington, and others, under recent anti-evolution laws, requires a close look at this unusual book. While it may have escaped notice when it was published, perhaps having been dismissed as merely another in the tiresome series of "creationist" tracts, it now merits serious attention from high school and college teachers alike. The former may be forced to use it, and the latter will be attempting to teach science to students who have been exposed to its curious view of science and reality.

A look at the introduction and table of contents gives the impression that "Biology, a Search", etc. is organized much as any other modern general text might be, with suitable consideration of the origins and nature of biological science, "chemical perspectives", "the continuity of life", the kinds of organisms, human biology, "theories of biological change", ecology and conservation. Indeed, there are well planned illustrations and well-written if somewhat out of date descriptions of the forms of life and the processes within living things. The text is admirably produced, with careful attention to chapter and section headings, pronunciation aids for unusual words, and art work that is in the main simple and informative. Presumably this excellence of form is due to the expertise of the publisher and to the careful work of the committee of twenty persons, many of them Ph.D's, who, according to the editors, labored "faithfully and willingly" without expectation of financial return.

The significance of the book is not in its form, however attractive, but in the philosophy that it propagates. The preface (by Henry M. Morris, President, Creation Research Society) frankly states, "There are essentially only two basic philosophies of origins among modern biologists—the doctrine of evolution and the doctrine of special creation. The former postulates the gradual development of the various forms of life and of life itself by natural processes over vast ages of time. The latter assumes the essentially instantaneous origin of life and of the major kinds of living organisms by special creative processes utilized directly by the Creator Himself (sic)". Further: "There . . . exists today a significant body of biologists and other scientists who are convinced that special creation provides a more reasonable and satisfying philosophy of origins than evolution. Many of these men (sic) are members of the Creation Research Society, an organization of approximately 350 scientists (with at least the M.S. degree, and representing most of the disciplines in the physical and biological sciences) dedicated to research and publication in support of creation versus evolution as the most likely explanation of origins."

Because the majority of modern biologists "prefer the evolutionary philosophy", the preface continues, there is "an effective monopoly of evolutionist opinion in modern textbooks", and a consequent need for "an introductory biology textbook that will both serve effectively in teaching the actual facts of biologic science and will also acknowledge the creation concept as the most acceptable underlying explanation of these facts." And, in describing the actual text, "it is explicit throughout the text that the most reasonable explanation for the actual facts of biology as they are known scientifically is that of Biblical creationism." In short, the preface announces the two purposes for which the book is intended: to teach biology and to defend creationism.

The authors have attempted to carry out both purposes.

The first, teaching the facts of biology, is done effectively at a level which, I suppose, can be described as "applied". As an example of the significance of biological science, applied entomology is used in the book's first section. Atomic and molecular concepts are then introduced, with a brief description of energy-releasing systems. Classical genetics is covered, I think quite well, and is followed by a "Supplement" discussing gene action, DNA structure, etc. Embryology is briefly treated. The living world is surveyed next, in seven rather detailed chapters. Then follows "The Biology of Man", in general a quite interesting exposition of human physiology and anatomy. The section on human reproduction seems quaintly modest; perhaps this is necessary in high school biology, but I hope not! Chapters 21 through 25 are under the heading "Theories of Biological Change". As might be expected, this section is incredibly wrong-headed from most biologists' point of view, for it consists of a thoroughgoing attack on the theory of evolution. The titles of its various sections are revealing: "Failures of Darwinian Theory"; "Lack of Fossil Evidence to Support Evolution"; "Methods of Fossil Dating Inconclusive"; "Fossils in 'Wrong' Locations"; "Search and Discovery of 'Early Man'; plus eight pages of 'Problems for Evolutionists'".

The authors' second purpose, acknowledging "the creation concept as the most acceptable underlying explanation" of the facts of biology, is attempted throughout the book. At every opportunity the incompleteness of knowledge is proclaimed as evidence that further understanding is possible only in terms of divine creation. There are by my count 130 separate references (in 19 of the book's 27 chapters) to God, the creative process, supernatural or miraculous events, and such mysterious things as vital forces behind and beyond the living process. If "acknowledging" a concept is proof, then the book proves its religious point over and over again.

But actually, in my opinion, the authors fail completely to support Biblical Creationism, let alone show that it is "the most reasonable explanation" for the actual facts of biology. No real arguments for creationism are presented.

On the contrary, an illogical method is followed. It has been said that the mental vice to which we are

most prone is the habit of believing that the weakness of one of two competing theories is evidence of the strength of the other. This is the basic fallacy of most of the anti-evolution propaganda. The latter is therefore not an argument in favor of creationism, but one which relies on the weaknesses of evolution theory (which, of course, really has weaknesses) to support divine creation. (Evolutionists sometimes make the same logical error, of course. Darrow's ridicule of Bryan's naive fundamentalist view of the Bible, in a famous trial, has been admired as a defense of science, which, I believe, it was not. Scientific theories do not rise or fall because of the reasonableness or naivete of religious beliefs.) Nowhere in the text reviewed have I found either a description or a definition, let alone a reasonable explanation, of creation.

The fallacious "mental vice" persists as a thread of illogic throughout most of the book. It appears first in a treatment of the uncertainty of scientific conclusions. After a rather clear restatement of the meaning of "hypothesis", "theory", and "law" in science, the authors discuss assumptions in science (pp 6-7). The assumption used as an example is "uniformity". Uniformity as a principle is praised as dependable, here and now, and "as far back as we have human records". And without the general reliability of this assumption, the authors continue, "there could be no science". But the surprising conclusion reached is that "it is logical to maintain that exceptions (to uniformity of process) could occur, especially in the distant past or distant future. The regular course of nature is not a 'god' to be worshiped. Creationists believe that the universe has undergone different phases of change throughout its past."

The treatment of gene action provides another example of the "mental vice". The authors give an admirably lucid description (pp 105-115) of the development of the Watson-Crick model and the concept involved in the breaking of the genetic code, and seem on the verge of celebrating the triumph of modern cytogenetics. Yet there follows a "Critique of the DNA concept" which asks a number of rhetorical questions. Concerning the hydrogen bonds connecting the DNA strands, for example, "Just why should this rather unusual bonding be possible?" "What gives the nitrogen and oxygen atoms this unusual power?" Further, "The same observations can be made for thousands of reactions going on in the cell that *greatly* (italics theirs) exceed the usual qualities of the atoms and molecules themselves." "Why should uracil be so uniquely valuable for RNA when chemically it is so very similar to thymine except for the CH₃ radical?" After several other such questions (addressed to a rather naive reader, the student, and, hence, unanswerably impressive) the authors conclude: "It would seem more plausible to believe that DNA and its product RNA are merely the *agents* (italics theirs) of the organism, used by it just as it uses oxygen for release of energy, and water for maintaining solutions." (Yes, teleology has been embraced in an earlier section!) While the organism as master of its physiology is not the same as God, the Creator of life, the pattern of reasoning is the same as

elsewhere in the text. Unanswered questions lead to the supernatural.

In science as most of us think of it, of course, unanswered questions lead to research! The conflict between science and religion (or at least the Creation Research Society's idea of religion) emerges in this text as an attack on the very nature of scientific inquiry. The great problems of biology, the nature of gene action, the intricacies of animal and human behavior, the history, and hence a major part of the nature, of life itself, are each presented as intellectual puzzles which the scientist cannot hope to solve. Research is praised for being practical, but denigrated when it presumes to touch fundamental questions.

For what is such a book suitable?

As an individual whose experience with protagonists of fundamentalism has been somewhat discouraging (I have been an active opponent of anti-evolution laws ever since I came to Tennessee in 1945), I do not feel qualified to say what kind of book would be good for teaching fundamentalism. I don't believe, however, that this book would do. Its presentation of creation as an undefined, undescribed belief, totally unsupported by any kind of scientific evidence, would tend, I should think, to make unbelievers out of the faithful. Only by propagating in students the same illogic that the authors exhibit, insisting that errors in one theory make another theory acceptable, could this book succeed in its missionary function. In my opinion, the Creator would be better off without such help as this book attempts to give!

Is it then more suitable as a science text than as a religious tract? I am on sounder ground here, having studied and taught biology for many (!) years. I think this book would tend to close young minds to the true nature of science. It emphasizes the limitation of research, much in the spirit of earlier attitudes that held back scientific progress by insisting on the perfect completeness of Aristotelian biology. It exaggerates the difficulties of interpreting biological phenomena, invoking vitalism as the supernatural (hence, inexplicable) cause of metabolism, gene action, etc. It lists "Problems for Evolutionists", including the supposed absence of evidence of any beneficial mutations, the difficulties of describing in detail the evolution of the vertebrate eye, the problem of the origin of life, the lack of transitional forms between major groups (gaps in the fossil record, missing links, etc.) and the uniqueness of human conscience! Such difficulties, it states, can be resolved only by Creationistic belief. As an example of scientific theory it cites the humoral theory of disease, which, it states, caused George Washington's death through therapeutic bleeding. Wisely, the authors say this was a "wrong theory". Perhaps this use of a wrong theory as an example has teaching value; but I can think of several "right theories" that might have been mentioned by authors even moderately sympathetic to scientific inquiry.

Scientists, like theories, are often wrong. Yet the frequent criticism of scientists in this book suggests that the scientist, already limited by the arbitrary boundaries mentioned above, is also restricted more than most

people by frailties of human nature, such as arrogance, bias in favor of one's own theories, and speculation beyond the limits set by evidence. For instance, p. 8: "Scientists are only men, and often they have not carried out each step (in investigation) faithfully. In gathering data they may rule out facts that point to an undesired conclusion, judging that those facts have no bearing. For instance, in searching for the 'origin' of man, an atheist might say that any fact that might support the concept of divine creation has no bearing on the subject. Another source of error is the affection a scientist naturally engenders for his own hypothesis, destroying his objective attitude toward it. Or he may announce his results prematurely to get ahead of another scientist." This section goes on to discuss objectivity ("they are often far from being objective") and "fads in science" which influence scientists as "'ruling' or prevalent ideas of their time". The above is part of Chapter 1, "The Scientist and His Methods". Elsewhere in the book various groups of scientists are characterized pejoratively. For instance, p 115: "Some molecular biologists in their enthusiasm would have us believe that *all activity* (italics theirs) of organisms, and this includes human beings, is directed by the order of nucleotides in the DNA". And, p 433: "too often evolutionists have assumed that which they attempt to prove" or, p 424: "Evolutionists have given attention to aspects of embryonic development to piece together data favorable to their argument without considering the phenomenon of development as an integrated whole". Naturally, I suppose, the faults of evolutionists would in such a book as this be given more attention than those of other scientists. But the authors seem to have created an image of the scientist in general as all too human, biased, blinded by opportunism and more often than not the victim of his own faulty logic. Thus by implication, the student is turned away from biology and biologist as career or career model, respectively.

I suppose it is unnecessary in a review of a fundamentalist text to dwell on the treatment of evolution. Certainly the authors are right in saying that the majority of biologists view evolution with favor. The naive student, reading this assertion, then finding in the section on evolution no mention of the strengths of evolution theory, only its real and imagined weaknesses, would conclude, I should think, that the majority of biologists, to believe in such a theory, must indeed be foolish, or dishonest, or gulled by propagandists. Belief

in creation would not follow, but mistrust of the scientist would surely be enhanced.

This is an unsuitable book. Yet I recommend that the book be read by teachers. We should realize that there is such a book, and that the writers and publisher produced it in the hope that it would be widely used. Reading it ourselves, before it is adopted by school boards under Fundamentalist pressure, or by State Textbook Commissions forced by law to select it, will give us the stimulus we need to oppose religious indoctrination in the name of science, and scientific obscurantism in the name of religion.

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