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# PHYSIOLOGIC HOMEOSTASIS OF BIRDS

BY GARY C. PACKARD

Physiologic homeostasis is often interpreted as meaning the regulative control of major parameters of body fluids (for example, temperature, osmotic pressure, and pH) within narrow limits by active, interacting—sometimes opposing—physiologic factors. Although this definition may be useful when applied to dogs and cats, the animals for which it originally was intended (Cannon, 1939), it certainly does not always apply, especially to birds. First of all, variation in the internal environment is as characteristic of some birds as control of the internal environment within narrow limits is of others. And second, adaptation of some birds to stressful situations has apparently been achieved in part through increased tolerance of tissues and cells to fluctuations in the internal environment. In the following paragraphs I will give a few examples to support my contention that homeostasis need not imply constancy of the internal environment and, also, that the term need not imply active physiologic regulation.

Available data indicate that a physiologic characteristic shared by most birds is the ability to tolerate a temporary state of hyperthermia (an increased body temperature that is caused by "storing" heat internally) (Dawson and Schmidt-Nielsen, 1964). Techniques of radio telemetry may soon show that this tolerance of temporary hyperthermia is an important adaptation to flight (when accumulation of metabolic heat may proceed faster than dissipation of heat), but at the present time hyperthermia appears to be important to survival mainly in birds living in hot environments.

Physiologic problems relating to heat and water often are two sides of the same coin. When desert birds such as Abert Towhees (*Pipilo aberti*) or California and Gambel quail (*Lophortyx californicus* and *L. gambelii*) are exposed to ambient temperatures of 40°C (104°F), body temperatures increase several degrees above the normal resting levels (40–42°C). These birds apparently have the ability to dissipate heat by evaporation from the respiratory tract by panting, but elimination of heat by evaporation is physiologically expensive in terms of water loss. Consequently, tolerance of a "heat load" (and the associated hyperthermia) can be regarded as a means of conserving water by transfering the burden of heat dissipation from evaporative mechanisms to radiation and conduction of heat from the body surface (Schmidt-Nielsen, 1964). This kind of adaptation has been most studied in large mammals such as the camel, but the principle involved may apply equally well to birds. When water is not readily available, the camel experiences daily cycles of body temperature having an amplitude of as much as 6°C. During daylight hours, the camel's body temperature slowly rises to a maximum of 40–41°C in the afternoon, and at night heat is lost from the general body surface (by radiation and conduction) until the body temperature falls to 34–35° just before dawn. The tremendous heat load taken on during the hot part of the day enables the camel to conserve water that otherwise would be lost as perspiration. Thus, water reserves may be adequate to allow survival of a camel for 17 days on the waterless desert (Schmidt-Nielsen, 1964).

If comparing the physiologic problems of desert birds and mammals adds to our understanding of homeostasis of birds, a consideration of arctic endotherms might also be profitable. Scholander *et al.* (1950) have shown that temperature regulation in cold by resting husky dogs (and other large mammals) is effected primarily by increasing the effectiveness of the insulation by erecting the hair (and thereby increasing the thickness of the already dense fur). During periods of activity when output of metabolic heat increases, the heavy insulation tends to impede rapid dissipation of heat to the environment. The consequence is a temporary state of hyperthermia (Johansen, 1962). Thus, further studies of arctic birds may show that tolerance of temporary hyperthermia is important to their survival through periods of activity, even in the cold of the arctic winter.

The nightly torpor of hummingbirds and the seasonal hibernation of Poor-wills (*Phalaenoptilus nuttallii*) are examples of the most pronounced variations in avian body temperatures. Body temperatures of torpid Poor-wills have often been recorded as low as 5–10°C (normal, 42°) (King and Farner, 1964).

In any case, survival of drastic fluctuations in body temperature must have its basis in reduced sensitivity of structural proteins and enzyme systems to temperature variations of this magnitude; other biologic systems would experience a denaturing of proteins or some interruption of metabolic pathways under the same conditions.

Hibernal torpor of the Poor-will leads again to speculation regarding similarities between mammals and birds. During hibernation, small mammals like ground squirrels (*Spermophilus* spp.) and bats (Vespertilionidae) show an increase in the plasma levels of important electrolytes such as magnesium (and perhaps potassium) (Riedesel, 1960). This may indicate active regulation of *intra*-cellular conditions by the cells, or it may indicate increased tolerance of the cells to alterations in cytoplasmic ions. Although the biologic import of these fluctuations is not yet clear, it is entirely possible that similar fluctuations will be found to be characteristic of hibernating birds.

Poulson and Bartholomew (1962) have recently studied osmotic and ionic regulation in Savannah Sparrows (*Passerculus sandwichensis*). Certain populations of this species are resident in salt marshes along the California coast, whereas other populations breed in riparian situations adjacent to fresh water. Interestingly, salt marsh Savannah Sparrows are able to survive with only sea water to drink, and additionally, these sparrows are able to produce a much more concentrated urine than other birds produce. Linked to this capacity is an ability to tolerate elevated levels of plasma chloride and increased blood osmotic pressure. Salt marsh sparrows can withstand serum chloride levels of 185 to 215 mEq per liter and serum osmotic pressures of 490 to 610 mOs; Savannah Sparrows from fresh water habitats can tolerate only 175 mEq of chloride per liter and osmotic pressures not exceeding 400 mOs.

Tolerance of relatively large fluctuations in serum concentrations of potassium ions and in blood pH seems to be an adaptation to diving in ducks (and other diving birds?). For the duration of a dive the peripheral tissues of a duck are subjected to transient anaerobiosis. (Anaerobiosis refers to cellular metabolism in the absence of oxygen.) Changes in the circulatory system inhibit blood flow to and from peripheral tissues, and oxygenated blood is directed to the heart and central nervous system. Under such conditions sugars are incompletely oxidized in peripheral tissues, and an intermediate substance, lactate, accumulates in the cells. Following emergence from a dive, blood pH may drop from 7.5 to 7.0 as the circulatory shunts are removed and lactate is flushed out of peripheral cells and into the general circulation. (A change of pH of this magnitude is lethal to man.) At the same time that pH decreases, the serum concentration of potassium may increase by a factor of 2.5 (Andersen, 1964).

These examples are sufficient to indicate that a rigid interpretation of the term *homeostasis* is not possible. Instead, homeostasis must be taken to mean *the maintenance of the internal environment (both intra- and extra-cellular) within limits conducive to the survival of the organism.* This may be achieved either by active physiologic regulation of the intra-cellular or extra-cellular environment, or by increased tolerance of cells to alterations in their internal composition. Thus, as Bartholomew has noted (1964: 9), as long as an organism is alive, "it is the example *par excellence* of the phenomenon of homeostatis."

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*The Museum of Natural History, The University of Kansas, Lawrence, Kansas, 25 October 1965.*


**A Comparison of Foods Eaten by Eastern Kingbirds and Western Kingbirds in Kansas.**—The three large flycatchers, the Eastern Kingbird (*Tyrannus tyrannus*), the Western Kingbird (*T. verticalis*), and the Scissor-tailed Flycatcher (*Muscivora forficata*), share largely congruent ranges in Kansas. The niche-preferences of these species are not identical (personal observation), but there appears to be considerable overlap, and the over-all distributional and ecological similarities of the species, coupled with their similarities of structure and behavior, would seem likely to lead to significant interspecific competition. But, interaction leading to aggression is rare, if it occurs at all, and this rarity indicates that there must be differential reliances on the available habitat among them. In other groups of birds, where different, closely-related species were seemingly in competition for environmental resources, it has been shown that certain behavioral, structural, or ecological differences separate them (for example, see: Lack, *Darwin's Finches* (Cambridge Univ. Press), 1947; MacArthur, Ecology, 39, 1958:599–619; Brewer, Auk, 80, 1963:9–47; and in the Tyrannidae, Lanyon, Condor, 63, 1961:421–449; and, Hespenheide, Wilson Bull., 76, 1964:265–281). We therefore expect that such a separation may occur in the kingbirds.

In order to shed some light on the relationships of these species, kingbirds (including *Muscivora*) were collected at random in Kansas from areas where they were common. The stomachs of these birds were subsequently analyzed to obtain comparative data on the food items taken by these species. A sample was taken 7½ miles north of Elkhart, Morton County, in southwestern Kansas, from 11 to 14 July 1964; 22 birds (9 *T. tyrannus*, 11 *T. verticalis*, and 2 *Muscivora*) were collected from open riparian cottonwood woodland there. These birds are in the Museum of Natural History at The University of Kansas, and bear the catalog numbers: KU 45540–45549, 45551–45563. A second sample was taken from Lawrence, Douglas County, in northeastern Kansas, from 16 to 20 July 1965; 31 birds (17 *T. tyrannus* and 14 *T. verticalis*) were collected on consecutive days from 8:00 a.m. to 9:00 a.m. from various edge and open-country habitats in the vicinity of Lawrence, and bear the catalog numbers: KU 48056–48086. Percentages of food-items (arthropods) in the stomachs of the birds mentioned above are listed in Table 1; 115 arthropods were in the stomachs of the sample from Morton County, and 147 were in the birds from Douglas County.

TABLE 1

ARTHROPODS IN STOMACHS OF KINGBIRDS FROM KANSAS

| Insect Order | Morton County | | | Douglas County | |
|---|---|---|---|---|---|
| | *T. tyrannus* (N* = 9) | *T. verticalis* (N = 11) | *M. forficata* (N = 2) | *T. tyrannus* (N = 17) | *T. verticalis* (N = 14) |
| Coleoptera | 48.8 | 29.5 | 15.4 | 57.8 | 88.2 |
| Diptera | 9.8 | 1.6 | 0 | 2.2 | 2.0 |
| Hymenoptera | 31.7 | 45.9 | 61.5 | 22.2 | 2.9 |
| Hemiptera | 0 | 4.9 | 7.7 | 2.2 | 0 |
| Orthoptera | 4.9 | 8.2 | 7.7 | 0 | 3.9 |
| Odonata | 4.9 | 4.9 | 7.7 | 2.2 | 0 |
| Lepidoptera | 0 | 3.3 | 0 | 11.1 | 1.0 |
| unidentified | 0 | 1.6 | 0 | 0 | 2.0 |
| Arachnid | 0 | 0 | 0 | 2.2 | 0 |
| Total | 100.1 | 99.9 | 100.0 | 99.9 | 100.0 |

* Number of specimens examined.

Quantitative differences in foods taken by the Eastern and Western kingbirds are shown by Table 1. These differences are especially evident in the relative percentages of Coleoptera, Hymenoptera, and Lepidoptera taken. The Scissor-tailed Flycatcher also appears to show a distinct pattern, but the sample taken is too small to be conclusive. There are at least three possible explanations for these observed differences: (1) different foods are preferred and consquently selected by the different species; (2) the species forage in different manners and therefore sample different species of insects; (3) the species forage in and/or occupy different parts of the available habitat and that the differences in the foods taken thus reflect a difference in the available insect fauna. Neither of the first two explanations is supported by our observations on the birds' behavior: both species of kingbirds seem to forage indiscriminately on all insects of suitable size, hawking them on the wing, or picking them off of the ground. Furthermore, while certain relative quantitative differences are clear within one locality, there is little correlation of these between localities; if certain types of foods were preferred by one species of kingbird over the other, this would seem to hold true from all localities. Eastern Kingbirds took more coleopterans, for example, in Morton County than did Western Kingbirds (48.7 *versus* 29.5 per cent), whereas in Douglas County Western Kingbirds took more coleopterans than did Eastern Kingbirds (88.2 *versus* 57.8 per cent). Hence, we postulate that the Eastern and Western kingbirds do indeed occupy and forage in significantly different parts of the general habitat, and thus reduce direct competition for food by consuming somewhat different portions of the available insects.—JAMES A. DICK AND JAMES D. RISING, *Museum of Natural History, The University of Kansas, Lawrence, Kansas, 2 October 1965.*

**A Summer Specimen of the Wright Flycatcher (*Empidonax oberholseri*) From Western Kansas.**—On 22 June 1965, while John E. Rising and I were collecting along the Smoky Hill River, 14 miles west and 18 miles south of WaKeeney, Trego County, Kansas, John shot a female Wright (Dusky) Flycatcher (*Empidonax ober-*

*holseri*). The specimen is in The University of Kansas Museum of Natural History, and bears the catalog number, KU 49246.

Her skull was fully ossified, and she weighed 11.8 grams, had little fat, and had recently ovulated (at least three ruptured follicles, about two weeks old, were visible). In Idaho, Wright Flycatchers start nesting by mid-June (Bent, *Life Histories of North American Flycatchers, Larks, Swallows, and Their Allies* (Bull. 179, U. S. Nat. Mus.), 1942:235); in South Dakota, Wright Flycatchers are in breeding condition by 11 June (Pettingill and Whitney, *Birds of the Black Hills* (Spec. Publ. No. 1, Cornell Lab. Ornith.), 1965:60). Hence, it is reasonable to assume that this individual had laid a clutch by mid-June. The Wright Flycatcher, although breeding in the montane west, selects broad-leaved trees for nest-sites (see Bent, and Pettingill and Whitney, *op. cit.*). The present specimen was shot from the lower branches of a cottonwood tree (*Populus deltoides*) along the edge of an open cottonwood grove, roughly 25 feet from a fringe of schrub willows (*Salix* sp.) bordering the Smoky Hill River. Although this bird probably was merely a post-breeding wanderer whose nesting effort had failed, its apparent physiological condition, and the general configuration of the habitat, suggest that this Wright Flycatcher bred in western Kansas.

Graber and Graber (Trans. Kansas Acad. Sci., 54, 1951:157) took three specimens of the Wright Flycatcher, 8 miles south of Richfield in Morton County, the southwesternmost county in Kansas, 8 and 12 May 1950; these are the only previous records of this species for the state (Johnston, *Directory to the Bird-life of Kansas* (Misc. Publ. No. 23, Univ. Kansas Mus. Nat. Hist.), 1960:37). I thank Dr. Ned K. Johnson who kindly checked the identity of the specimen. My field work in the summer of 1965 was partially supported by grants from the Frank M. Chapman Memorial Fund of the American Museum of Natural History, and the Kansas Academy of Science.—JAMES D. RISING, *Museum of Natural History, The University of Kansas, Lawrence, Kansas, 2 October 1965.*

**Distributional Notes on Birds From Western Kansas.**—In the summer of 1965, I observed and collected birds along the Cimarron, Arkansas, Smoky Hill, and Republican river systems in western Kansas. Although I was working primarily on various species of birds known to hybridize in western Kansas, certain other observations made in this time variously clarify or extend our knowledge of the distribution of birds in western Kansas as summarized in the *Directory to the Bird-life of Kansas* (Johnston, 1960), and *The Breeding Birds of Kansas* (Johnston, 1964). Field work was done under the auspices of The University of Kansas; all specimens taken are in the Museum of Natural History of that institution. John E. Rising and James A. Dick accompanied me at various times in the summer, and I thank them for their assistance. I express my gratitude also to the many citizens of Kansas who kindly let me camp and hunt on their lands. My field work during the summer of 1965 was supported partially by grants from the Frank M. Chapman Memorial Fund of the American Museum of National History, and The Kansas Academy of Science.

ACCOUNTS OF SPECIES

Turkey: *Meleagris gallopavo* Linnaeus.—According to Johnston (1964:610–611) Turkeys, presumably derived from stocks introduced in Oklahoma, are found in south-central Kansas, but he gives no nesting record for Kansas. Mary Einsel of Wilmore, Kansas, and Ron Beeley of Coldwater, Kansas (pers. comm.) tell me that Turkeys are seen regularly along Mule Creek in eastern Comanche County. Twice in the third week of August, 1965, Mr. Beeley saw two adult (presumably a pair) and seven or eight young Turkeys, 7 miles north and ½ mile east of Sitka, Clark County. Marie Swisher (*in litt.*) of Coldwater, wrote that Weldon Trummel of Wilmore found a hen with five young near Mule Creek early in the summer of 1965. In the previous year, Trummel had seen as many as 30 Turkeys along the creek. One of Mrs. Swisher's students, Mary Rhodes of Protection, Kansas, saw a Turkey nest in Comanche County (exact locality not available) that contained nine eggs on 16 May 1965. This nest, originally located by Ralph Sanders, was on the ground in a wheat field. Mrs. Swisher further related that she frequently sees small numbers of Turkeys on the road between Coldwater and Protection. On 6 June 1965, I saw one Turkey, 8 miles east and 9 miles south of Ashland, Clark County, as it was walking in brush near a cottonwood-tamarisk woodland along the Cimarron River. The above observations constitute good evidence that Turkeys are now established and nesting in Clark and Comanche counties. I especially thank Mrs. Swisher and Mr. Beeley for telling me of their observations.

Chimney Swift: *Chaetura pelagica* (Linnaeus).—Johnston (1964:619) calls the Chimney Swift a common resident in eastern Kansas; however, the western limits of breeding for the state seem to be poorly known (see Johnston, 1960:32). I saw Chimney Swifts as far west as Scott City, Scott County (23 June); Garden City, Finney County (16 June); Hugoton, Stevens County (11 June).

Chuck-will's-widow: *Caprimulgus carolinensis* Gmelin.—On the night of 6 June, I heard at least three male Chuck-will's-widows calling from mixed, mesic cottonwood-tamarisk woodlands in the flood-plain of the Cimarron River, 8 miles east and 9 miles south of Ashland, Clark County. A breeding female was taken there the following morning. This species was not previously known to occur or breed west of Shawnee, Greenwood, Stafford and Sedgwick counties in Kansas (Johnston, 1964:618). Specimen (1): ♀, KU 49243, largest follicle about 2 mm., oviduct somewhat enlarged, no fat, 104.5 gm.

Ash-throated Flycatcher: *Myiarchus cinerascens* (Lawrence).—A male Ash-throated Flycatcher was taken 8 June, 19 miles south and 2 miles west of Meade, Meade County. The three previous records of this species from Kansas are all from Morton County, the southwesternmost county in the state (Graber and Graber, 1954:156, and Rising and Kilgore, 1964:24). This specimen thus extends eastwards our knowledge of the distribution of this species in Kansas. Dr. George M. Sutton wrote me that the Ash-throated Flycatcher is not uncommon in western Oklahoma, where it frequently occurs, as the Meade County specimen did, in the same woodlands as the Great Crested Flycatcher (*M. crinitus*). Specimen (1): ♂, KU 49250, testis 10 × 6 mm., little fat, 28.5 gm.

Traill Flycatcher: *Empidonax traillii* (Audubon).—A male Traill Flycatcher was taken 8 June, 21 miles south of Meade, Kansas, in Beaver County, Oklahoma. This species occurs in summer, and is known to breed, in extreme northeastern Kansas (Johnston, 1964:624–625), and it probably breeds in Cherokee County, in southeastern Kansas (Rising, 1965:12). The present specimen was not in definite breeding condition, but the date on which it was taken, and the size of the testis (5 × 3 mm.) indicate that it might have been a nesting bird. Specimen (1): ♂, KU 49245, testis 5 × 3 mm., little fat, 16.2 gm.

Eastern Wood Pewee: *Contopus virens* (Linnaeus).—Barlow and Rising (1965:14–16) have recently discussed the status of *Contopus* in southwestern Kansas. A singing male (KU 49249), *C. virens* by song, was taken on 11 June, 7½ miles north of Elkhart, Morton County, from an area where previous specimens of *Contopus* have been taken (KU 45567–8). This individual, the first heard singing in western Kansas, resembles *C. virens* both in coloration and in dimensions (wing, 83.7 mm.). A second specimen (KU 49248) was taken 27 June, 3 miles north of Sharon Springs, Wallace County; this bird seems intermediate in coloration between *C. virens* and the Western Wood Pewee, *C. sordidulus*; the length of the wing (86.7 mm.) indicates that it might be best referred to the latter species. Specimens (2): ♂, KU 49248, testis 3 × 2 mm., moderate fat, 15.9 gm.; ♂, KU 49249, testis 9 × 5 mm., little fat, 13.8 gm.

Carolina Chickadee: *Parus carolinensis* Latham.—According to Johnston (1964:631), Carolina Chickadees are found west to Comanche County, and breed as far west as Barber and Montgomery counties. I found this species to be common in riparian brush along the Cimarron River in southwestern Comanche County, and in adjacent southeastern Clark County, and took two specimens (KU 49264–5) on 7 June, 8 miles east and 9 miles south of Ashland, Clark County, and one specimen

(KU 49266) on 7 June, 10 miles south of Protection, Comanche County. The degree of ossification of the skulls of the two specimens from Clark County indicates that they were birds of the year; this, along with their abundance there, strongly indicates that this species breeds in Clark County. Specimens (3): ♀, KU 49264, ovary small, little fat, 10.5 gm.; ♀, KU 49265, ovary small, little fat, 11.5 gm.; ♂, KU 49266, testis $4 \times 3$ mm., little fat, 11.0 gm.

Swainson Thrush: *Hylocichla ustulata* (Nuttall).—A Swainson Thrush was heard singing on the morning of 7 June, 8 miles east and 9 miles south of Ashland, Clark County. This is a notably late date for this species in Kansas (Johnston, 1960:45); however, Rising (1965:13) took a specimen on 4 June, in Cherokee County.

Gray-cheeked Thrush: *Hylocichla minima* (Lafresnaye).—I took a Gray-cheeked Thrush on 15 June, 1 mile southwest of Coolidge, Hamilton County, Kansas, and saw individuals of this species near Hugoton, Stevens County (10 June), and near Sharon Springs, Wallace County (27 June). These are notably late dates of occurrence for this species in Kansas (Johnston, 1960:45). Specimen (1): ♂, KU 49268, testis $10 \times 6$ mm., moderate fat, 33.6 gm.

Blue-gray Gnatcatcher: *Polioptila caerulea* (Linnaeus).—According to Johnston (1964:635) gnatcatchers nest commonly in eastern Kansas; his records were from stations east of Riley and Cowley counties. I found gnatcatchers in Grant, Morton, Finney, Ford, Logan, and Wallace counties in the summer of 1965, and took a specimen (KU 49272) from Wagon Bed Springs, 12 miles south of Ulysses, Grant County (10 June), and a breeding pair (KU 49270–1) from 7½ miles north of Elkhart, Morton County (11 June). These birds were in open, dry cottonwood woodlands with sparse understory, although this species generally prefers more mesic areas in eastern Kansas. Specimens (3): ♂, KU 49270, testis $7 \times 5$ mm., little fat, 6.9 gm.; ♀, KU 49271, ruptured follicles, brood patch, little fat, 6.9 gm.; ♂, KU 49272, testis $6 \times 5$ mm., moderate fat, 6.4 gm.

Baird Sparrow: *Ammodramus bairdii* (Audubon).—Johnston (1960:61–62) mentions only five known specimens of the Baird Sparrow from Kansas. Five additional specimens were obtained from a tower kill on the morning of 11 September 1964, from beneath the KLOE-TV tower in Goodland, Sherman County. These birds were all in juvenal plumage. Specimens (5): ♀, KU 46366, ovary inactive, skull not completely ossified (snco), little fat, 16.2 gm.; sex = ?, KU 46367, snco, moderate fat, 16.3 gm.; ♀, KU 46368, ovary inactive, snco, moderate fat, 16.0 gm.; sex = ?, KU 46369, snco, moderate fat, 17.0 gm.; ♂, KU 46370, testis 1 mm., heavy fat, 18.2 gm.

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JAMES D. RISING, *Museum of Natural History, The University of Kansas, Lawrence, Kansas, 25 October 1965.*

**Louisiana Waterthrush Nest in Riley County, Kansas.**—Johnston (*The Breeding Birds of Kansas* (Univ. Kansas Publ. Mus. Nat. Hist.), 1964:639) lists the Louisiana Waterthrush (*Seiurus motacilla*) as an uncommon summer resident in eastern Kansas, and gives breeding records from Douglas, Miami, Linn, Crawford, and Decatur counties, noting that eggs are laid in May and June. On 18 May 1963, Richel Englund, Elizabeth Fisher, Roberta Foote, Rose Thorpe, Emma Thompson and Joyce Thompson visited the R. P. Barry farm in southeastern Riley County, approximately one mile north of Interstate 70 in the Deep Creek Valley. While walking along the creek, Joyce Thompson noticed a pair of waterthrushes carrying food into a dark grotto-like opening in the east bank. This discovery was reported to me, and upon visiting the Barry farm on 19 May, I found the nest.

The stream near the grotto was shallow and I enjoyed the pleasant rippling sound it made as it slipped along its rocky bed. Both of the adult waterthrushes soon appeared and spent a good part of their foraging time exploring riffles near the larger stones in the stream, although they disappeared into the woods at irregular intervals. The grotto was formed at a point where a small drainage channel had broken through the east bank of Deep Creek. This erosive current had cut an elliptical basin with the bottom elevation slightly below the opening to the creek, and provided a small tea-colored seepage pool. The walls of the basin were somewhat concave with an overhanging mat of rootlets at the rim and larger roots trailing down along the sides. Over this basin the surrounding vegetation had formed a dense canopy, completing the grotto and filtering the sun's rays to a soft twilight. On the south wall of this grotto, two feet above the pool and four feet east of the opening, the waterthrushes had constructed their leafy nest among the hanging roots. A mat of mud-caked brown leaves marked an obscure path up the wall to the nest which contained two nestlings apparently about eight days old.

The nest site was similar to those described by Forbush and May (*Natural History of the Birds of Eastern and Central North America* (Houghton Mifflin Co.), 1939: 446) and by Griscom and Sprunt (*The Warblers of North America* (Devin-Adair Co.), 1957:198–200) for the Louisiana Waterthrush. It seems likely that many of the rocky streams flowing through wooded areas in central and eastern Kansas provide suitable habitat, and a careful search of such areas may eventually lead to a more complete definition of the nesting range of the Louisiana Waterthrush in Kansas.—ORVILLE O. RICE, *1663 W. 28th St. Terrace, Topeka, Kansas, 30 November 1965.*

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