

A Patternless Phase of the Copperhead*

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In the course of a ten-year study 1279 copperheads (*Agkistrodon contortrix mokeson*) have been examined from the University of Kansas Natural History Reservation, a 590-acre tract in the northeastern corner of Douglas County, Kansas, along with many others from nearby areas in the same and adjoining counties. Some attention has been directed to the amount of individual variation in pattern. The chestnut "hourglass" markings vary in shape, in number and in deviation from symmetry between left and right sides, to such an extent that their arrangement provides a valuable check on the identity of recaptured individuals marked by scale clipping. Color also varies, but color differences between individuals are in part secondary sexual characters and also result from ontogenetic changes and the different stages in the molt cycle.

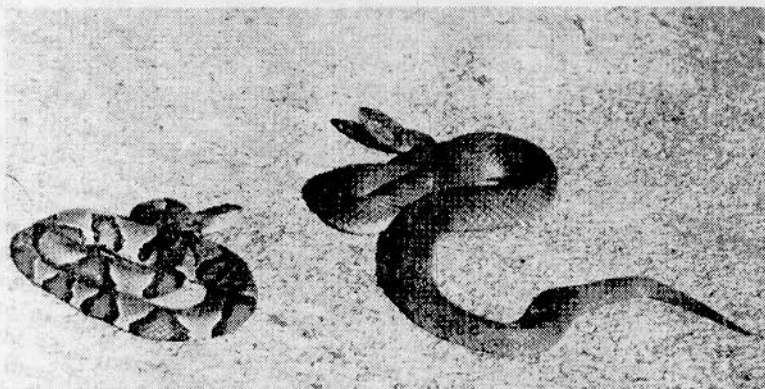


Fig. 1. Patternless adult male copperhead and normal adult female.

Although there is some variation in color and pattern, the general appearance is much the same in different individuals; to one familiar with the species, ordinarily each snake is immediately recognizable as a copperhead and as a member of the northern subspecies, noticeably different in appearance from the southern subspecies *contortrix* or the southwestern subspecies *laticinctus*. However, from time to time, individuals that were extraordinarily different in appearance were encountered. On September 22, 1957, a female of normal appearance gave birth to four young; two females of normal appearance and two patternless males of uniform dull brown. In all characters other than pattern, these two individuals seemed to be normal. They were kept in captivity and force fed with strips of raw beef. They thrived on this diet. However, on one occasion when they were nearly a year old, after a routine feeding was completed and the second snake was returned to the container, the other, irritable as usual after handling, struck it just behind the eye. Almost immediately the bitten snake showed signs of distress, and in less than a

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minute it collapsed. After a few minutes of slow, spasmodic writhing, on its sides or back, it died.

On July 20, 1958, a third patternless male copperhead was found alive in a funnel trap. This individual was probably near ten months old at the time of its capture (since the young are born in early fall), but its length (280 mm.) was not much greater than that of normal individuals at the time of birth. On September 8, 1958, another female of normal pattern produced a litter of five young (three males and two females) all normal except for one patternless male.

On September 28, 1958, a patternless adult male was trapped at a hibernation ledge; a normal adult female was in the same trap with him. In this adult male the appearance was like that of the four young seen previously. In all, the ground color, both dorsally and ventrally, was that of a normal copperhead; a buffy brown with grayish suffusion, but the darker markings that normally occur on this background were totally lacking. It lacked the characteristic facial mask, consisting of a narrow, hairpin shaped dark streak with a whitish inner margin, running from the eye back to the lower temporal region and looping behind the angle of the mouth to pass anteriorly along the side of the lower jaw.

The capture site of the adult male was only 150 feet from the site where the patternless young was trapped two months earlier. An individual copperhead usually stays within a home range of only a few acres. Therefore this patternless young (or its mother) may have been sired by the patternless adult. The other two litters with patternless young born in captivity, were probably not derived from him. One of the gravid females was caught 4300 feet, the other 3000 feet, from the capture site of the male, and these females were some 1600 feet apart. Therefore it is most probable that the sires were different, and that the genetic factors causing the patternless condition are scattered throughout the local population.

The area within which the patternless phase occurs is probably small, otherwise the patternless snakes would have been noticed before by the many collectors from the University of Kansas who have found copperheads in various localities in Douglas County. Vernon Mann of La Cygne, Kansas, approximately 50 miles south-southeast of the Reservation, has collected several thousand copperheads in that vicinity, but has never seen a patternless individual.

The copperhead's normal pattern is highly adapted to camouflage the snake against its normal background of leaf litter in the forest. Without the ruptive effect of the normal markings the snake would be far more conspicuous against its normal background. The snake might then be handicapped in the ambushing of prey by which copperheads normally hunt. Also, the snake might be made more vulnerable to predators. The ratio of four newborn young (of three litters) to one adult among the patternless snakes suggests that most of them are soon eliminated by natural selection and that the normal pattern is favored. Among copperheads born in captivity (approximately 80 per cent males) the patternless phase appeared in three of 323 individuals and two of 61 litters and it appeared in one of 127 first-year young (90 of them males) found in the field. But it appeared only once in the 829 older young and adults (including 490 males) among which six or seven occurrences might have

been expected if the patternless young were found in their true ratio to normal young, and if the numbers of patternless individuals were not reduced more rapidly than the normal individuals in later life.

Although these figures suggest that the patternless copperheads may be eliminated at six or seven times the rate of their normal counterparts, lack of pattern may be advantageous under some circumstances. In leaf litter the varying shades of brown, and the contrasting pattern of light and shadow on the curled leaf surfaces produce a background against which the copperhead's normal pattern harmonizes. However, on the Reservation, the population of copperheads disperses into varied habitats in summer, and the snakes may live in tall grass not associated with woodland. The mat of dead grass at ground level is a dull grayish brown, approximating the color of the patternless snakes and perhaps providing a favorable background for their concealment. Also, the outcrops of limestone which are common on the Reservation and throughout much of northeastern Kansas, are generally grayish brown and might similarly provide a favorable background for the patternless snakes, depending on the stratum of origin of the rock, and the prevalence of lichen growths on its surface.

Such an abrupt change in pattern in a population on the margin of the range might conceivably open the way for invasion of a new habitat and partial separation from the parent type and eventually, the differentiation of a new form. This has actually occurred in the common water snake (*Natrix sipedon*), similar to the copperhead in both pattern and coloration. The Lake Erie subspecies (*N. s. insularum*) is in the process of losing its cross-bands and attaining a dull uniform brown much like that of the patternless copperhead—a color concealing it effectively on the rocky shoreline where it is usually found. Evidently several genes are involved in the water snake and varying degrees of intermediacy between the patternless and the normally cross-banded snakes may be found in individuals of the several island populations. Camin, Triplehorn and Walters (1954, Nat. Hist. Misc., 131: 1-3) have shown that in the young, the ratios of banded to patternless individuals are markedly higher than in the adults, indicating intensive selection against the normal type. Gulls are thought to be the chief predators.

Gloyd (1958, Bull. Chicago Acad. Sci., 10 (12): 186-187) described and figured an aberrantly patterned copperhead from Atherton, Jackson County, Missouri, approximately 50 miles east of the Reservation. It was a juvenile male, found with two normally patterned females that were suspected to be a parent and a litter mate. In this male the hourglass markings were developed only on the anterior and posterior ends of the body. For more than half the length of the body in its mid-section, the dark chestnut markings that normally have an hourglass shape were fused to form a broad longitudinal band on each side, with an intervening mid-dorsal area of the pale ground color forming a stripe approximately equal in width to each of the lateral stripes. The tail was normally banded. Livezey (1949, Herpetologica, 5(4): 93) described a specimen from Walker County, Texas, which might be interpreted as showing an incipient tendency toward the same type of pattern. Many of its cross-bands failed to meet dorsally, but some were confluent on the lower part of one side to form a lateral band. Mr. George A. McDuffie kindly presented me

with a lantern slide, in color, of a copperhead with still another aberrant type of pattern. This individual, from central Ohio, was partly melanistic. On the body the markings were partly obscured by the dark pigment, but the head was suffused with reddish pigment, contrasting sharply with the more somber color of the body.

Nothing is known of the incidence of occurrence of these several abnormalities, or whether they represent isolated occurrences. On the Reservation the incidence and nature of the "patternless" gene is in part revealed by the data already accumulated. Obviously the gene is recessive since phenotypically normal females produce both patternless young and those of normal appearance in the same litter. That all five of the known patternless individuals are males might be due to chance and the fact that males are more numerous (in approximately a 3:1 ratio at birth). If the patternless individuals can be explained simply as the possessors of a homozygous recessive gene, the gene possibly occurs in from one-fifth to one-sixth of the entire population locally. More probably, sex-linkage is involved, with the gene expressing itself in the phenotype of the male because he has only one X chromosome, and lacks a dominant masking allele. Inheritance probably would follow the pattern of such classic examples as color-blindness or hemophilia in man. Four types of matings involving the patternless gene would be possible. A patternless male mating with a normal female would produce offspring all of normal appearance but half the females would be heterozygous carriers of the patternless gene. A normal male mating with a heterozygous female (of normal appearance) would produce females all phenotypically normal but half heterozygous and males half of which would be normal and half patternless. Matings between individuals both of which carried the patternless genes would be much rarer; patternless parents would produce only patternless offspring, and a patternless male with a heterozygous female would produce young half patternless and half phenotypically normal in each sex. Of the phenotypically normal young the females would be heterozygous and the males normal. If this hypothesis is the correct one, as many as one-thirtieth of the local population may be carrying the patternless gene according to the data from females (two of 62), or as few as one eighty-fourth on the basis of records of the first-year males (four of 349).

Actually the sample is too small for a reliable estimate of the ratio of patternless individuals. Also, mating is probably not random. The tendency to stay within a small area and return to the same vicinity along the rock ledges for hibernation would promote matings between near relatives and this inbreeding would result in frequent phenotypic expression of recessive genes.

An incidental result of the occurrence of patternless copperheads may be added hazard to humans. Several persons to whom the captive patternless copperheads were shown, reacted with consternation and said that in the field they might have failed to recognize such a snake as venomous and might have undertaken to catch or handle it, without realizing the danger.

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