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THE SUBSPECIES OF THE RIDGE-NOSED RATTLESNAKE, CROTALUS WILLARDI

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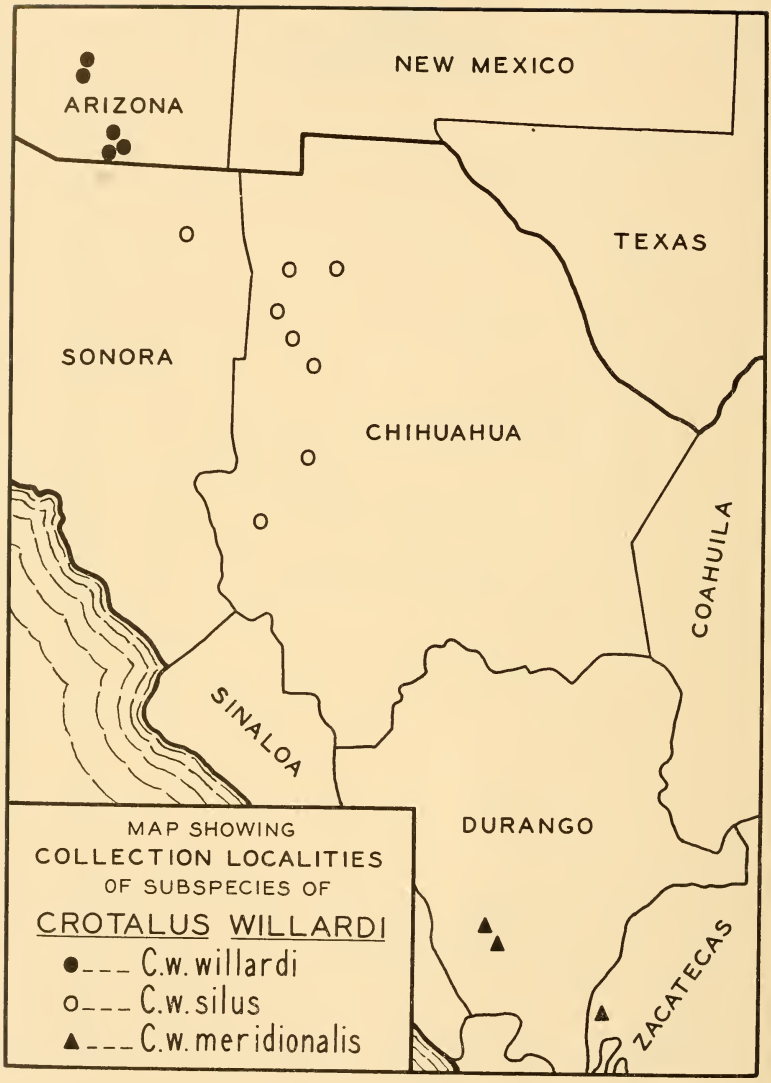
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The small, montane rattlesnake *Crotalus willardi* inhabits the ranges of the Sierra Madre Occidental, from the Santa Rita and Huachuca mountains of southeastern Arizona, southeasterly to southern Durango and western Zacatecas in central Mexico. It is a well-differentiated species, characterized, as its common name implies, by having an upturned ridge on the snout, a feature unique among the rattlesnakes. Other distinctive features of the species are dorsal blotches that, although well separated by light interspaces, merge with the ground color laterally; a tail partly blotched and partly striped; subcaudals that are white-edged where they contact the lateral scales; sharply pointed posterior scales feathering over the proximal rattle; and dark, decidedly rounded rattles. Viewed from above, the snout is particularly sharp.

With the availability of more specimens, it has become apparent that the central and southern populations of *C. willardi* are sufficiently different to deserve subspecific recognition. Curiously enough, the southern and northern races differ from the intermediate race in pattern more than they do from each other. In addition to describing the new subspecies, I shall redefine the typical (northern) subspecies as newly delimited.

Crotalus willardi willardi Meek

ARIZONA RIDGE-NOSED RATTLESNAKE

Plate 8, fig. 1.

1905. *Crotalus willardi* Meek, Field Columbian Mus., pub. 104; Zoöl. Ser., vol. 7, no. 1, p. 18.

Type Specimen.—No. 902 in the collection of the Field Museum (now the Chicago Natural History Museum). Collected by Frank C. Willard above Hamburg, in the middle branch of Ramsey Canyon, Huachuca Mountains (altitude about 7000 ft.), Cochise County, Arizona. Meek originally reported the type locality as Tombstone, Cochise County, but Swarth (1921, p. 83), on the basis of data secured from Willard, made the correction here accepted.

Diagnosis.—*Crotalus willardi willardi* usually has 25 scale rows while the other subspecies normally have 27. It has fewer body blotches than *meridion-*

alis; also more ventrals, fewer subcaudals, and a proportionately shorter tail. It differs from *silus* in having a conspicuous vertical light line on the rostral and mental, together with other head marks that *silus* lacks.

Material.—This description of the typical subspecies is based on 24 specimens, including the type; there are 11 males and 13 females. All were collected in the Huachuca and Santa Rita mountains of southeastern Arizona.

Description of the Subspecies.—This is a small rattlesnake characterized by having sharply uptilted internasals, and, to a less extent, raised anterior canthals, these forming the ridge bordering the snout that gives the snake its name.

The largest specimen that I have seen is a male 593 mm. (23¼ in.) long, collected by C. F. Kauffeld in Ramsey Canyon at 6800 ft. Three recently born young, 189 to 193 mm. (about 7½ in.) long, indicate the approximate size at birth. In adult males the tail length averages 10.2 per cent of the length over-all, and in the mature females 8.0 per cent. The head in the adults is about 5.2 per cent of the length over-all.

Most specimens have 25 scale rows at mid-body; 3 out of 24 have 27, and one has 26. The complete scale row formula is usually 29–25–19. The middorsal rows are keeled, but the lowest 3 rows on either side are smooth.

The ventrals in the males vary from 147 to 154, with a mean of 151.0; and the females from 152 to 159, with an average of 154.8. The subcaudals in the males range from 25 to 28, mean 27.2; and in the females from 21 to 25, mean 22.7.

The crown is definitely concave in well-preserved specimens, and the rostral slants backward below. The rostral is higher than wide, and does not curve backward above as it does in most rattlers. The two internasals are sharply creased transversely; their forward halves turn upward at right-angles with the top of the head, to form a ridge (fig. 2). The anterior canthals are also upturned, but to a lesser degree. The posterior canthals carry the ridge rearward in some specimens, but in others they are almost flat. The uptilted snout, accentuated by the internasal-canthal ridge, consistently serves to distinguish the subspecies of *willardi* from all other rattlesnakes. Also, when viewed from above, the snout is more pointed than in other species. The scales on the crown in the internasal-prefrontal area are quite small, numbering from 20 to 40; those of the frontal and prefrontal areas are not separated by a suture. The supraoculars are by far the largest scales on top of the head. The least number of scales between the supraoculars varies from 6 to 9. On the sides of the head the scales are of types common to many rattlers. The prenasal contacts the first supralabial in all specimens. The loreals may number 1 or 2, but the upper preocular does not contact the postnasal. There are at least 2 scales between the supralabials and the orbit. The preoculars are undivided, and neither divided first infralabials, intergenials nor submentals are present. The supralabials vary from 12 to 15, average 13.6, and the infralabials from 12 to 16, average 13.6.

Crotalus w. willardi is a small, brownish rattlesnake, notable for the lack of lateral borders of the dorsal blotches and the conspicuous light marks on

the head. A white line, arising at the internasals, passes downward and backward across the nostril, the lower preocular, and the last 5 or 6 upper labials, to the angle of the mouth. This stripe is occasionally bordered by black dots and widens posteriorly. Above it there is a brown bar, somewhat darker than the ground color of the head, that passes from the eye to a point above the last supralabial. The upper edge of this dark bar is bordered by a light line that is almost obsolete in many specimens; in none is it as conspicuous or definite as the lower light line first mentioned. On the center of the rostral there is a vertical white line which, on reaching the lip, splits, to pass backward along the lower edges of the first 5 or 6 supralabials on each side. A similar vertical light line on the mental widens across the inner ends of the first infralabials, and continues, ever widening, across the genials and gulars, so that the entire lower surface of the head is light, except for a brown ellipse on either side, anteriorly, and a second pair of dark marks engaging the posterior infralabials and the adjacent gulars. (These blotches are less punctated in *w. willardi* than in *meridionalis*.) The brown areas of the head are often bordered by black dots, and the brown color itself results from dense stippling in various shades of brown. The top of the head is liberally sprinkled with irregular black dots.

Dorsally, the body of the snake is brown, marked by a series of blotches that are separated by clearly outlined light interspaces, usually buff in color. These interspaces are accentuated middorsally but not laterally; on the sides the dorsal blotches merge without a break into the brownish ground color. The dorsal blotches are darkened where they approach the interspaces, the inner borders being quite dark-brown or even black. The shading from these dark edges back toward the blotch centers, is gradual, resembling color applied with an air brush. The dorsal blotches are about 5 to 8 scales long (end to end); the interspaces are only one scale wide. The color contrast between blotches and interspaces sharpens posteriorly. Lateral secondary blotches are seldom evident, except for an irregular row of about three times the number in the dorsal series marking the lowest lateral scale rows. Scattered about over the body, both dorsally and laterally, are many dark-brown or black dots. The ventrum is buff, heavily spotted or mottled with dark-brown or black. These markings become denser posteriorly.

The body blotches of the main series vary in number from 20 to 25, with an average of 21.8. As the tails are partly ringed and partly striped, the count of the rings has little significance.

Anteriorly the tail is crossed by from 1 to 3 crossbands similar to those on the body; posteriorly it is grayish, with a darker longitudinal line along the top. Spots and punctations are considerably in evidence. The outer edges of the lowest lateral rows of scales and of the subcaudals are light gray or even white.

The rattle matrix is brown or red-brown, often spotted with dark-brown or even black. The rattles themselves are darker than in most other rattlesnakes, and have a notably rounded conformation. The dorsal scales that

feather out over the proximal rattle are particularly pointed. The rattles of the adults average 6.5 mm. in width, but may occasionally reach 7 mm.

The hemipenes exhibit no peculiarities when compared with those of other rattlesnakes. The spines on the shoulders are short and heavy, and the transition to reticulations quite sudden, as in all members of the genus *Crotalus* except *C. lepidus*. A few small spines are present within the crotch.

Well-preserved specimens from the Santa Rita Mountains are too few to allow it to be determined whether they differ significantly from those of the Huachucas. The Santa Rita snakes may be slightly grayer. There are no differences in squamation.

Range.—Thus far this subspecies has been collected only in the Huachuca and Santa Rita mountains of southeastern Arizona. The specific localities follow: Huachuca Mountains in Cochise County: Ramsey Canyon at 6500, 6800 and 7000 (Hamburg Mine), and 7500 feet; Carr Canyon (head of canyon at 7500 feet); also reported from Post Canyon, but no specimen available. Santa Rita Mountains in Santa Cruz and Pima counties: Mount Baldy at 8000 feet (also at the head of Temporal Gulch on Mount Baldy, Santa Cruz County); Madera (also known as White House) Canyon at 9000 feet, Pima County; has been reported in Florida (or Florita) Canyon (either Santa Cruz or Pima County) but no specimen available.

Crotalus willardi silus subsp. nov.

Chihuahua Ridge-nosed Rattlesnake

1917. *Crotalus willardi* (part) Stejneger and Barbour, Check List of North American Amph. and Rept., [ed. 1], p. 111.

Type Specimen.—No. 46694 in the collection of the Museum of Vertebrate Zoölogy of the University of California. Collected August 13, 1948, by R. McCabe, on the Río Gavilán, 7 miles southwest of Pacheco, Chihuahua, Mexico, altitude 6200 ft.

Diagnosis.—A subspecies differing from the other two in not having a prominent vertical light line on the rostral or mental; other characteristic head marks are also absent. This subspecies usually has 27 scale rows while *w. willardi* normally has 25. *Crotalus w. silus* has more ventrals than *meridionalis*, and more subcaudals and a proportionately longer tail than *w. willardi*.

Description of the Type.—An adult male. The length over-all is 636 mm., and the tail length 67 mm.; ratio .105. The head measures 32.3 mm.; ratio .051.

The scale rows number 31–27–21, with 10 at the middle of the tail. The scales are moderately keeled middorsally; the 3 lowest rows on either side are smooth. Paired apical scale pits are faintly evident on some scales. The ventrals number 158 and the subcaudals 32, the last 6 of which are divided. The anal is entire. The supralabials number 15—15 and the infralabials 14—15. The first infralabials are undivided, and there are neither intergenials nor submentals. The rostral is higher than wide and is contacted by 9 scales:

paired first supralabials, prenasals, and internasals, a granule on each side at the supralabial-prenasal-rostral junction, and one on the right at the prenasal-internasal-rostral junction. The larger scales on the sides of the head comprise pre- and postnasals, 2 loreals, and upper and lower preoculars, the latter, as usual, thin and crescentic. There are 2 to 3 scales between labials and orbit. The scales on top of the head comprise a pair of sharply upturned internasals and, on each side, 3 canthals, of which the anteriormost is somewhat upturned to extend the ridge that characterizes this species. The scales on the crown are quite small, numbering about 40 anterior to the front edges of the supraoculars. There are 9+10 scales between the supraoculars. The mental is triangular. The first infralabials meet on the median line. Behind them 3 infralabials contact the genials on either side.

The rattles, of which there is an incomplete string of 7, measure 6.5 mm. across. They are dark-brown and have the rounded form characteristic of this species. The final scales on the tail are pointed and, as in the other *willardi* subspecies, feather out over the proximal rattle to a greater degree than in other rattlesnakes.

The head is brown on top, turning to dark-gray on the sides. Much of the color is applied by stippling, but there are also some larger black dots. The last 5 or 6 supralabials are lighter, with fewer punctations. The infralabials are punctated with gray, as are also the genials and the adjacent gulars.

The body pattern comprises a series of 25 round dorsal blotches on a brown background. The blotch limits are well defined only middorsally, for on the sides they merge into the ground color. Middorsally the interspaces are buff or light-brown, edged with irregular black spots. Posteriorly the middorsal light interspaces become more even and contrasting. No auxiliary lateral blotches are evident. The entire body is irregularly speckled with black or dark-brown dots. The lower surface is buff, heavily mottled with brown, especially toward the outer edges of the ventrals, and with more clouding evident posteriorly. The tail, anteriorly, is marked with two blotches like those on the body; posteriorly, it is unicolor, brown on top, changing to gray on the sides. At the junction of the lowest scale row with the subcaudals, the scales are edged with white. The undersurface is pinkish, mottled with brown.

Paratypes.—In addition to the type, 25 other specimens have been available, of which 13 are males, 9 females, and 3 indeterminate skins. Eight were from Sonora and the rest from Chihuahua. The paratypic series includes the following specimens: MZUM 78449-55*, MCZ 36889, MVZ 46692-3, 46695-6, USNM 26593, 42496-7, 42709, 46322-6, Prof. D. D. Brand 3 unnumbered.

Description of the Subspecies.—The following description is based on all available specimens, including the type. *Crotalus w. silus* is a small snake; the largest out of 26 is a male (the type) only 636 mm. (25 in.) in length. This specimen somewhat exceeds the longest *C. w. willardi*, which is 593 mm. (23¼ in.). The smallest juvenile measures 184 mm. (7¼ in.). A gravid female

* There are two small specimens under the single number 78455.

containing well-developed embryos is 452 mm. (17¾ in.) long. The tail length of adult males averages 11.0 per cent of the length over-all, and in the adult females 9.1 per cent. The head is about 5.1 per cent of the length over-all in adults.

Out of 25 specimens, 16 have 27 scale rows at mid-body, 7 have 25, and 2 have 26. The usual scale-row formula is 29–27–19, with 9 or 10 at the middle of the tail. The dorsal rows are keeled, but the 2 or 3 lowest rows on either side are smooth. Paired apical scale pits are faintly evident on some scales.

The ventrals in the males range from 149 to 158, with a mean of 153.2; and in the females from 154 to 159, with a mean of 156.9. The subcaudals in the males vary from 29 to 35, average 30.9; and in the females from 25 to 30, average 26.8.

The top of the head is concave, due to the tilting up of the internasals and first canthals, and sometimes the second canthals as well. Except for the supraoculars, all scales on the crown are quite small, the minimum number across the frontal area varying from 6 to 10. The scales on the side of the head have no outstanding peculiarities. Usually there are 2 loreals. The upper preoculars are not split. There is often an extra scale at the rostral-prenasal-supralabial junction. There are 2 to 3 scales between the supralabials and the orbit. Submentals and intergenials are absent and the first infralabials are undivided. The infralabials vary from 13 to 16, average 14.1; and the infralabials from 13 to 15, average 14.1.

The head marks in *C. w. silus* are much less conspicuous than in *C. w. willardi* or *C. w. meridionalis*. The top of the head is brown, spotted irregularly, especially toward the snout, with dark-brown or black dots. An ocular dark band varying from dark-brown to speckled gray begins at the eye and runs backward and downward to a point above the last supralabial. The upper edge of this dark band is not definite; but below it is bordered by a grayish to white streak that begins at the pit, or somewhat posterior thereto, and runs backward to the last supralabial. This light streak is bordered above by black dots. Anteriorly it is usually gray, punctated with brown dots. These dots disappear posteriorly, so that on the last 5 or 6 supralabials the streak may be almost clear white or buff, the lightest area on the head. The rostral and mental are punctated gray or brown, showing no vestiges of the vertical light lines so conspicuous in *w. willardi* and *meridionalis*. The lower surface of the head is cream or buff, speckled with gray, particularly anteriorly and laterally. In some snakes these punctations form darkened areas reminiscent of the brown blotches so characteristic of *w. willardi*.

The dorsal pattern comprises a series of dark-brown blotches, edged at each end, but not laterally, with black, and separated by gray or buff interspaces. The main blotches are about 5 scales long (end to end) and the interspaces measure about one scale. The blotches vary in number from 20 to 27, with a mean of 23.4. They are not clearly outlined laterally, although there is somewhat more contrast in well-preserved specimens between the blotches

and ground color than in *w. willardi*. The contrast between the blotches and interspaces is accentuated posteriorly. The entire dorsum is irregularly spotted with black and dark-brown dots. Lateral series of secondary blotches are evident in some specimens. The ventrum is buff, heavily speckled or blotched with gray, with an increase in maculations caudad.

Anteriorly, the tail is marked by from 1 to 3 blotches of the same character as those on the body; posteriorly it is punctated gray with a darker middorsal stripe, and a lateral stripe on each side. In some specimens, these longitudinal lines are only faintly in evidence. The under surface of the tail is gray or pink, punctated or spotted with brown. The subcaudals and the lowest laterals usually have light edges, a characteristic of the *willardi* subspecies. The rattle matrix is buff or brown, sometimes with black spots. As in the other subspecies, the rattle is dark-brown and has a rounded contour, and the scales that sheathe the proximal rattle are sharply pointed. The maximum rattle width noted was 7.3 mm., but 6.5 mm. is a more usual adult dimension.

The Sonora specimens are somewhat lighter than those from Chihuahua, but show no conspicuous intergrading tendencies toward *w. willardi*. The light head marks so typical of the Arizona subspecies are not evident.

Range.—This subspecies has been collected only in northeastern Sonora and western Chihuahua, at the following specific localities: SONORA: Above the Santa María Mine in El Tigre Mountains. CHIHUAHUA: Río Gavilán (7 mi. sw. of Pacheco) at 5700, 6200, and 6700 feet; Sierra Madre (near the summit) at 2400 meters (7874 feet); near Colonia García; Río Piedras Verdes at 6900 feet (at the head of the canyon); half way between Nahuárachic and Las Varas at 7000 to 8000 feet; Tamarino; Distrito Guerrero at 2250 and 2365 meters (7382 and 7759 feet); Mojarachic.

Crotalus willardi meridionalis subsp. nov.
SOUTHERN RIDGE-NOSED RATTLESNAKE

1936. *Crotalus willardi* (part) Klauber, Trans. San Diego Soc. Nat. Hist., vol. 8, no. 20, p. 231.

Type Specimen.—No. 6569 in the collection of L. M. Klauber. Collected in August, 1904, by Edmund Heller and Charles M. Barber at Coyotes, Durango, Mexico, at elevation 8000 ft. This is the Coyotes on the railroad to El Salto. The locality will be found on Am. Geogr. Soc. Millionth Map, sheet North F-13, where the altitude is given as 2574 m. (8445 ft.). The specimen was formerly one of a pair, carrying the single number 1493, in the Field Museum collection, now the Chicago Natural History Museum.

Diagnosis.—This subspecies differs from *w. willardi* in having a proportionately longer tail, more scale rows, more subcaudals, more body blotches, but fewer ventrals. From *silus* it differs in having a conspicuous vertical light line on the rostral and mental, and other head marks not evident in *silus*. On the average, it has fewer ventrals than *silus*.

Description of the Type.—The type specimen is an adult female with

a length over-all of 562 mm. and a tail length of 53 mm.; ratio of tail to total length .094. The head length is 30½ mm., and the width 20½ mm. The fang length (point to lower end of upper lumen) is 5.8 mm. The rattle width (3 segments of equal size remain) is 6.1 mm. The rattles are more rounded than in most other rattlesnakes, as is characteristic of *willardi*.

The scale rows number 29–27–19, with 9 at the middle of the tail. The dorsal rows are strongly keeled, but the rows above the ventrals, which are also the largest, are smooth, and the next two rows only faintly keeled. Paired apical scale pits are faintly in evidence.

The ventrals number 149; the anal is entire; the subcaudals number 30, of which the last 3 are divided, the final row being feathered out into a ring of pointed scales that jut over the proximal rattle.

The rostral is flat, square-topped, and is higher than wide; it engages the first supralabials, a pair of large prenasals, and a pair of internasals. The latter are the most distinctive scales in this snake, for their anterior halves turn upward at right angles to form a ridge above the rostral, giving the snake its popular name. Behind each internasal there are 3 canthals; the first of each series is uptilted to form a posterior continuation of the ridge formed by the internasals; the second is the largest of the series and is slightly raised outwardly; the last, which is quite small, engages the supraoculars. The area between the canthals is concave and contains about 25 small scales. The frontal area is also filled with small scales, there being a minimum of 7 bridging the space between the supraoculars. The supraoculars are the largest scales on the head; they narrow to points anteriorly. On each side there is a large anterior nasal, followed by a smaller postnasal; 2 loreals, the upper smaller; and 2 preoculars, the upper larger and the lower long and thin, and forming, with the lower loreal, the upper border of the pit. There are 6 sub- and postoculars on the right and 7 on the left. There are 3 rows of scales between the labials and the orbit. The supralabials number 14—14 and the infralabials 14—15. The mental is triangular. The first infralabials are undivided; they meet on the median line behind the mental and are followed by a pair of enlarged genials, which are contacted by the first 3 infralabials on either side. There are no submentals or intergenials.

The condition of this specimen precludes a description of the body pattern with assurance, as the epidermis has been scraped from some areas.

The head is brown above, the color being applied in the form of very fine stippling. There are scattered black dots on the supraoculars, with some smaller, less prominent ones on the canthus. The sides of the head are strikingly marked with white lines on a brown background. There is, first, a thin vertical white line down the center of the rostral; upon reaching the lower edge of the rostral this line branches to right and left and becomes a narrow white border of the upper lip; it continues back to the fifth supralabial, where it disappears. A second white stripe begins at the upper center of each prenasal and passes backward and downward across the pit and below the eyes, to terminate on the last supralabials at the angle of the mouth. This streak

widens posteriorly and is lined with dark-brown dots on some scales. The underjaw is also brightly marked with white streaks. Down the center of the mental there is a narrow white streak, which is a continuation of that on the rostral. This widens as it follows the median line between the genials. At the first gulars it diverges to the gulars adjacent to the last supralabials. The area between is irregularly spotted and blotched with gray, so that some gulars are white while others are gray. A second light line on each side begins as a narrow white edge on the lip at the third infralabial and passes backward, widening along the lip until about the ninth infralabial. Here it turns down, following the first row of scales below the infralabials, until the commissure is reached, where it branches, one part turning upward to the commissure, while the other passes back to the neck. Except for the white areas, the underjaw is gray-brown anteriorly and gray toward the neck.

The dorsal pattern comprises a series of 29 brown blotches on a lighter-brown ground color. The blotches are not well defined, although they are somewhat clearer medianly, where the contrast between the dark blotches and the light interspaces is accentuated. The lateral edges of the blotches are quite indefinite, but this may be due to the condition of the specimen. Posteriorly, the blotches form fairly well-outlined crossbands. There are a few widely spaced dark-brown or black dots scattered over the dorsum. The sides are somewhat grayish. The ventrum is buff anteriorly, increasingly punctated and blotched with gray toward the tail, so that two definite lines of gray mottling are formed.

The tail is crossed by 3 brown bands anteriorly, with light-brown interspaces. Posteriorly it is gray-brown on the dorsum and gray laterally. On the sides many of the scales contain a black spot posteriorly, and the lowest lateral row is edged with white. Below, the tail is light-gray, speckled and spotted with dark-gray or black. The rattle matrix is light-gray with a few scattered black spots.

Paratypes.—There are three paratypes: Chicago Natural History Museum No. 1493, one of a pair from Coyotes, Durango, of which the other is the holotype; Chicago Academy of Sciences No. 13953 from Weicher Ranch, 50 miles west of Durango, Durango (State); and U. S. National Museum No. 46332 from Sierra Madre, Zacatecas, Mexico.

The first is a male 510 mm. in length over-all with a tail 58 mm. long, and a head length of 29½ mm. It has 27 scale rows at mid-body, 146 ventrals, and 31 subcaudals. The supralabials number 17—15, and the infralabials 15—14. The minimum scales across the frontal space number 8. There are 28 body blotches.

The Chicago Academy specimen is a young male measuring 233 mm. over-all with a tail length of 27 mm. The head measures 16 mm. There are 27 scale rows at mid-body, 148 ventrals, and 34 subcaudals. The supralabials number 14—15 and the infralabials 14—14. The minimum count of scales between the supraoculars is 8. The body blotches are indeterminate because the skin is torn at the neck.

The National Museum specimen is a small female in rather poor condition. It is 257 mm. long, with a tail length of 28 mm. and a head length of 18.3 mm. There are 29 scale rows, 147 ventrals, and 30 subcaudals. The labials number 14—15, 14—15, and the minimum scales in the supraocular bridge, 8. The condition of the specimen is such that the blotches cannot be counted.

The patterns of the paratypes, to the extent that they can be determined, are much the same as in the type. The heads are brown above, with some black specks, which are particularly evident on the supraoculars and canthals. On the sides and below, the pattern of white streaks, as described in the type, is strikingly evident, especially the vertical line on the rostral and mental, and the side stripes marking the labials. Below there is a pair of divergent gray-brown blotches, punctated with black, that cover the anterior gulars.

The dorsum is marked with a series of square brown blotches separated by light-brown to buff interspaces. The anterior blotches are rather poorly defined, with little contrast between blotches and interspaces; posteriorly the contrast increases. All blotches are rather poorly defined on the sides. Below the main series on either side, 3 other series of small dark spots may sometimes be distinguished; these become darker as the ventrum is approached. Fine black or brown punctations are scattered over the dorsum. Larger spots often mark the edges of the light interspaces. The ventrum is heavily mottled with dark-gray to black, although the mid-ventral line is somewhat clearer.

The dorsal blotches are continued on the anterior third of the tail, but the final section is longitudinally striped, instead of being crossbarred. Laterally and below, the tail is gray. A thin serrated white line marks the outer edges of the subcaudals.

Intersubspecific Trends

Although the statistics of the subspecies *meridionalis* are uncertain because of the meagreness of the material, it appears that the subspecific trends are geographically consistent in most characters. Scale rows, subcaudals, labials, body blotches, and tail-length proportionality all increase from north to south, that is, from *w. willardi* through *silus* to *meridionalis*. An inconsistency is shown by the ventrals, for in *silus* these scutes apparently average slightly higher than in *w. willardi*, while in both the ventral count exceeds that of *meridionalis*. The most surprising inconsistency, speaking geographically, is to be found in the head pattern, for the two terminal forms have retained a striking pattern unique among the rattlesnakes, whereas the intermediate subspecies, although retaining some traces of what must have been the ancestral pattern, has reverted to a nondescript design without distinctive elements. Thus it has lost the vertical white lines on the rostral and mental; the clear white streak from the nostril to the last supralabial, except for a less-contrasting rear half; the second, but shorter, streak along the bottoms of the first five supralabials; also the two pairs of brown ovals on the lower jaw. All of these color

features serve to make *w. willardi* and *meridionalis* the most strikingly marked of all rattlesnakes, as far as head pattern is concerned. It is surprising to observe the similarity of *w. willardi* and *meridionalis* in head marks, separated as these subspecies are by 600 miles of mountain chain, much of which is occupied by the race *silus* that has lost these marks. This is apparently an example of central rather than peripheral differentiation.

LIFE HISTORY AND MORPHOLOGY

Not much is known concerning the habits of *willardi,* since the relative inaccessibility of the mountain areas where it occurs has made it rare in collections. It is probably moderately common in some places, for such collectors as have reached its habitat — this being true particularly of *silus* — have been rewarded with a half-dozen or more specimens.

That it is consistently a mountain form, is indicated by the fact that none of the 50 or more specimens now available came from an altitude below 5700 feet. The maximum record is somewhat above 9000 feet. Kauffeld (1943, p. 355) refers to it as an alpine forest snake, and suggested that it is not as partial to rocky areas as *Crotalus lepidus klauberi.* However, the two specimens that he did collect in the Huachucas were found near or under rocks. Dr. D. D. Brand, who captured three at between 7 and 8000 feet in Chihuahua, found them coiled in rock ledges.

Crotalus willardi is known to feed on both mammals and lizards. Like most rattlesnakes of the smaller species, it is probable that lizards comprise a major part of the diet, particularly of the juveniles. A *Sceloporus,* probably *S. j. jarrovii,* was found in a specimen of *w. willardi,* and an alligator lizard, *Elgaria kingii,* in a *silus.* Mammal remains were found in all three subspecies. Kauffeld (1943, p. 355) had one strike and quickly kill a white mouse, from which he judged the venom to be relatively powerful. One of his two captive specimens took dead mice readily, but the other had to be force-fed. To Kauffeld it appeared that *willardi,* in captivity, showed some resemblance to specimens of *Agkistrodon* and *Bothrops.* It remained stretched out rather than assuming the typical resting coil of a rattler, and had the habit of turning to bite. It seemed quite inquisitive.

A specimen of *w. willardi* 481 mm. (19 in.) long contained 6 eggs; and a *silus* 452 mm. (17¾ in.) in length contained at least 2 well-developed embryos, which gives an idea of the size of the adult females. As in all rattlesnakes except *Crotalus cerastes,* the adult males exceed the females in length by about 10 to 15 per cent. The ratio of the size of the young at birth to the ultimate adult size (about .32) is high, as is usual in the smaller species of rattlesnakes, when compared to the larger. Proportionately, *willardi* has the largest head of any rattlesnake; the adult head length is about .052 times the body length. The typical subspecies has a slightly larger head than *silus.* Also, it has a somewhat longer fang (relative to head length) than most other small species of rattlers. The rattles are distinctive in both form and color,

being more rounded and darker than in other species. The terminal body scales that edge the proximal rattle are particularly pointed in this species.

Key to the Subspecies of *Crotalus willardi*

A1 No white vertical line on the rostral or mental — *silus*

A2 A white vertical line on the rostral* and mental (fig. 3)

- B1 Scale rows usually 25; ventrals 150 or more; subcaudals in males 28 or fewer, in females 25 or fewer; body blotches 25 or fewer — *willardi*
- B2 Scale rows more than 25; ventrals fewer than 150; subcaudals in males more than 28, in females more than 25; body blotches more than 25 — *meridionalis*

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Summary

The ridge-nosed rattlesnake, *Crotalus willardi* Meek, 1905, a distinctive montane species restricted to the Sierra Madre Occidental, is now divided into 3 subspecies, based on differences in lepidosis and pattern. These are *C. w. willardi* of the Santa Rita and Huachuca ranges of southeastern Arizona; and two new subspecies: *C. w. silus*, of northeastern Sonora and western Chihuahua, and *C. w. meridionalis*, of western Durango and southwestern Zacatecas, Mexico.

* Sometimes abraded on specimens that have been long in captivity.

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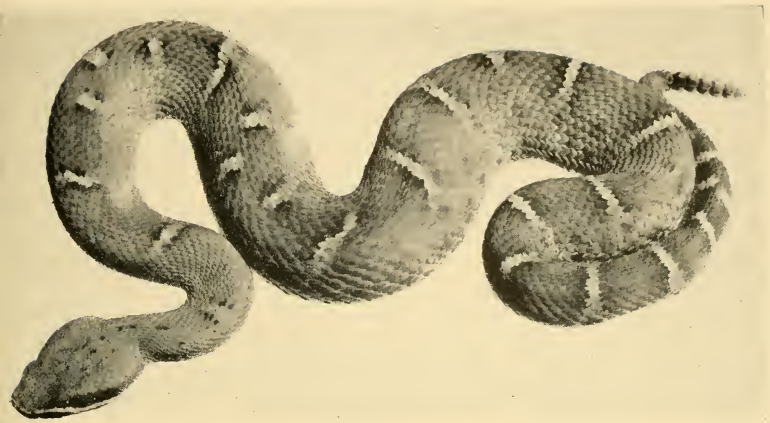

Fig. 1. *Crotalus willardi willardi* Arizona Ridge-nosed Rattlesnake. Adult male from Ramsey Canyon, Huachuca Mountains, Cochise County, Arizona.

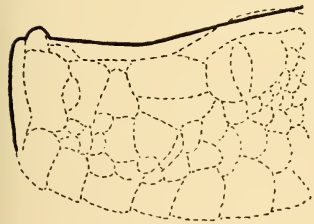

Fig. 2. Cross-section of head showing internasal ridge.

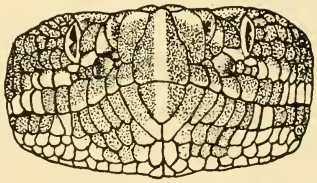

Fig. 3. Snout showing vertical light line on rostral and mental.