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ART. 15. THE GROUND SNAKE, *HALDEA VALERIAE*, IN
PENNSYLVANIA AND WEST VIRGINIA WITH DESCRIPTION OF
NEW SUBSPECIES*

BY NEIL D. RICHMOND

INTRODUCTION

When Blanchard revised the genus *Virginia* (*Haldea*) in 1923, no specimens were available from either Pennsylvania or West Virginia. In 1936 Conant reported finding *Virginia valeriae valeriae* in eastern Pennsylvania. In 1947 Swanson listed eight counties in Pennsylvania in which *Haldea valeriae valeriae* had been taken. Cooper (1948) reported finding a specimen of *Haldea valeriae valeriae* in Garrett County, Maryland. It was first reported from West Virginia in 1950 by Wilson and Friddle. In 1953, in the course of field work of the Pennsylvania Herpetological Survey, 15 additional specimens of this secretive form were collected, and four of the females conveniently produced broods in the laboratory, adding 25 juveniles. These, with occasional specimens collected in recent years, have provided 60 specimens from Pennsylvania and 6 from West Virginia, 30 more than Blanchard had available in 1923 from the entire range of *valeriae*.

Examination of this material disclosed two forms, one of which has not previously been recognized. The specimens from eastern Pennsylvania and from West Virginia are referable to *Haldea valeriae valeriae*. Those from the Appalachian Plateau of western Pennsylvania differ from both *valeriae* and *elegans* and are here described as a new subspecies of *valeriae*.

DESCRIPTION

Haldea valeriae pulchra subsp nov.

Mountain ground snake

Diagnosis. A form of *Haldea valeriae* with keeled scales in 15-17-17 rows. In the other two forms known, *elegans* has scales in 17-17-17 rows, usually more or less keeled, and *valeriae* has scales in 15-15-15 rows, usually smooth, rarely with a few keeled scales posteriorly.

Holotype. Carnegie Museum no. 32205, an adult female collected August 10, 1953, four miles north of Van, Venango Co., Pa., by Neil D. Richmond.

Paratypes. All from Pennsylvania. C.M. 29382, 29384, Venango Co., 1 mi. NE. of Sadler's Corner; C.M. 32204, Venango Co., 4 mi. N. of Van; C.M. 32137-32146, 32244, Warren Co., 10 mi. SW. of Warren; C.M. 32219, Forest Co., 3 mi. SW. of Tionesta.

Description of type. Head scutes the same in number and arrangement as in the other two races of the species. Rostral almost triangular, slightly higher than wide, the tongue groove a pronounced notch; internasals two, small and triangular; prefrontals two, subquadrate, an extension from the posterolateral angle entering the orbit; frontal longer than wide, same length as distance from its anterior end to snout. Two nasals, the nostril in

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the posterior margin of the anterior nasal. Loreal almost rectangular, longer than high, in contact with the orbit posteriorly, the upper anterior border of the orbit formed by a posterolateral extension of the prefrontal. Postoculars two on each side, the upper being the larger. Eye moderate, diameter greater than the height of the labials below it. Supra-ocular long and narrow, widest posteriorly; parietals long, widest anteriorly, narrowly separated from fifth supralabial, and in contact with upper postocular. Temporals one and two, the anterior the larger, lying in the angle formed by the fifth and sixth supralabial and narrowly contacting the upper postocular. Supralabials six, the fifth much enlarged. The third and fourth supralabials enter the orbit, the fifth is separated from the orbit by the postoculars. Infralabials six, the first pair meeting on the mid-ventral line. Infralabial four is the largest and contacts both the anterior and posterior chin shields. The sixth infralabial is separated from the first ventral by two rows of scales. Two pairs of chin shields, the first pair in contact throughout their length, the second pair diverging posteriorly and inclosing a small scale and the first ventral.

Dorsal scales glossy, without apical pits and all keeled except rows one and two, the first two much wider than others. The dorsal scale formula is 15-17-17, or expressed according to the system proposed by Dowling (1951):

$$15 - \frac{+ 3 (18)}{+ 3 (18)} - 17 - 17 (126)$$

The ventrals as shown in the formula, are 126 plus a divided anal plate, subcaudals 31 pairs plus a terminal spine. Total length, 310 mm.; tail length, 50 mm.; tail length, 16 per cent. of total length.

In alcohol, the dorsal color is uniform dark brown, gradually fading toward the sides and extending onto the tips of the ventrals. There is an irregular row of minute black flecks along scale rows four and five; these flecks cover less than half of a scale, and are barely visible. The ventral color is uniform whitish. The head is dark brown above, darker than the body. The side of the head has a dusky, almost black, shading on the postoculars and loreal, sharply delimited by the pale supralabials. The infralabials and chin are light like the belly.

VARIATION

The following discussion of variation in color and scutellation is based on 53 specimens (including the type and paratypes) from Pennsylvania.

In eight specimens, each has a small pre-ocular; in seven of these the pre-ocular is cut off from the prefrontal and in one the posterior end of the loreal is cut off. Only two specimens have a pre-ocular on each side.

The postoculars vary in number, size and shape. Sometimes they are almost displaced by a downward extension of the supra-ocular and an upward extension of the fourth supralabial. The number of postoculars ranges from one to three. In 52 specimens 30 have two, 15 have three, and 7 have one. There is no significant difference between the sexes in the

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The small, harmless Ground Snakes are so secretive in their habits that as late as 1923 there were only 30 specimens available from the entire eastern United States. During the work of the Pennsylvania Herpetological Survey, a Carnegie Museum project sponsored by the Sarah Mellon Scaife Foundation of Pittsburgh, Curator Richmond discovered the optimum weather conditions for collecting these snakes. As a result, Carnegie Museum now has 60 specimens from Pennsylvania alone. When this large series was studied, the snakes from the mountains of western Pennsylvania proved to be a form new to science.

The Mountain Ground Snake is believed to have entered Pennsylvania before the last glaciation and adapted itself to the long winter, cool summer climate of the unglaciated, high plateau during the thousands of years when ice covered much of western Pennsylvania. The small-headed garter snake, which is found only in the same region, probably had a similar history.

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distribution of this variation. With one exception, the number of postoculars was the same on both sides of the head.

The number of labials is six upper and six lower on all but four specimens. Three of these have five lower labials on one side and six on the other, while the fourth specimen has five upper labials on one side and six on the other. The large fifth supralabial is always separated from the orbit, commonly by the lower postocular but sometimes by a projection of the fourth supralabial that extends between the orbit and the fifth supralabial.

Dorsal scale rows 15-17-17 in all but one specimen; C.M. 32206-H has 14-15-17-17 rows of scales, as the result of the loss of the mid-dorsal row opposite the twelfth ventral.

There is some variation in how far forward the third scale row extends, ranging from opposite the 44th ventral to opposite the 15th ventral, usually opposite ventrals 20-30. Usually the third row of scales begins at approximately the same place on each side. However, occasional specimens will show a great difference; for example, one with the third row on the right side starting opposite the 26th ventral and the same row on the left starting opposite the 44th ventral.

Variation in the number of ventrals and caudals is discussed under sexual dimorphism.

The color pattern varies in this series from uniform gray or brown to specimens that have a faint stripe on the mid-dorsal line bordered with flecks of black arranged in two irregular rows. Every specimen has a dark shadow around the eye, consisting of black pigment on the postoculars and loreal. On most specimens the labials and chin are immaculate white but some of the specimens from the northern counties show a tendency to melanism and have the labials and chin dusky. On these, the dorsal color is almost black and continues dark to the ends of the ventrals and is in sharp contrast with the white under side.

Living specimens are reddish brown rather than gray as most *valeriae*. The amount of black flecking is less than in *valeriae*. The pinkish color of the dorsal surface extends onto the ends of the ventrals, shading to a clear yellow on the mid-ventral line. Although the scales are keeled, they have a glossy surface and the keels are not easily seen without a lens. The pinkish tone of the dorsal and ventral colors, as well as the pale yellow of the mid-ventral line, so noticeable in living specimens, disappear rapidly in preservative.

OTHER SPECIMENS

In addition to the 53 specimens discussed above, there are two specimens from western Pennsylvania that deserve separate mention, one because of its history and the other as possible evidence of intergradation with *valeriae*.

Atkinson (1901), in "The Reptiles of Allegheny County, Pennsylvania," listed a specimen of *valeriae* that he had collected in Wilkesburg in 1899. On the basis of this report, Surface (1906) included *valeriae* in his list of the snakes of Pennsylvania. In 1928, Dr. Atkinson gave Carnegie Museum a collection of snakes in which was one specimen of *valeriae* with the same

data as that reported in 1901, and presumably the same snake. This specimen, C.M. 4763, is definitely *valeriae*. It is a female with smooth scales in 15-15-15 rows, 123 ventrals, and 25 caudals, and does not resemble the *Haldea* of western Pennsylvania. Wilkinsburg is completely outside of the known range of *valeriae* and is about forty miles west of the mountainous area where *pulchra* has been taken. In view of this the measurements and scale counts of this specimen were omitted from those of *pulchra*, and Allegheny County, Pa., is not included in the range of either form.

Of seven specimens from Somerset County, Pa., one, C.M. 26133 ♂, has scales in 15-15-15 rows with keels throughout, 119 ventrals. The tail is broken off this specimen at the 27th caudal. This specimen might be considered aberrant in having the scale-row formula of *valeriae*. On the other hand, the fact that the nearest known locality for lowland *valeriae* is in the Potomac Valley only some forty miles away suggests that intergradation with upland *pulchra* may occur in this area.

RANGE

This subspecies is apparently restricted to the unglaciated Allegheny High Plateaus and Allegheny Mountain section of the Appalachian Plateau Province from New York to West Virginia. Although no specimens are known from New York, it should occur in Allegany State Park. Southward it has been found along the mountains from Warren County to Somerset County, Pa. Two specimens of *Haldea* have been reported from Swallow Falls State Park, Garrett County, Md. (Lemay, 1952 and Cooper, 1948). It has not been possible to examine either of these; however, the scale counts of one as given by Cooper were 15-17-17-17, and it is presumably *pulchra*. Garrett County, Md., is on the Allegheny Plateau and adjoins Somerset County, Pa. *H. v. pulchra* should be looked for in similar habitat in the adjoining mountain counties of West Virginia.

Fig. 1 shows distribution of the two subspecies of *Haldea valeriae* in Pennsylvania.

Haldea IN WEST VIRGINIA

In West Virginia, *Haldea* has been found in the extreme southwest and the extreme northeast. The specimens examined all have smooth scales in 15-15-15 rows, and are referable to *Haldea valeriae valeriae*. In the east this form has apparently entered the state along the Potomac River and the population there is continuous with that of *valeriae* of the Piedmont and Coastal Plain. The population in the west occurs in the drainage area of the west-flowing tributaries of the Ohio and apparently is a northern extension of the population of *valeriae* in Kentucky and southern Ohio. No specimens of *Haldea* are known from the high mountains of West Virginia although the northern form should occur there.

SEXUAL DIMORPHISM

The following characters will distinguish the sexes of *Haldea valeriae pulchra*.

Caudals: males 38-45, average 41.4; females 31-37, average 33.7.

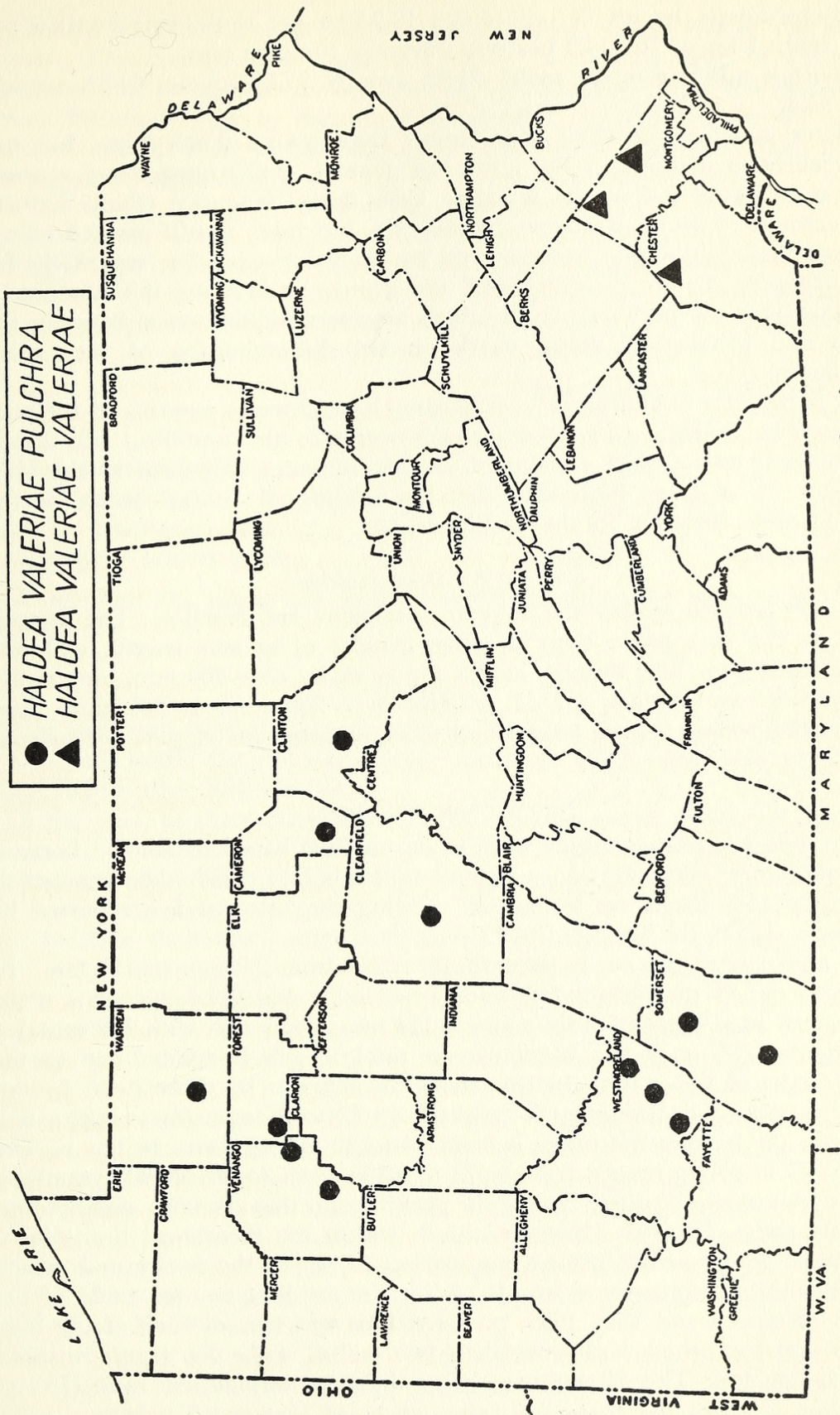


FIG. 1. Distribution of the two subspecies in Pennsylvania.

Proportionate length of tail: males 18.7-20.6 per cent., average 19.6 per cent.; females 15.1-17.9 per cent., average 16.7 per cent.

Ventrals minus caudals: males 74-82, average 77.6; females 84-97, average 90.8.

Other measurements and scale counts show sexual dimorphism, but not sufficiently to distinguish the sexes. In general, males have fewer ventrals and more caudals than the females. Combining these two counts reduces the amount of difference between the sexes, but there is still marked sexual dimorphism, making it necessary to use data for each sex separately for comparison with other members of the genus. Subtracting the number of caudals from the number of ventrals exaggerates the difference between the sexes and provides a useful check on sex determination of very small specimens.

In both sexes the umbilical scar occurs 11 to 16 scales anterior to the anal plate. The number of ventral scales anterior to the umbilical scar shows approximately the same amount of sexual difference as is seen in the total number of ventrals, indicating that the additional ventral scales of the female occur anterior to the umbilicus.

SIZE OF MATURE *Haldea*

In the mature snakes the longest specimens are females. The longest male is 277 mm. while there are five females of greater length, with the longest 320 mm. The average length for 10 males over 200 mm. long is 241 mm. while the average for 11 females over 200 mm. is 269 mm. The extremes for each sex are larger than those reported for *elegans* (Blanchard, 1923).

DESCRIPTION OF YOUNG

The following observations were made on four litters of *Haldea* born in the laboratory, between August 19 and September 14, 1953. The number of young in each litter was 5, 5, 7, 8. Adding the litter of five reported by Swanson (1952), the average litter size is six.

In total length the newly born young range from 95 mm. to 123 mm. In this series of 25 the shortest specimen is a female and the longest is a male. The mean total length for six males is 114 mm., compared with 109 mm. for 19 females. Most of this difference in total length is attributable to the longer tails of the males. In this series the sex can be determined by tail length alone, as in the males it ranges from 22 to 23 mm. (mean=22 mm.), while in the females the range is from 16 to 20 mm. (mean=18 mm.). The weight of 19 young ranged from 0.475 to 0.860 gram (mean=0.804 gram).

The sex ratio of these young is peculiar in that females greatly outnumber males, 19 to 6. However, this is within the theoretical limits for a sample of 25 specimens from a population in which the sex ratio is 50-50. The theoretical limits for a sample of this size are 5 of one sex to 20 of the other. (Simpson and Roe, 1939, p. 184.) This was true of each of the four litters, none of which had more than two males, while one litter consisted of five females. The 29 mature snakes have a normal sex ratio (15 ♂, 14 ♀).

The size at birth is surprisingly large compared to the size of the adult female. The average total length of each litter is 36 per cent. of the total length of the parent female. At birth they are larger than the young of either *Storeria dekayi* or *Storeria occipitomaculata*, which share the same habitats. Table 1 shows the size of newly born *Haldea* and three other species in the same habitat.

TABLE 1

Comparison of the size at birth of *Haldea valeriae pulchra* and three species associated in the same habitat. The females measured were the parents of the young measured. The number in parenthesis is the number of females measured of each species.

Name	Number of young measured	Average total length at birth in mm.	Average total length of female in mm.
<i>Haldea valeriae pulchra</i>	25	107	292 (4)
<i>Storeria dekayi</i>	17	96	295 (2)
<i>Storeria occipitomaculata</i>	63	98	360 (5)
<i>Thamnophis brachystoma</i>	20	147	435 (2)

When born the young are without markings, dull gray above and white beneath.

HABITAT

The preferred habitat appears to be grassy areas near or in forests. They are usually found under small rocks, boards or other cover and are most often found after heavy rains.

In the parts of Pennsylvania where these snakes occur, prolonged rainfall is usually associated with low temperatures so that following such a rain, *Haldea* and other small snakes are more likely to be found under stones that are warmed by the sun. At such times, *Haldea* may be collected in numbers that indicate their usual scarcity must be the result of a behavior pattern that makes them difficult to find. The experience reported by Swanson (1952) is typical of people who happen to find *Haldea* at the right time. "I looked in vain for this snake for twenty years; then in 1949, Borland, Shively and I caught eight in a few minutes." After several days of rain in April, 1953, Hal H. Harrison and I collected 10 in approximately one hour. This might be interpreted as evidence that *Haldea* lives in small isolated colonies. However, most of the locality records are based on individual specimens. Further evidence that rain makes them more available is offered by the results of a trip in August, 1953. On the first clear day after two days of rain, four specimens of *Haldea* were collected in three localities. The second day after the rain, only one specimen of *Haldea* was found, and on the third day none was found, although all of the localities visited were in areas where *Haldea* had been collected.

United States Weather Bureau records for these dates show that each date of collection was preceded by two to four days of rain with an average four-day total of 2.2 inches. Since the average monthly total is only three to

four inches in this area, it is apparent that optimum collecting dates followed periods of unusually heavy rainfall.

The following figures show the amount of rain in a four-day period preceding the date of collection, and the number of specimens collected.

Collecting date	Weather Bureau station	Inches of rain for each day before collecting date					No. of Haldea
		1	2	3	4	Total	
June 29, 1949	Franklin	0.08	0.36	0.81	0.58	1.83	8
May 27, 1953	Warren	1.06	0.00	0.00	2.37	3.43	10
Aug. 10, 1953	Franklin	1.03	0.32	0.00	0.04	1.39	4

DISCUSSION

Of the two previously known forms, *elegans* is the least specialized and presumably the more primitive. Although the new form is between *valeriae* and *elegans* in some characters (number of scale rows, number of ventrals, and size of eye) it is even less specialized than *elegans* in degree of keeling, body size and number of caudals. In all characters the montane form resembles *elegans* more than it does *valeriae* although it is about 500 miles from the nearest Indiana locality for *elegans*.

One explanation of the peculiar present-day distribution of the genus *Haldea* is that *valeriae* very early split off from a parent form with keeled scales arranged in 17 or more rows, and spread east and north along the coastal plain and Piedmont, while the prototype of *elegans* spread north and east in the interior until it reached western Pennsylvania prior to the Wisconsin glaciation and then became separated into two populations by the Wisconsin ice sheet, and that the montane population in the east persisted throughout the glacial period in or near its present range. Although the other forms of the genus are primarily southern, *pulchra* occupies the coldest and most northern unglaciated area in the eastern United States.

The range of *pulchra* is entirely within an area of very short cool summers. The average length of the frost-free season is 120-140 days, while the ranges of both of the other forms have a frost-free season of not less than 180 days, and the greater part of their ranges has 200-280 frost-free days.

All of the localities where *pulchra* has been taken have an average July temperature of 70° F. or less, compared with an average July temperature of 75° F. or more for the localities where *valeriae* and *elegans* occur.

This peculiar distribution resulting in a montane form in northern Pennsylvania with its nearest relative in the mid-west is similar to that of *Thamnophis brachystoma*, also restricted to northern Pennsylvania and with *Thamnophis butleri* of the mid-west as its nearest relative. Conant (1950) includes a statement by Netting postulating that both *butleri* and *brachystoma* were derived from some widespread pre-Wisconsin form, and that *brachystoma* also survived during Wisconsin times in or near its present range.

LOCALITY RECORDS

Haldea valeriae pulchra

Specimens examined, including the type and paratypes. (All numbers are Carnegie Museum numbers.)

Pennsylvania. **Cameron Co.** Gibson Twp. (28284-28285). **Clinton Co.** Keating (8842), Sproul Forest (12715). **Forest Co.** 3 mi. SW. of Tionesta (32219, 32220 A-G, 32221, 32222 A-E). **Somerset Co.** 5 mi. S. of Biglow Heights (21939-21944), 15 mi. SW. of Johnstown (26133). **Venango Co.** 1 mi. NE. of Sadler's Corners (29382-29384), 4 mi. N. of Van (32204-32205, 32206 A-H). **Warren Co.** 10 mi. SW. of Warren (32137-32146, 32244). **Westmoreland Co.** (5010), near Waterford (4886), near Laughlintown (21625), 3.5 mi. E. of Indian Head (27424), Pine Flat (29200).

Haldea valeriae valeriae

Pennsylvania. **Berks Co.** 7. mi. NNE. of Elverson (9654). **Montgomery Co.** Sumneytown (9695-9696), 2 mi. NE. of Prospectville (28710).

West Virginia. (C.M.=Carnegie Museum, W.B.S.=West Virginia Biological Survey collection.) **Hampshire Co.** near Romney (C.M. 23794-23795). **Hardy Co.** 1 mi. E. of Moorefield (W.B.S. 1945), 5 mi. S. of Moorefield (W.B.S. 1313). **Kanawha Co.** Belle (W.B.S. 2293). **Lincoln Co.** Ranger (W.B.S. 2439). **Mineral Co.** 3 mi. SE. of Keyser (C.M. 9028), Rawlings (C.M. 13826), Mingo Park (C.M. 13893). **Wayne Co.** Spring Valley (W.B.S. 2108). **Wirt Co.** Elizabeth (W.B.S. 1472).

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