# THE VARIATION EXHIBITED BY THAMNOPHIS ORDINOIDES (BAIRD AND GIRARD), A GARTER SNAKE INHABITING THE SAN FRANCISCO PENINSULA.

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## INTRODUCTION.

The more one reviews the literature of the garter snakes of North America, the more one becomes impressed with the necessity of ascertaining the complete range of variation that may be exhibited by each of the well-established species in the genus. To determine this it will be requisite to collect a fair series of specimens from a restricted locality and to record its slightest variations. Similar studies will have to be made of sets from widely separated regions. In order to facilitate the comparison of the data an endeavor should be made to conform to a uniform method of tabulating the figures and presenting the facts.

In the past *T. ordinoides* has been divided into as many as eight species and subspecies; this alone implies that the form is subject to considerable variation. What this variation really amounts to can only be appreciated by one who has seen large series from all parts of its range, for it is difficult to believe that the dwarfed and sombre-hued examples from the north, with the minimum scale count of 17–15, are one and the same species as the large brilliantly colored specimens from the south or the veritable giant from the Santa Clara Valley, whose body alone measures 1,040 mm. and has a maximum scale formula of 21–23–21–19–17.

Dr. Ruthven in his Memoir on the Garter Snakes of North America[1] recognizes *Thamnophis elegans* (Baird and Girard) 1853, and *Thamnophis ordinoides* (Baird and Girard) 1852, as distinct species. In speaking of *T. elegans*[2] he writes: " . . . its western limit can not be drawn exactly owing to the fact that it intergrades with another form . . . " referring to *T. ordinoides*. In speaking of

[1] 1908, Bull. 61, U. S. National Museum. [2] Idem, p. 143.

*T. ordinoides*[1] he states: "I believe that it is impossible to fix the exact eastern and southern boundary of *ordinoides* for the reason that it intergrades with *elegans* throughout the entire length of its range." From this two inferences may be drawn: These species are either valid and the specimens are amenable to unquestionable separation, or our recognition of them as two distinct forms must give way to the fact that there is complete intergradation, hence they are not distinct and require to be united.

The initial step in the direction of attempting to ascertain the final status of these two species was taken when 50 specimens of *T. ordinoides* from the Sausalito Peninsula were subjected to a critical examination.[2] The present contribution offers the data obtained from a similar number of specimens captured in Golden Gate Park on the San Francisco peninsula along with a comparison of the two series. As a further illustration of the need of these and similar studies there is appended the record of 80 specimens from twelve different localities.

## METHODS.

In order that the data be correctly coordinated it is necessary to ascertain the highest scale row count that obtains in the genus. In *Thamnophis* the maximum is 23 rows. The paired rows are designated by permanent numbers from I to XI and the median by M, the count being made from without inward.

When the number of scale rows is decreased the sequence of suppression is constant and is as follows:

23 rows, V row suppressed, leaving,
21 rows, VI row suppressed, leaving,
19 rows, IV row suppressed, leaving,
17 rows, VII row suppressed, leaving,
15 rows, which are continued to the vent.

In dealing with a specimen in which the maximum count is 21 rows it is necessary to regard the V row as suppressed constructively. In enumerating the rows one must count I, II, III, IV (V suppressed), VI, VII, VIII, IX, X, XI, and the median. In such a specimen when the 21 rows are reduced posteriorly to 19 rows it will be found to be due to the termination of the fifth row in actual counting, but this row in terms of the generic count is the VI row and must be so recorded. When the 19 rows are decreased to 17 it is due to the ending of the fourth row in actual counting, which is also the IV row in the generic sense. When the 17 rows are reduced to 15 it is due to the loss of the fourth row in actual counting, which in this case is the VII row in terms of the generic count. Constant attention to these details is imperative.

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[1] 1908, Bull. 61, U. S. National Museum, p. 149.
[2] 1914, Thompson, Proc. U. S. Nat. Mus., vol. 47, pp. 351–360.

## VARIATION IN NUMBER OF DORSAL SCALE ROWS.

This species presents the widest range of variation in the number of scale rows that is to be found in the group. There are at present known in the genus eleven distinct scale formulae, ten of which have been recorded in *T. ordinoides*. These ten and the frequency of occurrence of the five combinations found in the San Francisco series are as follows:

| | Per cent. |
|---|---|
| 21-23-21-19-17 | 0 |
| 21-19-17 | 12 |
| 19-21-19-17 | 56 |
| 19-21-19-17-15 | 8 |
| 19-17 | 16 |
| 19-17-15 | 4 |
| 19-17-15-13 | 0 |
| 17-19-17-15 | 0 |
| 17-15 | 0 |
| 15-17-15 | 0 |
| Asymmetrical | 4 |

The influence of sex upon the variations in this character is clearly demonstrated. Among the specimens that vary from what may be assumed to be the normal count of 19–21–19–17, those having the lower counts are prone to be males, and those with the higher counts are largely females. This increase in the number of scale rows in the female is associated with the need for the increase in the diameter of the abdominal cavity when carrying the young.

| | Males. | Females. |
|---|---|---|
| | *Per cent.* | *Per cent.* |
| 21—19—17 | 17 | 83 |
| 19—21—19—17 | 39 | 61 |
| 19—21—19—17—15 | 50 | 50 |
| 19—17 | 86 | 14 |
| 19—17—15 | 67 | 33 |

The data showing the gastrostege levels on the right and left side of the body at which the added rows begin and the suppressed rows end may be learned from the following tables:

### Scale Formula 21—19—17.

This is next to the highest count recorded in the species. In this series it occurs in 12 per cent of the specimens of which 16 per cent are males.

| U.S.N.M. No. | Sex. | Ventrals. | Scale rows. | | |
|---|---|---|---|---|---|
| | | | 21—VI. | 19—IV. | 17 cont. |
| 52176 | Male | 158 | 68 76 | 92 92 | |
| 53575 | Female | 151 | 71, IV 74 | 98, VI 99 | |
| 52190 | do | 153 | 70 70 | 92 95 | |
| 52159 | do | 155 | 71 76 | 89 88 | |
| 53545 | do | 155 | 65, IV 71 | 82, VI 87 | |
| 53577 | do | 157 | 71 73 | 99 101 | |

Scale Formula 19—21—19—17.

This formula may be regarded as the normal for this immediate region. It is found in 56 per cent of the specimens; of these, 39 per cent are males.

Male.

| U.S.N.M. No. | Ventrals. | Scale rows. | | | |
|---|---|---|---|---|---|
| | | 19+VI. | 21—VI. | 19—IV. | 17 cont. |
| 52184..... | 154 | 26 28 | 51 42 | 77 76 | ........... |
| 53583..... | 157 | 32 30 | 51 58 | 78 78 | ........... |
| 52163..... | 158 | 47 41 | 53 43 | 79 80 | ........... |
| 53573..... | 158 | 27 25 | 60 65 | 83 86 | ........... |
| 52179..... | 159 | 24 27 | 68 74 | 89 89 | ........... |
| 52180..... | 159 | 24 37 | 60 60 | 86 86 | ........... |
| 52166..... | 160 | 26 24 | 70 70 | 86 87 | ........... |
| 52174..... | 160 | 27 24 | 62 63 | 82 83 | ........... |
| 53581..... | 161 | 34 26 | 44 32 | 87 82 | ........... |
| 52181..... | 162 | 32 32 | 69 62 | 86 86 | ........... |
| 52162..... | 162 | 30 31 | 71 75 | 92 93 | ........... |

Female.

The influence of sex on this character is evident. On the average the VI row tends to be longer in that it begins further forward and extends more to the rear. The IV row also ends further back. This lengthening of the scale rows is associated with the stouter body in the female.

| U.S.N.M. No. | Ventrals. | Scale rows. | | | |
|---|---|---|---|---|---|
| | | 19+VI. | 21—VI. | 19—IV. | 17 cont. |
| 52170..... | 147 | 32 32 | 50 50 | 76 76 | ........... |
| 53541..... | 149 | 23 22 | 60 61 | 87 86 | ........... |
| 52161..... | 150 | 32 44 | 55 53 | 82 82 | ........... |
| 52175..... | 150 | 24 23 | 61 62 | 80 82 | ........... |
| 52171..... | 151 | 31 36 | 40 55 | 79 79 | ........... |
| 52160..... | 152 | 13 13 | 68 71 | 90 93 | ........... |
| 52168..... | 153 | 26 26 | 58 58 | 83 84 | ........... |
| 52165..... | 153 | 30 41 | 51 51 | 81 79 | ........... |
| 53576..... | 153 | 22 23 | 68 67 | 88 90 | ........... |
| 53542..... | 153 | 26 28 | 54 53 | 82 86 | ........... |
| 53585..... | 154 | 24 24 | 65 68 | 88 92 | ........... |
| 52167..... | 155 | 29 27 | 64 65 | 89 87 | ........... |
| 52164..... | 155 | 22 20 | 62 64 | 85 92 | ........... |
| 52185..... | 156 | 21 13 | 68 71 | 91 95 | ........... |
| 52158..... | 157 | 27 23 | 63 71 | 89 88 | ........... |
| 52178..... | 160 | 27 26 | 67 59 | 88 89 | ........... |
| 52186..... | 166 | 12 15 | 75 75 | 91 92 | ........... |

It will be noted that No. 52170 is bilaterally symmetrical. It is comparatively rare for the scale rows to arise and to be suppressed at exactly the same gastrostege levels.

### Scale Formula 19—21—19—17—15.

This is not a common variation. It occurs in 8 per cent of the series, and of these 50 per cent are males. In specimens with this formula there are five zones on the body, each with a different count. In two examples the VII rows reappeared just anterior to the vent, thereby increasing the count to 17 in this zone.

| U.S.N.M. No. | Sex. | Ventrals. | Scale rows. | | | | |
|---|---|---|---|---|---|---|---|
| | | | 19+VI. | 21—VI. | 19—IV. | 17—VII. | 15 cont. |
| 52182.... | Male..... | 156 | 30 30 | 54 51 | 77 77 | 121 124 | ......... |
| 52173.... | ...do..... | 156 | 30 28 | 51 62 | 84 86 | 122 129 | ......... |
| 53580.... | Female.. | 158 | 28 35 | 49 50 | 83 81 | 130 141 | ......... |
| 52172.... | ...do..... | 151 | 31 43 | 57 52 | 81 79 | 135 135 | ......... |

### Scale Formula 19—17.

This formula is found next in frequency to the normal. It occurs in 14 per cent of the series, and of these 86 per cent are males. Two specimens in this table exhibited bilateral symmetry, the rows terminating on each side at exactly the same level.

| U.S.N.M. No. | Sex. | Ventrals. | Scale rows. | |
|---|---|---|---|---|
| | | | 19—IV. | 17 cont. |
| 52169......... | Male....... | 152 | 75 75 | ........... |
| 53578......... | ...do....... | 156 | 81 81 | ........... |
| 53579......... | ...do....... | 157 | 80 80 | ........... |
| 53584......... | ...do....... | 159 | 78 80 | ........... |
| 53543......... | ...do....... | 159 | 78 79 | ........... |
| 53544......... | ...do....... | 159 | 81 82 | ........... |
| 52187......... | Female.... | 152 | 83 83 | ........... |

### Scale Formula 19—17—15.

This is the least frequent count in the series. It occurs in but 6 per cent, of which 66 per cent are males.

In both these specimens the VII rows reappear a short distance anterior to the vent.

| U.S.N.M. No. | Sex. | Ventrals. | Scale rows. | | |
|---|---|---|---|---|---|
| | | | 19—IV. | 17—VII. | 15 cont. |
| 52177....... | Male....... | 153 | 77 78 | 135 138 | ........... |
| 53582....... | ...do....... | 156 | 74 76 | 112 118 | ........... |
| 52188....... | Female.... | 156 | 78 79 | 135 137 | ........... |

BILATERALLY ASYMMETRICAL.

| U.S.N.M. No. | Sex. | Ventrals. | Scale rows. | | | |
|---|---|---|---|---|---|---|
| | | | 19+VI. | 21—VI. | 19—IV. | 17 cont. |
| | | | *rt. Lt.* | *rt. lt.* | | |
| 52183...... | Male....... | 158 | 33 | 51 | 81 82 | ........ |
| 52189...... | Female.... | 159 | 28<br>41 | 34<br>43 | 87 87 | ........ |

It will be noted that in both these cases the asymmetry consists in an absence of the VI row on the left side of the body. It is this row that is normally added to the 19 row zone anteriorly and raises the count to 21 rows. In the male the VI row exists on the right side between the level of the thirty-third and the fifty-first gastrostege. In the female this row is also present only on the right side; it differs in being interrupted, one series extending from the twenty-eighth to the thirty-fourth, and the other from the forty-first to the forty-third gastrostege.

There is one important question bearing on these dermal characters that requires to be settled, and that is whether the number and extent of the scale rows are definitely fixed from birth and remain the same throughout the life of the individual, or if their number and extent may be increased as a sequel to abundant food, corpulency, pregnancy, and old age. The fact seems to be, that when a series of these garter snakes from the same locality is examined, a suspiciously large percentage of the low-scale row counts are found in the young and half-grown examples.

## OTHER VARIATIONS.

All of the dermal characters show more or less variation. The scale rows in the zones of transition from the neck to the body and between the body and the tail are too irregular and complicated to permit the making of satisfactory records. There is some variation in the size and shape of the rostral, frontal, and parietal shields that depends upon the age of the specimen. The numerical variations in other characters are very important to ascertain, for they confirm beyond dispute, as Doctor Ruthven has demonstrated, the genetic relationships among the species.

### VARIATION IN GASTROSTEGES.

Attention is drawn to the fact that the minimum and maximum counts have been found in the female specimens. In the males the range of variation is but 55 per cent of the total and centers nearly around the mean for the series.

*Diagram showing the variation in the number of gastrosteges in specimens from San Francisco.*

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | ♀ | | | ♂ | | | ♂ | | | | | | | |
| | | | | | | ♀ | | | ♂ | | | ♂ | | | | | | | |
| | | | | | ♀ | ♂ | | ♀ | ♀ | ♀ | ♂ | ♂ | | | | | | | |
| | | | | ♀ | ♂ | ♀ | | ♀ | ♀ | ♂ | ♂ | ♀ | ♀ | | | | | | |
| | | | ♀ | ♀ | ♀ | ♀ | ♀ | ♀ | ♂ | ♂ | ♂ | ♂ | ♂ | | ♂ | | | | |
| ♀ | | ♀ | ♀ | ♀ | ♀ | ♀ | ♂ | ♀ | ♂ | ♀ | ♂ | ♂ | ♂ | ♂ | ♂ | | | | ♀ |
| 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 |

Females.

Males.

Range of variation in 50 specimens .......... 147–166
Males, 23 specimens .......... 152–162
Females, 27 specimens .......... 147–166

*Diagram showing the variation in the number of gastrosteges in Sausalito specimens.*

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | ♂ | | | | | | | |
| | | | | | ♀ | | | | | | ♂ | ♀ | | ♂ | | | | | |
| | | | | | ♀ | | | | ♂ | | ♂ | ♂ | | ♂ | | | | | |
| | | | | | ♀ | | | | ♀ | ♂ | ♀ | ♂ | | ♂ | | | | | |
| | | | | | ♀ | | ♀ | ♀ | ♀ | ♂ | ♂ | ♀ | | ♂ | ♂ | | | | |
| ♀ | | | | ♀ | ♂ | ♀ | ♀ | ♂ | ♀ | ♂ | ♂ | ♂ | ♂ | ♂ | ♂ | | | ♂ | ♂ |
| ♀ | ♀ | ♀ | | ♀ | ♀ | ♀ | ♀ | ♂ | ♂ | ♂ | ♂ | ♂ | ♀ | ♂ | ♂ | ♀ | ♂ | ♂ | ♂ |
| 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 |

Female.

Male.

Range of variations in 59 specimens .......... 145–164
Males, 34 specimens .......... 150–164
Female, 25 specimens .......... 145–161

An occasional specimen is seen in which some of the gastrosteges are incomplete in that they fail to reach across the body. These incomplete shields usually extend nearly to the median line. Where there are several on one side the asymmetry is often compensated for by there being nearly an equal number on the opposite half of the body.

One specimen, a female, from San Francisco, Cat. No. 53574, U.S.N.M. (Orig. No. T–136), that is not included in the series, has nine incomplete gastrosteges on the right and none on the left side of the body. It is further abnormal in having a low gastrostege count of 149 (right), a scale formula of 21—19—17—15, and eight infralabial shields on the left side.

### Variation in Anal.

The normal condition is for this shield to be entire. There are no specimens in this series in which it is divided.

### Variation in Urosteges.

These plates are normally paired. An occasional specimen may be found in which from one to two of the urosteges remain entire. When this occurs, these undivided shields are regularly situated near the base of the tail. All showing this variation are males.

Paired throughout, 94 per cent; 1 to 2 entire, 6 per cent.

*Diagram showing the variation in the number of urosteges in specimens from San Francisco.*

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | ♂ | | | | | | |
| | | ♀ | | | | | | | | | | | ♂ | | | | | | |
| | | ♀ | | | | | | ♂ | | | | | ♂ | | | | | | |
| | | ♀ | | ♀ | | | | ♂ | | | | ♂ | ♀ | ♂ | | | | | |
| | ♀ | ♀ | | ♀ | ♀ | ♀ | ♀ | ♀ | | | | ♂ | ♀ | ♀ | | ♂ | | | ♂ |
| ♀ | ♀ | ♀ | | ♀ | ♀ | ♀ | ♀ | ♀ | ♀ | ♂ | ♂ | ♂ | ♂ | ♀ | ♂ | ♂ | ♂ | | ♂ |
| 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 |

Female:

Male.

Range of variation in 42 specimens:
Males, 18 specimens ........................................ 74—85
Females, 24 specimens ........................................ 66—80

Further along when the table comparing these specimens with the series from Sausalito is reviewed; it will be noted that in both localities the range in the number of urosteges is from 66 to 85. These bare figures fail to bring out one salient feature—the higher average that exists in the Sausalito set. This difference may be seen at a glance if the preceding and following diagrams be compared.

*Diagram showing the variation in the number of urosteges in specimens from Sausalito.*

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | ♂ | | | |
| | | | | | | | | | | ♀ | | | | | | ♂ | | | |
| | | | | | | | | | | ♂ | | | | | ♂ | ♂ | | | |
| | | | | ♀ | | | | | | ♀ | | | | | ♀ | ♂ | | | |
| | | | | ♀ | | | | | | ♂ | | | | ♂ | ♂ | ♂ | | ♂ | ♀ |
| ♀ | | ♀ | ♀ | ♀ | ♀ | | ♀ | ♀ | | ♂ | ♂ | ♂ | | ♂ | ♂ | ♂ | | ♂ | ♂ |
| 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 |

Female.

Male.

Range of variation in 32 specimens:
Males, 19 specimens ........................................ 76—85
Females, 13 specimens ........................................ 66—85

Over one-half of these from Sausalito have the tail docked, while less than one-fifth of the snakes from Golden Gate Park are similarly crippled. In grazing land this is frequently due to their being trodden upon by cattle. Where field rodents are plentiful the tail is often bitten off and devoured by these animals.

### VARIATION IN PREOCULAR.

The normal condition is a single preocular. Where two exist it is due to the fragmentation of the lower one-third of the normal shield. Where three are found it is due to a middle plate which has become separated from the anterior superior shield. In the majority of specimens the lower portion of the preocular is of a lighter tint and frequently is indented at the margins. In the specimens showing variation in this character 25 per cent are males.

| | Per cent. |
|---|---|
| 1 normal ........................................ | 92 |
| 1-2 asymmetrical ........................................ | 4 |
| 2 bilateral ........................................ | 2 |
| 2-3 asymmetrical ........................................ | 2 |

### VARIATION IN POSTOCULARS.

In this series the variation in the postocular shields is limited, much more so than in the Sausalito specimens. When the number is reduced to two it is due to the fusing of the normal middle and inferior shields; when increased to four it is due to the dividing of the inferior shield. In the specimens showing variation in this character 50 per cent are males.

| | | Per cent. |
|---|---|---|
| 3 | normal | 96 |
| 3–2 | asymmetrical | 2 |
| 3–4 | asymmetrical | 2 |

### VARIATION IN ANTERIOR TEMPORAL.

This shield is subject to but slight variation. When there are two it is due to a separation of the antero-external angle of the parietal. This part of the parietal is at times dented or partially incised. The single specimen showing an aberration in this character was a male.

| | | Per cent. |
|---|---|---|
| 1 | normal | 98 |
| 1–2 | asymmetrical | 2 |

### VARIATION IN POSTERIOR TEMPORALS.

These shields exhibit considerable irregularity as to shape and size. Their number may be increased to three; very rarely they become fused into one. The abnormal specimens were all females.

| | | Per cent. |
|---|---|---|
| 2 | normal | 92 |
| 2–3 | asymmetrical | 4 |
| 3 | bilateral | 4 |

### VARIATION IN SUPRALABIALS.

The normal is 8 supralabials with the fourth and fifth bordering the orbit. When the number is reduced to 7 it is due to the fusing of the normal second and third shields (66 per cent), or the sixth and seventh shields (33 per cent). None of the specimens in this set showed the increase to 9 supralabials which is known to occur at times in this species. In the specimens showing variation in this character 20 per cent are males.

| | | Per cent. |
|---|---|---|
| 8 | normal | 90 |
| 8–7 | asymmetrical | 10 |

### VARIATION IN INFRALABIALS.

The normal count is 10 infralabials. When the number is decreased to 9 it is due to the fusing of the normal third and fourth shields (82 per cent), or the normal seventh and eighth (18 per cent). When the number is further reduced to 8 it is due to the fusing of these same pairs—namely, the third and fourth and the seventh and eighth. None in this set showed the increase to 11 infralabials which is known to occur in specimens from this part of the State. Among the specimens showing variation in this character 27 per cent are males.

| | Per cent. |
|---|---|
| 10 normal | 78 |
| 10–9 asymmetrical | 14 |
| 9 symmetrical | 2 |
| 9–8 asymmetrical | 4 |
| 8 symmetrical | 2 |

One specimen, Cat No. 53574, U.S.N.M. (Orig. No. T–136), a female, shows marked asymmetry, there being 10 shields on one and 8 shields on the other side. This is the specimen in which many of the gastrosteges are incomplete.

### VARIATION IN GENEIALS.

The anterior and the posterior pairs may be equal in length, one pair may be longer or shorter than the other, and it often occurs that there is much discrepancy between the length of the right and left posterior shields. In spite of these facts, this purely book character—the relative length of the anterior in terms of the posterior pair of geneials—has been made use of in the attempt to separate this complex Pacific Coast garter snake into endless species.

### VARIATION IN GULARS.

The gular shields that lie between the posterior geneials and the first gastrostege are irregularly paired anteriorly and azygos posteriorly. The normal count is two paired and two unpaired shields. The variation ranges from four paired and one unpaired to one unpaired and four azygos shields.

## SUMMARY OF VARIATIONS.

The following may be assumed to be the normal conditions:

| | Per cent. |
|---|---|
| Scale rows, 19–21–19–17 | 56 |
| Preocular, 1 | 90 |
| Postoculars, 3 | 96 |
| Anterior temporal, 1 | 98 |
| Posterior temporals, 2 | 92 |
| Supralabials, 8 | 90 |
| Infralabials, 10 | 78 |
| Anal, entire | 100 |
| Urosteges, paired | 94 |

The following table shows the percentage of normal individuals and the percentage of those that are abnormal in one or more characters:

| | Per cent. |
|---|---|
| Normal in all characters | 38 |
| Abnormal in one character | 30 |
| Abnormal in two characters | 22 |
| Abnormal in three characters | 8 |
| Abnormal in four characters | 2 |

*Tabulated summary.*

| U.S.N.M. No. | Sex. | Scales. | Oculars. | | Temporals. | | Labials. | | Gast. | An. | Urost. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Pre. | Post. | Ant. | Post. | Supra. | Infra. | | | |
| 52176 | Male | 21-19-17 | | | | | | | 158 | | 81 |
| 52190 | Female. | 21-19-17 | | | | 3 | | | 153 | | 74 |
| 52159 | do | 21-19-17 | 2 | | | | | 9-10 | 155 | | ? |
| 53575 | do | 21-19-17 | | | | 3 | | | 151 | | 73 |
| 53577 | do | 21-19-17 | | | | | | | 157 | | 68 |
| 53545 | do | 21-19-17 | | 3-4 | | | | | 155 | | 75 |
| 52184 | Male | 19-21-19-17 | | | | | | | 154 | | 78 |
| 52163 | do | 19-21-19-17 | | | | | | | 158 | | ? |
| 52179 | do | 19-21-19-17 | | | | | | | 159 | | 76 (III) |
| 52180 | do | 19-21-19-17 | | | | | | | 159 | | 78 |
| 52166 | do | 19-21-19-17 | | | | | | | 160 | | 79 |
| 52174 | do | 19-21-19-17 | | | | | | | 160 | | 78 |
| 52181 | do | 19-21-19-17 | | | | | | 10-9 | 162 | | ? (II-IV) |
| 52162 | do | 19-21-19-17 | | | | | | | 162 | | ? |
| 53573 | do | 19-21-19-17 | | | | | | | 158 | | ? |
| 53583 | do | 19-21-19-17 | | | | | | 9 | 157 | | 77 |
| 53581 | do | 19-21-19-17 | | | | | | | 161 | | 82 |
| 52170 | Female. | 19-21-19-17 | | | | 3-2 | | | 147 | | 66 |
| 52161 | do | 19-21-19-17 | | | | | | | 150 | | ? |
| 52175 | do | 19-21-19-17 | | | | | | | 150 | | 70 |
| 52171 | do | 19-21-19-17 | | | | | | | 151 | | 67 |
| 52160 | do | 19-21-19-17 | 2-3 | | 2-1 | | | | 152 | | 74 |
| 52168 | do | 19-21-19-17 | | | | | | | 153 | | 70 |
| 52165 | do | 19-21-19-17 | | | | | | 10-9 | 153 | | ? |
| 52167 | do | 19-21-19-17 | 2-1 | | | | | | 155 | | 68 |
| 52164 | do | 19-21-19-17 | | | | | | | 155 | | 67 |
| 52185 | do | 19-21-19-17 | | | | | | | 156 | | 72 |
| 52158 | do | 19-21-19-17 | | | | | | | 157 | | ? |
| 52178 | do | 19-21-19-17 | | | | | | | 160 | | 71 |
| 52186 | do | 19-21-19-17 | | | | | | | 166 | | 74 |
| 53576 | do | 19-21-19-17 | | | | | | | 153 | | 71 |
| 53585 | do | 19-21-19-17 | | | | 3-2 | | 9-10 | 154 | | 68 |
| 53541 | do | 19-21-19-17 | | | | | | | 149 | | 68 |
| 53542 | do | 19-21-19-17 | | 4-3 | | | | | 153 | | 68 |
| 52182 | Male | 19-21-19-17-15 | | | | | 7-8 | | 156 | | 85 |
| 52173 | do | 19-21-19-17-15 | | | | | | | 156 | | 82 |
| 52172 | Female. | 19-21-19-17-15 | | | | | | | 152 | | 72 |
| 53580 | do | 19-21-19-17-15 | | | | | | | 151 | | 70 |
| 52169 | Male | 19-17 | | | | | 8-7 | 10-9 | 152 | | 74 |
| 53584 | do | 19-17 | | | | | | 9-8 | 159 | | 70 |
| 53579 | do | 19-17 | 1-2 | | | | 7-8 | 8-9 | 157 | | 79 |
| 53543 | do | 19-17 | | | | | | | 159 | | 80 |
| 53544 | do | 19-17 | | 3-2 | | | | 9-10 | 159 | | 74 |
| 53578 | do | 19-17 | | | | | | | 156 | | 79 (III) |
| 52187 | Female. | 19-17 | | | | | | | 152 | | 80 |
| 52177 | Male | 19-17-15 | | | | | | 9-10 | 153 | | 83 |
| 53582 | do | 19-17-15 | | | | | 8-7 | 8 | 156 | | 85 |
| 52188 | Female. | 19-17-15 | | | | | | | 156 | | 79 |
| 52183 | Male | Asymmetrical | | | | | | | 158 | | 80 |
| 52189 | Female. | Asymmetrical | | | | | 8-7 | | 159 | | 79 |

For the sake of clearness the normal records are indicated by dashes.

This table brings to light an interesting condition: Specimens that have the normal scale row count of 19–21–19–17 are prone to be normal in the remaining characters in that only 33 per cent of them present any variations; on the other hand, in those having an abnormal scale row count 66 per cent, possess other variations from the normal. This is an analogous condition to that shown in the study of degenerates among the human species. Individuals are much more liable to have several stigmata than but a single earmark of faulty heredity.

## INFLUENCE OF SEX ON VARIATION.

In zoology it is a fairly well established point that in a given species the range of variation is regularly greater in a series of males than in a series of female specimens. In the anthropoid apes and in the human species this is particularly noticeable, the female remaining nearer the infantile and generalized type than the male.

When the influence of sex is examined for *T. ordinoides*, it is found that the opposite condition prevails. The following list shows that a greater number of variations occur among the female specimens:

| | Male. | Female. |
|---|---|---|
| Abnormal as to— | *Per cent.* | *Per cent.* |
| Scale rows | 45 | 55 |
| Preocular | 25 | 75 |
| Post oculars | 33 | 67 |
| Anterior temporal | 100 | 0 |
| Posterior temporal | 0 | 100 |
| Supralabials | 20 | 80 |
| Infralabials | 27 | 73 |

## VARIATION IN COLOR.

In the young the ground color is almost invariably a dark olive; the dorsal and lateral rows of spots are large, regular, and sharply defined; the median stripe is pale yellow; the underside is greenish grey; no specimens are seen with even a trace of red.

In the adults the ground color varies in different examples, there being many hues of dull brick red, olive brown, and dark olive; the dorsal and lateral spots are clearly marked, in some the dorsal series is partly fused; the median stripe is sharply defined, varying from pale yellow to dark orange, and when of the latter color it is at times dotted with salmon; the lateral stripe is yellowish or greenish grey, in some this line is also dotted with salmon; the underside is usually a uniform bluish or greenish grey, and in a few specimens there are a few irregular reddish spots.

The most striking chromatic character in this set is the absence of any examples having the striped pattern, those in which the ground color is a solid dark brown, without spots or red, and with the median and lateral stripes bright and sharply defined. In having but the one color pattern this set from Golden Gate Park is distinctive. Series from over a score of different localities have been studied and each set regularly contained from two to three separate designs.

## FOOD.

The food was found to consist almost entirely of slugs, of the family *Arionidæ*. Two of the largest snakes had eaten small rodents, and several had remains of salamanders, *Batrachoseps*, and *Autodax* in the stomach.

The garden slugs in and about San Francisco are abundant and are most destructive to small and tender cultivated plants. As the Bay Region has not proved favorable for the establishing of toad colonies, the garter snakes assume a rôle of particular economic interest. They should become a special object of care and protection on the part of florists and gardeners.

## COMPARISON BETWEEN SAN FRANCISCO AND SAUSALITO SERIES.

There is presented for comparison in the following parallel columns a summary of the variations in the series from the two localities on either side of the Golden Gate:

| | San Francisco. | Sausalito. |
|---|---|---|
| Scale rows: | *Per cent.* | *Per cent.* |
| 21—23—21—19—17 | ............ | ............ |
| 21—19—17 | 12 | 6 |
| 19—21—19—17 | 56 | 66 |
| 19—21—19—17—15 | 8 | ............ |
| 19—17 | 14 | 10 |
| 19—17—15 | 6 | 12 |
| 19—17—15—13 | ............ | ............ |
| 17—19—17—15 | ............ | ............ |
| 17—15 | ............ | ............ |
| 15—17—15 | ............ | ............ |
| Asymmetrical | 4 | 4 |
| Preocular: | | |
| 1 normal | 92 | 86 |
| 1–2 asymmetrical | 4 | 10 |
| 2 bilateral | 2 | 4 |
| 2–3 asymmetrical | 2 | ............ |
| Postoculars: | | |
| 3 normal | 94 | 80 |
| 3–2 asymmetrical | 2 | 10 |
| 3–4 asymmetrical | 4 | 6 |
| 2 bilateral | ............ | 2 |
| 4 bilateral | ............ | 2 |
| Anterior temporal: | | |
| 1 normal | 98 | 94 |
| 1–2 asymmetrical | 2 | 4 |
| 2 bilateral | ............ | 2 |
| Posterior temporals: | | |
| 2 normal | 92 | 82 |
| 2–3 symmetrical | 4 | 12 |
| 3 bilateral | 4 | 6 |
| Supralabials: | | |
| 8 normal | 90 | 94 |
| 8–7 asymmetrical | 10 | 4 |
| 8–9 asymmetrical | ............ | 2 |
| Infralabials: | | |
| 10 normal | 78 | 74 |
| 10–11 asymmetrical | ............ | 6 |
| 10–9 asymmetrical | 14 | 10 |
| 10–8 asymmetrical | ............ | 2 |
| 9 bilateral | 2 | 4 |
| 9–8 asymmetrical | 4 | 4 |
| 8 bilateral | 2 | ............ |
| Anal: | | |
| Entire normal | 100 | 90 |
| Divided | ............ | 10 |
| Urosteges: | | |
| Paired normal | 94 | 72 |
| 1 to 4 entire | 6 | 28 |
| Gastrosteges (plates) | 147–166 | 145–164 |
| Urosteges (plates) | 66–85 | 66–85 |

The following table accentuates the difference in the two series, the San Francisco group containing fewer specimens that vary from what may be assumed to be the normal for the region.

| | San Francisco. | Sausalito. |
|---|---|---|
| | *Per cent.* | *Per cent.* |
| Normal in all characters | 38 | 14 |
| Abnormal in one character | 30 | 44 |
| Abnormal in two characters | 22 | 20 |
| Abnormal in three characters | 8 | 14 |
| Abnormal in four characters | 2 | 6 |
| Abnormal in five characters | ...... | 2 |

The color characters of the two sets differ to a marked degree. All the specimens captured or seen in Golden Gate Park have the pronounced spotted pattern. Of those from the Sausalito peninsula about two-thirds of the examples are similarly marked, though in darker tones. The remaining one-third have the striped pattern; in these the ground is a dark brown, the dorsal and lateral spots are absent, the median and lateral stripes are distinct, and are without any red on the underside.

### GEOGRAPHIC VARIATION.

In the Memoir of Doctor Ruthven it was pointed out that the specimens of this species became smaller, the head shields reduced in number, and the scale rows less numerous as the range extended to the north. The various sets presented in the following tables confirm these findings. The one additional fact brought out is that these dwarfed members of the species are prone to be found in localities having lower temperatures, rather than merely a higher latitude.

#### Merced County, California.

Scale formulas 21—23—21—19—17
21—19—17

| Museum. Cal. Ac. Sci. | Locality. | Sex. | G. | A. | U. | Scale rows. 21+V. | 23—V. | 21—VI. | 19—IV. | 17 cont. | Gulars. Prs. | Azy. | Pro. | Pto. | Supral. | Infral. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13635 | Los Baños | ♀ | 152 | ϵ | 71 | 25 25 | 56 54 | 80 83 | 129 125 | ...... | 1 | 4 | 1 | 3 | 8 | 10 |
| 13636 | do | ♂ | 158 | ϵ | 77 | 29 38<br>43 | 53 39<br>43 | 81 82 | 116 122 | ...... | 1 | 3 | 1 | 2 | 8 | 9 |
| 13637 | do | .... | 154 | .... | (?) | 27 28 | 63 60 | 81 85 | 112 115 | ...... | 2 | 3 | 1 | 3 | 8 | 10 |
| 13638 | do | ♀ | 156 | ϵ | 69 | ...... | ...... | 78 81 | 98 98 | ...... | 2 | 3 | 1 | 3 | 8 | 11-10 |
| 13640 | do | ♀ | 153 | ϵ | 72 | ...... | ...... | 76 80 | 93 97 | ...... | 2 | 3 | 1 | 2-3 | 8 | 11 |
| 36071 | do | ♀ | 154 | ϵ | (?) | 47 40 | 49 48 | 83 83 | 104 105 | ...... | 1 | 3 | 1 | 3 | 8 | 11-9 |
| Univ. Cal. 5428. | Gadwell | ♀ | 154 | ϵ | (?) | 28 30 | 60 62 | 81 82 | 114 111 | ...... | 1 | 4 | 1 | 3 | 8 | 11 |

The color of the specimens from Los Baños is of one pattern: The ground a uniform light-brownish olive; faint trace of small dorsal spots; these tend to encroach upon the median stripe; the median stripe indicated by a paler tint than the ground color; below no spots.

### Monterey County, California.

Scale formulas 19-21-19-17
19-17
19-17-15

| Museum Cal. Ac. Sci. | Locality. | Sex. | G. | A. | U. | Scale rows. 19+VI. | 21—VI. | 19—IV. | 17—VII. | 15 cont. | Gulars. Prs. | Azy. | Pro. | Pto. | Supral. | Infral. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13756 | Carmel | ♂ | 157 | ϵ | (?) | 36 39 | 54 55 | 79 81 | ........ | ...... | 1 | 3 | 1 | 3 | 8 | 10 |
| 13760 | do | ♂ | 152 | ϵ | (?) | 39 42 | 56 55 | 85 85 | ........ | ...... | 2 | 2 | 1 | 3 | 8 | 10 |
| 13761 | do | ♂ | 149 | ϵ | (?) | ...... | ...... | 81 81 | 147 142 | ...... | 1 | 3 | 1 | 3 | 8 | 10 |
| 13764 | Monterey | ♂ | 147 | ϵ | 76 | ...... | ...... | 78 80 | ........ | ...... | 1 | 2 | 1 | 3 | 8 | 10 |
| 13765 | do | ♂ | 155 | ϵ | (?) | ...... | ...... | 84 85 | 131 143 | ...... | 1 | 2 | 1 | 3 | 8 | 10 |
| 13757 | Carmel | ♀ | 142 | ϵ | 65 | ...... | ...... | 62 56 | 97 99 | ...... | 1 | 3 | 1 | 3 | 7 | 10 |
| 13758 | do | ♀ | 155 | ϵ | 68 | 23 23 | 71 74 | 89 91 | ........ | ...... | 2 | 3 | 1 | 3 | 8 | 10 |
| 13759 | do | ♀ | 146 | ϵ | 69 | 17 20 | 66 62 | 85 87 | ........ | ...... | 2 | 3 | 1 | 3 | 8 | 10 |

The color of this set is as follows: The ground varies from a very dark red-brown to a dark brown; the dorsal and lateral rows of spots absent or when visible ranging from a mere shade darker than the ground color to sharply defined marks; the median stripe uniform canary yellow or mixed yellow and salmon; the lateral stripe yellowish green or nearly solid salmon.

### San Mateo County, California.

Scale formulas 19-17
19-17-15
17-15

| Museum U.S.N.M. | Locality. | Sex. | G. | A. | U. | Scale rows. 19—IV. | 17—VII. | 15 cont. | Gulars. Prs. | Azy. | Pro. | Pto. | Supral. | Infral. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 50307 | Half Moon Bay | .... | 157 | ϵ | 83 | 82 82 | ........ | ...... | 1 | 3 | 1 | 3 | 8 | 9-10 |
| 53538 | San Andreas | ♀ | 151 | ϵ | .... | 81 81 | ........ | ...... | 2 | 3 | 1 | 3 | 8 | 10 |
| 53540 | do | ♀ | 144 | ϵ | 75 | 74 75 | 133 126 | ...... | 2 | 2 | 1 | 3 | 8 | 10 |
| 53539 | do | ♀ | 141 | ϵ | .... | ...... | 78 79 | ...... | 2 | 2 | 2 | 3 | 7 | 8-9 |

One of the most interesting garter snakes on record is Cat. No. 53539, U.S.N.M. (Orig. No. K. 103), collected by H. C. Kellers, United States Navy. It is the only specimen known from south of Eureka with the minimum formula of 17–15. Associated with this low scale count is a reduction in the supralabial shields to 7, a condition also found as far as this species is concerned only in the north.

### Alameda County, California.

Scale formulas 21-19-17
19-21-19-17
19-17

| Museum No. U.S.N.M. | Locality. | Sex. | G. | A. | U. | Scale rows. | | | | Gulars. | | Pro. | Pto. | Supral. | Infral. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 19+VI. | 21−VI. | 19−IV. | 17 cont. | Prs. | Azy. | | | | |
| 52194.......... | Alameda.......... | ♂ | 162 | ϵ | (?) | 28 33 | 63 67 | 90 93 | ...... | 1 | 3 | 2 | 3 | 8 | 10 |
| 52195.......... | .....do.......... | ♂ | 161 | ϵ | 86 | 28 29 | 63 75 | 88 89 | ...... | 1 | 3 | 1 | 3 | 8 | 10 |
| 52196.......... | .....do.......... | ♀ | 162 | ϵ | 84 | ...... | 81 83 | 105 104 −III | ...... | 1 | 4 | 1 | 3 | 8 | 10 |
| Cal. Ac. Sci. 13223. | San Leandra..... | ♂ | 162 | ϵ | (?) | 28 27 | 61 66 | 89 85 | ...... | 2 | 2 | 1 | 2 | 8 | 9 |
| Univ.Cal.5417 | Berkeley........ | ♀ | 158 | ϵ | 80 | 23 26 | 67 66 | 90 91 | ...... | 2 | 2 | 2 | 3 | 8 | 10 |
| 5418.......... | .....do.......... | ♀ | 163 | ϵ | 82 | 25 27 | 69 69 | 88 89 | ...... | 2 | 2 | 1 | 3 | 8 | 10 |
| 5419.......... | .....do.......... | ♀ | 158 | ϵ | 78 | ...... | ...... | 81 83 | ...... | 3 | 1 | 1 | 3 | 8 | 10 |

The prevailing arrangement of color in this set is as follows: Ground dark olive brown; dorsal and lateral spots usually present in the young and absent in the adult; median stripe pale yellow in the young, orange or vermillion in the adult; lateral stripe light olive gray, with or without salmon; below uniform greenish gray, or with salmon spots.

### Sonoma County, California.

Scale formulas 19-17
19-17-15

| Museum Cal. Ac. Sci. | Locality. | Sex. | G. | A. | U. | Scale rows. | | | Gulars. | | Pro. | Pto. | Supral. | Infral. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 19−IV. | 17−VII. | 15 cont. | Prs. | Azy. | | | | |
| 28021.......... | Scaggs.............. | ♂ | 158 | ϵ | 90 | 85 86 | 125 123 | ...... | 1 | 3 | 1 | 3 | 8 | 10 |
| 28025.......... | Springs.............. | ♂ | 160 | ϵ | 86 | 79 83 | 138 133 | ...... | 1 | 2 | 1 | 3 | 8 | 10 |
| 28029.......... | .....do.............. | ♂ | 162 | ϵ | 87II-IV | 88 91 | ........ | ...... | 1 | 3 | 1 | 3 | 8 | 10 |
| 28019.......... | .....do.............. | ♀ | 150 | ϵ | 71 | 80 82 | ........ | ...... | 2 | 2 | 1 | 2 | 8 | 10 |
| 28024.......... | .....do.............. | ♀ | 150 | ϵ | (?) | 77 79 | ........ | ...... | 1 | 3 | 1 | 3 | 8 | 9 V+VI |

The color pattern of this set is as follows: The ground is a dark olive brown; the dorsal and lateral rows of spots are usually absent or but faintly defined; the median stripe bright yellow; the lateral stripe yellowish gray; below uniform olive gray.

MENDOCINO COUNTY, CALIFORNIA.

Scale formulas 19–21–19–17
19–17–15

| Museum Cal. Ac. Sci. | Locality. | Sex. | G. | A. | U. | Scale rows. 19+VI. | 21−VI. | 19−IV. | 17−VII. | 15 cont. | Gulars. Prs. | Azy. | Pro. | Pto. | Supral. | Infral. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28302 | Comptche | ♂ | 152 | ϵ | 75 | ...... | ...... | 81 84 | −III<br>126 133 | ...... | 1 | 3 | 1 | 3 | 8 | 10 |
| 28303 | do | ♂ | 154 | ϵ | 85 | ...... | ...... | 83 83 | 141 141 | ...... | 1 | 3 | 1 | 3 | 8 | 10 |
| 28304 | do | ♂ | 153 | ϵ | 76 | ...... | ...... | 73 71 | 103 118 | ...... | 1 | 3 | 1 | 3 | 8 | 9 III+IV |
| 28306 | do | ♂ | 157 | ϵ | (?) | 23 26 | 51 61 | 84 85 | ........ | ...... | 1 | 3 | 1 | 3 | 8 | 10 |
| 28308 | do | ♂ | 148 | ϵ | 83 | ...... | ...... | 77 79 | 130 137 | ...... | 1 | 4 | 1 | 3 | 8 | 9 III+IV |
| 28307 | do | ♀ | 149 | ϵ | (?) | 13 26 | 68 63 | 89 90 | ........ | ...... | 2 | 2 | 1 | 3 | 8 | 10 |

The color design of this set is as follows: The ground varies from olive brown to olive gray; dorsal and lateral spots when present small and indistinct; the median stripe distinct and yellowish or merely indicated as a lighter tint than the ground color; lateral stripe usually poorly defined.

DEL NORTE COUNTY, CALIFORNIA.

Scale formulas 19–21–19–17
19–17

| Museum Cal. Ac. Sci. | Locality. | Sex. | G. | A. | U. | Scale rows. 19+VI. | 21−VI. | 19−IV. | 17 cont. | Gular. Prs. | Azy. | Pro. | Pto. | Supral. | Infral. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29076 | Regua | ♂ | 156 | ϵ | 79 (II−III) | 29 31 | 58 54 | 78 82 | ...... | 1 | 3 | 1 | 3 | 8 | 10 |
| 29081 | do | ♂ | 155 | ϵ | 80 | ...... | ...... | 77 79 | ...... | ... | ... | 1 | 3 | 8 | 9 |
| 29073 | do | ♀ | 157 | ϵ | (?) | 28 26 | 60 60 | 89 89 | ...... | ... | ... | 1 | 3 | 8 | 8 II+III 10<br>VIII+IX |
| 29080 | do | ♀ | 147 | ϵ | (?) | ...... | ...... | 74 75 | ...... | ... | ... | 1 | 3 | 8 | 9 |
| 29082 | do | ♀ | 153½ | ϵ | 68 | ...... | ...... | 84 86 | ...... | ... | ... | 1 | 3 | 8 | 10 |

The colors are dull; ground dark brown; spots absent or indicated by darker tones; median stripe dull orange, lateral yellowish grey. This set begins to show the marked reduction in size that occurs to the north; the largest, No. 29081, measures 640 mm.; tail, 161; head, from tip of snout to behind angle of jaw, 22.5; snout, 7.2; eye, 3.5.

CURRY COUNTY, OREGON.

Scale formulas 17-19-17-15
17-15

| Museum Cal. Ac. Sci. | Locality. | Sex. | G. | A. | U. | Scale rows. | | | | Gulas. | | Pro. | Pto. | Supral. | Infral. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 17+IV. | 19–IV. | 17–VII. | 15 cont. | Prs. | Azy. | | | | |
| 29272 | Harbor..... | ♂ | 139 | ϵ | 70 | 27 40<br>29<br>33 47 | 27 41<br>29<br>34 48 | 85 81 | .... | 1 | 3 | 1 | 3 | 7 | 8 III+IV 9 |
| 29274 | .....do...... | ♂ | 146 | ϵ | 77 | ...... | ...... | 77 82 | .... | 1 | 3 | 1 | 3 | 7 | 9 |
| 29275 | .....do...... | ♂ | 148 | ϵ | 77 | ...... | ...... | 76 79 | .... | 1 | 3 | 1 | 3 | 7 | 9 |
| 29268 | .....do...... | ♂ | 153 | ϵ | 77 | ...... | ...... | 74 75 | .... | 2 | 2 | 1 | 3 | 7 | 9 |
| 29273 | .....do...... | ♀ | 140 | ϵ | ... | ...... | ...... | 80 80 | .... | 1 | 3 | 1 | 3 | 8 (II) | 9 |
| 29277 | .....do...... | ♂ | 140 | ϵ | ... | ...... | ...... | 77 77 | .... | 1 | 3 | 1 | 3 | 8 (II) 7 | 8 (III+IV) |
| 29278 | .....do...... | ♀ | 1 | ϵ | ... | ...... | ...... | 84 83 | .... | 1 | 3 | 1 | 2 | 7 | 8 (III+IV) |
| 29269 | .....do...... | ♀ | 2 | ϵ | 66 | ...... | ...... | 78 75 | .... | 1 | 3 | 1 | 3 | 7 | 8 (III+IV) |
| 29276 | .....do...... | ♀ | 2 | ϵ | ... | ...... | ...... | 85 87 | .... | 1 | 3 | 1 | 3 | 7 | 8 rt, VII+VIII<br>8 lt, VIII+IX |
| 29271 | .....do...... | ♀ | 5 | ϵ | 59 | 45 | 56 | 97 101 | .... | 1 | 3 | 1 | 3 | 7 | 9 |
| 29279 | .....do...... | ♀ | 5 | ϵ | 64 | ...... | ...... | 79 81 | .... | 1 | 2 | 1 | 3 | 7 | 8 III+IV |
| 29270 | .....do...... | ♀ | 7 | ϵ | 70 | 39 | 39 | 74 76 | .... | 2 | 1 | 1 | 3 | 7 | 8 III+IV |

The color pattern of this set is quite simple; ground light olive brown, or brown; spots usually absent, or indicated as darker shades of brown; stripes indistinct or sharply marked, median brick red, ateral faintly paler than ground color; below bluish grey, with or without red.

It will be noted that the predominant type of scale formula is the one with 17 rows anteriorly and 15 posteriorly, this occurring in 75 per cent of the specimens. Those in the 17–19–17–15 class are either asymmetrical or have very few scales in the added IV row. All are of small size, the average being about 400 mm. in length.

In looking over the tables which will follow of series from localities to the north, it will be observed that the specimens are larger and the increased scale formula of 17–19–17–15 again prevails as it does to the immediate south. Incidentally, southwestern Oregon is one of the coldest portions of the Pacific coast region, and the localities mentioned to the north are actually much warmer. It becomes evident that the reduced size and lower scale counts in *T. ordinoides* are correlated with colder climate rather than mere extension of the range to more northern latitudes.

### TILLAMOOK COUNTY, OREGON

Scale formulas 17-19-17-15
17-15

| Museum Cal. Ac. Sci. | Locality. | Sex. | G. | A. | U. | Scale rows. 17+IV. | 19−IV. | 17−VII. | 15 cont. | Gulars Prs. | Azy. | Pro. | Pto. | Supral. | Infral. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29688 | Tillamook | ♂ | 145 | ϵ | 60 | 27 31 | 57 57 | 87 85 | .... | 2 | 2 | 1 | 3[8] | 7 8 II | 10 VIII III 9 VIII |
| 29693 | .....do.... | ♂ | 146 | ϵ | (?) | ...... | ...... | 90 87 | .... | 1 | 2 | 1 | 3 | 7 | 8 |
| 29690 | .....do.... | ♂ | 149 | ϵ | 71 | 29 27 | 52 50 | 93 94 | .... | 1 | 2 | 2 | 3 | 7 | 8 |
| 29692 | .....do.... | ♀ | 142 | ϵ | 59 | 26 37 | 56 60 | 101 100 | .... | 1 | 2 | 1 | 3 | 7 | 9 III 8 |
| 29694 | .....do.... | ♀ | 146 | ϵ | 56 | 26 26 | 65 63 | 120 120 | .... | 1 | 2 | 1 | 3 | 6 V+VI 7 | 8 |
| 29697 | .....do.... | ♀ | 150 | ϵ | (?) | ...... | ...... | 90 89 | .... | 2 | 2 | 1 | 3 | 7 | 8 |
| 29695 | .....do.... | ♀ | 152 | ϵ | (?) | 38 | 43 | 93 95 | .... | 1 | 2 | 1[8] | 3 | 7 | 8 |

This set has the normal scheme for the northern limits; ground brown; spots absent or small; median stripe orange or yellowish green. The largest (No. 29694) measures 496 mm.

### CHEHALIS COUNTY, WASHINGTON.

Scale formulas 17-19-17-15
17-15

| Museum Cal. Ac. Sci. | Locality. | Sex. | G. | A. | U. | Scale rows. 17+IV. | 19−IV. | 17−VII. | 15 cont. | Gulars Prs. | Azy. | Pro. | Pto. | Supral. | Infral. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29940 | Melbourne. | ♂ | 139 | ϵ | (?) | 30 27 | 53 53 | 82 78 | .... | 1 | 2 | 1 | 3 | 7 | 8 |
| 29938 | .....do..... | ♂ | 143 | ϵ | 63 | 20 22 | 58 57 | 90 87 | .... | ... | ... | 2 | 2 | 6 III+IV 7 | 9 VII 8 |
| 29930 | .....do..... | ♂ | 145 | ϵ | 67 | 29 36 | 51 54 | 98 96 | .... | ... | ... | 1 | 3 | 7 | 9 VII 8 |
| 29932 | .....do..... | ♂ | 147 | ϵ | 63 | 30 30 | 55 55 | 89 88 | .... | ... | ... | 1 | 3 | 7 | 9 VII 8 |
| 29937 | .....do..... | ♂ | 147 | ϵ | 61 | ...... | ...... | 99 97 | .... | ... | ... | 1 | 3 | 7 | 8 |
| 24101 | Montesano. | ♂ | 150 | ϵ | (?) | ...... | ...... | 86 90 | .... | 0 | 4 | 1 | 3 | 7 | 8 |
| 29931 | Melbourne. | ♀ | 141 | ϵ | (?) | 23 24 | 63 60 | 85 92 | .... | ... | ... | 2-1 | 3 | 7 | 8 |
| 29935 | .....do..... | ♀ | 141 | ϵ | (?) | 27 26 | 66 63 | 90 90 | .... | ... | ... | 1 | 3 | 7 | 8 |
| 29936 | .....do..... | ♀ | 143 | ϵ | (?) | 26 26 | 56 55 | 96 88 | .... | ... | ... | 1 | 3 | 7 | 8 |
| 29933 | .....do..... | ♀ | 144 | ϵ | 60 | 41 31 47 | 41 31 48 | 91 83 | .... | ... | ... | 1 | 3 | 7 6 IIII+IV | 8 |
| 29939 | .....do..... | ♀ | 144 | ϵ | 63 | 20 13 | 75 77 | −III125 122 | .... | ... | ... | 1 | 3 | 9 II 8 | 9 VII |
| 24102 | Montesano. | ♀ | 145 | ϵ | 59 | 25 23 | 70 76 | 121 122 | .... | 1 | 2 | 1 | 3 | 7 | 7 VII+VIII |
| 29934 | Melbourne. | ♀ | 146 | ϵ | 57 | 23 23 | 56 52 | −III 84 83 | .... | ... | ... | 1 | 3 | 7 | 8 |
| 24103 | Montesano. | ♀ | 148 | ϵ | 59 | 26 28 | 69 70 | 115 110 | .... | ... | ... | 1 | 3 | 7 | 8, 7 III+IV |

The color pattern of these northern specimens is generally dull, not pronounced; ground olive grey; dorsal and lateral spots small and faint; median stripe barely a shade paler than the ground color, in others sharply defined.

### Pacific County, Washington.

Scale formulas 17-19-17-15
17-15

| Museum No. Cal.Ac. Sci. | Locality. | Sex. | G. | A. | U. | Scale rows. 17+IV. | 19−IV. | 17−VI. | 15 cont. | Gulars Prs. | Axy. | Pro. | Pto. | Supral. | Infral. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29925 | Trap Creek ..... | ♂ | 144 | ϵ | (?) | 22 22 | 58 54 | 107 103 | .... | 1 | 3 | 2 | 3 | 7 | 9 VII 8 |
| 29924 | .....do.......... | ♂ | 146 | ϵ | 72 | 35 31 | 54 56 | 113 116 | .... | 1 | 3 | 2 | 3 | 7 | 8 |
| 29923 | .....do.......... | ♀ | 146 | ϵ | 60 | .......... | .......... | 108 100 | .... | 1 | 3 | 1 | 3 | 7 | 8 |
| 29926 | .....do.......... | ♀ | 146 | ϵ | (?) | +V 25 26 | −IV 66 69 | 94 100 | .... | 3 | 0 | 1-2 | 3 | 7 | 9 VII |

This set has markedly somber hues; the ground dark brown; dorsal and lateral spots indicated by darker shades; median stripe narrow, pale yellow; lateral stripe distinct; below dark grey. The measurements of the largest specimen, No. 29923, are as follows: Total length, 516 mm.; tail, 115; head, 17; snout, 4.8; eye, 2.6 mm.

## SUMMARY OF SCALE FORMULAE IN THAMNOPHIS ORDINOIDES.

A tabulated summary of the occurrence of the different scale formulae in these various sets will show at a glance the prevailing types for each locality; to facilitate comparison they are given as percentages.

| Scale formulas. | California. Merced. | Monterey. | San Mateo. | Alameda. | San Francisco. | Sausalito. | Marin. | Sonoma. | Mendocino. | Del Norte. | Oregon. Curry. | Tillamook. | Washington. Chehalis. | Pacific. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21-23-21-19-17.... | 72 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 21-19-17.......... | 28 | .... | .... | 14 | 12 | 6 | 33 | .... | .... | .... | .... | .... | .... | .... |
| 19-21-19-17........ | .... | 50 | .... | 71 | 56 | 66 | .... | .... | 33 | 40 | .... | .... | .... | .... |
| 19-21-19-17-15.... | .... | .... | .... | .... | 8 | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 19-17.............. | .... | 12 | 50 | 14 | 16 | 10 | .... | 63 | .... | 60 | .... | .... | .... | .... |
| 19-17-15........... | .... | 37 | 25 | .... | 4 | 12 | 66 | 37 | 66 | .... | .... | .... | .... | .... |
| 19-17-15-13........ | .... | .... | .... | .... | .... | 2 | .... | .... | .... | .... | .... | .... | .... | .... |
| 17-19-17-15........ | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 16 | 57 | 82 | 21 |
| 17-15.............. | .... | .... | 25 | .... | .... | .... | .... | .... | .... | .... | 76 | 28 | 18 | 79 |
| 15-17-15........... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 1 | .... | .... |
| Asymmetrical...... | .... | .... | .... | .... | 4 | 4 | .... | .... | .... | .... | 8 | 14 | .... | .... |

This table brings out several instructive facts. The decrease in the number of rows in specimens from more northern regions is not a perfectly regular one, each locality having a decidedly different average. In the same locality there is never a single type. Where two or more fomulas exist they are never equally divided among the specimens, one type regularly predominating to a marked degree.

## NOTE ON SCALE FORMULA IN THAMNOPHIS PARIETALIS (SAY) AND THAMNOPHIS COCCINUS (HALLOWELL).

Another species of garter snake found in the same region with *T. ordinoides* is *Thamnophis parietalis* (Say) 1823; this form is noteworthy in possessing but one type of squamation, there being 19 rows anteriorly and 17 posteriorly. As this formula is a fairly prevalent one in *T. ordinoides* it will prove of interest to compare a small set of each species from the same locality. Specimens have been chosen from Skaggs Springs, Sonoma County, California, owing to this place being approximately in the middle of the area occupied by *T. ordinoides.*

SKAGGS SPRINGS, SONOMA COUNTY, CALIFORNIA.

T. ORDINOIDES.

| Museum Cal. Ac. Sci. | Sex. | G. | Scale rows. | | |
|---|---|---|---|---|---|
| | | | 19—IV. | | 17 cent. |
| 27940 | Male | 157 | 80 | 79 | |
| 28029 | ...do | 162 | 88 | 91 | |
| 28024 | Female | 150 | 77 | 79 | |
| 28019 | ...do | 150 | 80 | 82 | |
| 27938 | ...do | 160 | 84 | 85 | |

T. PARIETALIS.

| Museum Cal. Ac. Sci. | Sex. | G. | 19—IV. | | 17 cent. |
|---|---|---|---|---|---|
| 28026 | Male | 157 | 100 | 90 | |
| 28023 | Female | 151 | 89 | 88 | |
| 28028 | ...do | 154 | 80 | 82 | |
| 28027 | ...do | 157 | 84 | 85 | |
| 28022 | ...do | 157 | 90 | 87 | |

This table shows that there is a tendency in *T. parietalis* for the 19-row zone to be continued a little further down the body. This, however, is merely a slight difference in the averages of two small sets.

The only remaining species found along the Northwest Coast is *T. coccinus* (Hallowell) 1852, this also presents the one scale count of 19–17.

TRASK, TILLAMOOK COUNTY, OREGON.

T. COCCINUS.

| Museum Cal. Ac. Sci. | Sex. | G. | Scale rows. | | |
|---|---|---|---|---|---|
| | | | 19—IV. | | 17 cent. |
| 29740 | Male | 167 | 87 | 91 | |
| 29738 | ...do | 162 | 88 | 89 | |
| 29741 | ...do | 160 | 83 | 84 | |
| 29737 | Female | 159 | 90 | 89 | |
| 29734 | ...do | 154 | 92 | 94 | |

This table shows that the IV row does not extend quite so far down the body as in *parietalis*.

SUMMARY OF SCALAE FORMULAS IN GENUS THAMNOPHIS.

Doctor Ruthven recognizes 19 species of garter snakes in North America. Among these there are known 11 distinct combinations of scale row counts. The occurrence of the various combinations among the different species may be seen from the following table:

| Species. | 21–23–21–19–17. | 21–19–17. | 19–21–19–17. | 19–21–19–17–15. | 19–17. | 19–17–15. | 19–17–15–13. | 17–19–17. | 17–19–17–15 | 17–15. | 15–17–15. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Megalops* | * | * | * |  | * |  |  |  |  |  |  |
| *Marciana* |  | * |  |  |  |  |  |  |  |  |  |
| *Rudix* |  | * | * |  | * |  |  | * |  |  |  |
| *Butleri* |  |  |  |  | * |  |  | * |  |  |  |
| *Proximus* |  |  |  |  | * |  |  | * |  |  |  |
| *Saurita* |  |  |  |  | * |  |  |  |  |  |  |
| *Sackeni* |  |  |  |  | * |  |  |  |  |  |  |
| *Angustirostris* | * | * | * |  |  |  |  |  |  |  |  |
| *Elegans* |  | * | * |  |  | * |  |  |  |  |  |
| *Ordinoides* | * | * | * | * | * | * | * |  | * | * | * |
| *Hammondi* |  | * | * |  |  |  |  |  |  |  |  |
| *Melanogaster* |  |  | * |  |  |  |  |  |  |  |  |
| *Scalaris* |  |  | * |  |  |  |  |  |  |  |  |
| *Phenax* |  |  | * |  | * |  |  |  | * |  |  |
| *Eques* |  |  |  |  | * |  |  |  | * |  |  |
| *Sumichrasti* |  |  |  |  |  | * |  | * |  | * |  |
| *Parietalis* |  |  |  |  | * |  |  |  |  |  |  |
| *Coccinus* |  |  |  |  | * |  |  |  |  |  |  |
| *Sirtalis* |  |  |  |  | * |  |  |  |  |  |  |

Inspection of this table shows that the formula of 19–17 is the most frequent, as it occurs in 12 species; also that there are eight species with only one scale row count, which in these cases is regularly one of the following three: 21–19–17, 19–21–19–17, or 19–17; and, finally, that in *Thamnophis ordinoides*, there are to be found twice as many combinations as are to be seen in any of the other species.

If *ordinoides* is a valid species it offers an example at variance with the prevailing condition in which it is the species with the widest ranges that vary the most, for *ordinoides* has one of the smallest areas of distribution in the genus. If the converse is true, which is most probable, and it ultimately proves to be inseparable from *elegans*, it will then conform to the rule in having a wide distribution and a large variability.

The handling of large series of garter snakes will inevitably result in bringing about a readjustment and broadening of one's concept of what may be implied by Wallace's phrase: "The variability of a species in the state of nature."