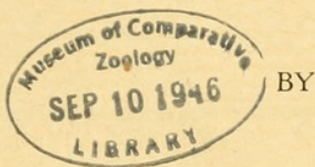


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THE GOPHER SNAKES OF BAJA CALIFORNIA,
WITH DESCRIPTIONS OF NEW SUBSPECIES OF
PITUOPHIS CATENIFER



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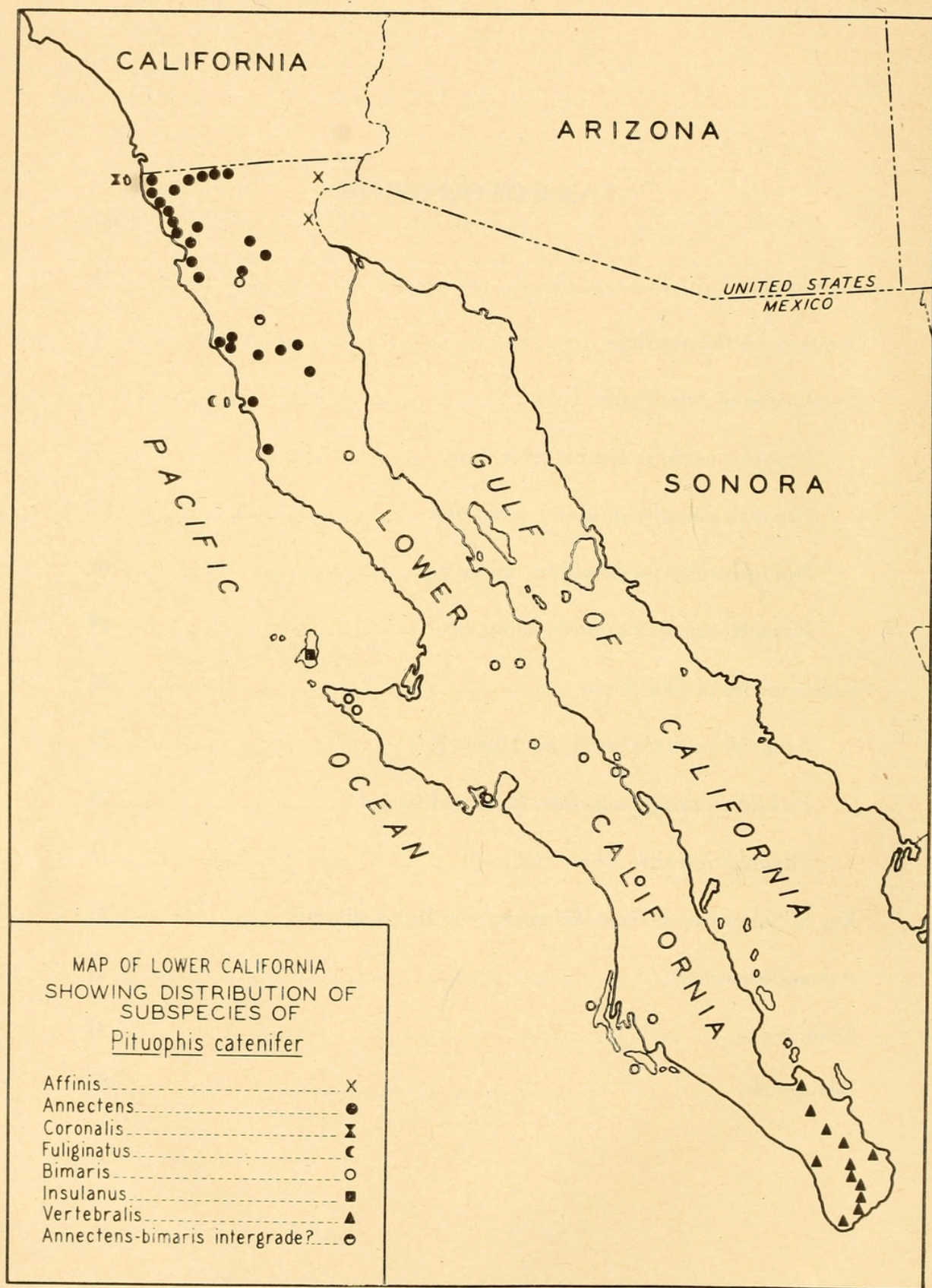
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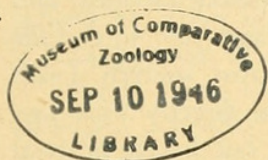
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TABLE OF CONTENTS

	<i>Page</i>
Introduction	1
Summary of Relationships	1
Descriptions of New Forms	7
<i>Pituophis catenifer bimaris</i> subsp. nov.	7
<i>Pituophis catenifer insulanus</i> subsp. nov.	11
<i>Pituophis catenifer fuliginatus</i> subsp. nov.	14
<i>Pituophis catenifer coronalis</i> subsp. nov.	19
Redescriptions of Old Forms	22
<i>Pituophis catenifer vertebralis</i> (Blainville)	22
<i>Pituophis catenifer annectens</i> Baird and Girard	25
<i>Pituophis catenifer affinis</i> Hallowell	28
Key to Subspecies of <i>Pituophis catenifer</i> in Baja California	31
Acknowledgments	32
Summary	33
Bibliography	33



898
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INTRODUCTION

There have been lately added to the collection of the San Diego Society of Natural History, and to my own, specimens of gopher snakes of the genus *Pituophis* from various localities in Baja California, Mexico. Some of these are from areas of importance in determining relationships, and it therefore has seemed desirable to resurvey the snakes of the peninsula. Through the courtesy of a number of institutions I have had the privilege of examining their collections from Baja California. As a result, I find four new subspecies to be distinguishable, one mainland and three island. These I shall describe, following which the previously known forms, as newly delimited, will be summarized. These determinations have been facilitated by recently acquired material from the southwestern United States not available to those who have previously made revisions of the genus (Van Denburgh and Slevin, 1919; Van Denburgh, 1920; Miss Stull, 1932, 1940). I expect to discuss the classification of some of the forms not occurring in Baja California in a subsequent paper.

SUMMARY OF RELATIONSHIPS

Before undertaking the descriptions of the new forms, it is necessary to summarize my reasons for considering all of them, and in fact all the gopher or bull snakes of the region west of the Mississippi River (except *ruthveni*), to be subspecies of a single form, *Pituophis catenifer*. I find an unbroken chain of intergradation connecting them all, either evident or strongly indicated.

First, the subspecies *catenifer catenifer* intergrades with *annectens* north of Santa Barbara, California. These two subspecies are not sharply differentiated and therefore the zone of intergradation is broad.

Catenifer intergrades with *deserticola* in the western Mojave Desert at the foot of the Tehachapi Mountains, and in the Lassen and the Klamath

areas. Similarly, *annectens* intergrades with *deserticola* where the San Gabriel and San Bernardino ranges descend into the Mojave Desert.

Deserticola, in turn, intergrades with *affinis* along the northern border of Riverside County, California, and across the Grand and Marble canyons, and to the south of Kayenta, in northern Arizona. *Affinis* and *sayi* intergrade along a broad contact from central New Mexico south across western Texas into Chihuahua and Coahuila. *Deserticola* may intergrade directly with *sayi* at the headwaters of the Green River in western Wyoming, but I have no final proof of this.

Annectens and *affinis* may contact or overlap in eastern San Diego County, California; there is no evidence here of intergradation, although fairly good series of both forms are available from closely contiguous points, which, in this area, involve a steep ecological gradient. Two peculiar specimens from the Sierra Juárez in Baja California suggest the possibility of *annectens-affinis* intergradation in the mountain passes there. In any case, the *annectens-affinis* interconnection is complete through *deserticola*.

Summarizing, in the United States we have the unbroken chain, *annectens-catenifer-deserticola-affinis-sayi*, together with the short circuit, *annectens-deserticola*, and possibly *deserticola-sayi*. In Baja California the connection *annectens-affinis* is suggested but not proven.

The weakest strand in the web is that connecting *vertebralis* with the rest. *Vertebralis*, through the new mid-peninsular subspecies *bimaris*, with which it undoubtedly intergrades, overlaps *annectens*, based on USNM 37536, a specimen of *bimaris* from Alamo (Lat. 31°30' N.) on the coastal side of the Sierra Juárez. This specimen was collected by Nelson and Goldman and thus there is every reason to accept the accuracy of the locality data. Should further collecting in this vicinity substantiate this *bimaris-annectens* overlap, it will be a pertinent argument against considering *vertebralis* a subspecies of *catenifer*. However, there is another route by way of which there may be intergradation. Along the desert side of the mountains in northeastern Baja California, there is no specimen of *Pituophis* available from between El Mármol (Lat. 30° N.), where *bimaris* occurs, and the vicinity of El Mayor (Lat. 32° N.), where *affinis* has been collected. All of the intervening country is undoubtedly inhabited by *Pituophis*, but much of it is quite inaccessible, so that no specimens are available yet. *Bimaris* resembles *deserticola*—particularly specimens from the western Mojave Desert—in many ways. It appears to me that an intrusion of *affinis* into the Salton or Cahuilla Basin has broken a contact between them; but just as *deserticola* intergrades with *affinis* in Riverside County, so I think it probable that *bimaris* and *affinis* will be found to intergrade in the Gulf-coast desert between El Mármol and El Mayor, no doubt somewhere in the vicinity of San Felipe (Lat. 31° N.). Hence, partly because of this expected intergradation, and also by reason of the obvious resemblance between *deserticola* and *bimaris* (although territorially separated by the intrusion of *affinis*), I have considered *vertebralis* to be a subspecies of *catenifer*. If future collecting along the northeastern desert coast of Baja California should eventually show

an overlap between *bimaris* and *affinis*, then the Cape form must be known as *vertebralis vertebralis*, with *bimaris* and *insulanus* as its subspecies.

As to the island forms *insulanus*, *fuliginatus*, and *coronalis*, so obvious are the relationships of the first to *bimaris*, and of the two latter to *annectens*, together with some overlapping in the distinguishing characters, that I think subspecific rather than specific segregation is to be preferred. This carries with it no suggestion of weakness with respect to the validity of the new forms.

Since I am considering all of the forms discussed to be subspecies of *Pituophis catenifer* (Blainville), 1835, I shall simplify the discussions by usually employing only the subspecific names, without repeating the generic and specific names or initials.

DESCRIPTIONS OF NEW FORMS

The first new form to be described is one which occupies the middle section of the peninsula. The snakes of this area have hitherto been considered to belong to the species *Pituophis vertebralis* (Blainville), whose revised status I shall touch on later.

Pituophis catenifer bimaris subsp. nov.

BAJA CALIFORNIA GOPHER SNAKE

1899. *Coluber catenifer*, var. *vertebralis* Mocquard, Nouv. Arch. Mus. Nat. Hist., ser. 4, vol 1, p. 320.
1900. *Pityophis vertebralis* (part) Cope, Rept. U. S. Nat. Mus. for 1898, p. 879.
1917. *Pituophis vertebralis* (part) Stejneger and Barbour, Checklist of N. A. Amph. and Rept., ed. 1, p. 86.

Type.—No. 32621 in the collection of LMK. Collected at Santa Gertrudis, near El Arco (Lat. 28° N.), Baja California, Mexico, by Robert S. Hoard, August 1939.

Diagnosis.—A subspecies closely allied to *vertebralis*, from which it differs in having black (sometimes blackish-brown) anterior body blotches, whereas in the Cape form the anterior dark blotches are red or red-brown. From *deserticola*, of the Great Basin and the Mojave Desert, *bimaris* may be segregated by its fewer body blotches. It more often has a dark subcaudal stripe than *deserticola*, and less often shows dark streaks in the anterior dorsal light areas or interspaces, these streaks being characteristic of most *deserticola*. *Affinis* has brown anterior blotches as compared to the black of *bimaris*. The narrow and raised rostral in *sayi* is quite distinct from the broader and flatter scale in the Baja California form. *Bimaris* has fewer blotches than *insulanus*, *annectens*, *catenifer*, *coronalis*, or *fuliginatus*.

Description of the Type.—An adult male with a length over-all of 1728 mm., and tail length of 231 mm., ratio .134. The body is of normal *Pituophis*

form, the head wedge-shaped when viewed from above, and moderately distinct from the neck. The scale rows are 31-31-22, the ventrals number 243, and the subcaudals 65, all divided. The anal is entire. The central dorsal scale rows are strongly keeled; the ridges become fainter on the sides and the 5 lower lateral rows are smooth. The two lowest are considerably enlarged. There are paired apical scale pits.

The rostral is triangular and is somewhat wider than high. It is slightly raised above the surrounding scales, and, viewed from above, is moderately convex. It contacts the first supralabials, prenasals, and internasals, indenting the latter for about half their depths. There are four prefrontals, the inner long and slim; they are widest anteriorly. The outer prefrontals curve down over the canthus to contact the loreals. The frontal is widest anteriorly. The parietals are fused into a single wrinkled and irregular scale.

The nasals are subequal. The loreal is small, longer than high, and pointed posteriorly. There are two preoculars, the upper much the larger. There are three postoculars, the middle somewhat larger than the other two. The temporals are not in regular rows and are of uneven size; they are 3+3, 3+3. The supralabials number 8-8, the next to the last being the largest, and the fourth touching the eye. The infralabials number 13-12, the seventh being much the largest. The mental is small and triangular; it is followed by the first infralabials, which are in contact medianly. There are two long anterior genials, followed by a shorter, somewhat divergent pair separated by two rows of gulars.

The head is brown above, almost without marks. Below it is immaculate cream-color.

The dorsum is marked with 40 dark blotches, and the tail with 10. The anterior blotches are jet-black. Beginning at the eighth the blotches turn brownish until at mid-body they are reddish-brown, the posterior tips of the scales being darker. Then again the blotches turn darker; about thirteen anterior to the vent they are jet-black and remain so to the tip of the tail.

Anteriorly, the blotches are highly irregular and confluent. They are somewhat longer than wide. On each side there is an alternating series of long, thin black blotches which form lateral boundaries of the interspaces, and almost surround them. Below are two other series, the lower and smaller engaging the edges of the ventrals, which are otherwise clear. The anterior light interspaces are not streaked with dark.

Posteriorly, the main dorsal blotches become somewhat shorter and more regular. On the tail they are oval in shape, and are about equal to the interspaces. Here there is a single row of secondary blotches on either side. Mid-ventrally on the tail there is a longitudinal dark streak with serrated edges.

The body surface between blotches is cream-colored to white, as is also the ventrum. However, it is probable that there was once considerable orange-color dorsally and anteriorly between blotches.

Paratypes.—Sixteen paratypes are available, the localities being listed from south to north as follows: LMK 2934-5 El Refugio (northeast of Magdalena Bay); USNM 15157 Ballenas Bay; LMK 32523 18 miles north of Punta

Prieta (Lat. 27° N.); LMK 3813, SDSNH 11553, MVZ 10673-4, MZUM 76462 San Ignacio; LMK 31032 Thurtoe Bay (1 mile south of Turtle Bay, on the west coast); SDSNH 17562-3 Rancho Las Flores (12 miles east of El Arco); LMK 1129, LMK 1181, CAS 62957 El Mármol (= Onyx Mine, Lat. 30° N.); USNM 37536 Alamo (= El Alamo, Lat. $31\frac{1}{2}^{\circ}$ N.). In addition, two island specimens are at hand, USNM 37537 from Santa Margarita, and CAS 59390 from Magdalena, which are tentatively assigned to this subspecies; however, they are not included in the statistics which follow, although the type is.

The scale rows at mid-body vary from 31 to 35, being 33 in half the specimens, and less often 35 in the remainder than 31. The ventrals in the males (13) range from 238 to 249, mean 243.5; and in the females (4) from 253 to 257, mean 255.5.* The subcaudals in the males range from 63 to 72, mean 67.0, and in the females from 56 to 63, mean 58.8. The supralabials are usually 9, sometimes 8, and rarely 10; they average slightly under *vertebralis*, which has a mean of 9, the highest in the genus. The infralabials in *bimaris* range from 11 to 14, being most often 13. The preoculars always number 2; and the postoculars usually 3, but occasionally 4 and in one case 5. One labial contacts the eye in every specimen. The first temporals vary from 3 to 6 and the second from 3 to 5; they are highly irregular in arrangement. The scales on top of the head are rather constant for *Pituophis*. An azygos, which I should define as a central scale at the junction of the frontal and prefrontals, is not present in any specimen. There are four prefrontals in all specimens but one, in which each outer scute is fused to an inner.

Although the longest specimen I have seen measured about 1800 mm., I am told that this snake grows to a larger size, especially in the vicinity of San Ignacio. The ratio of the tail length to length over-all averages about .140 in adult males, and .127 in adult females.

The body blotches vary from 34 to 46, mean 40.8; and the tail spots from 8 to 13, mean 11.3. These numbers are lower than in almost any other subspecies.

The pattern of *bimaris* is characterized by the presence of jet-black blotches both anteriorly and posteriorly. Between, the northerly specimens may be black throughout, but more often the blotches at mid-body are brown, streaked with dark-brown or even with black. Toward the south, as the range of *vertebralis* is approached, the number of the anterior black blotches decreases, there being a greater expanse of brown, or even red blotches, in the mid-section.

The secondary side-blotches are usually confluent with the main series anteriorly, thus isolating the first few interspaces into light spots within a solid black band, in a manner characteristic of *deserticola*; however, these light spots are not streaked with dark, as is so marked in most *deserticola*, although sometimes lacking in specimens from the western Mojave. In general, the streaking, both dorsally and laterally, is less evident in *bimaris* than *deserticola*.

* In comparing these figures with those given by Miss Stull for *vertebralis* (1940, Table 9, p. 92), it should be noted that all specimens in her table are of the sex opposite to that listed.

Ventrally *bimaris* is unmarked cream-color or white, except that the outer edges of the scutes are frequently blotched by the lowest row of lateral dark spots. All but four specimens have a dark caudal mid-ventral line, particularly evident posteriorly, but this is not so uniform as in *vertebralis*.

The ground color is cream or white, and is clearer and brighter than in any other subspecies except *vertebralis* and the most southwesterly *deserticola*. The dorsal interspaces and the head in *bimaris* are usually orange or red, particularly in the southerly specimens, but this color virtually disappears in preservation.

Except for a dark subocular vertical line, the head of *bimaris* is usually unmarked. Sometimes the dark labial sutures so characteristic of most *Pituophis* are present; a few inconspicuous marks are occasionally seen on the frontal and parietals, but they are not strongly evident as in *insulanus*.

The two specimens from Santa Margarita and Magdalena islands do not seem to be peculiar in any way, except that the one from Santa Margarita has an unusually high ventral scale count; it is a female with 263 scutes compared with a record of 257 among the mainland specimens.

Range.—*Bimaris* occurs in the peninsula of Baja California from about Lat. $24^{\circ} 20'$ N. to Lat. 30° N., and from coast to coast. One record is known north of the latter line, this being Alamo, Lat. $31\frac{1}{2}^{\circ}$ N. It is likewise found on Santa Margarita and Magdalena islands.

In addition to the localities given in listing the types and paratypes, the following have been cited in the literature: Arroyo de Santa Agueda, San Bartolomé Bay, and Comondú.

Remarks.—*Bimaris* certainly intergrades with *vertebralis* to the south, and the area of intergradation is probably fairly broad. Nevertheless, the geographical segregation is remarkably consistent for snakes as variable in pattern as these gopher snakes. If we take, as an arbitrary division, a line drawn across the south end of the peninsula at its narrowest point, where indented by the Bay of La Paz (about Lat. $24^{\circ} 20'$ N.), we have the following segregation:

	North of Bay of La Paz	South of Bay of La Paz
Anterior dark blotches black or dark-brown	21	2
Anterior dark blotches red or red-brown	1	33

In this table I have included the three specimens mentioned by Mocquard, 1899; without them none north of the line would have failed to key correctly. As it is, allowing for an intergrading area which may be more accurately delineated when additional material has been obtained, probably 90 per cent or more of the specimens will key out correctly.

The absence of specimens from critical areas renders the northerly con-

tacts of *bimaris* much less certain. I think it likely that it will eventually be shown to intergrade with *affinis* somewhere along the desert (Gulf of California) coast northward between El Mármol and the delta of the Colorado River, where *affinis* is known to occur. The intervening territory is well suited to either of these desert subspecies. The single specimen from Alamo remains somewhat of an anomaly.

Intergradation with the coastal-mountain *annectens* seems very doubtful, not only because of the presence of the undiluted Alamo specimen in *annectens* territory, but because of the lack of *bimaris* tendencies in the most southerly *annectens*. The distance separating this *annectens* (collected at the mouth of the Rosario River) from the nearest *bimaris* at El Mármol is some sixty miles. El Mármol is almost due east of Rosario and lies on the opposite side of the rolling hills at the south end of the Sierra San Miguel. If intergradation occurs, the modification must be quite abrupt.

That *insulanus* of Cedros Island is an off-shoot of *bimaris* is suggested by a number of characteristic features of pattern. Nevertheless the differences, which will be discussed in connection with the description of the island subspecies, have now become consistent enough to warrant a subspecific segregation. There is no overlap in number of body blotches, although a slight overlap may be found when larger series of both forms become available.

***Pituophis catenifer insulanus* subsp. nov.**

CEDROS ISLAND GOPHER SNAKE

Plate 1, fig. 1.

1926. *Pituophis catenifer annectens* (part) Slevin, Proc. Cal. Acad. Sci., ser. 4, vol. 15, no. 3, p. 206.
1932. *Pituophis vertebralis* (part) Stull, Occ. Papers Mus. Zool., Univ. Mich., no. 250, p. 3.

Type.—No. 56353 in the collection of the California Academy of Sciences. Collected on Cedros (Cerros) Island off the west coast of Baja California, Mexico, by J. R. Slevin, August 7, 1922.

Diagnosis.—A subspecies nearest to *P. c. bimaris*, from which it differs in having more than 50 body blotches while *bimaris* has less than this number. From *vertebralis* and *affinis* it may be segregated by its black anterior blotches, while they have brown or red. *Insulanus* has a shorter tail and fewer dorsal blotches than *annectens*; is darker than *catenifer*, and has more ventral scales; lacks the subocular scales of *coronalis*; and is without the paired subcaudal dark stripes of *fuliginatus*. It differs from *deserticola* in pattern, and from *sayi* in having a flatter and less protruding rostral.

Description of the Type.—A female with a length over-all of 1210 mm., and tail length of 151 mm., ratio .125. The body is of normal *Pituophis* shape, the head wedge-shaped when viewed from above, and moderately distinct from the neck. The snout is neither as sharp as in *affinis* nor as blunt

as in *annectens*. The scale rows are 32-33-23, the ventrals number 247, and the subcaudals 58, all divided. The anal is entire. The central dorsal scale rows are keeled, but the 9 lower lateral rows are smooth. The lowest row is somewhat enlarged. Paired apical scale pits are present and in some scale rows are accentuated by dark dots.

The rostral is triangular and is wider than high. It contacts the first supralabials, prenasals, and internasals. It indents the latter for about half their depths. There are four prefrontals, the inner long and slim; they are widest anteriorly. The outer curve down over the canthus to contact the loreals. The frontal is widest anteriorly. The parietals are wrinkled and irregular, and are separated by a crooked suture. Each supraocular is partly sutured posteriorly, this being characteristic of this subspecies.

The nasals are subequal. The loreal is pointed posteriorly; there is a small subloreal on the right. There are two preoculars, the upper much the larger. There are three postoculars, the middle somewhat larger than the other two. The temporals are not in regular rows; they are 3+5, 5+5. The supralabials number 8-9, the next to the last being the largest; the fourth touches the eye on the right and the fifth on the left. The infralabials number 13-13, the seventh being the largest. The mental is small and triangular; it is followed by the first infralabials which are in contact medianly. There are two long pregenials, followed by a shorter pair, separated by two rows of gulars.

The head is tan above (it was red in life), heavily mottled with black from the frontal posteriorly. There is a faint vertical dark mark below the eye and a few spots remain of a postocular dark stripe. The chin is immaculate cream.

The dorsum is marked with 57 dark blotches, and the tail with 12. The anterior blotches are jet-black; they are confluent laterally, thus accentuating the interspaces as small buff spots on a black background. At the third or fourth dark blotch back of the head a few lighter streaks become evident at the scale centers. These gradually increase in size and number until, at mid-body practically all the scales in the dark blotches are gray, only a few scale edges remaining black. The interspaces, however, remain cream and virtually clear, except that some of the scales toward the sides have dark central streaks. Then posteriorly there is again an increase in dark pigment; the grayish scales are increasingly edged with black until, some 10 blotches anterior to the vent, they are solid-black and continue so to the tip of the tail. On the sides there are subsidiary alternating blotches. These begin as black streaks on the neck, but at mid-body become an irregular mixture of scales with black central streaks and others punctated with gray. These side marks are confluent with the main dorsal series so that throughout there is more regularity in the light dorsal interspaces, which are essentially a series of light blotches, than in the dark blotches. Posteriorly the lateral auxiliary blotches become more regular; they are black and it can be seen that there are four series on each side, the lowest engaging the outer edges of the ventral scutes. These ventral marks, on an otherwise clear cream background, are darkest posteriorly. The underside of the tail is much mottled, with a mid-ventral dark line posteriorly.

Paratypes.—Six paratypes, all from Cedros Island, are available: USNM 14088 and 54764; MCZ 19732.4; and CAS 59568.

The following statistics will serve to summarize the subspecies. The type has been included in these data. There are three of each sex available and one, a skin, which is indeterminate.

The scale rows at mid-body are usually 33, occasionally 31. The ventrals in the males are all 240, and in the females 247 or 248. The subcaudals in the males range from 58 to 65, mean 62.3; and in the females from 57 to 59, mean 58. The supralabials are usually 9, occasionally 8, and rarely 10. The infralabials are generally 12 or 13, but sometimes 14. The rostral is wider than high, with the upper lateral edges somewhat concave. The snout is blunt and the rostral is not raised above the adjacent scales. The indentation of the internasals is usually to about half their depths, but may be less. The loreal is wider than high and pointed posteriorly; in half the counts there is a second smaller loreal in the upper angle between two supralabials (the second and third, or third and fourth) in a manner characteristic of many specimens of *deserticola*. There are usually 2 preoculars, but sometimes 1 or 3. The postoculars are most often 3 but may number 4 or 5. The temporals are 3 to 5 in the first row, and 4 or 5 in the second; they are too irregular in size and arrangement to be of any interest diagnostically. An upper labial (the fourth or fifth) contacts the eye in every specimen. The scales on top of the head are rather constant. Every specimen has 4 prefrontals; none has an azygos. The greatest irregularities are in the supraoculars, which are likely to have partial or complete posterior diagonal sutures, although this is not true of every specimen. The parietals are wrinkled and uneven, with no well-defined sutures separating them from the succeeding head scales.

This snake grows to a length of at least 1400 millimeters. The adult tail proportionalities (to length over-all) are about .143 in the males and .129 in the females.

The body blotches vary from 52 to 64, mean 55.3; and the dorsal tail spots from 11 to 17, mean 13.6.

The pattern of *insulanus* comprises a series of irregular dorsal blotches which are black anteriorly and posteriorly, but gray (rarely brown) at mid-body. The change from black to the lighter color is produced by the gradual lightening of scale centers. At mid-body the posterior ends of the scales tend to be darker. On the sides there are auxiliary alternating blotches which are often confluent with the dorsal series and with each other; they are highly irregular and there is extensive dark streaking within and between them, thus producing a much more mottled appearance than is evident in *bimaris* or the more southerly *deserticola*. Anteriorly the first side-blotches are joined to the main series so that the light interspaces are themselves isolated into a series of light blotches in the manner characteristic of *bimaris* and *deserticola*. The edges of these blotches are rather irregular in *insulanus*, and they are less marked by dark streaks on the scale keels than is usual in *deserticola*. Toward the tail the dorsal blotches are more regular and well-defined.

Judging from the type, which I saw alive through the courtesy of Mr.

J. R. Slevin, these snakes are brilliantly marked with red anteriorly, between the black blotches, but this color is lost in preservation, becoming yellow or cream. The outer edges of the ventrals are blotched with black or gray by the lowest series of lateral body spots. The tail is much mottled with black on the underside, and posteriorly there is sometimes a black line like that which characterizes *bimaris* and *vertebralis*.

The head, which is probably red in life, is spotted above with a large number of conspicuous round or oval black spots, which are especially evident on the frontal, supraoculars, and parietals. These marks are characteristic of this subspecies and are present in all well-preserved specimens. The postocular dark dash and the dark lines which mark the labial sutures in most forms of *Pituophis* are absent or only faintly evident in *insulanus*; their absence is in peculiar contrast to the unusual and accentuated spotting on top of the head. Below, the head is unicolor cream.

Range.—*Insulanus* is found only on Cedros Island, off the Pacific Coast of Baja California, Mexico.

Remarks.—*Insulanus* is most closely related to the nearest mainland form, *bimaris*, through which, in turn, it is allied to *vertebralis* and to *deserticola*, rather than to either *annectens* or *affinis*. This is evident from the tail proportionality and various characteristics of pattern, yet it is more mottled than either. In almost all cases the black spots in the frontal area serve as a key character that will readily segregate *insulanus*. There is no overlapping in number of body blotches between *insulanus* and *bimaris*, for the former has from 52 to 64 with an average of 55.3, while the latter ranges from 34 to 46 with an average of 40.8. Even when much larger series have become available, it may be expected that only rarely will a specimen of one form fall within the limits of the other. *Insulanus* does overlap *deserticola* in blotch counts, yet it is readily distinguishable by the lack of regularity of its anterior blotches, the lack of dark streaks in the interspaces (which may, however, be absent in some Mojave specimens of *deserticola*), and the absence of postocular and subocular dark vertical lines or streaks.

***Pituophis catenifer fuliginatus* subsp. nov.**

SAN MARTÍN ISLAND GOPHER SNAKE

- 1877. *Pityophis sayi bellona* Streets, Bull. U. S. Nat. Mus., no. 7, p. 40.
- 1895. *Pituophis catenifer deserticola* Van Denburgh, Proc. Cal. Acad. Sci., ser. 2, vol. 5, p. 149.
- 1905. *Pituophis catenifer* (part) Van Denburgh, Proc. Cal. Acad. Sci., ser. 3, vol. 4, no. 1, p. 21.
- 1919. *Pituophis catenifer annectens* (part) Van Denburgh and Slevin, Proc. Cal. Acad. Sci., ser. 4, vol. 9, no. 6, p. 216.

Type.—No. 17449 in the collection of the San Diego Society of Natural History. Collected on San Martín Island, off the west coast of Baja California, Mexico, by Lewis W. Walker, July 11, 1939.

Diagnosis.—A subspecies closely allied to *P. c. annectens* of the adjacent mainland, from which it differs in having a darker pattern, much black spotting on the head, a lower average number of body blotches, usually single instead of two preoculars, a high frequency of aberrant prefrontals, and in the possession of paired, dark, longitudinal streaks on the ventral surface of the tail, the latter being rarely and less perfectly present in *annectens*, wherein these streaks, if present, comprise series of separate, dark triangles. The same differences of blotch counts, pattern, and tail length which segregate *annectens* from the other subspecies of the genus will apply as well to *fuliginatus*, except that the latter is nearer *catenifer* in blotch counts.

Description of the Type.—A young adult female. Length over-all 960 mm.; length of tail 153 mm.; ratio of tail to length over-all .159. The body is of normal *Pituophis* proportions. The head is moderately distinct from the neck, and is wedge-shaped, but blunt anteriorly, when viewed from above. The scale rows are 31–35–25. The dorsal rows are much smaller than the lateral and are strongly keeled; about 8 lateral rows on either side are smooth. There are paired apical scale pits, which are moderately evident posteriorly.

There are 245 ventrals, and 72 paired subcaudals. The anal is entire.

The rostral is large, recurved, deeply indented below, and contacts the first supralabials, the prenasals, and the internasals. It is wider than high and is not raised above the adjacent scales. The internasals are narrowly in contact on the median line and diverge posteriorly. There are four prefrontals, with an azygos at the point where they contact the frontal. The outer prefrontals diverge anteriorly and curve downward over the canthus, where they touch the loreals, postnasals, and, narrowly, the internasals. The frontal is widest anteriorly and only slightly indents the parietals. The supraoculars are narrow anteriorly and touch the outer prefrontals at a point. The parietals are short and posteriorly irregular.

The nasals are subequal and are narrowest at the nasal suture. The loreals are longer than high and are pointed posteriorly where they abut the preoculars. There is a small extra loreal below on the right. There are two preoculars on either side (not characteristic of this subspecies), the upper large, the lower very small. There are four subequal postoculars on either side. The temporals are highly irregular in size and arrangement; they are 4+4, 4+5. There are 8 supralabials on the right and 9 on the left, the next to the last being the largest, followed by the next anterior. The fourth touches the eye on the right and the fifth on the left. The lower labials are 13–13, the seventh being the largest. The mental is small and triangular. It is followed by the first infralabials, which are in contact medianly; then a pair of long genials medianly in contact, and a second shorter pair separated by two rows of gulars.

The head is brown above, heavily mottled with black, especially posterior

to the central prefrontals. On the sides it is buff, with a wide black streak from the eye to the angle of the mouth, a wide vertical line below the eye, and narrower black lines following the sutures between the lower labials. The ground color of the sides of the head is buff to gray. The lower surface is cream-color. All of these colors refer to the specimen as preserved in alcohol.

The dorsum is marked by a series of square black blotches about 7 scale-rows wide and $3\frac{1}{2}$ scales long (end to end). The interspaces are buff and about $\frac{1}{2}$ scale wide anteriorly, becoming brown and one scale wide posteriorly. There are about 70 blotches in the central series. Alternating with the main series there is a somewhat smaller series on either side, and these in turn are followed by two others, each smaller than that above, and therefore with wider interspaces. In general effect the light elements of the pattern form a net. Laterally the scales in the interspaces are centrally streaked or punctated with gray. The lateral blotches and interspaces are rather irregular. The ventral scales are yellowish-buff, and are blotched and stippled with dark gray, especially posteriorly. On the tail there are 19 squarish blotches above, with an alternating secondary series on either side. The interspaces are buff above and stippled-gray on the sides. The lower surface of the tail has a pair of dark-brown (almost black) streaks with an even, light stripe between. The outer edges of the dark streaks are serrated, since each subcaudal is marked with a spot which is widest posteriorly. Each spot contacts its posterior fellow, hence the dark streaks are continuous, although somewhat irregular posteriorly.

Paratypes.—Fourteen paratypes, all from San Martín Island, are available: SDSNH 17463-4; USNM 8565 and 24395; MVZ 9703-6; LA 633; and CAS 8678, 43588-9, and 59678-9.

The following summary is based on the type and paratypes: The scale rows at mid-body, while most often 33, may be 31 or 35. The ventrals in the males (10) vary from 224 to 234 with an average of 229.7; and in the females (5) from 236 to 245, average 242.2. This is a greater sexual difference than is to be expected when more specimens become available so that the probable population means may be more accurately known. The subcaudals in the males vary from 73 to 82, with an average of 76.5; in the females 67 to 72, average 70.3. The supralabials are 8 or 9, with the latter slightly predominating. Every specimen has at least one supralabial (the fourth or fifth) in contact with the eye, thus differing from *coronalis*; in 7 cases out of 30 two labials contact the eye, showing a resemblance in this character to *deppei* and *lineaticollis* of southern Mexico and Central America. The infralabials are most often 13, but may be 12, or, less frequently, 14. The rostral is pentagonal in shape and is wider than high. It usually indents the internasals for about half their depths, but may completely separate them. The loreal is longer than high, with a posterior point indenting the upper preocular. In several specimens subloreal are present, and in one the main loreal is divided vertically. *Fuliginatus* usually has a single preocular (23 out of 30 counts), a condition reversing that found in the peninsula specimens of *annectens*, in which a single preocular was noted in only 26 counts out of 102, the majority

having 2. This difference in proportions is, of course, significant. The postoculars generally number 4, but sometimes 3 or 5. Azygos scales are present in 6 specimens out of 15, a higher proportion than in any other western *Pituophis*; and, in general, this subspecies is notable for the irregularity of the plates in the prefrontal area. Only 3 specimens out of 15 have the arrangement which is characteristic of most mainland snakes—that is, 4 regular prefrontals. In these island snakes there seems to be no standard, each individual differing in some degree from its fellows. Thus there are central prefrontals fused to each other, or to either or both outer prefrontals, in a variety of ways. Several specimens have a diamond-shaped central prefrontal, surrounded by internasals and outer prefrontals. These anomalies occasionally include the frontal. The parietals are also highly irregular but this is not so unusual in *Pituophis*. The supraoculars are not sutured as in *insulanus*.

This snake grows to a length of at least 1400 mm. The smallest specimen measured 327 mm. The adult tail proportions, in relation to length over-all, average .175 in the males and .157 in the females, thus showing an affinity to *annectens* rather than *bimaris*.

The body blotches vary from 55 to 70, mean 62.6, and the tail spots from 14 to 22, mean 19.1. The blotches are significantly fewer than in mainland *annectens* but there is too much overlap to afford a useful key character.

The dorsal pattern of *fuliginatus* comprises a series of central blotches which are black anteriorly and at the tail, and may be either black, brown, or red-brown at mid-body. Anteriorly the main dorsal series is not regular in form, or well separated from the first lateral series on either side; the interspaces are narrow, much streaked with dark pigment, and comprise an irregular, light net-work. Posteriorly the blotches tend to become better separated and more uniform. The interspaces are cream anteriorly, and buff or brown toward the tail. There are about 6 auxiliary series of blotches on either side, the lowest engaging the ventrals. Anteriorly some of the light areas between these series tend to form light longitudinal lines, but these are not always present. Posteriorly the sides, between blotches, are suffused with gray or brown. The ventral surface is yellowish, much mottled or blotched with black or gray. On the underside of the tail is the most characteristic feature of the pattern of this snake—a mid-ventral, even-edged light stripe, bordered on either side by a black or dark-brown stripe. While interruptions in these stripes are not rare, they are quite regular in 12 specimens out of 15. One of the others has lost its tail so that no determination can be made; in a second the stripes are highly irregular, and in the last quite imperfect.

It is to be understood that paired dark stripes are occasionally met with in *annectens*, *deserticola*, and in *catenifer* as well, but when present they usually comprise rows of dark triangles, the upper points of which barely touch their fellows on the next scale. In *fuliginatus* the dark mark on each scale contacts its neighbor rather broadly, although the mark usually widens posteriorly, thus causing the outer edges of the dark streaks to be serrated. Occasionally specimens of *catenifer* or *deserticola* will be found, particularly in central Washington, Oregon, and northeastern California, in which the subcaudal tail stripes are as perfect as in *fuliginatus*. While this complicates the

preparation of a key, it does not invalidate *fuliginatus*, which differs from the northwestern snakes in other characteristics of scale counts and tail proportionality.

The excess of black pigment in *fuliginatus*, which results in the body being darker than in most *annectens*, also affects the head marks. The usual dark marks in western *Pituophis*—a line across the prefrontals, a stripe from the eye to the angle of the mouth, a vertical subocular streak or triangle, and dark marks in both the upper and lower labial sutures, are all present. In addition the frontal, supraoculars, and parietals are much mottled with black. In *annectens* such marks in the fronto-parietal area, if present, are generally brown. The ground color of the head of *fuliginatus* is brown above and buff below. The lower jaw is unmarked except for the dark lines between infra-labials.

Range.—*Fuliginatus* occurs only on San Martín Island, off the Pacific Coast of Baja California, at Lat. 30°29' N.

Remarks.—San Martín is a small volcanic island only a mile in diameter, and but 2½ miles from the coast. The nearest point on the mainland is the cape along the west side of San Quintín Bay.

Notwithstanding the proximity of the island to the mainland, the animal population must have been long isolated. All of the four reptiles thus far collected there show differences from the forms of the adjacent mainland. First there is *Uta martinensis*, which belongs to the *stansburiana* group and has been considered a valid species for forty years. Then there is an alligator lizard, *Gerrhonotus multicarinatus*, which Van Denburgh described as a new subspecies, *ignavus*, in 1905. Although this is not currently recognized, Fitch (1938, p. 399) states that its validity may well be demonstrated by additional material. One specimen of a ring-necked snake, *Diadophis amabilis similis*, has been collected on the island. Blanchard (1942, p. 46) has pointed out that this differs in certain particulars from the mainland form, and more specimens may justify segregation. Thus it might be expected that the gopher snakes also, of which an adequate series is available, would show differences warranting nomenclatorial distinction.

As would be anticipated, *fuliginatus* most closely resembles *annectens* of the adjacent mainland. It is not greatly different in pattern, although more completely pigmented with black, and generally darker, conditions probably not unrelated to the color of the lava on which it lives. It has somewhat fewer blotches on body and tail.

The tail-length proportionality in *fuliginatus* further verifies its close relationship with *annectens*; in fact, it may have the greater ratio of the two, although it would take more material to prove this. In any case, it differs, in this important character, from the shorter-tailed forms, *deserticola*, *affinis*, *bimaris*, *insulanus*, and *vertebralis*.

As to scalation, *fuliginatus* has 9 (instead of 8) supralabials somewhat oftener than *annectens*, has a higher percentage of single preoculars, and more often has fused and otherwise irregular prefrontals with azygos scales present.

With respect to the frequency of having 2 labials in contact with the eye, the proportion in *fuliginatus* was 7 out of 30 counts, or 23.6 per cent. In 94 counts on specimens of *annectens* from northwestern Baja California, there were 5, or 5.3 per cent with 2 labials in contact, and, in 174 counts on San Diego County specimens, 2.9 per cent.

Because of overlapping, none of these characters is as useful in a key as the parallel dark strikes under the tail. As these stripes are occasionally imperfect in *fuliginatus*, and sometimes appear (although seldom as continuous lines) in *annectens*, *catenifer*, and *deserticola*, I deem only a subspecific distinction to be warranted for the newly described form.

Laurence M. Huey tells me that the gopher snakes are quite common on the island, although they are not easy to catch, since they readily escape into the lava crevices. No doubt they feed on the two mammals found there, an endemic wood rat, *Neotoma martinensis*, and a white-footed mouse, *Peromyscus maniculatus exiguus*. J. R. Slevin found one eating a young bird.

***Pituophis catenifer coronalis* subsp. nov.**

CORONADO ISLAND GOPHER SNAKE

1914. *Pituophis catenifer* Van Denburgh and Slevin, Proc. Cal. Acad. Sci., ser. 4, vol. 4, no. 5, p. 141.
1919. *Pituophis catenifer annectens* (part) Van Denburgh and Slevin, Proc. Cal. Acad. Sci., ser. 4, vol. 9, no. 6, p. 216.

Type.—No. 20229 in the collection of LMK. Collected on South Coronado Island, Mexico, by Philip M. Klauber, June 11, 1933.

Diagnosis.—A subspecies closely allied to the mainland *P. c. annectens*, from which it differs in usually having suboculars interposed between the supralabials and the eye, and in the frequent abnormalities of the head scales. There are some differences in pattern; among others the island form has fewer blotches, but the overlap would prevent this being employed as a key character. The presence of suboculars will distinguish *coronalis* from other *catenifer* subspecies. In some areas suboculars occur with considerable frequency in *deserticola*, but this subspecies has fewer subcaudals and body blotches than *coronalis*, and differs in other ways.

Description of the Type.—A female with a length over-all of 1150 mm., and tail length of 171 mm., ratio .149. The body is of normal *Pituophis* shape, the head rather blunt when viewed from above, and moderately distinct from the neck. The scale rows are 33-33-23, the ventrals number 232, and the subcaudals 71, all divided. The anal is entire. The central dorsal scale rows are keeled, but the 10 lower lateral rows on each side are smooth. The three lowest are considerably enlarged. Apical scale pits seem to be virtually absent, although a few pairs may be discerned.

The rostral is triangular and is wider than high. Viewed from above it is slightly convex; it is not raised above the other scales. It contacts the

first supralabials, prenasals, and internasals, and deeply indents the latter. There are four prefrontals, the inner triangular, and the outer small, with their anterior halves split off to form an extra outer prefrontal on either side. The frontal is widest anteriorly, the supraoculars posteriorly. The parietals are wrinkled and irregular.

The nasals are subequal. The loreal is small and pointed posteriorly. There are two preoculars, the upper much the larger. There are four postoculars, of which the two lower are the smaller. The two lower are really to be considered suboculars, since they completely prevent any contact between the upper labials and the eye, a condition rare in *Pituophis*. The temporals are not in regular rows; they are 4+4, 4+4. The supralabials number 10-9, the next to the last being the largest. The infralabials number 13-14, the seventh being much the largest. The mental is small and triangular; it is followed by the first infralabials which are in contact medianly. There are two long anterior genials, followed by a shorter pair which are separated by two or three rows of gulars.

The head is light-brown above, with an irregular dark spot on the parietals. There is a dark streak in the suture below each eye, and the penultimate supralabial is marked posteriorly. Some of the sutures between the lower labials are darkened, otherwise the lower surface of the head is immaculate cream.

The dorsum is marked with about 64 dark blotches, and the tail with 20. They are highly irregular and often confluent anteriorly, so that opinions might differ as to the number. The anterior blotches are black; at mid-body they are brown, speckled with dark-brown. Posteriorly they are darkened, again becoming black on the tail. In the posterior part of the body they are square, well separated, and are about equal to the interspaces. The ground color is grayish-buff, laterally suffused with brown, but becoming lighter posteriorly.

The ventrum is buff, the posterior edge of each scute being somewhat darkened. There is no distinctive pattern on the underside of the tail.

Paratypes.—There are three paratypes, SDSNH 11365 and CAS 13588-9. The latter are from South Coronado Island as is the type, but the locality of No. 11365 is given merely as "Coronado Islands." I have no record of gopher snakes having been taken on any of this group but South Island; however, there may be some significance in the fact that this is the only specimen of the four in which the labials contact the eyes.

The following statistics summarize this rather inadequate series, in which I have included the type. There are three females and one male.

The scale rows at mid-body vary from 31 to 35. The male has 222 ventrals, the females 229 to 233. The subcaudals number 82 in the male, 69 to 71 in the females. The supralabials vary from 7 to 10, and the infralabials from 11 to 14. Both series of labials are characterized by occasional fusions of adjacent members into scales of abnormal length. The rostral is wider than high and is not raised. The loreal is longer than high and is single in all cases. There are usually 2 but, in one case, 3 preoculars; the postoculars number 3 to 5. As the labials contact the eye in only one specimen out of four, and then narrowly, the lower of these postoculars are, in fact, suboculars. The temporals

vary from 3+4 to 4+5. The prefrontals are quite irregular; in no specimen are there 4 in what is the normal arrangement for *annectens*. Usually the posterior ends of what would ordinarily be the outer prefrontals are fused to the inner, while the outer ends, separated by sutures, might be considered supraloreals. In the single specimen wherein the labials contact the eye, the contact is quite narrow, just the opposite of the condition in the other *annectens* island relative, *fuliginatus*, in which it is particularly wide. No specimen has an azygos.

The longest available specimen is the type, 1150 mm., the shortest is 353 mm. We have too few specimens, only one an adult, to determine the tail proportionality; it is apparently similar to that of *annectens*.

The body blotches vary from 64 to 70 and the tail spots from 20 to 24. These are lower than average figures for *annectens*.

In pattern *coronalis* is much like *annectens*, except that the body blotches are narrower, more circular, and more widely separated, especially toward the tail; there is also less streaking between blotches and on the sides. The anterior and posterior blotches are black, those between brown; in this there is no difference from most *annectens*. The ground color is buff or yellowish, suffused with gray or brown punctations laterally. The ventrum is buff with scattered suffusions or blotches of gray or black. The tail of one specimen has an imperfect double row of triangles on the underside; the others are virtually unmarked.

The head is not conspicuously marked—less so than in most *annectens*. A subocular dark line is always present.

Range.—*Coronalis* is found only on South Coronado Island, off the northwest coast of Baja California, Mexico. One specimen is labeled only "Coronado Islands", and may have come from one of the others of the group. These Coronado Islands* are not to be confused with those in the Gulf of California, or with Coronado, a city on the broad section of the peninsula which forms the southwesterly outer boundary of San Diego Bay.

Remarks.—*Coronalis* is obviously derived from *annectens*, from which it has been isolated long enough to have acquired differences in pattern and head scales. The former, while useful when comparative material is available, will not serve as a key character, although it may be noted that the four specimens of *coronalis* available have an average of 67.3 body blotches, while *annectens* in northwestern Baja California has 75.5, and in San Diego County 76.8. More important are the irregularly fused head plates in the island form; and, above all, the lack of contact between labials and eye in three out of four specimens.

Out of 47 specimens of *annectens* from northwestern Baja California only two (both from San José) have suboculars preventing a contact of a labial with the eye, and in these this condition is found only on one side of the head. Thus the proportions are 6 out of 8 (75 per cent) on the island compared with 2 out of 94 (2.1 per cent) on the mainland. In 115 *annectens*

* More properly Coronados Islands.

selected at random from a San Diego County series, 7 counts out of 230 (3.0 per cent) proved positive. Only two specimens out of the 115 had suboculars on both sides. In some areas a considerable proportion of *deserticola* specimens have suboculars. This does not invalidate *coronalis*, since they differ in other characters, but it does complicate the preparation of a key.

A juvenile specimen of *coronalis* had eaten two fledgling birds.

REDESCRIPTIONS OF OLD FORMS

Pituophis catenifer vertebralis (Blainville)

SAN LUCAN GOPHER SNAKE

Plate 1, fig. 2.

- 1835. *Coluber vertebralis* Blainville, Nouv. Ann. Mus. Hist. Nat., vol. 4, p. 293. Type locality "Californie", which included Baja California; type specimen in Paris Museum.
- 1854. *Pituophis vertebralis* Duméril and Bibron, Erp. Gen., vol. 7, p. 238.
- 1860. *Pityophis haematois* Cope, Proc. Acad. Nat. Sci. Phila., vol. 12, p. 342. Type locality Cape San Lucas; type specimens USNM 4682 (2).
- 1861. *Pityophis vertebralis* Cope, Proc. Acad. Nat. Sci. Phila., vol. 13, p. 300.
- 1884. *Pityophis catenifer vertebralis* Garman, Bull. Essex Inst., vol. 16, p. 27.

Diagnosis.—A subspecies characterized by a short tail, high ventral scale counts, anterior red or red-brown blotches changing to black posteriorly, and a black mid-ventral band under the tail. Its nearest relatives are *bimaris*, *insulanus*, and *deserticola* in that order. The first two may be segregated from *vertebralis* by their black anterior blotches; the third is also black anteriorly, although occasionally specimens from the western Mojave Desert have reddish or brown blotches in front. But these usually have dark streaks on the keels of the light scales in the anterior interspaces, as well as dark frontal and postocular streaks; also, they rarely have the dark subcaudal stripe characteristic of *vertebralis*.

Applicability of Name.—Blainville's original description (1835, p. 293), and his figures (pl. 27), would lead one to question seriously whether the type really represented the snakes from the Cape region of Baja California that have so long been designated by the name *vertebralis*. However, the re-descriptions by Duméril and Bibron (1854, p. 238) and Bocourt (1888, p. 672), as well as the figure in Jan's Iconographie (1867, liv. 22, pl. 1), leave little doubt as to the applicability of the name, stressing as they do, such recognizable characters as the chainlike anterior pattern of light blotches, the black posterior blotches, and the subcaudal dark streak.

Material.—Of *vertebralis*, as now restricted by the segregation of *bimaris*, I have had available for study 33 specimens, as follows: LMK 3814, 20509-10,

20555, 20879, 20945, 21500, 21513, 23128, and ANSP 3791 Cape San Lucas; SDSNH 17660 10 mi. s. of Miraflores; USNM 12631 (2), 12644 La Paz, 37538 Cape San Lucas, 37539 San José del Cabo, 37540 Santa Anita, 64583 Miraflores; AMNH 5588-90 Miraflores; CAS 45874 San Pedro, 45875 San Antonio, 45876-7 San Bartolo, 45878 Agua Caliente; Stanford 4113 San José del Cabo; MVZ 11839-42 Todos Santos, 11843 Santa Anita, and 11844 Eureka. Counts are available on two other specimens, USNM 4682 (2) Cape San Lucas (the types of Cope's *haematois*). Of these specimens 21 are males, 14 females.

Description.—The following summary is based on the above material. The scale rows at mid-body usually number 33, sometimes 35 and rarely 31. Paired apical scale pits are evident. The ventrals in the males range from 238 to 251, mean 243.5; and in the females 246 to 257, mean 250.4. The anal is entire. The subcaudals vary in the males from 60 to 69, mean 65.0; and in the females from 57 to 63, mean 59.2. A few of the anterior scales are sometimes undivided. The supralabials are usually 9 but are occasionally 8 or 10; the average is almost exactly 9, the highest in the genus. The next to the last is the largest; the fifth touches the eye. The infralabials are most often 13, sometimes 12 or 14, rarely 11 or 15. Usually the seventh is the largest.

The rostral is wider than high, is only moderately convex when viewed from above, and is not raised above the surrounding scales. The apex of the rostral is rounded and indents the internasals to about half their depths. The loreal is wider than high and is posteriorly pointed, where it abuts the upper preocular. Rarely a small extra loreal may be noted above or below. The preoculars are 2, or rarely 1 or 3. The postoculars usually number 3, occasionally 4, and in one instance 5. The temporals are highly irregular in size and arrangement; they vary from 2+4 and 3+3 to 6+6. The scales on the top of the head are quite regular for *Pituophis*. No specimen has a true azygos (at the junction of the prefrontals and frontal), although in one specimen there is an extra scale between the internasals and the central prefrontals. Another has one outer prefrontal divided transversely. With these exceptions all specimens have 4 prefrontals. The supraoculars usually contact the outer prefrontals. The parietals are somewhat irregular, especially posteriorly; on the sides they are usually indented by a small scale back of each upper postocular.

The longest specimen I have seen measured about 1700 mm. The ratio of the tail to length over-all averages about .135 in the adult males and .123 in the females. Thus the tail is slightly shorter than in *bimaris* and closely approaches *affinis*; *vertebralis* is a much shorter-tailed snake than *annectens* or *catenifer*.

Vertebralis is the handsomest of the gopher or bull snakes, with the possible exception of *insulanus*. Preserved specimens give little idea of the brilliant anterior red color in life, as this fades to brown or may almost disappear. This is not the case with the black posterior blotches, which have remained unchanged in museum specimens collected nearly 100 years ago.

The pattern comprises a series of blotches which are red and saddle-shaped (that is, with narrow centers and wide lateral wings) anteriorly, gradually changing through red-brown and brown to jet-black somewhat anterior to the tail. On the neck the wings of the dorsal blotches tend to merge, as in *deserticola*, completely enclosing diamond-shaped light areas (the true interspaces) which are pink or sometimes orange. Posteriorly the blotches become square and well separated. The dorsal interspaces may continue pink to the tail, or they may become orange or yellowish posteriorly. The auxiliary lateral blotches are usually elongated anteriorly, and are rather indefinite in outline. Often the anterior lateral streaks may be darker than the main dorsal blotches; sometimes they are dark-brown or black. There are 2 or 3 rows of auxiliary lateral blotches on the neck. Posteriorly, as these blotches darken, they also become more evenly outlined; usually there are 3 or 4 alternating series at mid-body, the lowest engaging the edges of the abdominal scutes. The ground color, both laterally and ventrally, is yellow, cream, or buff. Below, the ventrum is usually clear anteriorly, but marked with gray or spots of black punctations caudad.

On the tail there is a series of dorsal black spots which may be square, round, or elliptical, with a single secondary series on each side anteriorly. On the underside of the tail there is usually a dark streak, often somewhat irregular and always with serrated edges. This stripe is quite characteristic of this subspecies (it is somewhat less frequent and perfect in *bimaris*); and, in the series available to me, is evident in all but 3 out of 33 specimens, although in some cases only on the posterior part of the tail.

The head is mottled or suffused with red above and is unmarked below.

This color description has been based largely on specimens from Cape San Lucas and San José del Cabo. Some of those from further north have darker scales, or scales with dark posterior tips, scattered within the anterior dorsal red blotches, or in the lateral series. CAS 45875 from San Antonio is quite dark anteriorly, although not as black as typical *bimaris*. Another dark specimen is MVZ 11842; this is black anteriorly and is much more like *bimaris* than *vertebralis*, although four other specimens from the same vicinity (Todos Santos) are typical *vertebralis*, except for more than the usual amount of dark streaking forward. These are the two specimens to which attention has been called in the table on page 10. Mainly, in distinguishing *vertebralis* from *bimaris*, one must look for a considerable contrast in color between the anterior and posterior dorsal body blotches in the former, while there is little or none in the latter.

The body blotches vary from 38 to 57, although all but 4 specimens fall between 39 and 49. The mean is 44.0. The tail spots vary between 8 and 15, with a mean of 11.3.

Range.—*Vertebralis*, as newly defined, occurs only in the Cape region of Baja California, south of the isthmus formed by La Paz Bay (Lat. 24°20' N.). Here it has been collected at La Paz, San Pedro, San Antonio, San Bartolo, Eureka, Todos Santos, Agua Caliente, Miraflores (also 10. mi. s.),

Santa Anita, San José del Cabo, and Cape San Lucas. It seems to be quite plentiful and well-distributed throughout this area.

Remarks.—*Vertebralis* intergrades with *bimaris*, the next subspecies to the north, which in turn relates it to *insulanus*, and, more distantly, to *deserticola*. The fact that *vertebralis* has light anterior blotches, as opposed to the dark *bimaris*, together with its slightly shorter tail, suggests a possible influence of *affinis*, across the Gulf of California in Sonora. Such relationships are found in other genera such as *Crotalus*, *Lichanura*, and *Coleonyx*.

***Pituophis catenifer annectens* Baird and Girard**

SAN DIEGAN GOPHER SNAKE

Plate 2, fig. 1.

1853. *Pituophis annectens* Baird and Girard, Cat. N. Amer. Rept., part 1, p. 72. Type specimen USNM 1839; type locality San Diego, California.
1859. *Pityophis annectens* Baird, Reptiles, in Explor. and Surv. for Railroad Route etc., vol. 10, part 3, p. 15.
1919. *Pituophis catenifer annectens* (part) Van Denburgh and Slevin, Proc. Cal. Acad. Sci., ser. 4, vol. 9, no. 6, p. 216.

Diagnosis.—A subspecies differing from all others except *catenifer*, *fuliginatus*, and *coronalis* in the high number of body blotches and the high tail-length ratio. On the average it has more body blotches and ventral scutes than *catenifer*, and is more often black and with confluent blotches anteriorly. It lacks the well-defined and continuous subcaudal stripes of *fuliginatus* and also the conspicuous black mottling on the head of the latter. From *coronalis* it differs in usually having a labial in contact with the eye.

Material.—Good series of this common snake are available for study, 52 from Baja California, over 300 from San Diego County, and 150 from elsewhere in southern California.

Description.—The following summary is based entirely on the Baja California specimens. The scale rows at mid-body are usually 31 or 33, occasionally 35 and rarely 37. The central dorsal rows are sharply keeled; these ridges are less accentuated laterally and the lowest 6 or 7 rows are smooth. The lowest 3 or 4 rows are larger than the rest. Paired apical scale pits are in evidence, often emphasized by tiny dark spots. The ventrals in the males (27) vary from 223 to 242, mean 232.6; and in the females (21) from 230 to 253, mean 240.6. The anal is entire. The subcaudals number from 75 to 89 in the males, mean 81.1. One specimen has 68 but it is impossible to tell whether the tail is complete. The females range from 73 to 82, mean 76.5. The supralabials most often number 8, sometimes 9, and rarely 10. The next to the last is the largest. Usually the fourth enters the eye, although if there are 9 it may be the fifth. In 2 counts out of 94 there is a complete row of sub-

oculars so that no labial touches the orbit. In 5 counts there were two labials touching the eye. The infralabials are usually 12 or 13, but are occasionally 14, or less often 11 or 15. The seventh is the largest; the first pair meet on the median line. Behind there is a pair of large chin shields, followed by a smaller, divergent pair, the latter separated by 2 or 3 rows of gulars.

The rostral is as wide as high, or, more often, slightly wider. It is not raised above the surrounding scales. Viewed vertically the front edge is almost flat, giving the snout a blunt appearance. The rostral parts the internasals for about half their depths; they are posteriorly divergent. There are usually 4 prefrontals, but sometimes they are fused into 3 scales, and, in six specimens, into 2. Six specimens out of 50 have an azygos, a central small scale posterior to the inner prefrontals. The supraoculars are widest posteriorly and the frontal anteriorly. The supraoculars contact the outer prefrontals. The parietals are wrinkled, and with uneven borders. The nasals are subequal, with the nostril at the upper end of the suture. The loreal is longer than high with a lower posterior point. Occasionally there is an extra loreal in the angle between the nearest supralabial sutures. One quarter of the specimens have a single preocular, the remainder two; when there are two the lower is much the smaller. The postoculars are most often 3, but there may be 4 or, less often, 5. The temporals, which are irregular in size and arrangement, number from 2+4 and 3+3, to 6+6.

The longest specimen I have seen from Lower California measures 1700 mm. This is the longest-tailed of all the gopher snakes (with the possible exception of two of the new island subspecies); adult males have a tail to length over-all ratio of about .170 and the females .155.

As to pattern, *annectens* is rather drab, lacking the bright and contrasting colors evident in the other subspecies. The dorsal blotches are usually black anteriorly and posteriorly; they may be black throughout, but more often are brown or red-brown at mid-body. Occasionally (6 cases out of 54) the anterior blotches are brown, although in such instances the blotches are bordered with black; or each scale may have a brown center with a black edge. Brown anterior blotches are more apt to be found in juveniles. Non-black blotches posteriorly occur more often. Sometimes the last blotches have gray or brown scales with black edges.

Anteriorly the dorsal blotches are quite irregular and indefinite; they are often confluent with each other and with the first lateral series. They are usually longer than wide. The interspaces comprise rows or streaks of yellow scales. Posteriorly the blotches become wider and rounder; the interspaces are buff or gray, streaked with brown, and the contrast remains imperfect. Finally, toward the tail the blotches become more distinct, the interspaces being lighter. There are usually 4 rows of alternating spots on each side anteriorly. The sides between blotches are so suffused with gray or brown punctations, or streaks on individual scales, that it is difficult to assign a color to the background. The lower surfaces are buff or yellow, spotted with black or punctated with gray. The outer edges of the ventrals are often marked by the lowest lateral series of blotches. The underside of the tail is usually stippled

with gray. Occasionally there are blotches subcaudally, and sometimes double rows of brown or black triangles, the analogues of the twin dark stripes in *fuliginatus*.

The head is brown above, sometimes mottled in the parietal area with darker-brown or black. There is generally a sharp contrast between the most advanced black body-blotch and the brown of the head. Usually there is a slightly darker-brown streak across the anterior ends of the supraoculars and the frontal. A postocular dark streak, ending at the angle of the mouth, is sometimes faintly in evidence. The dark streaks in the labial sutures, so characteristic of many *Pituophis*, are generally present, particularly the one immediately below the eye. The head is buff on the sides, and, except for the darkened labial sutures, is immaculate below.

Young specimens are usually brighter, with clearer spots and more color contrast.

The body blotches in these Baja California *annectens* vary in number from 57 to 90, mean 75.5; and the tail spots from 17 to 29, mean 23.0.

Range.—The subspecies *annectens* ranges from Santa Barbara County, California, south to the southern end of the San Pedro Mártir Mountains in Baja California (Lat. 30° N.). In this area it is found from the coast, through the interior valleys and mesas, to the crests of the mountains, and well down the desert slopes, but not on the desert itself.

Baja California localities are as follows: Tijuana, Rosarita Beach, Redondo (S. D. and A. E. Ry.), Lindero (S. D. and A. E. Ry.), half way between Tijuana and Tecate, Tecate, Zacatosa, Descanso Point (also 1 m. n.), Mesquite Point, San Miguel Mission, 6 m. s. of Jatay, El Tigre grade, Ensenada (also 3, 8, 10, 12, 15, and 23 mi. n., and 7 mi. s.), Guadalupe Valley, Laguna Hanson, Sierra Juárez, 8 mi. n. of Alamo, Santo Tomás, San Antonio del Mar (= Johnson Ranch, also 10 mi. n.), Johnson Canyon (n. of San Antonio del Mar), Trinidad (intergrade), San José (= Rancho San José, Lat. 31° N.), Socorro Mine, La Encantada, San Pedro (Mártir) Mt., San Quintín, and mouth of Rosario River (Lat. 30° N.).

Remarks.—*Annectens*, as it occurs in northwestern Baja California, does not differ in any notable way from the snakes found in the vicinity of the type locality, San Diego, California. The Baja California specimens have slightly higher ventral and subcaudal scale counts, and fewer blotches. As might be expected in an area extending from a foggy coast, through dry, interior valleys to mountains exceeding 10,000 feet in altitude, there is a considerable local variation in scale counts and pattern. Some of the mountain specimens, from such localities as Laguna Hanson and La Encantada, have fewer body blotches, but this is not a uniform tendency.

There are two aberrant specimens from *annectens* territory, not including USNM 37536 from Alamo, which I have discussed elsewhere. The first is SDSNH 16863 from 8 miles north of Alamo. This has an *annectens* tail ratio and is, in fact, *annectens* in all particulars except that it is red or red-brown throughout, without any black, and the blotch count is low. Tentatively,

I consider it an aberrant *annectens* with the black element of the coloring absent. It could hardly be considered an *annectens-affinis* intergrade in view of the tail length.

The other queer specimen is CNHM 1394 from Trinidad (Valle de la Trinidad). This is black both anteriorly and posteriorly, with a coloration and pattern reminiscent of both *bimaris* and *annectens*. It has a *bimaris* or *affinis* tail ratio; the blotch count (56) is too high for the former. I presume it is an intergrade, possibly *bimaris-annectens*. This can only be decided when much more material is available from this area.

The relationships of *annectens* to the island forms *fuliginatus* and *coronalis* have been discussed under those subspecies.

Of the mainland subspecies, *annectens* intergrades in northern Santa Barbara County with *catenifer*, from which it is not sharply differentiated. It intergrades with *deserticola* at the foot of the San Gabriel and San Bernardino ranges, where they merge into the Mojave Desert in Los Angeles and San Bernardino counties. Direct intergradation with *affinis* or *bimaris* is as yet uncertain.

***Pituophis catenifer affinis* Hallowell**

SONORAN GOPHER SNAKE

Plate 2, fig. 2.

- 1852. *Pituophis affinis* Hallowell, Proc. Acad. Nat. Sci. Phila., vol. 6, p. 181. No type specimen mentioned; type locality New Mexico, later (1854, p. 146) stated to be the Zuni River, New Mexico (which included Arizona).
- 1920. *Pituophis catenifer rutilus* Van Denburgh, Proc. Cal. Acad. Sci., ser. 4, vol. 10, no. 1, p. 24. Type specimen CAS 33869; type locality Tucson, Pima County, Arizona.
- 1932. *Pituophis sayi affinis* Stull, Occ. Papers Mus. Zool., Univ. Mich., no. 250, p. 4.
- 1943. *Pituophis catenifer affinis* Smith and Mittleman, Trans. Kans. Acad. Sci., vol. 46, p. 248.

Diagnosis.—A subspecies which can be distinguished from *catenifer*, *annectens*, *fuliginatus*, and *coronalis* by its proportionately shorter tail and fewer body blotches. It can be segregated from *deserticola*, *bimaris*, and *insulanus* by its brown anterior blotches, compared with black on the others. It may be separated from *vertebralis* since it lacks the black subcaudal stripe which characterizes the latter; also, *vertebralis* has black blotches at the base of the tail, while those of *affinis* are brown or dark-brown. *Affinis* has a rostral which is relatively wider and not so prominently raised above the surrounding scales as in *sayi*; when the rostral is viewed from above the anterior curve is flatter in *affinis* than in *sayi*.

Material.—Only two specimens of this subspecies from Baja California are available to me. These are USNM 22035 from Gardners Laguna, Salton

River (Mearns, 1907, p. 130), and MVZ 9562 from 23 miles north of El Mayor. Fortunately, adequate material is at hand from nearby Imperial County on the United States side of the international boundary, where the ecological conditions, involving both primitive desert and irrigated fields, are quite the same. In the days before irrigation these lowlands were occasionally watered by the overflow from the Colorado River, which periodically filled a number of shallow lakes. Similarly, the conditions in the Borego Valley of San Diego County match those at the foot of the Sierra Juárez and Sierra Cocopah below the line. Therefore, I have based the description of the subspecies *affinis*, which follows, on the two Baja California specimens, together with 12 from San Diego County and 73 from Imperial County. Of these specimens, 38 are males, 39 are females, and the rest are heads only. The Arizona material has been omitted because of territorial variations.

Description.—The scale rows at mid-body are most often 33 but may vary from 29 to 35. They are strongly keeled dorsally, but less so on the sides; from 5 to 7 of the lowest lateral rows are generally smooth. Paired apical scale pits are evident, particularly at the posterior end of the body, some being accentuated by dark spots. The ventrals in the males vary from 232 to 251; most of them fall between 234 and 244; the mean is 239.6. In the females the variation is from 234 to 257, with the major portion falling between 241 and 252; the mean is 246.0. The anal is undivided. The subcaudals vary from 61 to 70 in the males, with an average of 65.1; and in the females from 50 to 63, with an average of 57.7. The supralabials usually number 8, but are occasionally 9, and, rarely, 7 or 10. Usually the fourth touches the orbit, and the next to the last is the largest. The infralabials generally number 13, but are not infrequently 12 or 14, and rarely 11, 15, or even 16. The seventh is the largest. The first pair meet on the median line; they are followed, first by a pair of large genials in contact, and then by a pair of smaller divergent genials which are separated by two or three rows of gulars.

The rostral may be a little higher than wide or the dimensions may be equal. Viewed from above it is convex, the snout being slightly sharper than in *annectens*. Occasionally it is slightly raised above the surrounding scales. It indents the internasals for about half their depths. Most specimens have four prefrontals, although in some specimens an outer and an inner may be fused. Occasionally the outer end of a prefrontal is cut off to form what might be considered an upper loreal. The supraoculars are narrowest anteriorly; they usually contact the outer prefrontals. The parietals are triangular and have irregular outer edges, particularly because of the invasion of a scale behind the upper postoculars. The anterior nasal is slightly larger than the posterior. The loreals, of which there is usually only one on each side, are longer than high. The preoculars are ordinarily 2-2 with the lower quite small compared to the upper; in 14 per cent of the counts there is a single preocular. The postoculars are subequal; they are most often 3-3 but there may be 4 or even 5 on a side. The temporals are highly irregular in shape; they vary from 2 to 6 in the first row, and 3 to 6 in the second.

The longest specimen I have from Imperial County measures 1708 mm.,

and the shortest 415 mm. This snake grows to a large size in some sections of Arizona, probably well exceeding 2000 mm. The ratio of the length of the tail to the length over-all in the adults is about .136 in the males and .125 in the females. It is a short-tailed snake compared with *deserticola*, or especially with *annectens*. I have discussed tail-length equations and comparisons elsewhere (Klauber, 1943; see particularly p. 41 and table 13, but note that the series referred to as *P. c. deserticola* I, Imperial County, should be called *P. c. affinis*).

Affinis is primarily a brown-blotched snake with much dark streaking of individual scales in the interspaces. The main dorsal series is usually light-brown anteriorly, becoming darker toward the tail until, at the end, the blotches may be almost black. The anterior blotches are often outlined with dark-brown and sometimes even with black. The anterior blotches are not saddle-shaped, but the interspaces frequently are. The interspaces are usually buff, but within them there are many scales which are conspicuously darkened by brown streaks on their keels; this is particularly evident laterally, the dorsal interspaces being often clear. There are about four series of auxiliary and alternating blotches on the side. Both the main series and the auxiliaries tend to become more widely separated, and more even and clearly outlined posteriorly. The color below is cream or yellow, with some spotting on the outer edges of the ventrals. The subcaudal surface is usually spotted; rarely these spots may form longitudinal lines.

The head is light-brown or buff above, and lighter on the sides. There is usually a wide dark-brown line across the fronts of the supraoculars and the frontal. Back of this line there are dark-brown spots scattered in the frontal and parietal areas. There is generally a dark line from the eye toward the angle of the mouth, with a vertical termination between the last two supra-labials. There are the usual *Pituophis* streaks which follow the labial sutures, the one under the eye being widened and accentuated. The head is unspotted below.

The body blotches in these Californian specimens range from 41 to 62; with 4 exceptions out of 78 they fall between 43 and 58. The mean is 49.1. The tail spots vary from 10 to 19 with a mean of 14.1.

Range.—Since only two specimens are available from Baja California, collected at Gardners Laguna and near El Mayor, the range in the peninsula is imperfectly known. Reasoning from the situation in San Diego and Imperial counties, it may be expected to occur from the desert foothills of the Sierra Juárez eastward, and along the Gulf of California coast southward until it meets and intergrades with, or overlaps, *bimaris*, probably in the vicinity of San Felipe.

The general range of *affinis* is from central New Mexico, western Texas, Chihuahua, and southern Coahuila, westward through Arizona (excluding the section north of the Colorado River and extreme northern Navajo and Apache counties inhabited by *deserticola*) to central Riverside, Imperial, and northeastern San Diego counties in California; Sonora; extreme northern Sinaloa; and northeastern Baja California.

Remarks.—My reasons for assigning the gopher snakes of northeastern Baja California to the subspecies *P. c. affinis* rather than to *P. c. deserticola*, and the relationship between these two subspecies will be discussed in a subsequent paper on the gopher snakes of the Pacific Coast and Great Basin.

KEY TO SUBSPECIES OF *Pituophis catenifer*
IN BAJA CALIFORNIA

- | | | | |
|----|---|--------------------------|---|
| 1a | Supralabials usually not in contact with the eye | <i>P. c. coronalis</i> | |
| | South Coronado Island | | |
| 1b | At least one supralabial usually touching the eye | | 2 |
| 2a | Two parallel dark stripes formed of contiguous scale blotches on the underside of the tail | <i>P. c. fuliginatus</i> | |
| | San Martín Island | | |
| 2b | No parallel continuous dark stripes on underside of tail, although there may be rows of adjacent triangles | | 3 |
| 3a | Dark blotches on the body (exclusive of the tail) usually exceed 63; posterior lateral ground color suffused with gray | <i>P. c. annectens</i> | |
| | Northwestern coastal, foothill, and mountain area from the U. S. Border south to Lat. 30° N. | | |
| 3b | Dark blotches on the body (exclusive of the tail) usually 63 or less; posterior lateral ground color not suffused with gray | | 4 |
| 4a | Anterior body blotches black | | 5 |
| 4b | Anterior body blotches red or brown | | 6 |
| 5a | Body blotches 50 or more | <i>P. c. insulanus</i> | |
| | Cedros Island | | |
| 5b | Body blotches less than 50 | <i>P. c. bimarís</i> | |
| | Central area of the peninsula, from coast to coast, from Lat. 24°21' N. to Lat. 30° N. with an occasional specimen as far north as Lat. 31°30' N. Also Santa Margarita and Magdalena islands. | | |

- 6a Posterior body blotches (at base of tail)
brown; no subcaudal dark stripe *P. c. affinis*
Delta of the Colorado River and the north-
eastern desert area.
- 6b Posterior body blotches (at base of tail)
black; a dark subcaudal stripe usually present *P. c. vertebralis*
Cape region south of Lat. 24°20' N.

Note: It has been possible to simplify the key considerably by excluding subspecies which do not occur in Baja California. The gopher snakes are so variable that an infallible key cannot be devised. Successful determinations must be premised on the use of locality data as well, for the complete differentiation of subspecies is based on the summation of more characters than can be included in a key.

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The following abbreviations have been used in the designation of museum specimens:

AMNH	American Museum of Natural History
ANSP	Academy of Natural Sciences of Philadelphia
CAS	California Academy of Sciences
CNHM	Chicago Natural History Museum
LA	Los Angeles County Museum of History, Science and Art
LMK	Collection of L. M. Klauber
MCZ	Museum of Comparative Zoölogy, Harvard University

MVZ	Museum of Vertebrate Zoölogy, University of California
MZUM	Museum of Zoölogy, University of Michigan
SDSNH	San Diego Society of Natural History
SU	Natural History Museum, Stanford University
USNM	United States National Museum

SUMMARY

This paper comprises a resurvey of the gopher snakes of the genus *Pituophis*, found in Baja California, Mexico, based on additional material which has recently become available. All the gopher snakes of the area are deemed to be subspecies of *Pituophis catenifer* (Blainville), 1835.

Four new subspecies are described: *P. c. bimaris* from the central area of the peninsula; *P. c. insulanus* from Cedros Island; *P. c. fuliginatus* from San Martín Island; and *P. c. coronalis* from South Coronado Island. The first two are nearest to *P. c. vertebralis* of the Cape region, the others to *P. c. annectens* of the San Diegan faunal area. The only other form found in the peninsula is *P. c. affinis* of the northeastern desert and Colorado River delta.

The previously known forms, as newly circumscribed, are summarized. Relationships are discussed.

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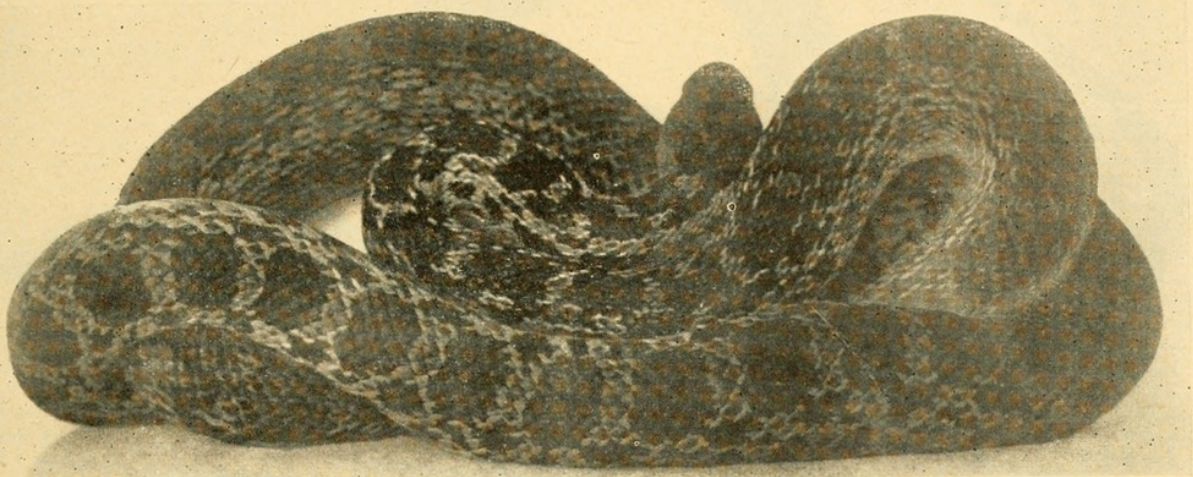


Fig. 1. *Pituophis catenifer insulanus*

Adult female (type specimen) from Cedros Island. Collected and photographed by J. R. Slevin, California Academy of Sciences.



Fig. 2. *Pituophis catenifer vertebralis*

Specimen from Cape San Lucas, Baja California. Collected by Fred Lewis.
Photograph by L. C. Kobler.

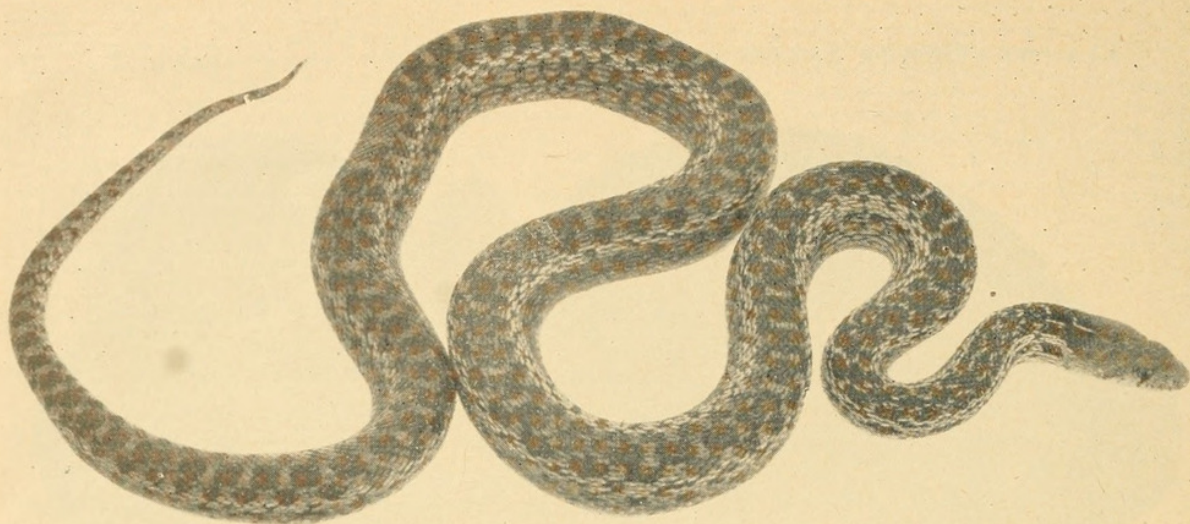


Fig. 1. *Pituophis catenifer annectens*

Adult female from Mesquite Point, Baja California. Collected by Dr. C. L. Hubbs. Photograph by L. C. Kobler.

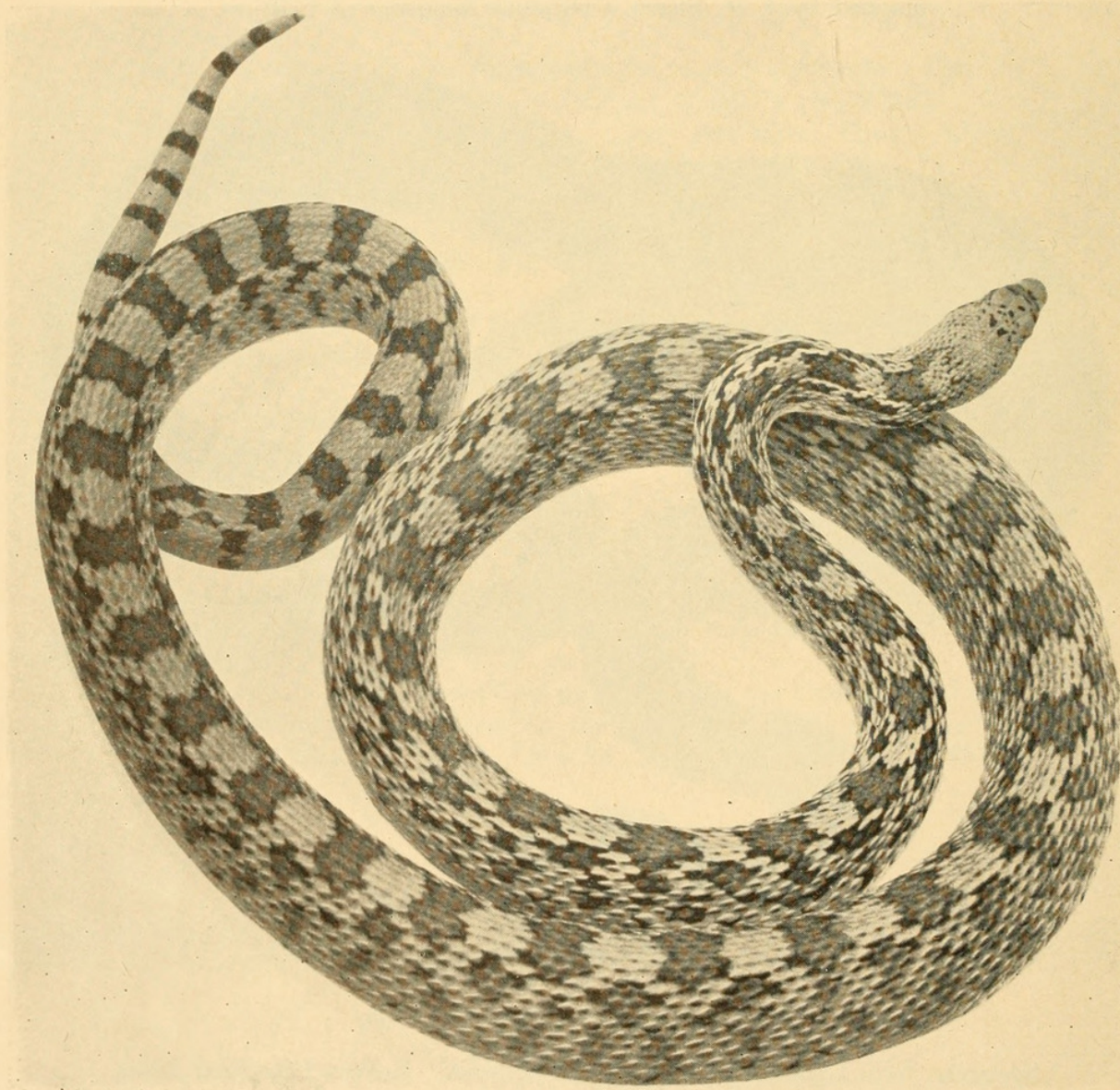


Fig. 2. *Pituophis catenifer affinis*

Adult male from 10 miles west of Benson, Cochise County, Arizona. Collected by Robert Hoard. Photograph by L. C. Kobler.



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