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A COMPARATIVE STUDY OF THE URINO- GENITAL SYSTEMS OF AN OVIPAROUS AND TWO OVOVIVIPAROUS SPECIES OF THE LIZARD GENUS SCELOPORUS*

BY

DOROTHEA DE MUTH MULAİK

In the comparative study of the urinogenital systems of the American lizards by Brooks (1906), all the species studied by him were oviparous. One of the genera, *Sceloporus*, is now known to contain ovoviviparous forms as well. The presence of both oviparity and ovoviviparity in the same genus suggested a comparison of the urinogenital systems in the two groups. Available for this study was a small series of *S. microlepidotus disparilis* Stejneger† (13 females and 5 males), *S. poinsetti* Baird and Girard (3 females and 2 males), and *S. olivaceus* Smith (6 females and 4 males). The first two species are ovoviviparous (Mulaik 1936; Smith, 1936, p. 612) and the third, under which Brooks' *S. floridanus* was synonymized (Smith, 1939, p. 111), is an oviparous form.

This study, largely of a gross anatomical nature, included some histological sections to clarify such morphological details as the position of the entrances of the urinary and genital ducts into the cloaca. The dissections were done with the aid of a binocular microscope. All measurements were taken either with the ocular micrometer or the Vernier calipers. Due to the length of time that most of the specimens had been in the preservative these measurements were only approximate.

This study did not involve every aspect of the urinogenital systems. New information on the hemipenes could be gained only by a detailed histological study such as Wöpke (1930-31) made of *Lacerta agilis* Linne, which was beyond the scope of this work. Neither were the femoral pores, adrenals and the fat bodies given any attention at this time.

The postcaval vein, formed by the junction of the vessels arising in the medial vicinity of the two kidneys, began in all specimens in the region between the caudal and anterior borders of the left gonad. The vein coursed for a short distance in the mesentery immediately dorsal to the right gonad; then, at a level midway of this organ, or at the anterior border, it entered the extended posterior tip of the right lobe of the liver and traversed it on its way towards the heart. A lateral mesentery of this portion of the liver also fused with the right mesorchium or mesovarium. In the females of *S. m. disparilis* the right hepato-ventral mesentery frequently fused with the anterior portion of the right mesometrium, thus forming a mesenteric sheet which partially separated the pleural region from the peritoneal region on the same side. This same lobe of liver was connected medially by another mesentery with the posterior tip of the right lung in specimens of *S. poinsetti* and *S. olivaceus*. In these two species in the majority of specimens the right lung (Figs. 1, 2, 4, 5) extended caudad to the level of the position of the right gonad. The right adrenal was also

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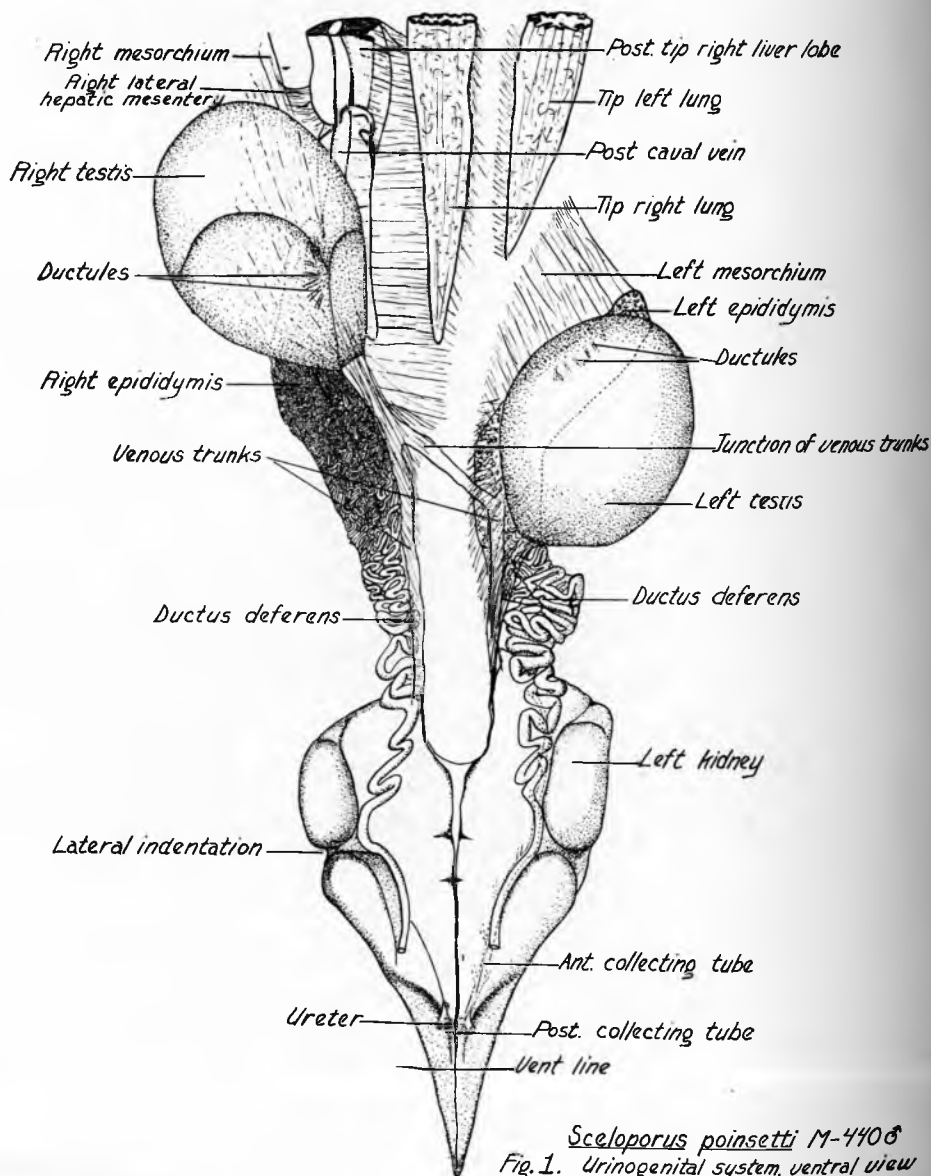
Dr. and Mrs. A. H. Wright
Mr. Stephen D. Durrant
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Karl P. Schmidt
Dr. Calvin A. Richins
Mr. Stanley B. Mulaik

†Smith, Hobart M., 1946, considers this species *S. grammicus disparilis* Stejneger.

involved. This mesenteric inter-relationship was so intimate that any movement of one organ moved the remainder of the group. Cope (1898) mentioned a similar relationship of these structures in connection with several lizard genera.

The urinogenital system of the male of *S. poinsetti* was as shown in Fig. 1. In all specimens the position of the testes was approximately 40 mm. anterior to the vent, a distance which varied from thirty-five to forty per cent of the vent to snout measurement. The right testis usually lay somewhat in advance of the left and on an oblique plane with reference to the vertebral column while the left testis paralleled it. At the level of its



Sceloporus poinsetti M-440♂
Fig. 1. Urinogenital system, ventral view

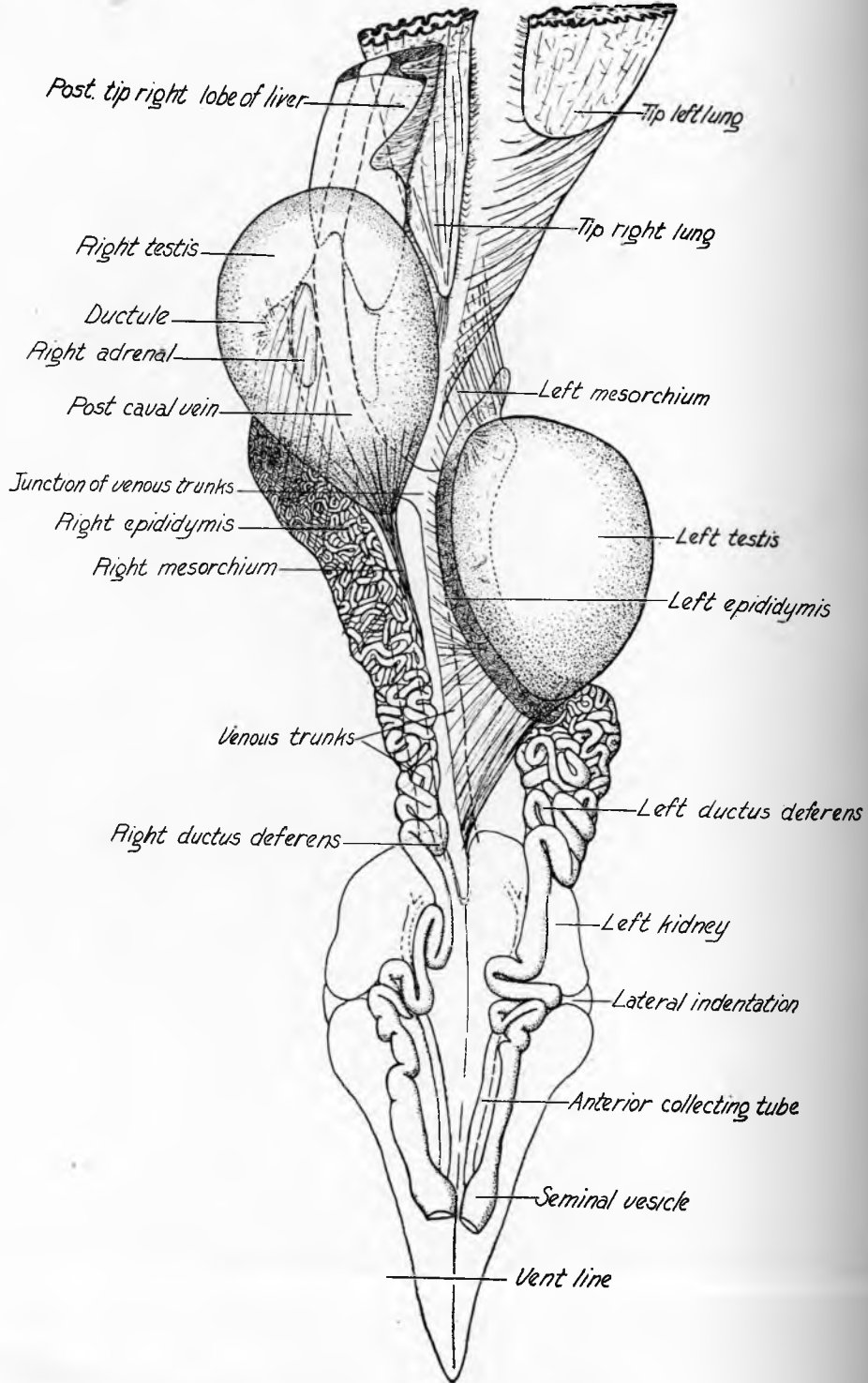
caudal border the right testis was separated by approximately 4 mm. from the left. The right organ was always larger in size. In the males of *S. olivaceus*, (Fig. 2), the position of the testes anterior to the vent varied from thirty to forty-seven percent of the vent to snout measurement. The right gonad, as in the *S. poinsetti* males, lay on an oblique plane but at a lesser angle to the vertebral column, while the left paralleled it. The two organs were separated, but the variable distance between them was less than it was in *S. poinsetti*. In every specimen the anterior border of the left testis was approximately 10 mm. posterior to that of the right. Both organs were about the same size. In the urinogenital system of the *S. m. disparilis* male (Fig. 3) the right testis lay completely anterior to the left, and the medial portions of both organs overlapped the middorsal line. Medially their mesorchia fused with the mesentery proper. The position of the right testis anterior to the vent was approximately forty percent of the distance from vent to snout, while that of the left was approximately thirty percent of the same measurement. The right organ was usually longer than the left but the differences in width were slight.

In all three species several minute tubules connected the anterior portion of each testis with the anterior end of the corresponding epididymis. Forbes (1941) mentioned that in the species used in his research only one of the several tubules was functional. Whether this was the case in these species was uncertain. The epididymides in the three forms were much coiled slender tubes held in a fusiform mass by folds of the mesorchia. Near the level of the caudal border of the left testis, sometimes more posteriorly, the epididymides became continuous with tubes of larger diameter, the ducti deferentia. The ducti deferentia at their beginning were greatly convoluted in *S. poinsetti* and *S. olivaceus* and in compact transverse coils in *S. m. disparilis*. They straightened out as they passed over the ventral surfaces of the kidneys. Near the entrances into the urodaeum each expanded into a seminal vesicle. In *S. m. disparilis* and *S. poinsetti*, the deferent duct of each side joined the corresponding ureter before emptying into the urodaeum at the tip of a papilla. It is debatable whether such a junction was made in *S. olivaceus* males because of conditions to be described in the discussion of the cloaca of this species. In two specimens of *S. olivaceus* (CA-9036, CA-6325) bi-lateral Mullerian ducts extended along the ventro-lateral edges of the epididymides and the deferent ducts.

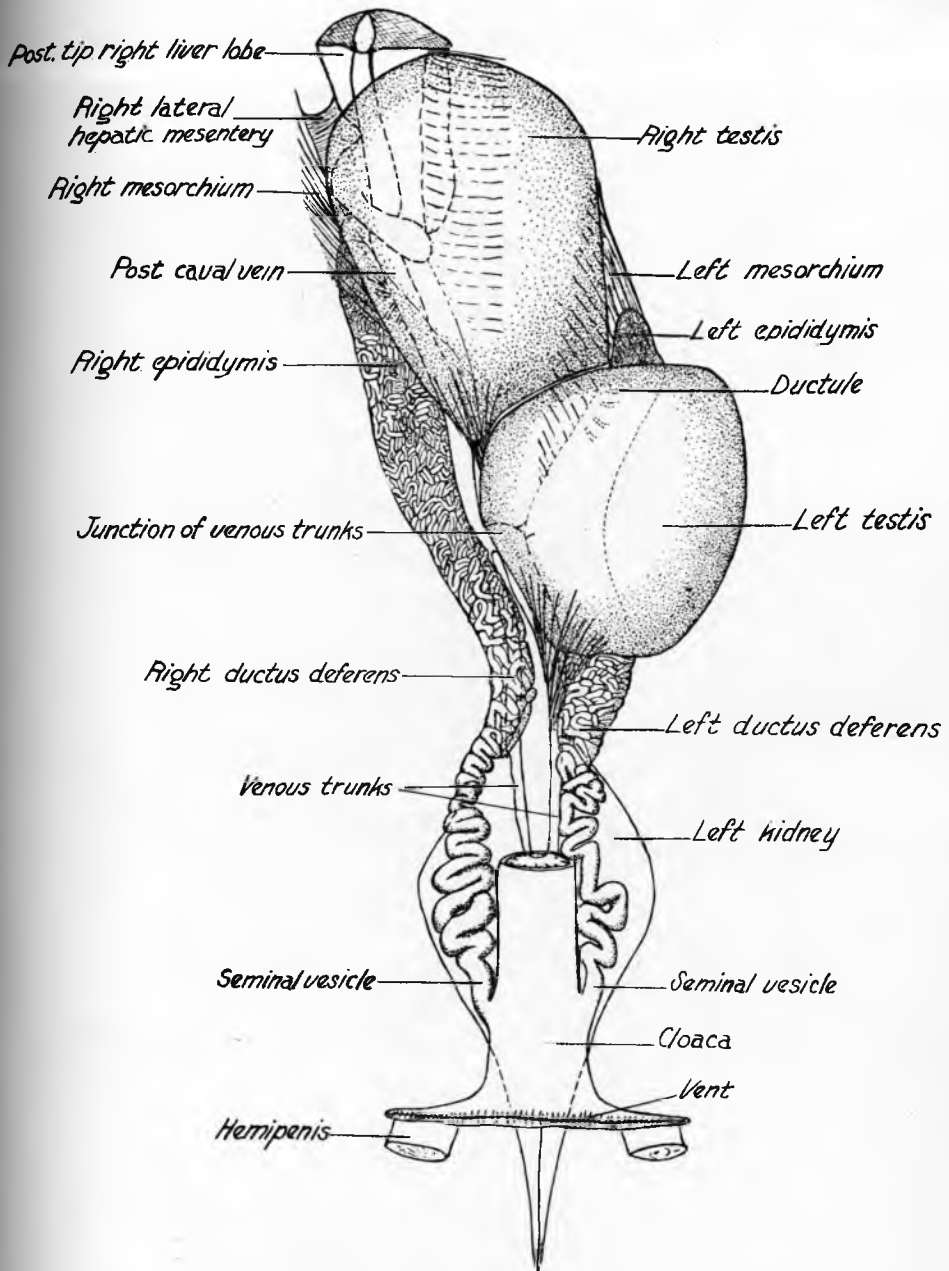
In the females of all three forms the ovaries were oval to rectangular shaped bodies suspended middorsally in the pleuroperitoneal cavity by their mesovaria. Posterior to the gonad the mesovaria took the form of strong cords along the median ventral surface of the venous trunks. The size of the ovaries varied with the maturity of the individual and with the season of the year, the maximum being attained just prior to ovulation. Developing ova gave the surface of the ovaries a lobulated appearance.

In *S. poinsetti* (Fig. 4) the ovaries were located anterior to the vent approximately one-fourth of the vent to snout measurement. There were six to eight ova in each ovary. The position of the ovaries anterior to the vent in *S. olivaceus* (Fig. 5) was one-third of the vent to snout distance. In this species the gonads averaged twelve ova each. Specimen CA-7207 had two right ovaries but the combined number of eggs was only one more than was counted in the left. In both species mentioned above the right ovary was slightly cephalad on the left. The right ovary in *S. m. disparilis* (Fig. 6) was anterior to the vent about forty percent of the vent to snout distance, while the corresponding position of the left organ was approxi-

SOME URINOGENITAL SYSTEMS

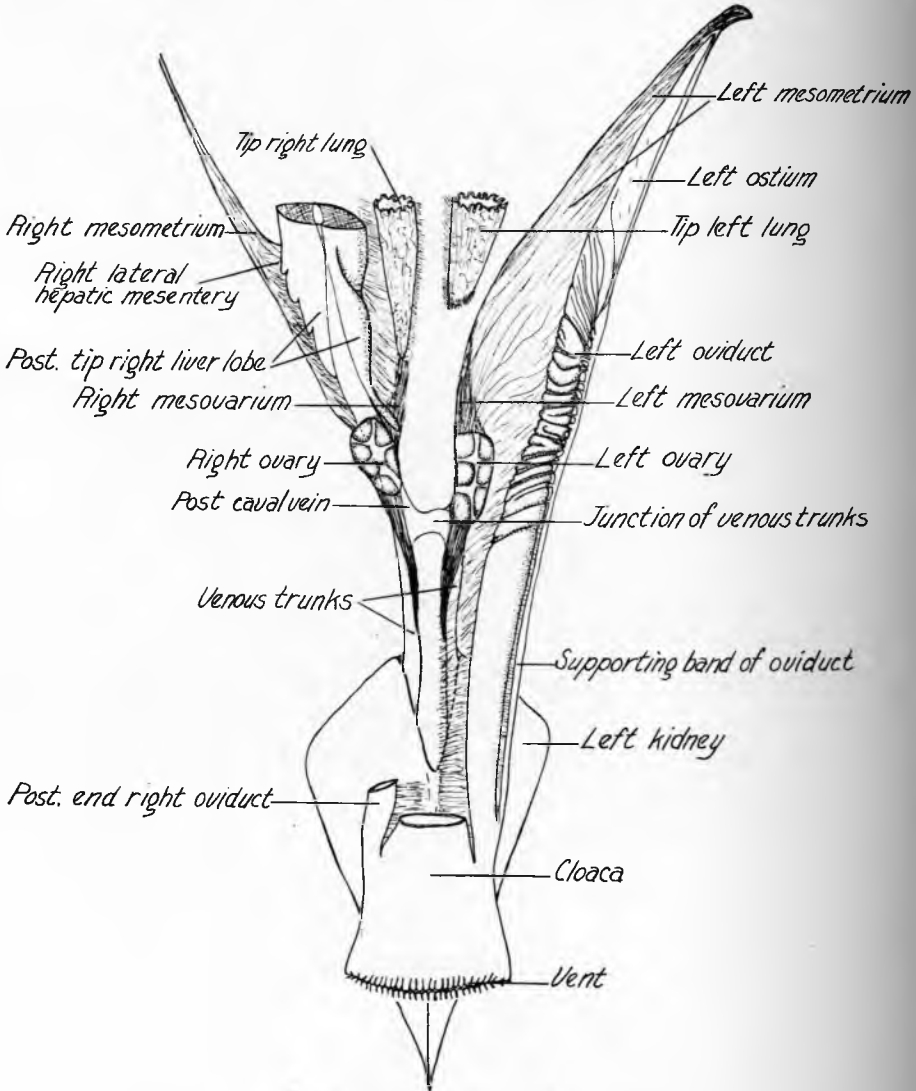


Sceloporus olivaceus CA-9036♂
 Fig. 2. Urinogenital system, ventral view



Sceloporus m. disparilis M-200 ♂
 Fig. 3. Urinogenital system, ventral view

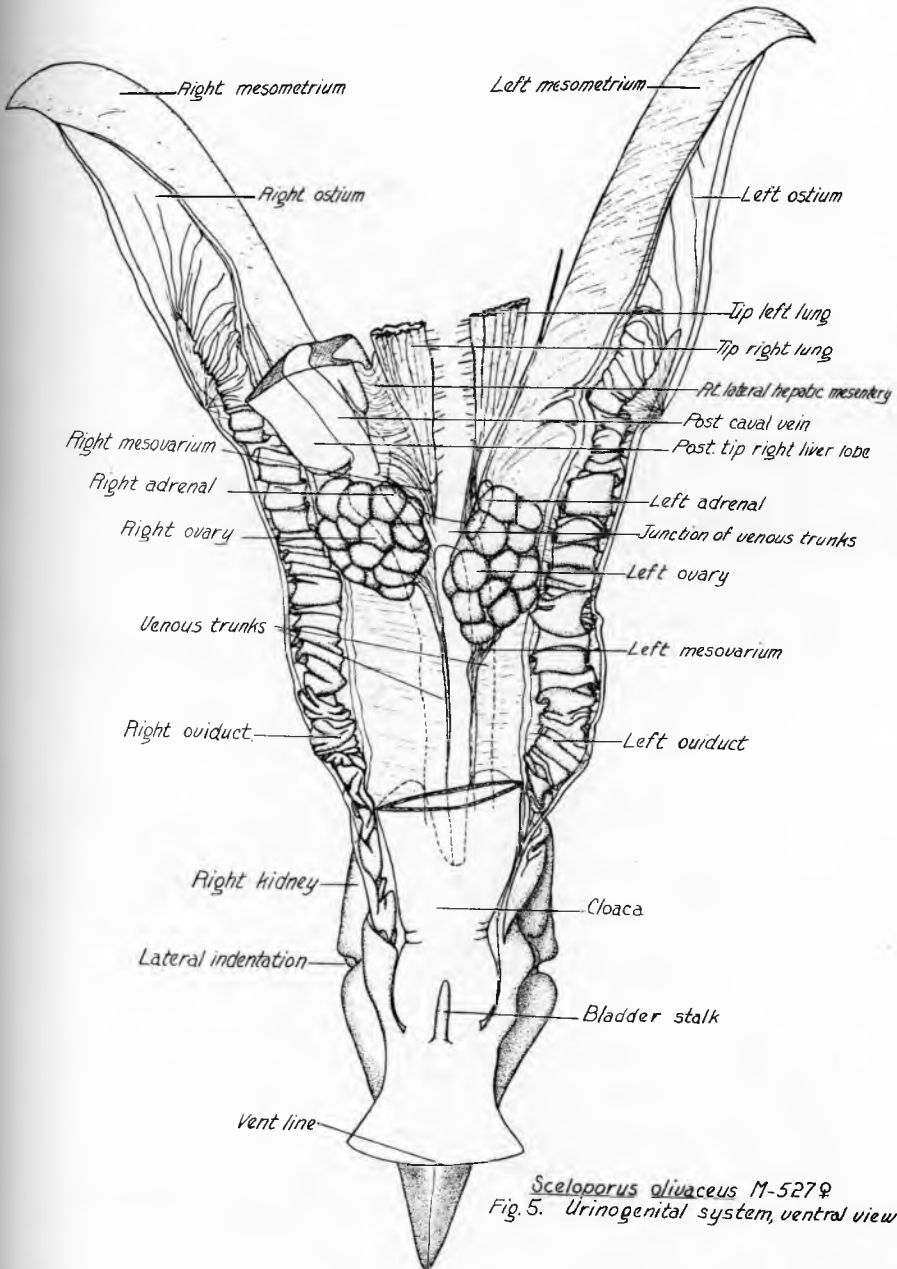
mately twenty-three percent of the same distance. Specimen CA-3764 had two ovaries on each side. The right ovaries were parallel to each other and were separated by the right adrenal. The left ovaries were one ahead of the other. In this species the right organ was usually larger than the left and frequently had one or more ova than the left. The average number of ova for the right was six and for the left five.



Sceloporus poinsetti M-441♀
Fig. 4. Urinogenital system, ventral view

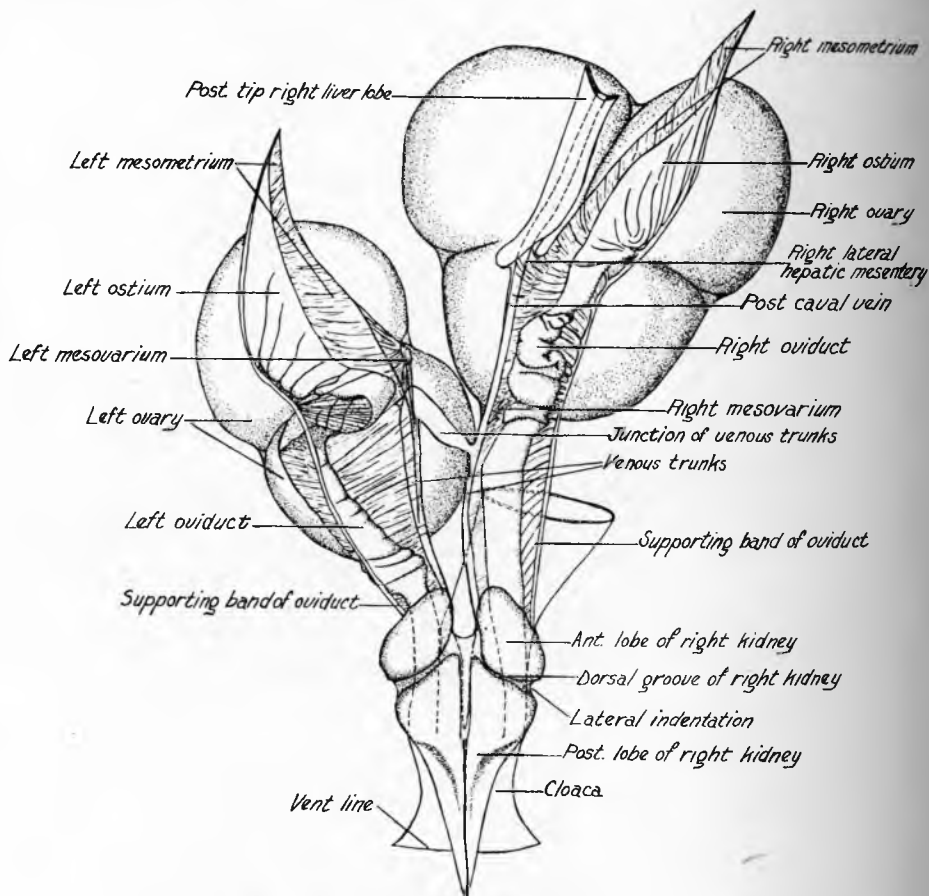
Dorso-lateral to the ovaries were the oviducts, ribbon-like tubes with the anterior ends expanded in the form of open funnels, the ostia. They were held in position by their mesenteries, the mesometria, whose most anterior points of attachment to the body wall were at variable distances

from the axillae of the forelimbs. From this anterior point the line of attachment to the body wall curved gradually medially and posteriorly. After fusing with the craniad portions of the mesovaria dorsad of the ovaries, the mesometria were traced caudad attached along the ventral surface of the two venous trunks until their fusion with the dorsal cloacal wall near the anterior urodaeal region. In *S. poinsetti* (Fig. 4) the line



Sceloporus olivaceus M-527♀
Fig. 5. Urinogenital system, ventral view

of attachment began ventro-laterally about 10.5 to 15.5 mm. posterior to the axillae. It was the most ventral in position of the three species. In *S. m. disparilis* (Fig. 6) the beginning point of the left mesometrium (usually lower than for the right) varied in position posterior to the axilla of the left forelimb from 5 to 10.5 mm., with 8 mm. being the most common distance. The antero-lateral points of attachment of the mesometria posterior to axillae were approximately 11 to 13 mm. in *S. olivaceus* (Fig. 5).



Sceloporus m. disparilis M-950 ♀
Fig. 6. Urinogenital system, dorsal view

The ventro-laterally openings of the collapsed ostia of the oviducts measured approximately 11 mm. in length in *S. poinsetti*, 5 to 7 mm. in *S. m. disparilis* and 8 to 17 mm in *S. olivaceus*. The common distance in the latter species was 11 mm. The free borders of each ostia united at their posterior ends, becoming continuous with the narrow band of tissue supporting the lateral edges of the oviduct and holding the folds in place. Posterior to the ostia the oviducts were constricted, then they widened gradually attaining their maximum width just caudad of the corresponding ovary after which they again

narrowed gradually to a width of about 2 mm. just prior to their entrances into the cloaca. In *S. poinsetti* and *S. m. disparilis* the oviducts were in many transverse folds and pleats between the neck of the ostia and the level of the posterior edges of the ovaries, but caudad of this latter area they curved medially and posteriorly to the cloaca with scarcely a fold. In *S. olivaceus* the oviducts were in numerous transverse folds and pleats between the necks of the ostia and the junction of their posterior ends with the cloaca.

Early in this study it was discovered that some of the gravid females of the ovoviviparous species showed the presence of a placental structure in the oviducts. Corpora lutea were present in the ovaries of these specimens. A full description of the origin and development of this structure in the two species has been postponed until more extensive collecting can be done over a period of several years to insure the inclusion of gravid females with embryos in all stages of development. In the study of the *S. m. disparilis* specimens it was noted that the condition of the reproductive structures correlated with the collecting dates indicated a probable two year reproductive cycle in this species.

In immature specimens of all three species the oviducts were thin-walled and somewhat transparent. In specimens with well developed ova they were thicker walled, more convoluted and opaque. In the ovoviviparous gravid specimens containing well developed embryos the oviducts were semi-transparent and thin walled except along the medial edges where the placental-like structures were noted.

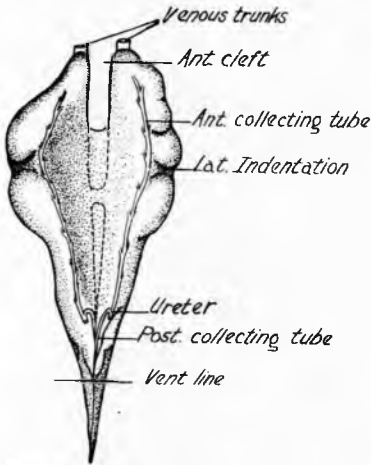
Strong sphincter muscles were present in the posterior ends of the oviducts as they approached the summits of the papilae in the urodaeum. In addition, in the lumen of this region, particularly in the ovoviviparous specimens, there were numerous complicated frimbrae projecting cranial.

The two kidneys in both sexes of all three species were retroperitoneal and located dorsal to the cloaca against the vertebral column in the extreme posterior portion of the pleuroperitoneal cavity. In most cases part of the kidney tissue extended caudad of the vent for a distance which varied with the sex and the species. The histological sections revealed glomeruli to be distributed throughout the kidney. Because they were enclosed in a capsule and the posterior portions were partially conjoined, the two kidneys had the appearance of a single organ. The extent of the conjunction varied with the species and sex. A lateral indentation of varying width and depth, which may or may not extend either ventrally or dorsally, roughly divided each kidney into an anterior and a posterior lobe.

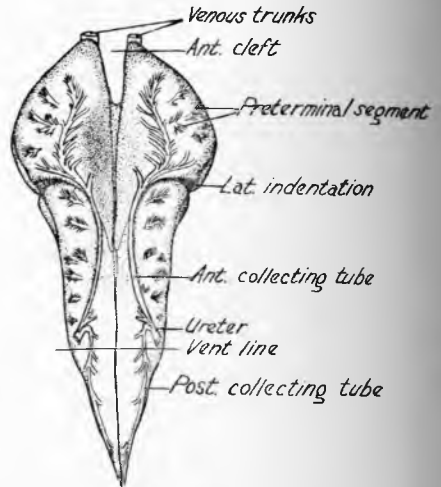
The ureters were short. Each was formed by the union of an anterior and a posterior collecting tube, which were in turn formed from varying number of branches. The former, approximately twice the length of the latter, began near the cranial border of each kidney and coursed imbedded either shallowly or deeply within the ventral tissue. In the males this tube was dorsal and medial to the corresponding deferent duct. The tube continued posteriorly, frequently following the contour of the lateral ridges of the kidney, and joined the posterior tube which came either medially or laterally from the caudal end of the kidney. The ureters entered the dorsal wall of the cloaca directly after emergence from the kidney. In the males of *S. poinsetti* and *S. m. disparilis*, as was mentioned earlier, each ureter was generally joined by its corresponding deferent duct before reaching the summit of the urinogenital papilla. An exception to this condition seemed to be true in males of *S. olivaceus*. In females, the

ureters enter the cloaca in the medial posterior region of the urodaeum at the summits of urinary papillae.

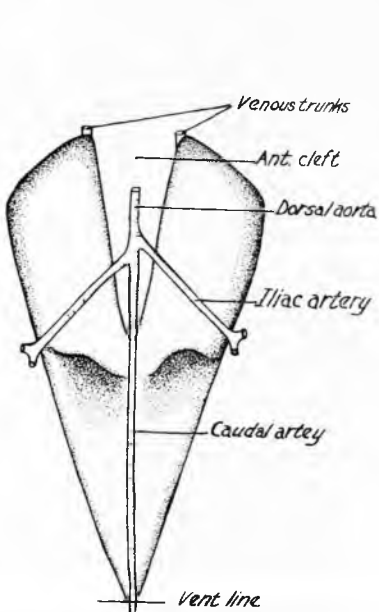
In the males of *S. poinsetti* the two kidneys (Fig. 10) considered together were roughly pentagonal in shape, with two sides elongated posteriorly and extended 5 to 8 mm. caudad of the vent. At the cranial borders



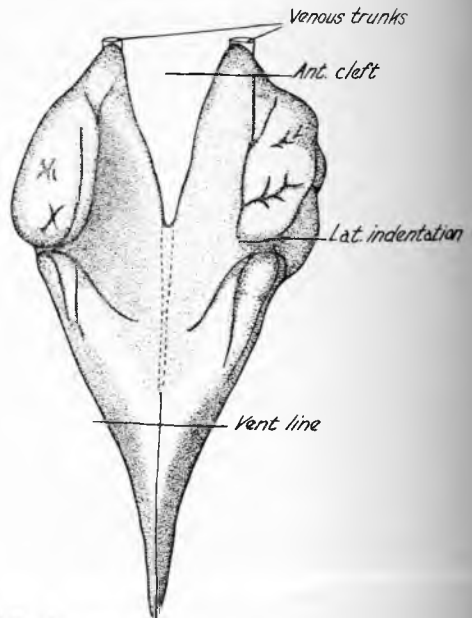
Sceloporus m. disparilis M-199 ♀
Fig. 7. Kidneys, ventral view



Sceloporus m. disparilis M-152 ♂
Fig. 8. Kidneys, ventral view

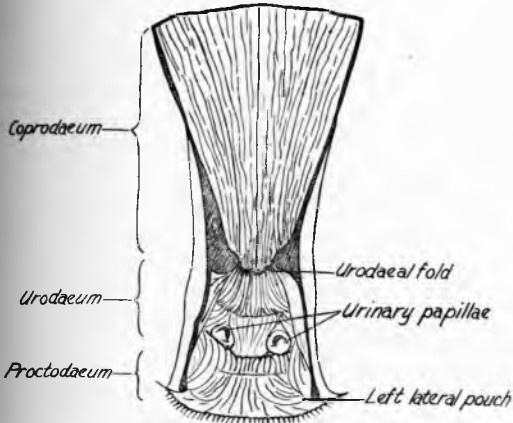


Sceloporus poinsetti M-953 ♀
Fig. 9. Kidneys, dorsal view

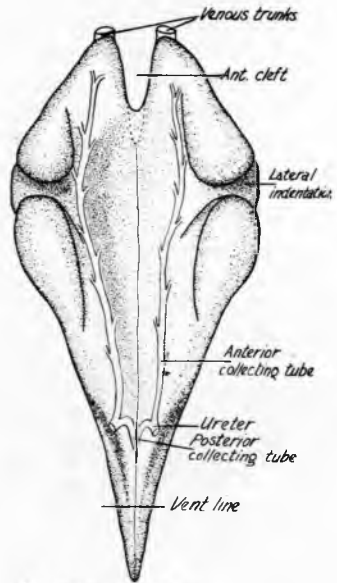


Sceloporus poinsetti M-159 ♂
Fig. 10. Kidneys, ventral view

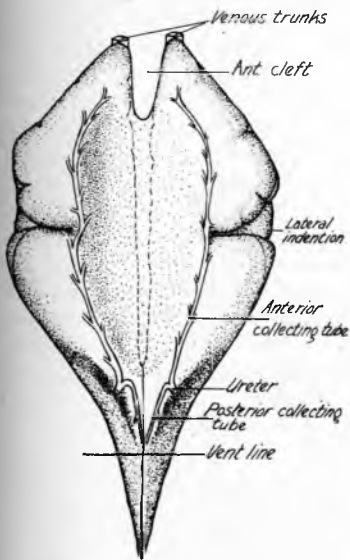
there was a medial separation of about 4 mm. which diminished gradually to where the kidneys become conjoined at the level of the lateral indentations. The conjunction of the posterior portions of the kidneys was sometimes as much as one-third of their length of 21 to 23 mm. The greatest width across the two kidneys was approximately 12 to 13 mm. at a level slightly anterior to the lateral indentations. These lateral indentations continued only slightly on the ventral surface and not at all on the dorsal. About one-half of the anterior portion of the ventral surface was concave



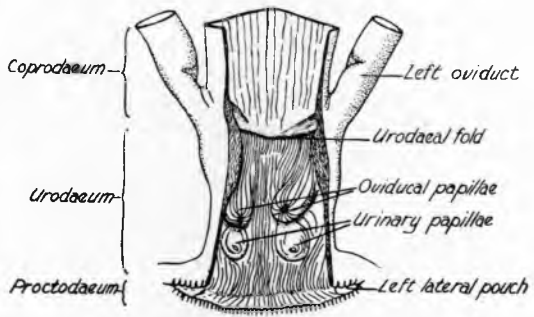
Sceloporus olivaceus CA-9036 ♂
Fig. 11. Cloaca, ventral view



Sceloporus olivaceus CA-9036 ♂
Fig. 12. Kidneys, ventral view



Sceloporus olivaceus 11-951 ♀
Fig. 13. Kidneys, ventral view



Sceloporus olivaceus 11-186 ♀
Fig. 14. Cloaca, ventral view

medially with shallow ridges craniad and laterad. The dorsal surface of the same region was somewhat convex and more or less smooth. The tapering posterior portions were united and elevated. Viewed ventrally, the coupled kidneys had the appearance of a scoop, of which the elongated posterior portion was the handle. It was not possible to ascertain the presence or absence of any preterminal segment such as Regaud and Policard (1903) reported only in males of certain species of lizards and snakes.

The kidneys (Fig. 9) of the females of *S. poinsetti* are similar in shape and appearance to those of the males, but are more flattened and extended caudad of the vent only 3 to 5.4 mm. In M-953 the kidney ended at the vent. The total length ranged from 14 to 25 mm. but in each specimen, as in the males, the measurement was approximately one-fifth of the vent to snout length. The anterior medial separation of the two kidneys was slightly greater than in the males, measuring 5mm., but the caudal extent of the cleft was about the same, being approximately 7 mm. The kidneys appeared to be conjoined from the bottom of this medial cleft to their caudal ends but were united only for the posterior half of this distance. The lateral indentations were not as deep as in the males, nor was the ventral surface as concave. The anterior and lateral bordering ridges were scarcely noticeable. The greatest width of the coupled kidneys ranged from 8 to 13.6 mm.

The kidneys of the males of *S. m. disparilis* are as in Fig. 8. Taken together, the anterior parts of the two kidneys were roughly oval in shape while the posterior united portions tapered off rapidly to a point. The enclosing capsule only partially followed the medial separation of the anterior portions. At the craniad borders this anterior cleft was about 1 mm. but its extent caudally was variable. The two kidneys were always united posterior to the emergence of the ureters and extended caudad of the vent from 3.5 to 4.5 mm. The length of the kidneys was from 12.5 to 13.3 mm. The greatest width was from 5.6 to 6.5 mm. at the level of the lateral indentations. These lateral indentations were shallow but continued on the dorsal surface as deep oblique grooves in which lay the iliac arteries, while on the ventral surface they became deep narrow clefts which strongly emphasized the two-lobed appearance. The anterior part of the ventral surface was concave medially, bordered by rather high broad craniad and laterad ridges. This concavity ended near the beginning of the region of conjunction. The dorsal surface was somewhat smooth, slightly convex anteriorly and keeled posteriorly. A preterminal segment (Fig. 8) of the uriniferous tube similar to that described by Regaud and Policard (1903) apparently was present in the males of this species.

The kidneys (Fig. 7) of the females of *S. m. disparilis* were similar in many respects to those of the males. In all specimens the length was approximately one-fifth of the vent to snout measurement. In five females the length of the kidneys was 12 mm. The maximum width of the two kidneys was slightly less than one-half the length, and ranged from 4.8 to 6 mm. The extension of the kidneys caudad of the vent varied from 2.7 to 4.2 mm. being somewhat less than it was in the males.

The kidneys of the males of *S. olivaceus* were as shown in Fig. 12. The craniad edges of the kidneys were 4 to 6 mm. caudad to the anterior border of the pelvic girdle. The shape of the two kidneys taken together was similar to that of the kidneys of *S. poinsetti* (Figs. 9, 10) but the anterior cleft was not as wide nor as deep. The width (1.5 to 2 mm.) was approximately the same throughout the extent of the cleft which was about 3 mm.

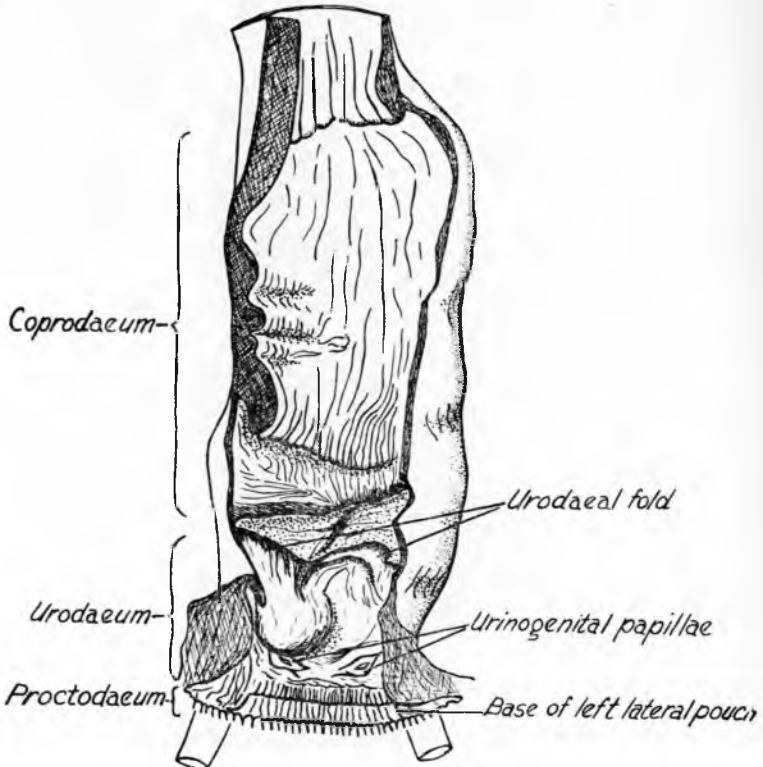
long. The anterior portions were somewhat flattened. Their dorsal surface was smooth and slightly convex, while the ventral surface had a medial concavity bordered by ridges approximately 2 mm. in width. The posterior portions of the kidneys were tapering, laterally compressed and elevated, making their dorsal surface keeled medially. The ventral surface was nearly level thus terminating the medial concavity of the anterior portions. Caudad to the level of the emergence of the ureters from the ventral surfaces, the kidneys were generally united. The length of the kidneys ranged from nineteen to twenty-two percent of the vent to snout measurement. The maximum width of the two kidneys was slightly less than one-half the length. The posterior portions of the kidneys extended caudad of the vent about 3 mm. The lateral indentations continued onto the ventral surface as short narrow grooves while on the dorsal surface they are scarcely noticeable. The surface of the kidneys showed no indication of the existence of any preterminal segment of the uriniferous tubes such as did the kidneys (Fig. 8) of the male *S. m. disparilis* M-152.

The kidneys of the females of *S. olivaceus* (Fig. 13) were similar in shape and appearance to those of the males, but their position in some specimens was usually more anterior, the craniad edges being at the level of the corresponding border of the pelvic girdle. The width of the anterior cleft was the same as in the male, but the cleft extended caudad about 3.5 mm. The length of the kidneys was quite constant being about one-fifth of the vent to snout measurement. The maximum width of the two kidneys was about the same as it was in the males. The posterior portions of the kidneys extended caudad of the vent from 3.5 to 5 mm.

The cloacae of both sexes of all three species were situated in the region bounded anteriorly by the craniad edge of the pelvic girdle and posteriorly by the vent. Each was distinctly divided into three chambers. The coprodaeum, the chamber into which the digestive tract emptied, was the largest, the most anterior and the most dorsal of the three. It had a cylindrical lumen. In all three forms the walls were somewhat thin, but in other aspects there were differences depending upon the sex and the species. The coprodaeum of the males of *S. poinsetti* were as shown in Fig. 15 and those of the males of *S. m. disparilis* were very similar. The same chamber in the females of *S. m. disparilis* (Fig. 16) and in the females of *S. poinsetti* were similar. In these two species the mucosa of this chamber had many longitudinal and transverse folds particularly in the posterior portion. In the male (M-200) and in a female (M-950) of *S. m. disparilis* two longitudinal folds, a dorsal and a ventral, almost met in the same sagittal plane in the lumen, roughly dividing the posterior part of this chamber into two short longitudinal cavities. In the females of this same species one of the transverse folds just anterior to the urodaeal fold almost encircled the lumen of the chamber. The mucosa of the coprodaeum of the males (Fig. 11) and of the females (Fig. 14) of *S. olivaceus* was folded into numerous, regularly spaced, low longitudinal ridges. Transverse folds were scarcely noticeable.

The middle chamber, the urodaeum, into which the urinary and genital ducts emptied, was separated from the coprodaeum by a structure termed the "urodaeal fold" by Wöpke (1930). Projecting craniad, this structure was crescentic, transverse fold of the mucosa located obliquely across the lumen of the cloaca. There was no indication of its presence on the outside of the cloaca. It was deepest mid-dorsally and laterally, rapidly diminishing to a low or slight ridge mid-ventrally. It contained a strong sphincter muscle. The shape of the lumen of the urodaeum was

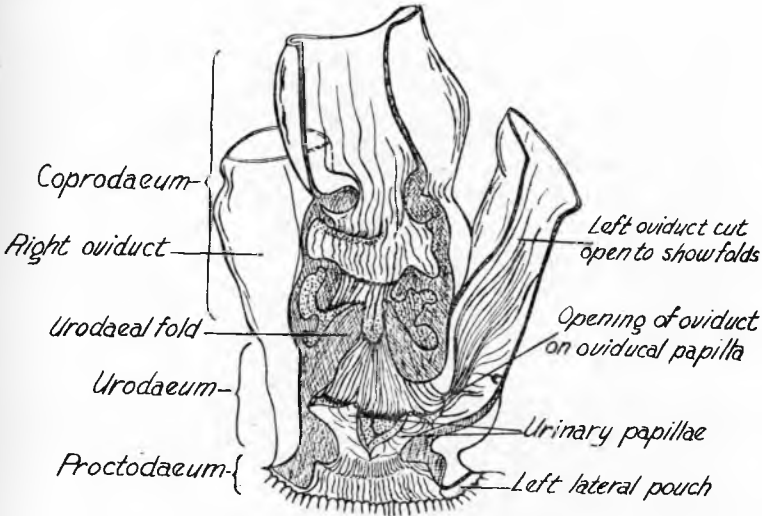
roughly a square. There were differences in the urodaeum depending upon the sex and the species. In both sexes of *S. poinsetti* and *S. m. disparilis* this chamber (See Figs. 15, 16) was thicker walled, more heavily muscularized, and more complicated in appearance than it was in both sexes of *S. olivaceus* (See Figs. 11, 14). The urinogenital papillae of the males and urinary papillae of the females were located in the median posterior portion of the chamber immediately anterior to the spincter valve separating the urodaeum from the proctodaeum. In the males of *S. poinsetti* and *S. m. disparilis* the smooth-walled cone-shaped urinogenital papillae were separated approximately 3 to 4.7 mm. In the males of *S. olivaceus* the same structures were about 2 mm. apart. At the summit of each urinogenital papillae in the *S. poinsetti* and *S. m. disparilis* males was the crescent-shaped opening of the short duct formed by the union of the ductus deferens and ureter of that side. In the males of *S. olivaceus* there was a shallow crescentic crater with the posterior border higher than the anterior upon the summit of each urinogenital papilla. In the bottom of the crater, separated by a narrow ridge of tissue were the openings of the ureter and the ductus deferens, the latter being posterior. This condition was not varified by histological sections. The two males of this same species in which Mullerian ducts were present, there were noted two dorso-lateral concavities caudad to the base of the urodaeal fold in the corresponding position of the oviducal papillae of the females. There seemed to be no openings into



Sceloporus poinsetti M-159♂

Fig. 15. Cloaca, ventral view

the vestigial oviducts. The urinary papillae of the females of *S. olivaceus* were lower than the same structures in the female of the other two species. In all three species the entrances of the oviducts into the urodaeal chamber were at the summits of short cylindrical papillae located in a dorso-lateral position at the base of the urodaeal fold.



Sceloporus m. disparilis M-197♀
Fig. 16. Cloaca, ventral view

In the females of *S. poinsetti* there was a short longitudinal fold of the mucosa protruding from the dorsal wall between the two oviducal papillae, partially dividing the dorso-anterior portion of the urodaeum into lateral chambers into which the oviducal papillae project. In the *S. m. disparilis* females this mid-dorsal protruberance was in the shape of a triangle with the base caudad ending just anterior to the urinary papillae. A similar structure did not seem to be present in the females of the third species. The dorsal "urogenital recess" of *Lacerta* described by Wöpke (1930, 1931) and Regamey (1933, 1935) did not seem to be present in any of these three species.

In the female (M-197) of *S. m. disparilis* glands similar to those Regamey (1935, p. 116) described for *Lacerta agilis* Linne were observed at the base of the oviducal papillae. Whether similar glandular tissue was present in the females of the other two species was not ascertained.

No Sceloporan species is believed to have a bladder sac but the histological sections of the cloacal regions revealed the presence of the bladder stalk (Fig. 17) in both sexes of *S. m. disparilis* and *S. poinsetti*. Once aware of its existence, it was easily seen by the unaided eye and was noted also in the dissections of both sexes of *S. olivaceus* (Fig. 5). The stalk with heavily vascularized walls was approximately 1 mm. wide and 3 mm. long and projected cranial in the cystic mesentery from the midventral wall of the urodaeum. It originated opposite and anterior to the entrances of the oviducts in the female and the urinogenital papillae in the male. Forbes (1941) noted a similar structure in the Sceloporan species used in his research studies.

A strong sphincter valve separated the urodaeum from the proctodaeum, the smallest, the most posterior and the most ventral of the three chambers. The proctodaeum opened to the outside by a transverse slit, the vent, guarded by a sphincter muscle. The chamber was a narrow transversely elongated cavity with two blind lateral pouches into which, in the male, the hemipenes evert from the dorsal side during copulation. These pouches were also present in the females but were not as extensive as in the males. Regamey (1933) stated that these blind pouches in the females of *Lacerta agilis* Linne received the hemipenes during copulation, while Woodbury and Woodbury (1945) mentioned that each hemipenis of the males of *Sceloporus g. graciosus* "fits into the enlarged posterior end of the oviduct opening into the cloaca." Though the latter condition was assumed by Ludwig and Rahn (1943) to be true for the prairie rattlesnake, it is still doubtful whether this condition is also true for the three species of lizards discussed in this paper. The proctodaea of both sexes of all three species were quite similar. The mucosa of each had numerous narrow, regular spaced longitudinal ridges.

When the examination was made of the histological sections of the cloacal region of several specimens some glandular tissue was noted out-

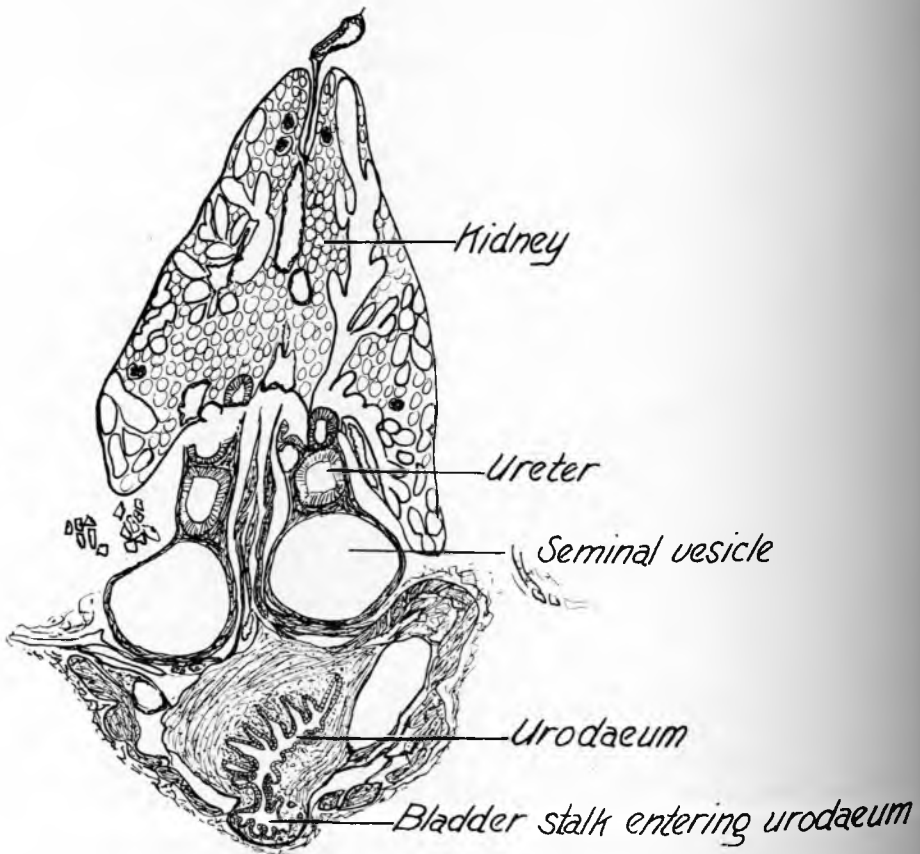


Fig. 17. *Sceloporus m. disparilis* M-200 ♂

side of the walls of the posterior chambers. All large masses of glandular tissue were noted either entirely ventral to, or extended dorsally only slightly around the sides of, the proctodaeum. They were present in both sexes of *S. m. disparilis* and *S. poinsetti* and in the males of *S. olivaceus*. (The cloacal region of the females of the latter species was not sectioned.) In the female of *S. poinsetti* (Fig. 18) the glandular mass measured 1.3 by 6 mm. The glands were of greater size in males captured during the season of sexual activity than in males taken at other times of the year; and greater in females taken with well developed embryos than in those collected at other seasons. When aware of their existence the glands could be seen with the unaided eye in males captured during the season of sexual activity, otherwise only examination of histological sections would reveal their presence. Ducts were associated with these glands but their number, arrangements and openings could not be ascertained at this time.

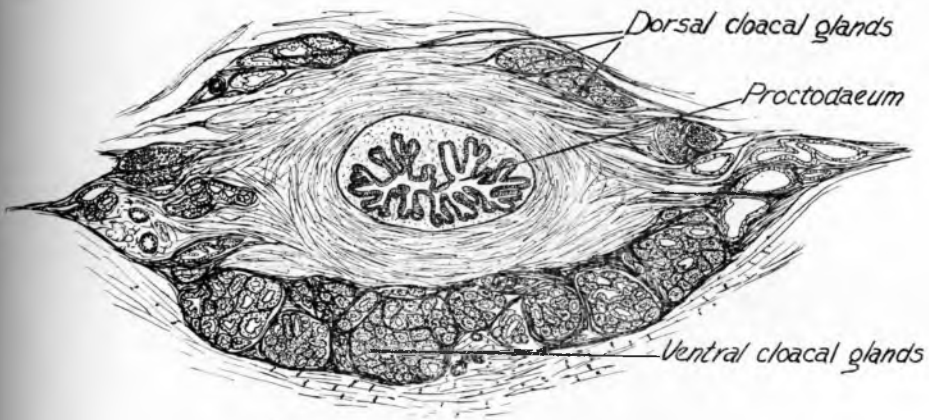


Fig. 18. *Sceloporus poinsetti* M-953 ♀

The cloacal region of a male (M-200) *S. m. disparilis*, collected October 15, 1935, was found to have three distinct masses of glandular tissue between the ventral cloacal wall and the muscles associated with the posterior ischiac symphysis just anterior to the level of the urinary papillae. Two large masses were lateral and the third medial. Caudally they became a continuous mass measuring 1.5 by 5 mm. At this level the mass extended laterally almost to the corners of the proctodaeum. Still further posteriorly there is a separation medially. Then the lateral masses rapidly diminish in size. At the vent level they measure 0.5 mm. by 1.5 mm. and are located near the corners of the proctodaeum. The large median dorsal glands in the cloacal region of *Lacerta agilis* Linne reported for both sexes by Regamey (1933, 1935) and Dantchakoff (1938) may have been represented by the median narrow intermittent strip of glandular tissue with slightly enlarged lateral masses which was noted dorsally in this same region in this male. The close association in this region of the kidneys to the dorsum of the cloaca would prevent the presence of a large mass of glandular tissue. In M-128 (Fig. 19), another male of the above mentioned species in which large ventral glands were present, there was also a small median dorsal strip of glandular tissue which continued posteriorly along the median borders of the hemipenes in their resting position.

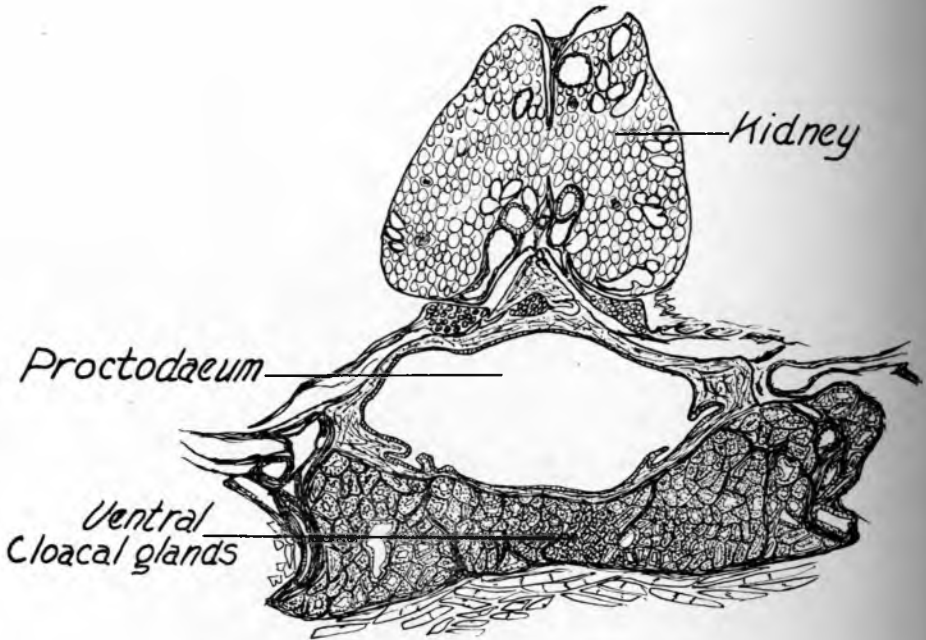


Fig. 19. *Sceloporus m. disparilis* M-128 ♂

DISCUSSION

A few morphological differences which might be correlated with the presence or absence of viviparity were revealed by this study of the urinogenital systems of these three species of the genus *Sceloporus*. There were fewer ova in the ovaries of *S. poinsetti* and *S. m. disparilis* than there were in the ovaries of *S. olivaceus*. Correlated with this condition were the numerous folds and pleats for the entire length of the oviducts caudad of the necks of the ostia of *S. olivaceus*, the oviparous species, while the oviducts of the two ovoviviparous forms had fewer folds just caudad of the necks of the ostia and scarcely any in their posterior portions. The cloacae of the ovoviviparous females were more muscular, particularly in the urodaeal and proctodaeal regions, than were the cloacae of the oviparous females. More complicated longitudinal and transverse folds and ridges were present in the mucosa of the cloacae of the ovoviviparous species than were present in the same structure in the oviparous species. The above mentioned observation also was true in the males.

The histological sections disclosed some additional differences between the two groups. Most important was the finding of the placental structure in the oviducts of the gravid females of *S. poinsetti* and *S. m. disparilis*. In the latter the structure appeared simpler than it did in the former. Glands were present around the base of the oviducal papillae in the ovoviviparous species. Since the cloacae of females of *S. olivaceus* were not sectioned, it is not known whether these glands were also present in that species. Ventral and dorso-lateral cloacal glands were found in the ovoviviparous females but remain unknown in the females of *S. olivaceus*.

Similar cloacal glands were noted in the males of all three species but their position was somewhat different from that described by Regamey (1933, 1935) for the cloacal glands in *Lacerta*.

A vestigial bladder, its heavy vascularization indicating the performance of some necessary function, was noted in both sexes of all three species. The mesentery of the right lung, and sometimes that of the left, was involved with the mesorchium or mesovarium of the corresponding side in both sexes of *S. poinsetti* and *S. olivaceus* but not in the third species. The kidneys of *S. poinsetti* and *S. olivaceus* were more similar in shape and appearance to one another than either were to the kidneys of both sexes of *S. m. disparilis*. The extension of the kidneys caudad of the vent was greater in *S. poinsetti* than it was in the other two species. The length of the kidneys in the females of the three species was one-fifth of the vent to snout measurement. This same proportion also was true for the kidneys of the males of *S. m. disparilis*, but in the males of *S. poinsetti* the length of the kidneys was seventeen to twenty percent of the vent to the snout distance. In the males of *S. olivaceus* their length varied from eighteen to twenty-two per cent of this same distance. Only in the males of *S. m. disparilis* could the existence of the preterminal segment of the uriniferous tubules be noted. In all specimens in which the kidneys extended caudad of the vent that portion of organ was found to be functional with a short collecting tube from it joining with the larger and longer anterior one to form the ureter. The existence of this posterior tube was not indicated in the diagrams of Brooks (1906) and Adams (1938).

In the three species the position of the gonads was distinctly anterior to the kidneys. This condition contrasted with the close association of the kidneys and the gonads in such reptiles as the turtle and the alligator. This study revealed considerable variation among the species of the position of the gonads anterior to the vent. In both sexes of *S. m. disparilis* the location of the right gonad was forty percent of the vent to snout measurement. But the position of the left gonad in females was twenty-three percent and in the males thirty percent of the same distance. In *S. poinsetti* the location of the ovaries was twenty-five percent while that of the testes was thirty-five to forty percent of the vent to snout distance. The position of the ovaries in *S. olivaceus* was thirty-three percent and that of the testes thirty to forty-seven percent of the same distance from the vent to the snout. The gonads of both sexes of *S. m. disparilis* were closely associated but in both sexes of the other two species they were separated somewhat medially. The oviducts of all the females in these three species were folded or pleated and in no case was their arrangement in transverse coils as in the diagrams of Brooks (1906) and of Adams (1938).

The craniad projection of the urodaeal fold in the cloacae of these three species gave a different aspect to the urodaeum of these animals than was described by Wöpke (1930), Regamey (1935) and Dantchakoff (1938) for some Lacertan species. Though some observers might consider the short middorsal protruberance of the mucosa between the oviducal papillae as was noted in *S. poinsetti* and *S. m. disparilis* as forming dorso-lateral pouches, in all three species it was considered that the entrances of the urinogenital ducts were directly into the urodaeal chamber and not first into the dorsal pouch, or dorso-lateral pouches, of the urodaeum. In the males of *S. poinsetti* and *S. m. disparilis* the ductus deferens

joined the ureter of its side just prior to reaching the summit of the urinary papilla, while in *S. olivaceus* the two ducts had separate openings into a shallow crater at the summit of the urinary papilla. Brooks (1906) used the term "conjointly" in describing the entrances of the oviducts and ureters into the cloaca. If he meant to convey the idea that the oviduct and ureter of each side joined before entering the urodaeum, this was not the case in the specimens involved in this study.

SUMMARY

Differences, more pronounced in the females than in the males, were observed between the urinogenital systems of the oviparous and the ovoviviparous species studied in the genus *Sceloporus*. Detailed histological examination of numerous specimens of both groups collected at regular intervals over a period of a year or more will be necessary to obtain an accurate knowledge of these and possibly other differences. The scarcity of literature upon the urinogenital systems of American lizards indicates the richness of the field for future research along the lines carried out by Regamey, Wöpke and others on the European forms and by Weekes on Australian forms.

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