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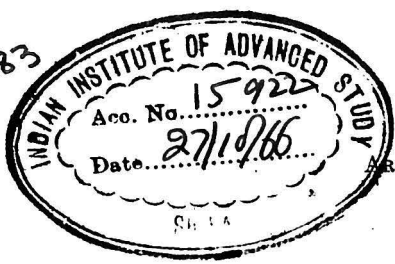
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ARTICLE No. 14.

The Habitat and Systematic Position of two imperfectly known Loaches from Afghanistan.

By SUNDER LAL HORA.

(Published with the permission of the Director, Zoological Survey of India.)

While studying the Indian material of the genus *Nemachilus* in the collection of the British Museum of Natural History I had an opportunity of examining the type-specimens of *N. boutanensis* (McClelland) and *N. griffithii* Günther. On the bottles containing these unique specimens there are to be found old labels in the same handwriting giving the locality of the species as "Affghan," though on labels of an undoubtedly later date the localities mentioned are "Butan" and "Assam" respectively as noted by Günther in his *Catalogue*. No further information could be obtained from the old registers of the fish collection in the Museum, but it has been possible for me to trace these specimens back to Griffith's field notes with the following interesting results.

In a general list of the specimens contained in Griffith's collection, McClelland (*Calcutta Journ. Nat. Hist.* II, pp. 573-575, 1842) has indicated the species of which examples were despatched "to the Museum at the India House" by placing the numbers of specimens despatched in Roman numerals after the names. A careful perusal of this list has indicated that McClelland sent to England specimens of two species of *Cobitis*—*C. boutanensis* and *C. marmorata*. On reference to Günther's *Catalogue* (VII, pp. 358, 360) it is clear that the author had specimens of only two species of *Nemachilus* from Griffith's collection—*N. boutanensis* and *N. griffithii*. Thus there can hardly be any doubt that the examples of the two species sent by McClelland served later on for the descriptions of the two species by Günther.

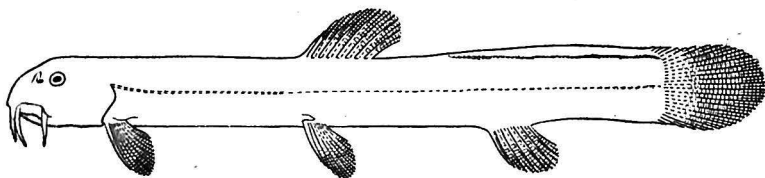
On referring to "Mr. Griffith's own remarks on the fishes he met with in Afghanistan and adjoining provinces" (*Calcutta Journ. Nat. Hist.* II, pp. 562-567, 1842) the following entries are to be found regarding the Loaches obtained by him.

- i. 1 Loach at Quettah.
- ii. "1 Loach of largish size, with a flat head colour reddish, with conspicuous brownish mottlings." This fish was obtained from "the Arghandab, a rapid and considerable sized tributary of the Helmund, which runs within two or three miles of Candahar."
- iii. "In the small channels by which the springs run off, a loach is very common." Here the reference is to the springs at

Sir-i-Chushmah. The loach is also said to occur "in the Helmund at Gridun Dewar, altitude 10,500 feet."

- iv. "The only other fish I have any knowledge of, inhabiting the waters of Toorkistan face of the Koh-i-Baba, is a Loach found at Kaloo, at an elevation of 11,000 feet."

It is well known that a great portion of Griffith's collection was lost and in view of the scanty particulars available of the existing material it is difficult to say with certainty which of the above mentioned Loaches represent *N. boutanensis* and *N. griffithii*. McClelland (*op. cit.*) in his account of Griffith's collection refers to a species of *Cobitis* ("probably *Cobitis armatis*?," p. 582. This seems to be a species of *Botia* from Loodianah and described *Cobitis boutanensis* from "Boutan, on the Mishmee Mountains" (p. 586). To me it seems likely that Boutan is a misreading of Bolan on the part of McClelland and that he confused the two localities in his account, for it can be seen from McClelland's own introductory remarks that Griffith collected specimens from "the Bolan Pass to the Helmund." Moreover "Boutan" or "Butan" probably refers to the Bhutan State (27.0 N; 91.0 E) which is a long distance away from the Mishmi Hill (28.12 N; 96.20 E).

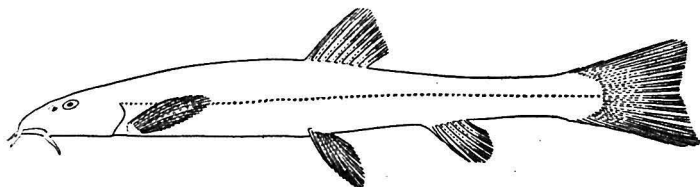


Text-fig. 1.—Lateral view of the type-specimen of *Adiposia boutanensis* (McClelland) $\times \frac{3}{4}$.

The type-specimen of *Nemachilus boutanensis* (*Brit. Mus.* No. 60.3.19. 775) bears a close resemblance to the fishes of the genus *Adiposia* described by Annandale and myself from the Helmand Basin, Seistan (*Rec. Ind. Mus.*, XVIII, p. 182, 1920). In the general build of its body and in the character of the adipose fin it is remarkably similar to *Adiposia rhadinaea*, from which it differs in the possession of distinct, imbricate scales, in the absence of lateral line beyond the base of the ventral fin and in its characteristic rounded caudal fin. Thus it would seem probable that *N. boutanensis* is also an inhabitant of the Helmand Basin (near Bolan Pass) and is rightly labelled on the old label as having been obtained in "Affghanistan"

Regarding *N. griffithii* I entertain no doubt that this is the fish collected by Griffith at Arghandab and so clearly described by him as of "a largish size, with a flat head, colour reddish, with conspicuous brownish mottlings." There also seems no

doubt that this must have been the fish determined by McClelland as "*Cobitis marmoratus*" in his list. According to Day (*Fish. India*, p. 621), who examined the type-specimens of *N. griffithii* in the British Museum (No. 60.3.19.93-94)¹ this species is synonymous with *N. stoliczkae*. In an earlier paper (*Rec. Ind. Mus.*, XXIV, p. 78, 1922) it has already been indicated by me that Day's "*N. stoliczkae*" is a composite species and it was possible for me to recognise several forms among the material assigned by Day to *N. stoliczkae*. I have compared in detail the types of *N. griffithii* with a typical specimen of *N. stoliczkae* from Rupshu in Tibet (the type-locality of the species) and find that the two are distinct. In *N. griffithii* the head is contained five times in the length without the caudal, the ventrals just reach the anus and are separated from the



Text-fig. 2.—Lateral view of the type-specimen of *Nemachilus griffithii* Günther x $\frac{3}{4}$.

anal fin by a considerable distance; whereas in *N. stoliczkae* the head is contained little over four times in the length without the caudal, the ventrals extend considerably beyond the anus and reach the origin of the anal fin. Moreover, in *N. stoliczkae* the barbels are much longer, the outer rostral being as long as the snout; whereas in *N. griffithii* the outer rostral is $\frac{2}{3}$ the length of the snout. In their general facies and colouration the two species are similar. *N. griffithii* also bears a close resemblance to *N. brauhi* Zugmayer from "Kelat." The latter, however, possesses a much longer head (five in total length), a deeper caudal peduncle (half as high as long) and the ventrals passing the anal opening. The above account leaves no doubt that *N. griffithii* is an Afghan fish and not an Assamese Loach as surmised by Günther.

SUMMARY.

i. *Nemachilus boutanensis* (McClelland) is a species of *Adiposia* collected by Griffith in the Helmand Basin probably in the neighbourhood of the Bolan Pass. It is erroneously said to have come from "Boutan" or "Butan."

¹ According to the list only one example of *Cobitis marmoratus* was sent to England, but this is evidently a mistake in printing overlooked by McClelland.

ii. *Nemachilus griffithii* Günther is a distinct species bearing resemblance to *N. stoliczkae* and *N. brauhi*. It was obtained by Griffith in Afghanistan in the neighbourhood of "Candahar" and is not an Assamese Loach.

London,

September, 1928.

A Case of Hermaphroditism in a common Indian Frog
Rana tigrina Daud, with a Note on the Classification of Hermaphroditic Cases.¹

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(Communicated by Lt.-Col. R. B. Seymour Sewell, I.M.S.)

INTRODUCTION.

Hermaphroditism is not unusual in Amphibians. In the genera *Rana*, *Hyla* and *Bufo* of the Anurans there have occasionally been recorded cases of hermaphroditism in normally unisexual individuals. The last mentioned genus (*Bufo*), in particular, has earned a classical reputation in possessing a graded series from the rudimentary to complete hermaphroditic condition, as shown by several European Vertebrate Anatomists. The singular possession of Bidder's organ has been, and is, in recent years, reputed by many authors to be responsible for such occurrences. Sutton (29) as a pathologist, has noted that the toads "afford ready and indisputable examples of functionless ducts (oviducts²) becoming cystic in parts of their course," and has clearly demonstrated that "the amount of development of these ducts (oviducts²) is in direct proportion to the size of Bidder's organ." A very curious fact to be noted in this connection, however, is that Johnston and Gillies (15) have observed that in males "of *Hyla caerulea*, the Australian green tree-frog, a series can be obtained from specimens devoid of the ducts (oviducts²) altogether, to those showing a development of these structures almost rivalling the female genital ducts in size, though the usual condition is not so pronounced." We may also note here, in passing, that *Hyla* does not seem to possess any such structure as Bidder's organ, nor has it so far been shown to possess ovotestes. The fact that *Hyla*, without possessing either Bidder's organ or ovotestes, shows similar grades of development of the oviducts as *Bufo*, seems to cast some doubt on the validity of the view that Bidder's organ can be in any way connected with the hermaphroditic condition.

Cases of hermaphroditism are not often found in the genus *Rana*, but that they are not very rare will be evident from a

¹ Read before the Fifteenth Annual Meeting of the Indian Science Congress held at Calcutta, 1928.

² The brackets are mine. J.L.B.

reference to the list of literature appended to this paper. With the exception of a joint paper by Bhattacharya and Das (1) on the persistence of oviducts with abnormal testes in a male Indian frog, *Rana tigrina*, we have, unfortunately, no other cases on record in India. I, therefore, take this opportunity of recording another instance which I chanced to discover last rainy season (9th June, 1927) in a male *Rana tigrina* during class demonstration in the University of Calcutta.

Since the publication of Hooker's paper (14), quite a mass of records has accumulated, and in view of the fact that there are some discrepancies in the former classifications of the hermaphroditic frogs, I have endeavoured in the second part of this paper to suggest a fresh classification from the instances hitherto recorded, and, in an appendix, I have given, according to my classification, a full record of cases with brief accounts, in compiling which I have consulted all the literature available in Calcutta, but it must be admitted, in this connection, that certain accounts which have been made use of there are not based on original papers, since the journals in which these appeared are not available in any of the Calcutta Libraries. Below is a list showing the sources of information from which I have compiled the accounts of the following authors.

<i>Authors.</i>	<i>Sources.</i>
1. Chidester (4)	.. <i>Zool. Ber.</i> , XII, 1927.
2. Kortschagin (17)	.. Ognew (23).
3. Pedaschenko (24)	.. "
4. Mitrophanow (22)	.. Hooker (14).
5. Tarnani (30)	.. "
6. Tichomirow (31)	.. "
7. Woronzowa (32)	.. <i>Zool. Ber.</i> , XI, 1927.
8. Clemens (5)	.. <i>Journ. R. Micr. Soc.</i> , 1922.
9. Boulangé (2)	.. Not known.

There are altogether at the present time 44 cases of hermaphroditism on record, but I have dealt with only 39 cases in the appendix, the reason for the omission of five cases being stated below. The first three authors' accounts, relating to four instances (*i.e.*, two Chidester and one each of Kortschagin and Pedaschenko), are not sufficiently detailed and have, therefore, been left out of consideration. With regard to Boulangé's account nothing, even in the form of an abstract, could be found, though an assiduous search was made.

PART I.

DESCRIPTION OF SPECIMEN *Rana tigrina*.A. *External characters.*

The individual was an adult, measuring 13·5 cm. in length. Externally it showed well-marked masculine features. Two subgular vocal sacs, conspicuous externally by the fold of the skin and also by the usual dark colour, were situated on the sides of the throat. The finger pads were also prominently present on the thumbs of both the forelimbs. It may not be out of place to point out that this frog had suffered a fracture of the left tibio-fibula, although this does not come under present review.

B. *Internal characters of the urino-genital organs (Plate 12).*

The two testes, right and left (R.T. and L.T.), of nearly equal size and of pale yellow colour, were situated on the ventral surface of the anterior head of each kidney (R.K. and L.K.). Both of them were unusually reduced in size in comparison to those found in normal adult male specimens. The measurements in millimetres are as follows:—

	<i>Length.</i>	<i>Breadth.</i>
Right testis ..	7·0	3·0
Left testis ..	8·5	2·5

Vasa efferentia were given off from each testis to the kidney. Mention should be made here that there was no deposit on the surface of either of the testes of any pigment such as might be taken to indicate the presence of ovarian tissue.

Although the specimen was not fixed with a view to studying the histological condition of the genital organs yet the left testis was removed and sectioned. The histology, as revealed in a series of sections, suggested an abortive condition rather than the primary stages of the development of the male sexual cells. Not a single ovum nor anything resembling an ovum was, however, observed in the spermatic tissue.

Clusters of well-developed fat bodies (C.A), apparently attached to the anterior margin of each testis as in normal males, were hanging freely in the body cavity from the upper border of each kidney.

From the postero-lateral border of each kidney (R.K. and L.K.) proceeded the genito-urinary duct (R.U.D. and L.U.D.) each exhibiting the dilatation of the vesicula-seminalis (S.V).

No trace of an ovary was found anywhere but the Müllerian ducts or oviducts (R.O. and L.O) were present. They were more or less thin but were well developed with many convolutions and exhibited the usual coelomic openings (F). The coiled

oviducts expanded posteriorly, as is usual in female frogs, into uterine dilatations (R.U. and L.U). In spite of the narrowness of the two oviducts the presence of a lumen was demonstrated by inserting a fine bristle into it. The posterior continuation of the uterine portion of the oviduct and the urino-genital duct (R.U.D. or L.U.D) on each side ran in close apposition to each other as far as the cloacal wall, but instead of opening separately, as is usually the case in *Rana*, they opened by a single common aperture (O) in the cloaca (Cl). The two apertures thus formed were separated by a papilla (P). The above mentioned fact was further substantiated by passing separate bristles into each of the male and female ducts of one side.

For comparison of the present specimen and other previously described examples, in which there appears to be a total absence of any ovary, the reader is referred to Group 1 of the Appendix. From there it will be seen that the present case differs from the previously recorded ones in such details as the smallness and abortive condition of both the testes and the relation of the openings of the two urino-genital ducts (male and female) in the cloaca.

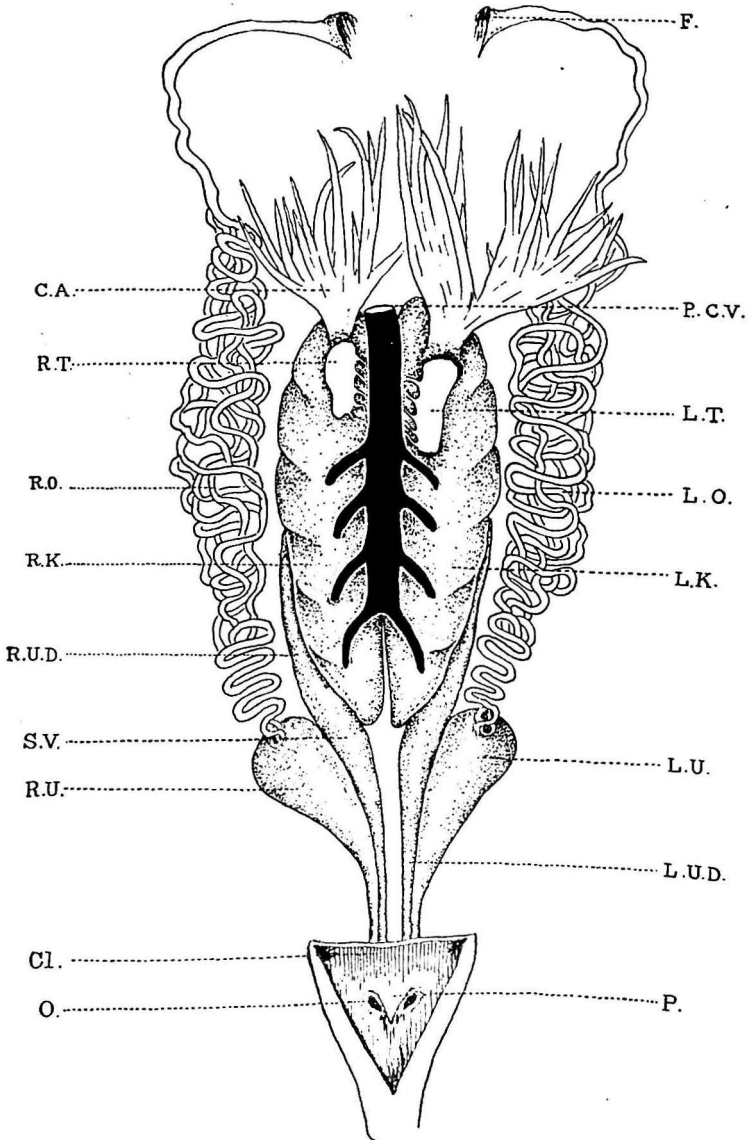
PART II.

CLASSIFICATION OF HERMAPHRODITISM.

In the following lines I have given a résumé of the classifications of hermaphroditic cases from the earlier records. Within the brief period of nine years (1904-1912) three attempts were made in this direction. Ernst Gaupp (9), the author of the revised edition of Ecker und Wiedersheim's "*Anatomie des Frosches*," was the first to attempt such a classification, and this he did under the heading "specielle Fälle" (*loc. cit.*, p. 350). Two years later Ognew (23) suggested a new classification in which he included a large number of cases but his scheme differed from Gaupp's in its main outlines: and, last but not least, is the noteworthy contribution of Hooker (14) who not only prepared a table on a classificatory basis, differing again from the above two authors, but also dealt thoroughly with the causes involved in such instances of hermaphroditism. The main outlines of the classifications of these three authors are given below with the names of the recorders as referred to by the classifiers.

GAUPP'S CLASSIFICATION.

- I. *Cases with preponderance of male characters on both sides.*
 - (a) Marshall (cases A and C), and Sumner.
 - (b) Balbiani (Pflüger, Born, etc.), and Friedmann.
 - (c) Latter, Mitrophanow, Marshall (case B), Ride-wood, Kent, and Cole.



Diagrammatic ventral view of the Urino-genital system of the frog *Rana tigrina* $\times 1\frac{1}{2}$.

C.A.—Corpus Adiposum.
 Cl.—Cloaca.
 F.—Anterior opening of Oviduct.
 L.K.—Left Kidney.
 L.O.—Left Oviduct.
 L.T.—Left Testis (with vasa efferentia).

L.U.—Left Uterus.
 L.U.D.—Left Urino-genital duct.
 O.—Common opening of Urino-genital duct.
 P.—Papilla
 P.C.V.—Post Caval Vein.

R.K.—Right Kidney.
 R.O.—Right Oviduct.
 R.T.—Right Testis (with vasa efferentia).
 R.U.—Right Uterus.
 R.U.D.—Right Urino-genital duct.
 S.V.—Seminal Vesicle.

- II. *Cases in which the character of the genitalia are essentially different on both sides.*
Marshall (case D), and Smith.
- III. *Cases with the preponderance of female characters on both sides.*
Bourne.

OGNEW'S CLASSIFICATION.

- I. *Nearly complete hermaphrodites.*
(Prevalance of male sexual organs.)
(A) Marshall (case B).
(B) Cole, Punnet, and Ridewood.
(C) Kent
- II. *Partial, strongly impressed hermaphrodites.*
 - 1. (Prevalance of male sexual organs.)
(A) Tichomirow, Sumner, Sutton, Marshall (cases A and C), Mitrophanow, Tarnani, and Latter.
(B) Spengel.
 - 2. (Prevalance of female sexual organs.)
(A) Bourne and Marshall (case D).
(B) Smith.
- III. *Partial, weakly impressed hermaphrodites.*
Pedaschenko.
- IV. *Showing imperfect development of the female sexual organs.*
Kortschagin.

HOOKER'S CLASSIFICATION.

- Group A. *Males with more or less developed oviducts.*
Tichomirow, Gerhartz, Sumner; Hooker (case A), Marshall (cases A and C), Tarnani, and Sutton.
- Group B. *Males with testes containing ova.*
Friedmann, Hoffmann, Latter, Marshall (case B), and Mitrophanow.
- Group C. *Hermaphrodites with both the sexual glands, but with the male preponderating.*
Cole, Ognew, Kent, Ridewood, and Punnet.
- Group D. *Almost or complete hermaphrodites.*
Hooker (case B), Smith, and Youngmap.
- Group E. *Hermaphrodites with both the sexual glands, but with the female preponderating.*
Marshall (case D), and Bourne.

Hooker (14), as will be seen by a reference to the above list, based his classification on 23 cases, but it has to be noted that he, unfortunately, missed four instances, which had been recorded previously, two by Goodall-Strickland (11) and one each by Yung (34) and Kuschakewitsch (18). At the present day the number of recorded cases has considerably increased, amounting to 45 in all, including the present instance. This rise in number, after Hooker's publication, is partially due to the contribution of Crew (7), who not only added as many as six cases of hermaphroditism, but also re-described Kents's (16) specimen carefully in 'case No. III' in his own paper.

In view of this increase in the number of recorded instances, I have attempted to revise the classification and to arrange the various examples in groups as shown in the Appendix given at the end of this paper. I have, however, not attempted to deal with the causes that may produce hermaphroditism as these have already been discussed by previous authors notably by Gaupp (9), and Hooker (14).

My scheme of classification and the brief accounts of previously recorded examples given in the Appendix will, I hope, be of general value to future recorders in view of its simplicity and easy reference. I have taken the gonads as the primary basis of my classification. In hermaphroditic cases like these the gonads may be either male or female or both together (in certain cases where both ovary and testis occur in a single organ, this is expressed in the term ovotestis). The gonads, again, may be in various conditions, viz., either rudimentary or developing, degenerate or functional, or small or large in size. In my classification I have not discriminated between cases in which the ovary and testis are present as separate organs and those in which there is an ovotestis: nor in these latter instances between cases in which one gonad greatly preponderates over the other, e.g., a single ovum occurring in an otherwise normal testis, and those in which the proportions are nearly equal.

I have divided all those instances of hermaphroditism regarding which I have been able to obtain information into the following groups:—

- Group 1. Cases where a testis and an oviduct are present on each side but no ovary.
- Group 2. Cases where both testis and ovary (ovotestis) are present on the right side only.
 - Section A. Ovary and oviduct are on the left side.
 - Section B. No ovary but testis and oviduct on the left side.
- Group 3. Cases where a testis and an ovary (ovotestis) are present on each side.
- Group 4. Cases where both testis and ovary (ovotestis) are present on the left side only.

Section A. Ovary and oviduct are on the right side.

Section B. No ovary but testis and oviduct on the right side.

Group 5. Cases where there is a testis on the one side and an ovary on the other side.

The details of all cases are given in the Appendix.

In conclusion I wish to express my great indebtedness to Lt.-Col. R. B. Seymour Sewell, I.M.S., Director of the Zoological Survey of India, for kindly going through this paper and making necessary suggestions.

APPENDIX.

Group 1. *Cases where a testis and an oviduct are present on each side but no ovary.*

- (1) *Rana temporaria* (case A). Testes are normal. Oviducts are well developed. Seminal vesicles are present.
Marshall (21) 1884.
- (2) *Rana temporaria* (case C). Right testis is almost absent while the left one is much enlarged. Oviducts and seminal vesicles are present.
Marshall (21) 1884.
- (3) *Rana temporaria*. Testes are normal. Oviducts are weakly developed and threadlike and end in seminal vesicles, which are normal.
Sutton (29) 1885.
- (4) *Rana esculenta*. Testes are normal. Oviducts are well developed. Seminal vesicles are present.
Tichomirow (31) 1887.
- (5) *Rana virescens*. Externally a male. Testes are normal. Oviducts are weakly developed but have no anterior orifices. Seminal vesicles are normal. Urino-genital ducts open normally in the cloaca.
Sumner (28) 1894.
- (6) *Rana esculenta*. Testes are normal. Oviducts are well developed. Seminal vesicles are absent.
Tarnani (30) 1898.
- (7) *Rana esculenta*. Externally young. Testes are doubly larger. Oviducts are highly coiled but have no uterus. Seminal vesicles are normal. Urino-genital ducts open normally in the cloaca.
Gerhartz (10) 1905.
- (8) *Rana fusca* (case A). Externally an adult male, and 7.3 cm. long. Testes are slightly enlarged. Oviducts are weakly developed and possess small uteri. Seminal vesicles are smaller than normal. Opening of the urinogenital ducts in the cloaca are normal.
Hooker (14) 1912.
- (9) *Hyla cœrulea*. Testes are normal. Oviducts are present, anterior ends are not so coiled. Seminal vesicles are not mentioned. Urino-genital ducts open normally in the cloaca.
Johnston and Gillies (15) 1918.
- (10) *Rana tigrina*. Externally a male. Right testes is very small (6/3.5 mm.) and has no vasa efferentia; the left testis is much larger (17/4.5 mm.). Right oviduct is well developed while the left one is less developed and there is no anterior orifice; it is further characterised by an interruption in its continuation. Seminal vesicles are present. Urino-genital ducts open normally in the cloaca.
Bhattacharya and Das (1) 1920-21.

Group 2. *Cases where both testis and ovary (ovotestis) are present on the right side only.*

(Section A. Ovary and oviduct are on the left side.)

- (1) *Rana temporaria* (case D). Right gonad consists of a very large testis and a small ovary. Left gonad is an ovary which contains only degenerate ova. Oviducts are normal. Seminal vesicles are absent.

Marshall (21) 1884.

- (2) *Rana temporaria* is externally a male and is unusually large in size. Right gonad is an ovotestis, testis being present without vasa efferentia, while ovary is slightly smaller than the left. Left gonad is an ovary which is quite normal. Oviducts are normal and uterine portion is much filled with ova. Seminal vesicles are absent.

Youngman (33) 1910.

- (3) Species not mentioned. Specimen is externally male. Right gonad is an ovotestis and consists of a large testis and a small ovary, the latter only caps the anterior border of the testis. Left gonad is entirely a normal ovary. Oviducts are normal. Seminal vesicles are practically absent, but there is an indication on the right side.

Leigh-Sharpe (20) 1922.

(Section B. No ovary but testis and oviduct on the left side.)

- (1) *Rana esculenta*. Externally a young male, and 7 cm. long. Right gonad is an (ovotestis) testis is smaller than left and it contains ovary. Left gonad is a testis, section reveals no actual ova in it. Oviducts are quite normal. Seminal vesicles are entirely absent.

Mitrophanow (22) 1894.

Group 3. *Cases where a testis and ovary (ovotestis) are present on each side.*

- (1) *Rana temporaria* (case B). Externally male. Right and left gonads are ovotestes, ovaries being contained in testes. Oviducts are normal. Seminal vesicles are small and spindle-shaped.

Marshall (21) 1884.

- (2) *Rana temporaria*, case No. III of Crew (7). Externally an adult male, and 6.5 cm. long. Right gonad consists of a small testis to which is attached a small ovary. Left gonad is an ovotestis, testis is normal (three times the right) and contains ova. Right oviduct is well developed while the left one is straight and rudimentary. Seminal vesicles are present but in a rudimentary condition. Openings of the urino-genital ducts are normal.

Kent (16) 1885.

- (3) *Rana fusca*. Externally male and one year old. Right and left gonads are ovotestes: ovaries are contained in testes. Seminal vesicles and other organs are not mentioned.

Hoffmann (13) 1886.

- (4) *Rana temporaria*. Externally male (one year old?). Right gonad consists of a very large testis and a small ovary. Left gonad is an ovotestis, a small ovary containing well developed ova is situated on the outer margin of a three-

lobed normal testis. Right oviduct is weakly developed while the left one is normal. Seminal vesicles are present but the right one is smaller than the left.

Ridewood (26) 1888.

- (5) *Rana temporaria*. Externally male. Right and left gonads are ovotestes, ovaries being contained in the testes. Right testis is smaller than usual. Oviducts are straight tubes and possess no anterior openings but there is a trace of uterus in the left one. Seminal vesicles are present, the left being larger than right.

Latter (19) 1890.

- (6) *Rana temporaria* is externally full-grown, but with debatable sex characters. Right gonad consists of a 15 mm. long testis and a small ovary. Left gonad consists of a normal ovary and a testis, the latter is present on the outer margin of the ovary. Oviducts are strongly developed. Seminal vesicles are entirely absent. Openings of urino-genital ducts are normal.

Smith (27) 1890.

- (7) *Rana temporaria*. Externally a young male. Right gonad is an ovotestis, an ovum being contained in a testis (11/5 mm.). Left gonad consists of a very small testis and a large ovary with degenerate ova. Right oviduct is weakly developed while the left one is fairly convoluted. Seminal vesicles are entirely absent. Urino-genital ducts open normally.

Cole (6) 1896.

- (8) *Rana viridis*. An adult specimen. Gonads are ovotestes, ovaries being contained in testes. Oviducts, seminal vesicles and others are not mentioned.

Friedmann (8) 1898.

- (9) Species not mentioned. It is externally male. Right gonad is an ovotestis, testis is normal but contains an ovum. Left gonad consists of a large ovary and a small testis. Oviducts are quite normal. Seminal vesicles are small. Urino-genital openings are normal.

Punnet (25) 1900.

- (10) *Rana fusca* (case B) shows externally both male and female characters combined, and is 8 cm. long. Right gonad consists of a large testis and a small ovary. Left gonad is an ovotestis consisting of normal testis and ovary. Oviducts are also quite normal. Seminal vesicles are small and spindle form. Openings of urino-genital ducts are normal.

Hooker (14) 1912.

- (11) *Rana temporaria* (case No. IV). Externally an adult male, and 7.8 cm. long. Right gonad consists of an irregular shaped testis bearing small scattered ovary. In the left gonad testis bears small ovary. Oviducts are normal. Seminal vesicles are present. Openings of urinogenital ducts are normal.

Crew (7) 1921.

- (12) *Rana temporaria* (case No. V). Externally an adult male, and 8 cm. long. Right gonad consists of large irregular

shaped testis bearing nodules of ovary. Left gonad consists of a large ovary and a small testis. Oviducts are normal. Seminal vesicles are small and spindle-shaped. Urino-genital ducts open normally in the cloaca.

Crew (7) 1921.

- (13) *Rana temporaria* (case No. VI) is externally nearly male, and 7.6 cm. long. Right gonad consists of an irregular testis with small ovarian tissue. In the left gonad testis is attended with ovarian tissue. Right oviduct is weakly developed, while the left one is well developed. Seminal vesicles are small and fusiform. Urino-genital ducts open normally in the cloaca.

Crew (7) 1921.

- (14) *Rana catesbiana*. Externally male. Gonads are ovotestes. Oviducts and seminal vesicles are present.

Clemens (5) 1921.

Group 4. *Cases where both testis and ovary (ovotestis) are present on the left side only.*

(Section A. Ovary and oviduct are on the right side.) In the following five cases the right testis is absent and the oviducts are normal.

- (1) *Rana temporaria*. Right ovary is well developed. Left gonad consists of a large ovary and a testis which is apparently devoid of vasa efferentia. Seminal vesicles are absent.

Bourne (3) 1884.

- (2) *Rana esculenta*. Externally male, and 73 mm. long. Right ovary is normal. Left gonad consists of an ovary (6.5 mm.) and testis (7.5/6 mm.). Seminal vesicles are not mentioned. Urino-genital ducts of either side united and opened by two apertures.

Yung (34) 1907.

- (3) *Rana temporaria* (case II). Externally female with debatable pads. Right ovary is normal. Left gonad consists of a fairly well developed testis and an usual ovary. Seminal vesicles are absent. Urino-genital ducts open normally.

Goodall (11) 1908.

- (4) *Rana temporaria* (case No. I). Externally adult female and is 8 cm. in length. Right ovary is large. Left gonad is an ovotestis, ovary being contained in a small testis. Seminal vesicles are absent but an indication is present. Urinogenital ducts open normally.

Crew (7) 1921.

- (5) *Rana temporaria* (case No. II). Externally nearly adult male, and 7.7 cm. in length. Right ovary possesses vasa efferentia. Left gonad is an ovotestis, three nodules of testis being present on an ovary with vasa efferentia. Seminal vesicles are small and spindle form. Urino-genital ducts open normally.

Crew (7) 1921.

(Section B. No ovary but testis and oviduct on the right side.) In the following four cases the right ovary is absent and the seminal vesicles are normal.

- (1) *Rana temporaria*. Externally male, and 71 mm. in length. Right testis is large. Left gonad consists of an ovary and a small testis without apparent vasa efferentia. Right oviduct is weakly developed and the left one is normal.

Ognew (23) 1906.

- (2) *Rana temporaria*. Externally male, and 8.5 cm. in length. Right testis is unusually large. Left gonad is an ovotestis which contains inseparable degenerate testis and ovary. Left oviduct is more well developed than the right one. Urino-genital ducts open by two apertures in the cloaca.

Heymons (12) 1917.

- (3) *Rana temporaria* (case No. VII). Externally an adult male, and 7.2 cm. long. Right testis is normal. Left gonad consists of an irregular shaped testis and an ovary which contains degenerate ova. Oviducts are normal. Urino-genital ducts open normally.

Crew (7) 1921.

- (4) *Rana temporaria*. Externally male. Right testis is normal. Left gonad is an ovotestis, degenerate ova being contained in the testis. Right oviduct is absent while the left one is fully developed. Seminal vesicle are present.

Woronzowa (32) 1926.

Group 5. *Cases where there is a testis on the one side and an ovary on the other side.*

- (1) *Rana temporaria*. Externally female. Right testis is absent but ovary on this side is very small. On the left side testis is present but ovary is absent. Oviducts are well developed. Right seminal vesicles is absent. Urino-genital ducts open normally.

Goodall (11) 1908.

- (2) *Rana esculenta*. Externally male (three months after metamorphosis). A normal ovary is present on the right side. A small testis is present on the left side. Other structures are not mentioned.

Kuschakewitsch (18) 1911.

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