

II. FURTHER NOTES ON *RANA TIGRINA* AND ALLIED FORMS.

By N. ANNANDALE.

Rana tigrina is one of the commonest Indian frogs and is used for dissection in all the North Indian colleges in which practical zoology is taught. Its identity is therefore a matter of more than usual interest to naturalists in India. I have recently expressed the opinion¹ that the species should be divided into three forms, which I have treated as specifically distinct. I have, however, pointed out that one of these forms (*R. cancrivora*, Gravenhorst) stands on a somewhat different footing from the other two (*op. cit.*, p. 136). Dr. G. A. Boulenger has replied to my observations in a paper printed immediately before this one. He holds that not three but five forms must be recognized. In this I am in agreement with him, but he differs from me in regarding all these forms as varieties or races of a single species. I am glad that my remarks have at any rate called his vast experience to bear on the problem, but there are still certain points both general and particular in which I find myself unable to accept his decision.

In the first place he expresses the opinion that if I had had a larger collection before me I would probably have come to conclusions other than those I arrived at with only the specimens in the Indian Museum to examine. This may be true, but only with qualifications. If I had had both this and the British Museum collections before me at the same time I would certainly have recognized the Madras form as distinct, but I do not think from what he says that I would have had reason to alter my views as to either the geographical or, with the exception stated, the taxonomic limits of the three forms that I recognized. The correct names (specific or racial) of the forms discussed (as distinct from their identity) depend, in the absence of adequate original descriptions, not on the examination of a large number of specimens from different localities, but rather on geographical considerations and on the interpretation of published figures.

The question whether the forms under discussion should be called species or races depends on one's concept of these terms—a subject on which a difference of opinion is perhaps legitimate. I have called certain forms allied to *R. limnocharis* “races or sub-species,” though Dr. Boulenger recognizes them as distinct species. My reason for this has been that the forms which I regard as mere races are to some extent isolated geographically and that a considerable proportion of the individuals representing each differ from the *forma typica* in relatively unimportant characters such as size and colour. On the other hand I call forms included under the specific name *Rana tigrina* by Dr. Boulenger “species,” because they are not isolated geographically but occur over large areas together, and because I do not think that individuals intermediate in character ordinarily occur.

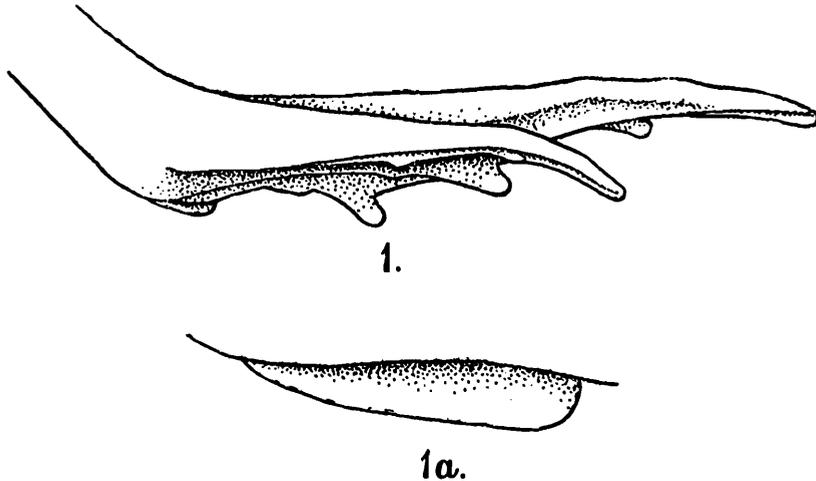
The following notes on the four forms that occur in the Indian Empire and the Malay Peninsula are based mainly on the examination of living

¹ *Mem. As. Soc. Bengal*, Vol. VI, part II, 1917.

or freshly preserved specimens examined since I have had the advantage of reading Dr. Boulenger's notes.

Rana tigrina, Daudin.

I have little to add to Dr. Boulenger's notes on this frog except in reference to its geographical distribution. I will, however, discuss the form and structure of its inner metatarsal tubercle in dealing with *Rana crassa*.



FIGS. 1, 1a.—Right foot of *Rana tigrina* from Calcutta, with metatarsal tubercle enlarged.

Geographical distribution.—I have made a careful examination of the specimens in the Indian Museum referred to in my original paper (*op. cit.*, pp. 125-126) and find no reason to change my opinion as to the great majority of them. The form certainly occurs not only in Northern India, but also at many places in the south of Peninsular India, as well as in Assam, Burma and Yunnan. Its range thus overlaps that of both *R. crassa* and *R. rugulosa*. Apparently it differs in habits from both these forms, being feebly or not at all possessed of powers of burrowing.

Rana rugulosa, Wiegmann.

The name of this species depends entirely on the interpretation of Wiegmann's figure. ¹I have great hesitation in differing from Dr. Boulenger on a point of interpretation, but cannot agree with him that the snout is represented as being pointed; indeed, Wiegmann says "Schnautze stumpf." Nor can I agree that the feet are meant to be webbed in exactly the same way as in the figure of *Rana vittigera* on the same plate. I have no doubt, therefore, that the types of my *Rana burkilli*, which are in very good condition, and also the series of specimens sent to me by Dr. Malcolm Smith from Siam are specifically identical with the specimen that Wiegmann selected to be figured as typical of his *R. rugulosa*.

¹ *Nov. Ac. Ac. Leop.*, XVII, pl. xxi, fig. 2 (1835).

Dr. Smith¹ has recently sent me three tadpoles, which agree well with Flower's figures.

Geographical distribution.—The species appears to be widely distributed in Burma, Siam and China. In Burma it is found commonly with *Rana tigrina*, s. s. and in Southern Siam with *R. cancrivora*, but apparently it does not penetrate far south into the Malay Peninsula.

According to Burkill² both this species and *R. tigrina* are eaten by the Burmese. At Prome the former is said to be distinguished from *R. tigrina* (which the Burmese call Hpa Zang under the name Hpa Boungh-she. It is stated by them to differ also in habits, in which apparently it resembles *R. crassa*, although the inner metatarsal tubercle is usually small and resembles that of *R. tigrina* in structure. The tubercle is perhaps, however, somewhat more prominent than in the latter.

***Rana crassa*, Jerdon.**

1854. *Rana crassa*, Jerdon, *Journ. As. Soc., Bengal*, XXII, p. 531.

Jerdon's original description of this species is very short and is not accompanied by a figure. The frog is, however, in my opinion quite distinct. The reason why I did not recognize it was that the only specimens I had examined were very old and all more or less distorted. Dr. J. R. Henderson has been kind enough to send me five living frogs from Madras. A comparison of these specimens with those already preserved in the Indian Museum has convinced me that there is much less variation within the limits of *Rana tigrina*, s. s. than I formerly thought to be the case.³

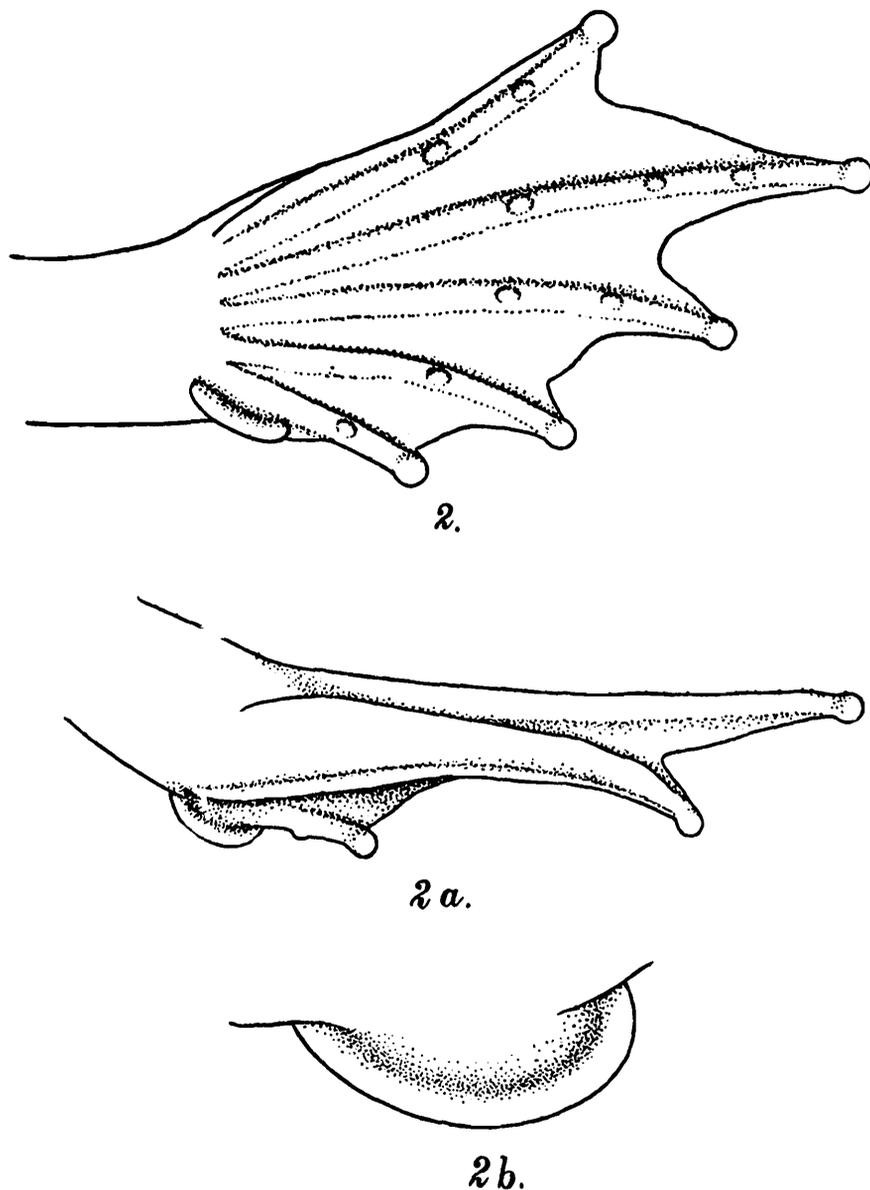
The most important difference to be recognized in preserved material lies not so much in the size as in the structure of the inner metatarsal tubercle, and this character is very liable to be obscured. In *R. crassa* the tubercle is usually larger than in *R. tigrina*, s. s., but my original statement that its size is not correlated with other characters is literally correct so far as either form is concerned. In *R. tigrina*, however, it is a simple broad longitudinal ridge rounded on the inner surface and situated at some little distance behind the base of the fifth toe; whereas in *R. crassa* it is much more prominent (at any rate in the living frog) and is distinctly concave on the inner surface, with a strong blunt carina running along its lower margin. It is also situated further forward

¹ Dr. Smith has just published further figures of the tadpole. See *Journ. Nat. Hist. Soc., Siam* II, p. 263, pl. iv, figs. 2, 2a.

² *Agricult. Ledg.*, No. 2, pp. 13 and 15 (1911).

³ Since Dr. Boulenger saw this note Dr. Henderson has sent me twelve further specimens of *R. crassa* well preserved in spirit. So far as the immediate neighbourhood of Madras is concerned they bear out the views expressed above. There is, however, one very important fact connected with them, viz., that Dr. Henderson captured at the same time a single specimen to which he drew my attention and which I cannot distinguish from *R. rugulosa* from Burma. The occurrence of a single individual of this form, so far from its proper home, suggests the question, may not *R. rugulosa* (or *R. tigrina* var. *burkilli* as Dr. Boulenger calls it) have arisen as a mutation of *R. crassa*? The fact that specimens of *R. crassa* itself have been found sporadically in Northern India, would further suggest that it also may have arisen as a mutation, from the typical *R. tigrina*. Further evidence is, however, necessary before attempting to answer this question. In any case it has no bearing on the taxonomic position of *R. cancrivora*.

on the foot, almost parallel to the basal part of the toe, and has a much stiffer consistency, being strongly cornified in old frogs. When specimens are preserved in spirit, however, the tubercle is apt, owing to the shrinkage of the soft tissues of the foot, to collapse in such a way that its concave surface lies flat on the sole and is thus entirely concealed. This has occurred in all the old specimens that I have examined.



FIGS. 2, 2a, 2b.—Right foot of *Rana crassa* from Madras ($\times 2$), with metatarsal tubercle further enlarged.

The colour of living specimens from Madras is similar to that of *R. tigrina*, but much duller, a dull brown being substituted for the greens and yellows, and with the exception that the throat is spotted with black. In general appearance the frog seems to be very like *R. rugulosa*, and Indian specimens that I referred to as being intermediate between that species and *R. tigrina* actually belong to *R. crassa*.

I have been able to examine only two tadpoles that can be assigned to this species. In one of them the hind legs are fairly well-developed, while in the other the toes are already differentiated. So far as it is

possible to make a definite statement on the basis of this material, they differ from those of the true *R. tigrina* in the following particulars:—

They are larger and of stouter build, with the abdomen more convex; the dorsal surface is more densely pigmented and there is a pale band extending backwards in an oblique direction from the nostril to a pale space surrounding the eye. They very closely resemble those of *R. rugulosa*, except that the dorsal membrane of the tail is not so elevated and that the coloration of the dorsal and lateral surfaces of the head and body is less uniformly mottled.

Geographical distribution.—The following specimens in the collection of the Indian Museum must be transferred to this species:—

9025. Agra, United Provinces. Agra Mus. (Ex.).

12572. Chandbally, Orissa. C. H. Dreyer.

9074-5: 9071. Ceylon. Dr. Kelaart.

9017: 9057: 9060. Colombo, Ceylon. Dr. J. Anderson.

Combining my records with those of Dr. Boulenger, we find, therefore, that *R. crassa* is by no means confined to South India, in some part of which it probably occurs together with *R. tigrina*, *s. s.*, and Ceylon, where it may occur alone. It is known from Agra and Benares in the United Provinces, from Orissa, from the town of Madras and from several other localities on both coasts of the Indian Peninsula, as well as from several localities in Ceylon.

The behaviour of the living specimens sent to me from Madras differed totally from that of individuals of *Rana tigrina*, *s. s.* The former when placed in a vivarium the bottom of which was covered with sand, burrowed immediately and concealed themselves below the surface. This I have never known *R. tigrina* to do. Moreover, they did not possess anything like the same power of leaping.

***Rana cancrivora*, Gravenhorst.**

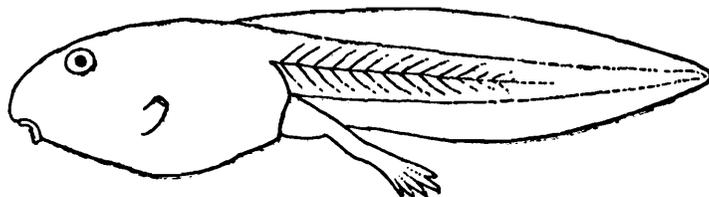
Dr. Boulenger's notes rather lead me to think that there may be in the Malay Archipelago several races or species closely allied to this form. Dr. Van Kampen's var. *angustopalmata*¹ may perhaps be distinct after all. My chief reason for including it in the synonymy of *R. cancrivora* was a letter from him in which he wrote as follows:—"My *angustopalmata* has a still somewhat shorter web than this *R. cancrivora*, but this difference does not occur in all specimens from Celebes, and as it is very difficult to describe it is perhaps better to drop the name."

It is important, therefore, that I should make it quite clear that my description was based almost entirely on specimens from Siam, one of which Dr. van Kampen had kindly compared with specimens from Java, the type locality of the species. I had also examined a series of old and sodden specimens from North Borneo, but had paid, in accordance with my usual rule, comparatively little attention to them.

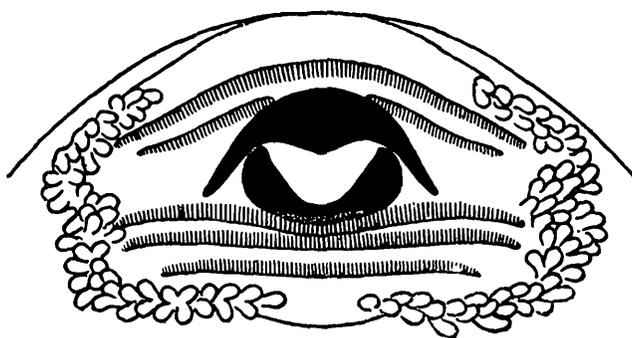
Doubt has been cast by Dr. Boulenger on the identification of the tadpole of this frog by Dr. van Kampen. *R. cancrivora* is a very common frog in the plains of Java, where *R. limnocharis* is, according to

¹ In Weber's *Zool. Ergebn. Neid. Ost.-Ind.*, IV, p. 388, pl. xvi, fig. 3c.

Barbour,¹ scarce. Dr. van Kampen paid great attention to the Batrachian larvae of the island when resident there for some years and it seems to me improbable that a tadpole so peculiar as that of the *R. tigrina* type, had it been at all common, would have escaped his notice. Moreover, Dr. Malcolm Smith of Bangkok has sent me tadpoles from Siam that



3.



3a.

FIGS. 3, 3a.—Tadpole of *R. cancrivora* from Siam ($\times 2$), with mouth-disk further enlarged.

conform, with minor differences, to the *R. limnocharis* type, and which he identifies as those of *R. cancrivora*. About them he writes:—

“The specimens that I sent you last week are I think without doubt *cancrivora*. My men brought in a large number from the mouth of the Chumpon River (P. Siam), where the frog was common, and with young ones just leaving the water from which I have made the diagnosis. They differ from van Kampen’s description only in the 3rd or lowest tooth row of the lower lip. In *cancrivora* this is nearly or quite as long as the row above, whilst in *limnocharis* it is only half the length. Koh Lah specimens confirm this, but I will get some living tadpoles and confirm the frog.”²

The chief differences between these tadpoles and the larvae of *R. limnocharis* are that (1) the dorsal membrane of the tail is much less sinuate in outline; (2) the tail is shorter and less pointed, and (3) the

¹ *Memoirs of the Museum of Comparative Zoology at Harvard College*, Vol. XLIV, No. 1, p. 65.

² Dr. Smith has recently (October 10th, 1917) sent me the following additional note:—“There is other evidence, however, by which I am quite sure that *R. rugulosa* and *R. cancrivora* are distinct. Their breeding calls are entirely different. That of the former is a deep “wrnk, wrnk, wrnk (WRNK)” of the latter a loud bleat, something like the noise produced by a goat. I have kept them both and am sure on this point.” I understand that Dr. Boulenger now accepts *R. cancrivora* as distinct. Dr. Smith (*Journ. Nat. Hist. Soc., Siam* II, 264) has just published a note on the tadpole.

dorsal coloration is darker and more uniform. The mouth-disk and its armature are closely similar except that the lowest tooth-row on the lower lip is broader and the teeth larger, and that the fringe of papillae is interrupted on the middle below.

Geographical distribution.—The only point precisely ascertained as to the general range of this species is that it occurs in South Siam, including the provinces of Singgora and Patani in the Malay Peninsula, as well as in Java. It is apparently synonymous with *R. schlueteri*, Werner, from North Borneo, but there is a possibility that the var. *angustopalmata* of van Kampen from Celebes may be distinct, if it is not synonymous with *R. vittigera*, Wiegmann, from the Philippines.

III. POST-SCRIPTUM.

By G. A. BOULENGER.

Dr. Annandale having most courteously communicated to me his reply to the suggestions contained in the first paper, I will add a few words rather than make any alteration to my original draft.

As I say in the last paragraph, my opinion on the rank to be assigned to *R. cancrivora* stands or falls on the question of the tadpole, and as Dr. Annandale appears to have proved his case, I have no further reason to disagree with him, except from the theoretical point of view.

The old conception of the frog in its development climbing up its own genealogical tree must be abandoned. As I pointed out twenty years ago,¹ "larval forms such as the tadpoles are outside the cycle of recapitulation, the ontogeny being broken by the intercalation of the larval phasis. The horny beak, the circular lip with its horny armature, the spiraculum, the enclosure of the fore limbs in diverticula of the branchial chambers, and such special adaptations as the ventral disc or sucker of certain mountain forms, clearly point to tadpoles having had a developmental history of their own. We need, therefore, not be surprised at occasionally finding, within the same genus, very different types of tadpoles, or even a total suppression of the larval stages, as is actually the case in the large and widely distributed genus *Rana*." That adaptational gyrinal polymorphism occurs has been pointed out by Camerano,² and I have myself drawn attention to a very remarkable dimorphism, apparently non-adaptive, in *Pelodytes punctatus*.³

Our progress in the knowledge of the metamorphoses of Batrachians has most decidedly invalidated the prediction of my late chief Dr. Günther who, in his Preface to my Catalogue of 1882, expressed the opinion that probably the next step in perfecting the system of classification would be marked by a consideration of the larval stages.

I conclude, from the close agreement of *R. cancrivora* with the other forms grouped under *R. tigrina*, that the differentiation of the tadpole has arisen independently from that of the adult, the cuspidate beak and other buccal features of the *R. tigrina* tadpole being, of course, as

¹ *Tailless Batrachians of Europe*, p. 110.

² *Atti. Acc. Torin.*, XXVI, 1890, p. 72.

³ *Proc. Zool. Soc.*, 1891, p. 617, pl. xlvii, figs. 1, 2.