A CASE OF POLYMELY IN THE INDIAN BULL-FROG,
RANA TIGRINA DAUD.

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1. Introduction.

Although many cases of the presence of supernumerary limbs in Salientia have been recorded from time to time, the majority being of "those in which an extra hind limb or pair of hind limbs is present" (O'Donoghue, 1910), no case, as far as I am aware, has so far been described of polymely in the common Indian bull-frog, Rana tigrina Daud. The extreme rarity of such an abnormality in this species is beyond doubt. For the last sixteen years, and perhaps more, we have been using over 600 individuals of this species per annum in our Intermediate dissection classes and we have not noted a single abnormality of this type. The specimen, described in the present paper, has lain in the Zoology Museum of our College, nobody can tell how long. Its label bears the legend "A freak of nature," but no data are available as to the locality from where it was obtained, the person who collected it, or the date of collection.

2. Historical Résumé.

As mentioned by O'Donoghue (1910), to whom I am grateful for much information about literature, Superville (1740) was perhaps the first to record a case of such abnormality, but he gave no more details than that the extra fore-limb was attached to the right shoulder. In 1864, Gervais described a specimen of Pelobates cultripes with a second left arm attached behind the normal one. In 1872, the Royal College of Surgeons catalogued a polymelous frog without sufficient details. In 1868, Lunel described an individual of Rana viridis with two supernumerary fore-limbs on the left side; a case similar to that described by Mazza in 1888 in Rana esamelica. In 1889, Bland Sutton noted a case of Rana temporaria with an extra fore-limb on the left side, while Bergendal described in detail a specimen of the same species showing similar abnormality. In 1899, Washburn noted an individual of Bufo columbiensis with an accessory arm anterior to the left normal one. In 1901, Johnson recorded a case of polymely in Rana palmipes and another
in *Rana halecinum*, while Eigerman and Cox described a specimen of *Rana pipiens* showing duplication of the right fore-limb. In 1910, O'Donoghue gave fairly detailed descriptions of two cases of polymely: one in *Hyla aurea*, in which the additional fore-limb was attached immediately in front of and slightly dorsal to the normal left arm; and the second in *Rana temporaria*, in which the accessory arm was situated slightly dorsal and posterior to the normal right arm.

### 3. **External Features.**

The polymelous frog, which forms the subject of the present paper, measured 2.6 inches from snout to vent, and belonged to the species *Rana tigrina* Daud., as determined by reference to Boulenger's keys for this genus (1890, 1920). Amongst the characters observed, I might particularly mention the presence of several longitudinal folds on the skin of the back, the commencement of the oblique series of vomerine teeth from the inner anterior corner of the choana, the almost entire webbing of the toes, the possession of a perfectly distinct tympanum and the bluntly-terminated nature of the toes. The tibio-tarsal articulation did not reach the tip of the snout, the outer metatarsal tubercle was absent, and the inner was small, blunt and compressed. The colouration of the specimen had become much faded, owing evidently to long preservation in formalin, but a few dark patches and the yellow vertebral stripe were still discernible. The absence of the vocal sacs and of the pads on the inner side of the first fingers showed that the individual was female.

The additional fore-limb (Plate XXXIX) was present on the right side, and it was attached immediately anterior to—and at level with—the normal arm. It was a little longer even than the normal appendage, being about 1.4 inches from its attachment with the shoulder-girdle to the tip of the longest digit, and thereby exceeding the normal limb of this side by 0.2 inches. Its elbow-joint was distinctly marked, and it had four fingers, of which the second was the longest, the third smallest, and the first and fourth approximately equal. Dorsal to the point of attachment of the normal and the accessory right arms with the shoulder-girdle, there was on this side a definite hump, which felt hard to the touch.

The previous workers seem to imply that smaller size distinguishes a supernumerary limb from a normal one, and I myself was at first inclined to regard the smaller, posteriorly-situated of the two right fore-limbs in this specimen as really accessory, and the anterior one as the normal. A scrutiny of the proportionate sizes of the digits, however, left no doubt as to the true state of affairs. The digits on the posterior one of these appendages correspond to the typical arrangement found on the right side in the manus of
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*Rana tigrina*, while those on the anterior one are really the exact reverse of this condition (Fig. 1, A, B and C).

![Diagram](image)

**Fig. 1.**—Diagrammatic view of the hands of the abnormal Frog, as seen from the front: *A,* Left manus; *B,* Manus belonging to the anterior (Supernumerary) right fore-limb; *C,* Manus belonging to the posterior (normal) right fore-limb (Approximately ×1).

The following table gives the measurements for the various digits in this connection.

**Table I.** Comparative Sizes of Various Digits.

<table>
<thead>
<tr>
<th>Apparent number of digit</th>
<th>Left manus</th>
<th>Anterior right manus</th>
<th>Posterior right manus</th>
</tr>
</thead>
<tbody>
<tr>
<td>First (i.e., the innermost)</td>
<td>7 mm.</td>
<td>6.5 mm.</td>
<td>6 mm.</td>
</tr>
<tr>
<td>Second</td>
<td>5 mm.</td>
<td>8.5 mm.</td>
<td>5 mm.</td>
</tr>
<tr>
<td>Third</td>
<td>8 mm.</td>
<td>5.5 mm.</td>
<td>8 mm.</td>
</tr>
<tr>
<td>Fourth (the outermost)</td>
<td>7 mm.</td>
<td>6.5 mm.</td>
<td>6 mm.</td>
</tr>
</tbody>
</table>

As is clear from this table, the *apparent* second (the *real* third) finger is the shortest both in the left manus and in the manus belonging to the posterior right fore-limb, denoting thereby that these limbs are the normal ones. This very digit is the longest in the manus of the anterior right fore-limb, thus corresponding to the apparent third finger of a normal manus. Thus the disposition of the fingers in the anterior right fore-limb (i.e., in the limb regarded by me as supernumerary) is the same as would be found in a normal left fore-limb removed from the left side and transplanted to the right.

For the sake of comparison, one might quote the following description of the normal digits in the manus of the frog from Ecker and Haslam (1889):—

"The hand has four fingers and the rudiment of a fifth, which latter is completely hidden under the skin, and as already explained, consists of a
metacarpal only. Of the four fingers, the fourth is the longest, the third the shortest, the second and fifth of intermediate and about equal length; the fourth and fifth fingers have each three phalanges, the second and third have each two.” This description refers more particularly to the species *Rana esculenta*, but it also fits in with the condition found in *R. tigrina*.

4. **Musculature.**

With reference to the polymelous specimen of *Hyla aurea* that he studied, O'Donoghue (1910) says, “This specimen had been preserved for a long while so that it was very difficult to make out the musculature and as the whole arrangement is abnormal the naming is only approximate.” He, however, mentions the names of some of the muscles that he found in it, as also in the polymelous individual of *Rana temporaria*, examined by him. Apart from this reference, as far as I am aware, Bergendal (1889) is the only person who has studied the musculature in a polymelous frog. In view of

![Diagram](image-url)

**Fig. 2.**—Muscles of the chest, throat and belly of the abnormal *Rana tigrina*: *D*, M. deltoideus (left); *D'*, M. deltoideus (right); *P*, M. pectoralis; *R*, M. rectus abdominis; *Sm*, M. submaxillaris; *Sr*, M. coraco-radialis or sterno-radialis.
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this paucity of information in this respect, I have been particularly careful to observe the various muscles in connection with the right fore-limbs in the present specimen, and my observations are given below.

On removing the skin from the ventral side of the trunk, it was clear (Fig. 2) that the line of origin of the muscle Coraco-radialis, Gaupp (= M. sternoradialis, Ecker; Pré-sterno-clavi-radial, Dugès) was not placed mid-longitudinally, but lay awry towards the right fore-limbs. The muscle Deltoideus, Gaupp and Ecker (= Pré-sterno-scapulo-huméral, Dugès), branched off into two divisions, one going into each of the two right fore-limbs. The M. pectoralis did not show any abnormality superficially besides its obliquely-placed line of origin. The musculature of the frog as seen in a lateral view (Fig. 3) confirmed my determination that the supernumerary limb was really the anterior one, the disposition of the various muscles in it being just the reverse of that found in a normal right fore-limb. A comparison of the musculature with Gaupp’s Fig. 72 (p. 126), or Ecker and Haslam’s 63 (p. 69), as well as with actual dissections of the normal right fore-limb of Rana tigrina, have left no doubt about my determinations. I wish only to draw attention here to the relation of the muscle Anconæus, Gaupp (= M. triceps brachii, Ecker; Scapulo-bi-huméro-olécranien, Dugès) to M. deltoideus and to M. coraco-brachialis brevis in order to show that the anterior fore-limb shows a reversed condition of musculature to that found in a normal limb of this side.

Fig. 3.—Muscles of the trunk of the abnormal Rana tigrina, from the right side: anc., anc′, M. anconæus; c.b.b., c′.b′.b′, coracobrachialis brevis; d, M. deltoideus; d.m., M. depressor mandibulae; d.s., M. dorsalis scapulae; l.d., M. latissimus dorsi [Names according to Gaupp, 1896].
The same type of reversal is found in the musculature of the arm belonging to the anterior right fore-limb (Fig. 4, A), as compared either to the arm of the posterior right fore-limb or to that found on the right side in a normal individual of *Rana tigrina*. For the sake of comparison, the musculature of the normal right arm of *Rana esculenta* from the same aspect is given in Fig. 4, B.

![Diagram of muscles](image)

**FIG. 4.—Muscles of the right arm, from inner aspect:** (A) Abnormal limb, *Rana tigrina*; (B) Normal limb, *R. esculenta* (after Ecker). *ed*, M. extens. digitorum communis; *ei*, M. abductor digitii II longus; *Fa’,* M. flexor antibrachii lateralis superficialis; *Fr*, M. flexor carpi radial; *Fe*, M. flexor carpi ulnaris; *Fe’,* M. flexor digitorum communis; *Sr*, tendon of the M. sternoradialis.

The remarkably well developed musculature on both the right fore-limbs doubtless indicates that they were equally functional in life, though I do not venture to suggest the actual mode of action of these limbs. I have no doubt that the supernumerary limb reached to, and rested on, the ground, both in view of the well developed palm and digits found on it, and of the muscles that cannot be regarded as vestigial or rudimentary in any sense.

5. **Skeleton.**

As the present specimen shows notable differences in the skeleton of the pectoral girdle from all the cases previously recorded, I have found it advisable to summarise the pertinent data in this connection in the following table.
**Table II.**

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of author and year of publication</th>
<th>Species showing polymely</th>
<th>Brief description of supernumerary limbs</th>
<th>Skeletal peculiarities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Superville (1740)</td>
<td>Not known</td>
<td>Extra fore-limb attached to right shoulder.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Gervais (1864)</td>
<td><em>Pelobates cultripes</em></td>
<td>Extra fore-arm behind normal left one.</td>
<td>A separate coracoid and scapula, a humerus and radio-ulna, fairly normal, and 3 digits, of which the two lateral were rudimentary, with but one phalanx each.</td>
</tr>
<tr>
<td>3.</td>
<td>Royal College of Surgeons (1872)</td>
<td>Not known</td>
<td>Extra fore-limb attached to sternum.</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Mazza (1888)</td>
<td><em>Rana esamelica</em></td>
<td>An additional pair of arms behind the normal left one.</td>
<td>The pair was attached to a separate shoulder-girdle formed by a single scapular &amp; double coracoid portions.</td>
</tr>
<tr>
<td>6.</td>
<td>Bland Sutton (1889)</td>
<td><em>Rana temporaria</em></td>
<td>Extra fore-limb on left side, with 3 digits.</td>
<td>Attached to left half of shoulder girdle by an extra coracoid (?)</td>
</tr>
<tr>
<td>7.</td>
<td>Bergendal (1889)</td>
<td><em>Rana temporaria</em></td>
<td>Extra fore-limb on the left side. With only 2 digits.</td>
<td>A fairly normal humerus and radio-ulna. Humerus runs forwards under the skin of the floor of the mouth from the dorsal side of the coracoid, but does not appear to articulate with it. The remaining part of the limb comes through the skin and projects backwards.</td>
</tr>
<tr>
<td>8.</td>
<td>Washburn (1899)</td>
<td><em>Bufo columbiensis</em></td>
<td>Extra arm in front of the left normal. With 7 digits.</td>
<td>According to the author, radius and ulna not fused, but separate. O'Donoghue (1910), however, is inclined to regard this as a case of &quot;a double radio-ulna and a double hand&quot;.</td>
</tr>
<tr>
<td>9.</td>
<td>Johnson (1901)</td>
<td>(1) <em>Rana palmipes</em></td>
<td>A pair of extra fore-limbs, one on each side: Left fairly normal, but small; right previously cut off.</td>
<td>Normal scapular region.</td>
</tr>
<tr>
<td>10.</td>
<td>Johnson (1901)</td>
<td>(2) <em>Rana halecinum</em></td>
<td>Has a peduncle from which two extra fore-limbs arise ventral to the normal right one. Each about the size of the left normal leg and distinctly larger than the right normal leg.</td>
<td></td>
</tr>
</tbody>
</table>
In the present polymelous specimen, the pectoral girdle is placed obliquely, being inclined at an angle of about 20° to the mid-longitudinal axis of the body. The left half of it is normal, and the humerus of the left fore-limb articulates with the glenoid cavity in the usual manner. On the right side, however, there are several remarkable deviations from the normal condition. The clavicle (Fig. 5) is distally single, but proxially it bifurcates to form a slender curved piece, which lies anterior to the right half of the girdle and is separated from the omo- and the epi-sternum by about 2 mm. There is an additional coracoid in connection with this clavicular piece, and the scapula shows two glenoid cavities: one posteriorly, which corresponds to the normal one, found on this side of the girdle; and the other anteriorly, which gives articulation to the humerus of the supernumerary limb. The portion of the scapula lying dorsal to the glenoid cavities is distinctly narrower than that in a normal girdle, being only 2·5 mm. broad all along, while this very portion on the left side is slightly more than 2·5 mm. even at the narrowest region. Unlike the left scapula, the right one is not a flattened piece, contracted in the middle, and wider at either end; but it is more or less cylindrical and is almost uniform in width above the glenoid cavities.
Between the two glenoid cavities, the scapula has a ridge dorso-ventrally on its outer surface.

The suprascapula of the right side also shows some peculiarities, worth noting. It has an abnormal posterior process, which diverges from its basal portion backwards, upwards, and inwards, and ends in a blunt extremity. I have no doubt that the presence of this abnormal process was responsible for the appearance of the hard hump dorsal to the attachment of the two right fore-arms, which I have described in connection with the External Features (vide supra). The main part of the right suprascapula, which appears to correspond to the whole of a normal suprascapula, has its anterior border bent down on itself in the normal manner (Ecker and Haslam, 1889, p. 38), but this border shows an unusual concavity (c in Fig. 5) from a dorsal view and does not sweep away in a straight curve from its anterior end down to the anterior border of the scapula, as is usually the case.

I might also mention that contrary to the normal condition in Rana tigrina, as described by Nicholls (1915), the coracoids do not overlap in the middle line, but are separated from each other by the median epicoracoidal cartilage. The omosternum, however, is distinctly bifid posteriorly and thus shows the typical condition found in the Indian Bull-frog (Nicholls, 1915).

The supernumerary fore-limb (Fig. 6) has—but for the absence of the rudiments of the first real digit—a complete set of the usual bones: the
humerus, the radio-ulna, the carpals, the meta-carpals, and the phalanges. The apparent first and second digits (the real second and third) have three phalanges each, while the apparent third and fourth (the real fourth and fifth) have only two. The single metatarsal forming the vestiges of the first digit is totally absent. The number of phalanges in the respective digits confirms what has been said above about the correspondence of the various fingers of the accessory limb to those of a normal right one (vide supra).


In the polymelous specimen of Hyla aurea described by him, O’Donoghue (1910) observed that the innervation of the supernumerary fore-limb was from an abnormal ganglion. "Anterior to and partially attached to the second spinal nerve, which supplied the left arm in a normal manner, was a slender nerve which after receiving a branch from the second spinal nerve, formed a noticeable ganglion. From this ganglion two nerves were given off which ran one to each side of the head of the abnormal arm and two other
Photograph of the abnormal frog (Dorsal view).
smaller nerves were given off to the muscles around it.' In the specimen of *Rana temporaria*, described by the same author, the accessory fore-limb was supplied by a large branch of the second spinal nerve.

The specimen of *Rana tigrina*, which forms subject of the present study, does not show any abnormal ganglion in connection with the brachial plexus. However, the second spinal nerve (Fig. 7) on the right side, unlike that on the left, bifurcates into two equi-sized branches, one going into each of the two right fore-limbs. The brachial plexus on the left side appears to be normal.

7. Summary.

In the present study, observations have been made on a polymelous specimen of *Rana tigrina* Daud., the first abnormality of this type recorded for this species. Not only is a complete description of the external features given, but an examination of the correlated abnormalities in the muscular, skeletal and nervous systems has also been made. Apparently, the supernumerary right fore-limb shows a reversed condition to that found in a normal right fore-limb in this species.

LITERATURE CITED.