

- |                                     |   |
|-------------------------------------|---|
| 79. <i>Chrysococcyx lucidus</i> .   | 98. <i>Cygnus atratus</i> .               |
| 80. <i>Phaps chalcoptera</i> .      | 99. <i>Cereopsis novæ-hollandiæ</i> .     |
| 81. <i>Peristera elegans</i> .      | 100. <i>Anseranas melanoleuca</i> .       |
| 82. <i>Synæcus australis</i> .      | 101. <i>Bernicla jubata</i> .             |
| 83. — <i>diemenensis</i> .          | 102. <i>Anas superciliosa</i> .           |
| 84. <i>Lobivanellus lobatus</i> .   | 103. — <i>nævosa</i> .                    |
| 85. <i>Scolopax australis</i> .     | 104. — <i>punctata</i> .                  |
| 86. <i>Schæniclus australis</i> .   | 105. <i>Malacorhynchus membranaceus</i> . |
| 87. — <i>subarquatus</i> .          | 106. <i>Biziura lobata</i> .              |
| 88. <i>Rhynchæa australis</i> .     | 107. <i>Nyroca australis</i> .            |
| 89. <i>Herodias syrmatophorus</i> . | 108. <i>Sternula nereis</i> .             |
| 90. <i>Nycticorax caledonicus</i> . | 109. <i>Pelicanus conspicillatus</i> .    |
| 91. <i>Grus australis</i> .         | 110. <i>Phalacrocorax carbooides</i> .    |
| 92. <i>Botaurus australis</i> .     | 111. — <i>leucogaster</i> .               |
| 93. <i>Platalea regia</i> .         | 112. — <i>sulcirostris</i> .              |
| 94. <i>Porphyrio melanotus</i> .    | 113. <i>Podiceps australis</i> .          |
| 95. <i>Fulica australis</i> .       | 114. — <i>gularis</i> .                   |
| 96. <i>Rallus pectoralis</i> .      |   |
| 97. <i>Gallinula tenebrosa</i> .    |   |

The following papers were read :—

# 1. On the Classification of the Anurous Batrachians.

By ST. GEORGE MIVART.

In June 1858 Dr. Günther read a very valuable paper before the Zoological Society \*, stating the principles according to which he was disposed to arrange, systematically, the Anurous Batrachians. The system therein offered is that adopted by the same author in his Catalogue of the Frogs and Toads contained in the British Museum †.

In 1865 Mr. E. Cope gave to the world another and very different plan for arranging the same animals ‡, a plan which he has amended and further elaborated in papers published in the 'Journal of the Academy of Natural Sciences of Philadelphia' §.

Dr. Günther's system reposes mainly on external and readily ascertainable characters.

Mr. Cope's system is founded on certain points of osteological detail.

I venture here to propose a classification which is derived from, and in all the most important points agrees with, that of Dr. Günther, but which differs from it in certain minor respects (owing to a different estimate of the value of certain points of structure), while

\* Proc. Zool. Soc. 1858, p. 339.

† 'Catalogue of the Batrachia Salientia in the Collection of the British Museum,' by Dr. Albert Günther. 1858.

‡ Natural History Review, vol. v. 1865, p. 97.

§ Vol. vi. of the new series of that Journal, part 1, July 1866, p. 67, and part 2, September 1867, p. 189.



it adopts from the labours of Mr. Cope osteological characters noticed by him, but which are here restricted in their application to the limitation of more subordinate groups than those for which he uses them.

Mr. Cope's osteological system would divide the Anura into two great series, the *Arciformia* and the *Raniformia*.

The *Raniformia* are thus characterized \* :—"Coracoidei abutting; epicoracoidei, when present, continuous, transverse, and abutting on coracoidei; not connected with the latter by overlapping longitudinal cartilages."

The *Arciformia* are distinguished as follows † :—"Acromials and coracoids divergent, the former directed forward and connected with the latter by a longitudinal arched cartilage, which is free from, and overlapped by, the corresponding cartilaginous arch of the opposite side."

This system associates *Bombinator*, *Pelodytes*, and *Cultripes* with *Hyla*, *Cystignathus*, *Hylodes*, and *Bufo*, in one division; while *Engystoma*, *Phryniscus*, and *Hemissus* are altogether separated from the true Toads, in order to be classed with *Rana*, *Hylarana*, &c.

Such approximations seem to me forced and unnatural, and likely to lead to the rejection of the system from which they necessarily result.

Mr. Cope employs other osteological characters for more subordinate groups; thus his *Hylidæ* ‡ are characterized, among other points, as having the "fronto-parietalia shortened anteriorly, usually embracing a fontanelle," and "superior plate of ethmoid never covered by fronto-parietals, usually produced anteriorly, between fronto-nasals."

Skeletal characters are, indeed, most valuable ones in leading us to detect the deepest and truest affinities of vertebrate animals. But these affinities once found, it is very desirable that zoological classifications should not, if it can possibly be avoided, *repose* upon them only, but rather on more external and more readily ascertainable characters. Such external characters will probably be found to exist in all really natural groups, although they may turn out to be distinctions so little obvious that they might never have been noticed, but for the guidance afforded by the previous careful study of the osteology of such groups.

As to the particular character selected to distinguish Mr. Cope's two great primary divisions, I cannot think it of anything like the importance § he attaches to it. The point is one easily to be studied, as the Common Frog is the type of the *Raniformia*, while the Common Toad exemplifies the *Arciform* type of structure.

When the two adult shoulder-girdles are compared, a considerable

\* Journal Acad. Phil. new series, vol. vi. pt. 2, p. 190.

† Ibid. pt. 1, p. 67.

‡ Ibid. p. 83.

§ I am fortified in this, I rejoice to say, by the valuable opinion of one of the very first of existing osteologists, I mean my esteemed friend Mr. W. K. Parker, F.R.S.



difference certainly appears at first sight to exist; but if a Frog of a somewhat earlier age is examined, it will be seen to be as "arciferous" as in the Toad. In Mr. Parker's elaborate Monograph on the shoulder-girdle, published by the Ray Society, this fact is well shown at plate 5, where the various stages are represented between the shoulder-girdle of the Frog-tadpole, "with budding limbs but perfect tail" (fig. 1), and that of the "old male Frog" (fig. 11). In the Frog, a few weeks after metamorphosis (fig. 9), the arched cartilages are well shown; and the young Frog *with the tail absorbed* (fig. 6) exhibits a condition, as regards the overlapping cartilaginous arches, *closely resembling that presented by the Toad of the first summer* (fig. 16).

Now the existence of structures in a rudimentary, transitory condition during the development of certain animals, does not necessarily invalidate the employment of the manifest conspicuous presence of such structures in the adult condition of other animals as distinguishing characters of the latter. But in all such cases a really marked distinction must be capable of being drawn. This cannot be said to be the case in the present instance, where two animals (the common Frog and Toad) closely resemble each other after they have assumed their final, adult external form.

The Anura, then, can hardly, I think, be divided into two primary sections on the strength of a character so little distinctive as Mr. Parker's observations prove the visible presence of these cartilaginous arches to be. I say *visible presence*, because even in the *old* male Frog this arch really persists, though its existence is disguised and hidden by the superficial extension over it of the lower part of the coracoid. Some of the other characters are also but little satisfactory. Thus the presence of a fontanelle is sometimes at least merely a proof of the immaturity of the individual possessing it.

The Anura form such a remarkably homogeneous group, that their subdivision is a work of great difficulty. I fully agree with Mr. Cope that adaptive modifications should be neglected as affording distinctive characters of groups, in favour of others going deeper into their essential relations and affinities. But here it is not at all evident to me which *are* the really essential characters; and when these cannot be clearly distinguished, I think it well to turn to such others as can easily be observed, though regretting at the same time the absence of more significant and satisfactory distinctions.

Thus the system proposed by Dr. Günther should, I think, be retained as far as possible, being so "complete and practically useful," as Mr. Cope acknowledges\*.

That Dr. Günther's system admits now of some modification, I think its author would freely acknowledge. The discovery that some species of *Callula* have very large digital disks, while others are totally devoid of such expansions, cannot but cause grave doubts as to the propriety of the dividing the Anura into large groups on the strength of such a character. Then the presence or absence of a

\* Natural History Review, vol. v. p. 120.



web is sometimes so variable in one and the same genus, that, I submit, *family* distinctness can hardly be determined by it. I therefore propose to treat the presence or absence of disks as a character of minor importance, and to place in one family all forms not otherwise distinguishable than by the presence or absence of a web.

The two remarkable and aberrant genera *Pipa* and *Dactylethra* (which agree in having the eustachian tubes so united as to have but one pharyngeal orifice, and in being destitute of a tongue) I am not disposed to regard as low forms. The absence of the tongue is a defect; but then the highest of all reptiles (the Crocodilia) differ from the inferior forms of their class by a similar one. The single eustachian opening is certainly rather an evidence of *higher* development.

It is with considerable doubt, and mainly out of deference to the opinion of others, that I make *Pipa* and *Dactylethra* types of one and the same primary subordinal division. It may be that *Pipa* is to the edentulous Anura what *Dactylethra* is to the toothed forms, and that they are, as Mr. Cope has suggested\*, extremes of two different series. Nevertheless the agreement between these genera is very remarkable, not only as to the absence of a tongue and the structure of the tympanum, but also as regards the expanded sacral vertebra, the absence of parotoids and of teeth on the palate, the hidden tympanum, and the broadly webbed toes.

In searching for an important character by which to divide primarily the rest of the Anura, I have to choose between that afforded by the expansion or non-expansion of the transverse process of the sacral vertebra, and the presence or absence of maxillary teeth, as (considering the conditions presented by the genus *Callula*) I decline altogether to adopt as an important distinction the expansion of the ends of the digits into disks.

The sacral dilatation is certainly a very remarkable structure, and one probably rather essential than adaptive†. Nevertheless, were it to be selected as the primary character, it would lead to the association of *Engystoma* and *Bufo* with *Hyla* and *Discoglossus*, and the radical separation of the last-named genus from *Rana*, and of *Poly-pedates* and *Hylodes* from *Hyla*. I therefore conclude to adopt that character which Dr. Günther considers the most important after the

\* Natural History Review, 1865, vol. v. p. 98.

† Dr. Günther says, "What influence the dilated or more cylindrical form of the process of sacral vertebra has upon the mode of life is difficult to explain, as it does not absolutely correspond with other physiological or anatomical characters. The pelvis obtains by the dilatation of these processes much more firmness; and a lateral motion is more or less entirely impeded. We should therefore expect to meet with this character in those Batrachians which are provided with the longest and most powerful hind legs, according to the physical problem that the longest lever requires the strongest centre. But, on the contrary, the Batrachians with the shortest legs exhibit a much-dilated sacral vertebra, whilst on the other hand the long-legged *Hylidæ* show the same peculiarity. In fact, *this osteological form seems to be connected with none of the modifications of locomotion*; for we find among these Batrachians good swimmers as well as bad, tree- as well as earth-frogs, those which always hop as well as those which often crawl; finally we are unable to refer to it a peculiarity of any part of the propagation." (P. Z. S. 1858, p. 340.)



tongue and digital disks—which latter I decline to select. This character is the presence of maxillary teeth.

On this subject Dr. Günther observes\*, “When we consider that the lower jaw of the tailed Batrachians is provided with a series of teeth, and that these are wanting in all the tailless Batrachians, we are obliged to acknowledge the importance of this character.” Since this was written, however, two forms have been discovered which *are* provided with mandibular teeth†; and this may perhaps be considered to strengthen Dr. Günther’s refusal to consider the possession of teeth a primary character—a refusal he fortifies by reference to the Edentata and Salmonidæ.

But the learned Doctor’s refusal was mainly grounded on his “not being able to consider the character of the dentition among the tailless Batrachians as one intimately connected with their mode of life”‡, an objection the force of which I am so far from being disposed to admit that I would select for classificatory purposes the least adaptive characters I could find, provided they were constant and easily to be ascertained. It is true that in the Edentata we have edentulous and many toothed forms, but then these forms are very distinct; we have no edentulous Armadillos and no toothed Ant-eaters, and indeed the order may well be primarily divided according to the dentition; so that I think that, on the whole, the Edentata favour my view.

Characters as to dentition serve also to define the primary divisions of the orders Primates, Chiroptera, Insectivora, Cetacea, and Marsupialia, at the least, if not others also; and the edentulous Chelonia form the most natural and well-defined primary groups of existing Reptiles.

Mr. Cope opposes the adoption of dental characters for important divisions as follows:—“The increase of knowledge furnishes us with cases of rudimental dentition, indicating a less significance for the character which has been supposed to characterize the Bufoniformia. Such occurs in the genus *Colostethus*, Cope, which seems to be quite identical with *Dendrobates*, except in the possession of teeth. *Microhyla*, a true Engystomatid, is said by Dr. Günther to possess teeth; and minute rugosities on the maxillæ of *Callula natatrix* deceived me into the belief at one time that teeth actually existed. Among arciferous genera *Eupemphix* (Steindachner) is said by him to possess very minute teeth, which in some adults are entirely wanting”§.

To this it may be replied that the loss of teeth in certain individuals, perhaps aged, can hardly be a valid reason to reject this character as one of weight. Secondly, *Microhyla* does *not* possess teeth; the possession of teeth was attributed to it by Dr. Günther on the

\* Proc. Zool. Soc. 1858, p. 340.

† These are:—*Hemiphractus scutatus*, described by Peters, in ‘Berlin. Monats.’ 1863, p. 144; and *Grypiscus*, described by Cope in ‘Journal of Acad. Philadelphia,’ 1867, vol. vi. part 2, p. 205.

‡ Proc. Zool. Soc. 1858, p. 340.

§ Journal of the Acad. of Nat. Sc. of Philadelphia, new series, vol. vi. part 2, p. 189.



authority of Tschudi\* and MM. Duméril and Bibron†. Thirdly, Mr. Cope admits that he was misled as to the existence of teeth in *Callula natatrix*. Perhaps a similar circumstance may have occurred as regards *Colostethus*, or perhaps *Hylaplesia* may be found to have teeth at some period of life.

Next in importance to the presence or absence of teeth I am disposed to rank the condition of the development of the ear and the dilatation of the sacral transverse process. I am moreover inclined to lay additional weight on them from their not being adaptive characters—the dilatation of the sacral vertebra being, as we have seen, apparently independent of locomotive habit.

As to the condition of the internal ear, neither Dr. Günther nor Mr. Cope are disposed to attach primary importance to it; and I fully agree with the first-named author in thinking that “the Batrachians with imperfectly developed ear would form together an unnatural group, and would be separated too far from other allied forms”‡, if that character were made the main character in Batrachian classification. Nevertheless it seems to me a character of such great importance that I propose to rank it next after the presence or absence of teeth.

Of the characters that remain the most readily available are the presence or absence of parotoids and the dilatation or non-dilatation of the tips of the digits.

That the latter character is, as Mr. Cope considers, not one of any great real value, seems to me to be demonstrated, as before said, by the varying condition in which it is found in the single genus *Callula*. The presence or absence of parotoids therefore may, I think, well take precedence of the digital disks as a distinctive character. As to the “presence or absence of a web between the toes,” that character can only be applied with doubt and uncertainty even to certain groups ranking as low as genera.

Making use of these characters in the subordination above indicated, we shall have, besides *Pipa* and *Dactylethra*, two great series—(1) a toothed (Frog) series, and (2) an edentulous (Toad) series. As some of the animals of the latter series seem to offer the lowest condition found in the order, we may ascend through them to the Frogs, beginning with a section containing those in which the ear is imperfect. The first family of these will be the *Rhinophrynidae*, which have parotoid glands and a tongue free anteriorly. The second family will be the *Phryniscidae*, in which there are no parotoid glands, and in which the tongue is fixed in front. The next edentulous section will consist of such toothless forms as have a perfect ear. It will contain one family with an undilated sacral vertebra (the *Hylaplesidae*) and three families in which the sacral vertebra is dilated, the first of the three (*Buфонidae*) having parotoid glands, the other two being destitute of such structures and distinguished from

\* ‘Classification der Batrachier,’ p. 71, “*Dentes maxillares et palatinos brevissimos.*”

† *Erpétologie Générale*, vol. viii. p. 614.

‡ *Proc. Zool. Soc.* 1858, p. 342.



each other by the tongue being fixed in front as usual (the *Engystomidæ*) or free in front (the *Xenorhinidæ*).

The toothed (or Frog) series may also be similarly divided into two sections:—first, those with an imperfect ear, the *Bombinatoridæ*; secondly, those with a perfect ear. This latter section contains more families than any other section of the order, there being three families in which the sacral vertebra is not dilated, and four in which it is dilated—seven in all. In order, however, to place those families in juxtaposition which have most affinity for each other (*e. g.* the *Discoglossidæ* next to the *Ranidæ*, &c.) I have thought it desirable, in the annexed table, to treat the dilatation of the sacral vertebra as subordinate to the presence or absence of parotoids. I do not, however, consider, as I have already said, the latter character to be inferior in importance; but such a way of treating the matter is convenient in this particular instance.

Thus the *Plectromantidæ*, with parotoids and non-dilated sacral vertebra, will come first, then those with parotoids and dilated sacral vertebra; first, the *Alytidæ*, without digital disks, and then the *Pelodryadidæ*, with them.

Of those without parotoids the *Hylidæ* have a dilated sacral vertebra and digital disks; while undilated sacral vertebra is common to the *Polypedatidæ* and *Ranidæ*, which differ in the presence or absence of the disks; after these the *Discoglossidæ*, which have the sacral vertebra dilated, but are devoid of disks.

Finally come *Pipa* and *Dactylethra*, which thus form a third primary division of the Anura, characterized by a highly developed tympanum, but no tongue.

## ANURA.

### A. Without maxillary teeth at any time of life, but with a tongue.

#### I. Ear imperfect.

Tongue free in front . . . . . *Rhinophrynidæ*.

Tongue fixed in front . . . . . *Phryniscidæ*.

#### II. Ear perfect.

α. Sacral vertebra not dilated . . . . . *Hylaplesidæ*.

β. Sacral vertebra dilated.

1. Parotoids . . . . . *Bufonidæ*.

2. No parotoids.

Tongue free in front . . . . . *Xenorhinidæ*.

Tongue fixed in front . . . . . *Engystomidæ*.

### B. With maxillary teeth at some time of life and with a tongue.

I. Ear imperfect . . . . . *Bombinatoridæ*.

#### II. Ear perfect.

α. Parotoids.

1. Sacral vertebra not dilated . . . . *Plectromantidæ*.

2. Sacral vertebra dilated.

No digital disks . . . . . *Alytidæ*.

Digital disks . . . . . *Pelodryadidæ*.



$\beta$ . No parotoids.

1. Sacral vertebra dilated; digital disks ..... *Hylidæ*.
2. Sacral vertebra undilated; digital disks ..... *Polypedatidæ*.
3. Sacral vertebra undilated; no digital disks ..... *Ranidæ*.
4. Sacral vertebra dilated; no digital disks ..... *Discoglossidæ*.

## C. No tongue; maxillary teeth present or absent.

- I. Maxillary teeth absent ..... *Pipidæ*.
- II. Maxillary teeth present ..... *Dactylethridæ*.

## Section A. No maxillary teeth; a tongue.

## Division I. Ear imperfect.

## Fam. I. RHINOPHRYNIDÆ.

No tympanum; no cavum tympani; no eustachian tubes; transverse processes of sacral vertebra dilated; parotoid glands present but hidden, large, with smooth surface; tongue free in front, fixed behind; fingers webbed at the base, toes half webbed; "no articulated ribs or opisthocœlian vertebræ;" "ethmoid septal walls ossified to the end of the muzzle, and separating the prefrontals; its superior plate covered by the completely ossified fronto-parietale. Fronto-nasalia well developed, entirely in contact with *fronto-parietalia*, separated by a median point of the latter and by the ethmoid septum." "Coracoid and epicoracoid divergent, connected by a narrow single cartilage; the former not dilated, in contact with, or slightly separated from, that of the opposite side." Nine vertebræ and a coccyx attached by two condyles.

Tropical America.

*Rhinophrynus*, Dum. & Bibron, viii. p. 758, pl. 91. figs. 2, 2a; Günther, P. Z. S. 1858, p. 348; Cope, Nat. Hist. Review, vol. v. 1865, p. 100.

Genus *Rhinophrynus*, Mexico.

## Fam. II. PHRYNISCIDÆ.

No tympanum; no cavum tympani; eustachian tubes absent or rudimentary; transverse processes of sacral vertebra dilated; no parotoid glands; tongue more or less elongate, fixed in front, free behind, where it is entire; digits free or webbed, but undilated or only moderately dilated. No arciform cartilages.

Neotropical and Australian, Indian and Ethiopian regions.

This is almost equivalent to the *Brachycephalina* of Dr. Günther, including, as it does, the *Phryniscidæ*, *Brachycephalidæ*, and adding to them the *Micrhylidæ* (Cat. of Bat. Salientia, pp. 42, 45, & 121, and Synopsis, p. 8).



Subfam. 1. PHRYNISCINA.

“ Prefrontals small, widely removed from each other and from the fronto-parietals; eustachian tubes rudimentary; no digital disks; precoracoidei present and smaller than coracoids”\*.

See Cope, Journal of Acad. of Phil. 1867, p. 195.

Genera:—*Phryniscus*, Neotropia; *Pseudophryne*, Australian; *Brachycephalus*, Neotropia.

Subfam. 2. HEMISINA.

No eustachian tubes; tongue posteriorly retractile into a sheath; fronto-parietal and prefrontal bones fully developed, in contact, the latter separated to end of muzzle by ossified ethmoid septum; manubrium present; coracoids more slender than precoracoids; no digital disks.

See Cope, *l. c.* p. 198.

Genus *Hemissus*, Ethiopia.

Subfam. 3. MICHRYLINA.

Precoracoidei wanting; no eustachian tubes; ethmoid arch ossified; prefrontals fully developed, in contact with each other and fronto-parietals; latter complete; moderate digital disks.

Genus *Micrhyla*, Indian region.

Division II. *Ear perfect.*

Subsection  $\alpha$ . *Sacral vertebra not dilated.*

Fam. III. HYLAPLESIDÆ (Günther).

A tympanum and cavum tympani; two eustachian tubes; processes of sacral vertebra not dilated; no parotoid glands; tongue free behind; digits free and all dilated at their ends; no arciform cartilages; precoracoids present; sacrum distinct from coccygeal style, three lobes to the liver; prefrontals widely separated; ethmoid broad, ossified to extremity of muzzle; terminal phalanges with two divaricate limbs.

Tropical America.

*Hylaplesidæ*, Günther, Cat. of Bat. Sal. p. 124.

*Dendrobatidæ*, Cope, Journal Phil. 1867, p. 197.

Genus *Hylaplesia*, Neotropia.

Subsection  $\beta$ . *Sacral vertebra dilated.*

Fam. IV. BUFONIDÆ (Günther).

A tympanum and cavum tympani; two eustachian tubes; pro-

\* These characters may not apply to *Pseudophryne*, which does not appear to be included by Cope in his *Phryniscidæ*, though in the paper in the Nat. Hist. Review it is placed beside *Phryniscus*, *l. c.* p. 102.



cesses of sacral vertebra dilated; parotoid glands present; tongue free behind; digits not dilated, toes more or less webbed.

Cosmopolitan, except Australia.

#### Subfam. 1. KALOPHRYNINA.

No arciform cartilages; precoracoids present; prefrontals fully developed, forming suture with each other and fronto-parietals; skin of the back forming one large flat parotoid. East-Indian islands.

Genus *Kalophrynus*, Indian region.

#### Subfam. 2. BUFONINA.

Arciform cartilages; precoracoids present; parotoids normal, prominent. Cosmopolitan, except Australia.

Genera:—*Bufo*, cosmopolitan, except Australia; *Otilophus*, Neotropical region; *Peltaphryne*, Neotropical region; *Pseudobufo*, East-Indian archipelago; *Schismaderma*, Ethiopian.

#### Fam. V. XENORHINIDÆ.

A tympanum and cavum tympani; two eustachian tubes; processes of sacral vertebra dilated; no parotoid glands; tongue entirely attached behind, free in front; digits all free, but only the toes provided with disks; tympanum distinct, large; no tarsal tubercle; habit of *Engystoma*.

New Guinea.

See Peters, Berlin. Monats. 1863, p. 82.

*Bombinator oxycephalus*, Schlegel, Handleiding tot de beoefening der Dierkunde, ii. p. 58, tab. iv. fig. 74.

Genus *Xenorhina*, Australian region.

#### Fam. VI. ENGYSTOMIDÆ.

A tympanum and cavum tympani; two eustachian tubes; processes of sacral vertebra dilated; no parotoid glands; tongue fixed in front; digital disks present or absent.

African, Indian, Neotropical, and Australian regions.

Includes *Engystomidæ*, *Rhinodermatidæ*, *Brachymeridæ*, and *Hylædactylidæ* of Dr. Günther, Cat. of Bat. Salientia, Synopsis, pp. 8 & 9.

#### Subfam 1. ENGYSTOMINA.

Coracoidei abutting; no precoracoids; no arciform cartilages. *Engystomidæ* of Cope, l. c. pp. 190 & 191.

Genera:—*Engystoma*, Neotropical region; *Diplopelma*, Indian region; *Cacopus* (*Systoma*), Indian; *Glyphoglossus*, Indian; *Callula*, Indian; *Brachymerus*, Ethiopian; *Adenomera*, Neotropical; *Pachybatrachus* (?), Australia.

#### Subfam. 2. BREVICIPITINA.

Coracoidei abutting; precoracoids present; no arciform cartilages.



Genera:—*Breviceps*, Ethiopian region; *Chelydobatrachus*, Australian; *Hypopachus*, Neotropical; *Rhinoderma*, Neotropical; *Ateopus*, Neotropical; *Copea*, Neotropical.

Subfam. 3. PALUDICOLINA.

Coracoids and precoracoids present; also arciform cartilages.

Genus *Paludicola*, Neotropical region.

Section B. *With maxillary teeth at some time of life, and with a tongue.*

Division I. *Ear imperfect.*

Fam. VII. BOMBINATORIDÆ (Günther).

Tympanum and cavum tympani present or absent; eustachian tubes always absent, or reduced to a minute foramen with an absent tympanum (*Cacotus*); transverse processes of sacral vertebra almost always dilated; no parotoid glands; tongue fixed in front; toes free or webbed; no digital disks; arciform cartilages present.

Palæarctic and Neotropical regions, and New Zealand.

Subfam. 1. BOMBINATORINA.

No tympanum; no cavum tympani; eustachian tubes rudimentary, minute, or wanting; tongue entirely adherent; fingers free; toes webbed; vomerine teeth; vertebræ opisthocælian; ribs present; a fronto-parietal fontanelle; prefrontals in contact anteriorly; one coccygeal cotylus.

Genus *Bombinator*, Palæarctic region.

Subfam. 2. PELOBATINA.

No tympanum; no cavum tympani; eustachian tubes, if present, very narrow; tongue free behind (*Didocus*?), nearly entire; vertebræ procælian; no ribs; vomerine teeth; "coccygeal style without condyloid articulation, its axial portion restricting that of the sacrum and connate with it."

Genera:—*Pelobates*, Europe; *Didocus*, Europe.

Subfam. 3. ALSODINA.

No tympanum, cavum tympani, or eustachian tubes (*Telmatobius*?); toes webbed; sacral vertebra not, or scarcely dilated; vertebræ procælian; no ribs; coccyx attached by two condyles; vomerine teeth present or absent.

Genera:—*Alsodes*, Neotropia; *Telmatobius*, Neotropia.

Subfam. 4. CACOTINA.

Tympanum absent, but minute eustachian tubes; sacral vertebra not dilated; toes quite free; vomerine teeth.

Genus *Cacotus*, Günther, P. Z. S. 1868, p. 482, Neotropia.



When reading his paper before the Zoological Society, Dr. Günther called attention to the interesting and highly remarkable parallelism between this genus of South America and the European *Bombinator*.

Subfam. 5. LIOPELMATINA.

Tympanum none (or hidden); no eustachian tubes; sacral vertebra dilated; no vomerine teeth; toes webbed at the base.

Genus *Liopelma*, Fitz., and Günther, B. Mus. Cat. MS., New Zealand.

Divison II. *Ear perfect*.

Subsection a. *Parotoids*.

Fam. VIII. PLECTROMANTIDÆ.

A tympanum and cavum tympani; two eustachian tubes, each with a considerable aperture; transverse processes of sacral vertebra not dilated; parotoids present as a large oblong gland behind the mouth; tongue large, rounded and free behind; toes nearly all free, but with small disks; no disks to fingers. [Arciform cartilages present?]

Genus *Plectromantis*, Neotropical region.

Fam. IX. ALYTIDÆ.

Answers to the *Alytidæ* and *Uperoliidæ* of Dr. Günther.

A tympanum, cavum tympani, and eustachian tubes present; transverse processes of sacral vertebra dilated; parotoid glands present; tongue fixed in front; digits not dilated at the tips; arciform cartilages present.

Palæarctic, Nearctic, and Neotropical regions.

Subfam. 1. ALYTINA.

Vertebræ opisthocœlian; ribs present; "first coccygeal vertebra united as usual with the second or style, but furnished with posteriorly divergent diapophyses, and attached to the sacral by two cotyloid cavities; a fronto-parietal fontanelle; terminal phalanges continuous, simple."

Genus *Alytes*, Palæarctic region.

Subfam. 2. SCAPHIOPODINA.

Vertebræ procœlian; no ribs; no coccygeal diapophyses; coccyx connate with sacrum; terminal phalanges continuous, conic.

Genus *Scaphiopus*, North America.

Subfam. 3. UPEROLIINA (*Uperoliidæ*, Günther).

Vertebræ procœlian; no ribs; coccyx separate, attached to two condyles, with no diapophyses; terminal phalanges simple.

Genera:—*Hyperolius*, Neotropical region; *Helioporus*, Neotropical; *Nattereria*, Neotropical.



## Fam. X. PELODRYADIDÆ (Günther).

A tympanum, cavum tympani, and eustachian tubes present; transverse processes of sacral vertebra dilated; parotoid glands present; tongue fixed in front; digits dilated at the tips.

Genera:—*Phyllomedusa*, Neotropical region; *Pelodryas*, Australian; *Chirodryas*, Australian.

Subsection  $\beta$ . *No parotoids*.

## Fam. XI. HYLIDÆ (Günther).

A tympanum, cavum tympani, and eustachian tubes present; transverse processes of sacral vertebra dilated; no parotoid glands; tongue fixed in front; digits dilated into disks at the tips; arciform cartilages present; coccyx articulated by two condyles; "fronto-parietals shortened anteriorly, usually embracing a fontanelle; terminal phalanges articulated inferiorly on to the extremity of the penultimate, globular or swollen proximally, and giving rise to the curved acute distal portion."

Genera:—*Hyla*, Cosmopolitan, except Indian and Ethiopian regions; *Hylella*, Neotropical; *Ololygon* (*Thoropa*), Neotropical; *Pseudacris* (*Chorophilus*), North American; *Pohlia*, Neotropical; *Litoria*, Australian; *Triprion*, Neotropical; *Opisthodelphys*, Neotropical; *Trachycephalus*, Neotropical; *Nototrema*, Neotropical.

## Fam. XII. POLYPEDATIDÆ (Günther).

A tympanum, cavum tympani, and eustachian tubes present; transverse processes of sacral vertebra not dilated; no parotoid glands; tongue fixed in front; arciform cartilages present or absent; digits dilated at the tips.

Answers to the *Polypedatidæ* and *Hylodidæ* of Dr. Günther.

Cosmopolitan, except Palæarctic region.

## Subfam. 1. POLYPEDATINA.

Coracoids and precoracoids, but no arciform cartilages; simple coccyx attached by two cotyloid cavities; manubrium bony. No fronto-parietal fontanelle; toes almost always more or less webbed.

Genera:—*Ixalus*, Indian and Ethiopian regions; *Megalixalus*\*, —?; *Hylarana*, Indian and Ethiopian; *Leptomantis*†, Indian; *Hylambates*, Ethiopian; *Platymantis*, Indian and Polynesia; *Cornufer*, Indian and Australian; *Hemimantis*, Ethiopian; *Rhacophorus*, Indian; *Chiromantis*, Ethiopian; *Polypedates*, Indian and Ethiopian; *Theloderma*‡, Indian; *Rappia*, Indian and Australian regions and the Seychelles.

## Subfam. 2. ACRIDINA.

Arciform cartilages present; vertebræ procœlian; simple coccyx

\* Skeletal characters unknown, but placed provisionally beside *Ixalus*.

† Placed here on the authority of Peters, who says it is so like *Ixalus*.

‡ Placed here on the authority of Cope.



with two condyles; terminal phalanges curved, sharp-pointed, swollen at the base, hyloid; ethmoid never covered by fronto-parietals.

Genera:—*Acris*, North America; *Leiyla*? (Kefersteine), Costa Rica.

#### Subfam. 3. HYLODINA.

Arciform cartilages present; vertebræ procœlian; coccyx separate, attached to two condyles; manubrium wanting, or cartilaginous; terminal phalanges with a transverse limb (*Strabomantis*?), not hyloid.

Genera:—*Elosia*, Neotropical region; *Epirhexis*, Neotropical; *Phyllobates*, Neotropical; *Hylodes*, Neotropical; *Cropodactylus*, Neotropical; *Strabomantis* (?), Neotropical.

#### Subfam. 4. CALOSTETHINA.

Precoracoids present, but no arciform cartilages; xiphisternum and manubrium wanting; terminal phalanges with transverse limb; no vomerine teeth.

*Calostethidæ*, Cope, Journ. Ac. Philad. 2nd ser. vol. vi. pt. 2.

Genus *Calostethus*, Neotropica.

### Fam. XIII. RANIDÆ.

A tympanum, cavum tympani, and eustachian tubes present; transverse processes of sacral vertebra not dilated; no parotoid glands; tongue fixed in front; arciform cartilages present or absent; digits not dilated at the tips.

Answers to the *Ranidæ* and *Cystignathidæ* of Dr. Günther.

Cosmopolitan.

#### Subfam. 1. RANINA.

No arciform cartilages; manubrium with a strong bony style; xiphisternum similar; no fronto-parietal fontanelle; no mandibular teeth.

Genera:—*Rana*, all regions except the Australian region; *Odonophrynus*, Neotropical; *Dicroglossus*, Indian; *Oxyglossus*, Indian; *Phrynobatrachus*, Ethiopian; *Hoplobatrachus*, Indian; *Phrynoglossus* (? skeletal characters unknown, but otherwise very like *Oxyglossus*); *Clinotarsus* (skeletal characters unknown), ——?

#### Subfam. 2. CYSTIGNATHINA.

Arciform cartilages present; manubrium wanting or cartilaginous (except *Limnocharis*); a styloid osseous xiphisternum with a cartilaginous disk; sometimes a fronto-parietal fontanelle; no mandibular teeth.

Genera:—*Pseudis*, Neotropical region; *Pithecopsis*, Neotropical; *Mixophyes*, Australian; *Pyxicephalus*, Ethiopian and Indian; *Ceratophrys*, Neotropical; *Zachænus*, ——?; *Platyplectrum*, Australian; *Neobatrachus*, Australian; *Cyclorhamphus*, Neotropical; *Limnodynastes*, Australian; *Crinia*, Australian; *Eusophleus*, Neotropical; *Pleurodema*, Neotropical; *Leiuperus*, Neotropical; *Hylorhina*, Neo-



tropical; *Limnocharis*, —?; *Cystignathus*, Neotropical and Ethiopian.

Subfam. 3. HEMIPHRACTINA.

Mandibular teeth.

Genus *Hemiphractus*, Neotropical.

Fam. XIV. DISCOGLOSSIDÆ (Günther).

A tympanum, cavum tympani, and eustachian tubes present; transverse processes of sacral vertebra dilated; no parotoid glands; tongue fixed in front; digits not dilated at the tips; arciform cartilages present or absent; bony manubrium present or absent; ribs present or absent; mandibular teeth present or absent.

Answers to both the *Discoglossidæ* and the *Asterophrydidæ* of Dr. Günther.

Cosmopolitan, except Nearctic and Ethiopian regions.

Subfam. 1. CHIROLEPTINA.

Vertebræ proœelian; no ribs; arciform cartilages present; manubrium wanting or cartilaginous; fronto-parietal bones complete, no fontanelle; xiphisternum a cartilaginous plate; no mandibular teeth.

Genera:—*Chiroleptes*, Australian region; *Zachænus*(?); *Calypotocephalus*, Neotropical.

Subfam. 2. ASTEROPHRYDINA.

Vertebræ opisthocœlian; no ribs; arciform cartilages present; no mandibular teeth.

Genera:—*Cryptotis*, Australian region; *Asterophrys*, Australian; *Xenophrys*, Indian; *Megalophrys*, Indian; *Nannophrys*, Indian.

Subfam. 3. PELODYTINA.

Vertebræ proœelian; no ribs; arciform cartilages present; no mandibular teeth.

Genera:—*Pelodytes*, Palæarctic region; *Leptobrachium*, Indian region.

Subfam. 4. DISCOGLOSSINA.

Vertebræ opisthocœlian; short ribs present; arciform cartilages present; no mandibular teeth.

Genera:—*Discoglossus*, Palæarctic region; *Zaphrissa*, Palæarctic; *Latonia*, Palæarctic.

Subfam. 5. ARTHROLEPTINA.

No arciform cartilages; no ribs; precoracoids present; no mandibular teeth; manubrium and xiphisternum bony; no fontanelle.

Genus *Arthroleptis*, Ethiopian region.



## Subfam. 6. GRYPISCINA.

Arciform cartilages present; no ribs (?); mandibular teeth developed.

Cope, Journ. Ac. Philad. 1867, vol. vi. pt. 2, p. 205.

Genus *Grypiscus*, Neotropia.

Section C. *No tongue; maxillary teeth present or absent.*

Division I. *No maxillary teeth.*

## Fam. XV. PIPIDÆ.

A tympanum and an entirely bony cavum tympani; eustachian tubes united, with a single oral opening; transverse processes of sacral vertebra dilated; no parotoids; no tongue; atlas and second vertebra confluent; vast cartilaginous xiphoid and great arciform cartilages.

Genus *Pipa*, Neotropical region.

Division II. *Maxillary teeth.*

## Fam. XVI. DACTYLETHRIDÆ.

A tympanum and an entirely bony cavum tympani; eustachian tubes united, with a single oral opening; transverse processes of sacral vertebra dilated; no parotoids; no tongue; atlas and second vertebra distinct; coccyx and sacrum confluent; moderate cartilaginous xiphoid, and no arciform cartilages; yet coracoid and pre-coracoid very widely diverging.

Genus *Dactylethra*, Ethiopian region.

2. Description of a New Genus and Species of the Family  
*Trochilidæ*. By JOHN GOULD, F.R.S. &c.

## Genus OREONYMPHA.

*Gen. Char.*—Bill longer than the head, stout, and with a somewhat downward curvature; wings large and sickle-shaped; tail ample and forked; tarsi clothed nearly to the toes, which are of moderate size; the hinder toe and nail rather shorter than the middle toe and nail.

Notwithstanding the length and stoutness of the bill, I consider this form to be nearly allied both to *Oxypogon* and *Ramphomicron*. It has the same kind of brilliant gular streak, a similar laxity of plumage, and soft flexible tail-feathers.

## OREONYMPHA NOBILIS.

Bill and legs black; crown blue, with a streak of black down the centre; on the throat a lengthened streak of brilliant feathers, of which those nearest the bill are green, those which succeed are red-





Mivart, St. George Jackson. 1869. "On the classification of the anurous batrachians." *Proceedings of the Zoological Society of London* 1869, 280–295.

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