

ment on this fundamental change of our conceptions, yet it is a fact that the most widely different properties of solutions agree qualitatively with the new conceptions. Quantitatively, the result calculated agrees very nearly with that found, but, thus far, the agreement is not always perfectly satisfactory. It is of chief importance for our purpose that a new impulse was thus given to the study of solutions of salts, acids and bases, *i. e.*, chiefly to inorganic compounds.

A final remark in closing: While it has been repeatedly emphasized, in the foregoing that it is chiefly inorganic chemistry that has been advanced by the new theoretical considerations, yet it is not meant that organic chemistry has thus lost in interest. On the contrary, the science of chemical equilibrium can be applied also here, and has already been thus applied.

The action of ferments is then taken up, and the work of Tammann and others cited to show that such act, at least in some cases, to only a limited extent, a condition of equilibrium being reached before the decomposition is complete. Thus, amygdalin is only partly broken down by emulsin, and the breaking-down goes farther if the decomposition products are removed. If, on the contrary, he had added the decomposition-products he would, perhaps, have effected the synthesis of amygdalin. In case the ferment is not changed by its action, on theoretical grounds a condition of equilibrium must be introduced, and not a total transformation, and, therefore, the opposite reaction should be realized. It is a fair question to ask whether (from the science of equilibrium) sugar cannot be formed from carbon dioxide and alcohol, under the influence of zymase, when the pressure of the carbon dioxide exceeds a certain limit; and also whether trypsin is not in the position, under conditions given by the science of equilibrium, to form albu-

min from the decomposition products which it itself yields?

"If I have gone too far in these last expressions they may remain as proof that I always have a warm heart for organic chemistry." Van't Hoff concluded with the wish that Germany, which is in danger of being surpassed in inorganic chemistry by other nations; which has recently lost from this field such men as Victor Meyer, Lothar Meyer, Gerhard Krüss and Clemens Zimmermann, will soon again occupy a leading position, through the choice of young men of our science to enter this field.

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CHEMICAL LABORATORY,
JOHNS HOPKINS UNIVERSITY,
November, 1898.

*THE TAILLESS BATRACHIANS OF EUROPE.**

THE anurous salient amphibians, or tailless batrachians, have been long favorite subjects of study in Europe, and much has been written upon their habits. Only a few years ago (in 1890) Dr. J. de Bedriaga published an elaborate monograph of the Amphibians of Europe (*Die Lurchfauna Europas*) giving very full descriptions of the species and their manner and customs. Now we have completed a still more elaborate work on a single order of Amphibians—the Salientia—including the frogs and toads and their relations. This work, entitled '*The Tailless Batrachians of Europe*,' is by Mr. G. A. Boulenger, and has been 'issued to the subscribers to the Ray Society,' in two bound volumes or parts for the years 1896 and 1897; the pagination is continuous from the first into the second volume (pp. 211–376). Doubtless many of the 'subscribers' will rejoice in the diversification of the subjects monographed, for nearly a

* *The Tailless Batrachians of Europe*. By G. A. Boulenger, F.R.S. London: printed for the Ray Society. 1897–1898. 2 parts, 8vo., t. p., iii, 376 pp., 24 pl., 7 maps.

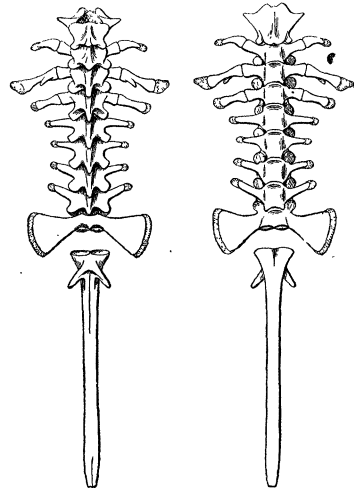
generation has passed since any volume on vertebrates was published, the last having been 'a monograph on the structure and development of the shoulder girdle,' by W. K. Parker, issued for 1867. All the volumes published since 1880 have been devoted to insects in the Linnæan sense.

Mr. Boulenger has been 'for twenty-five years a close student and collector of these animals, which have always exercised an extraordinary fascination' on his mind and he has utilized 'the enormous material which had gradually accumulated in the literature, [his] own notes, and the unrivalled collection in the British Museum.' The outcome is worthy of the distinguished author, and we have a monograph which may serve as a model for other lands, and not least for the United States.

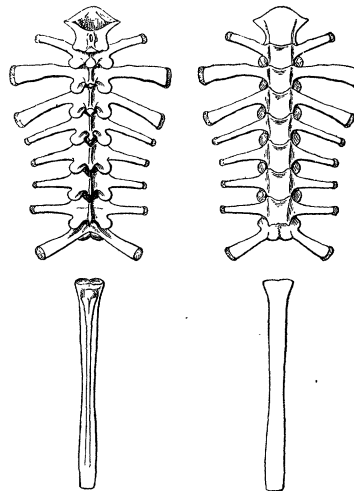
The first third of the work (p. 1-121) is an 'introduction' to Amphibiology, treating of the classification, external characters, integument, dermal secretion, skeleton, viscera, habits, voice, pairing and oviposition, spermatozoa, eggs, development and metamorphosis, tadpoles, hybrids, and geographical distribution. This introduction is illustrated by forty-seven cuts and three plates representing anatomical and physiological data. A most useful feature is the exhibition in dichotomous form of the 'external characters' (17), the 'osteological characters' (44), 'the chief differences in male uro-genital apparatus' (55), the amplexation or mode of embrace of the male (69), the nuptial asperities (70), 'the principal differences between the eggs' (79), and the characteristics of the tadpoles (105).

The characters thus clearly analyzed and exhibited among the Anurans may be considered to have been coordinated, and the resultant is a classification which expresses quite nearly an equation for the collective characters and is, therefore, a 'natural classification.' So uniform are the external

characters that not only are they no criteria of the mutual affinities of the various forms, but they are actually often misleading. The early naturalists distinguished among the phaneroglossate forms those with the upper jaw toothed or toothless and those with toes having terminal disks contrasted with



Discoglossus pictus, showing ribs.



Rana esculenta.

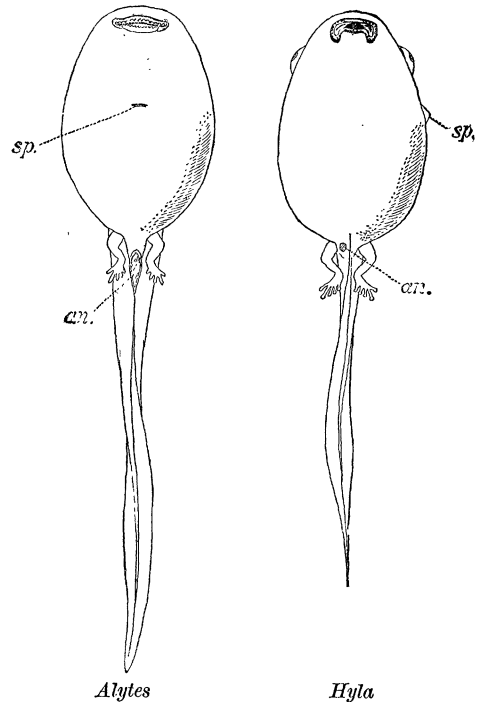
those without disks. Other characters were found in the presence or absence of a 'tympanum' or 'ear' and of 'parotoid glands' as well as other less-used variations. It became evident, however, that none of the

arrangements based on such characters was an expression of deep-seated affinities. It was not till 1865 that a key to the definitive arrangement of the group was discovered by Cope in the osteological characters and especially modifications of the sternal apparatus. Cope's arrangement has been called by Mr. Boulenger an 'epoch-making classification' and, in the form to which it has been brought by the later labors of Cope and Boulenger, will doubtless be near that which will gain ultimate general acceptance. Nevertheless, it may be thought too much value has been attached to the arciferous type of sternum. An arrangement of the phaneroglossate forms into three superfamilies, of which the arciferous family of *Discoglossidæ* is the most generalized, may be more acceptable to some; this has been named DISCOGLOSSOIDEA. The other Arcifera are the BUFONOIDEA, and the FIRMISTERNIA are equivalent to another superfamily of nearly equal systematic importance—the RANOIDEA.

The Discoglossoidæ differ from both the others in the possession of ribs in the adult, and by the median position of the spiraculum or outlet from the branchial chamber in the tadpole. Less important peculiarities are the arrangement of the male urogenital apparatus (so that 'the spermatozoa are conveyed through the vasa efferentia direct to the seminal duct; the latter produced forward beyond the kidney') and the disposition of the labial teeth series 'in two or three rows.' The single family—*Discoglossidæ*—contains three European genera and five species; the genera were widely separated by the old systematists, and it was to Cope that the earliest appreciation of their relationship was due.

The Bufonoidea, or typical Arcifera, are represented in Europe by three families—*Pelobatidæ*, *Bufonidæ* and *Hylidæ*. The *Pelobatidæ* of Boulenger were distributed by Cope among two families, one of the Euro-

pean genera (*Pelodytes*) having been designated as the type of Pelodytidæ, and the other (*Pelobates*) associated with the American *Scaphiopus* in the family Scaphiopidæ. There can scarcely be any question that Boulenger is correct in reducing the two Copian families to one. The only characters



used to differentiate them were the 'sacrum united with the coccyx by condyle' in the *Pelodytidæ*, and the 'urostyle without condyloid articulation, its axial portion restricting that of the sacrum and connate with it,' in the *Scaphiopidæ*.*

The inconstancy of this character in some groups has been shown by Boulenger. "Dugès, basing his observations [on the *Pelobates cultripes*], has denied the fusion of the sacral vertebra with the coccyx described by Mertens in *Pelobates fuscus*, with which *P. cultripes* was then confounded; he observes, however, that the articulation, by means of one condyle, is an almost immovable one.

* Cope Batr. N. Am., 296.

In a specimen from Bordeaux, from which [Boulenger] prepared the first skeleton, [he] found matters as stated by Dugès, whilst in two other skeletons, from Bordeaux and Avignon, the two bones are as completely fused as in *P. fuscus*." Mr. Boulenger well adds: "As the ankylosis of the sacrum and coccyx has been given as a generic character of *Pelobates*, it is important to note the inconstancy of the character in this species at least." Still less is the character of family value. Further, an examination of the skeletons of *Pelodytes*, *Pelobates* and *Scaphiopus* should convince a competent observer that the difference between *Pelobates* and *Pelodytes* are much less than those between *Pelobates* and *Scaphiopus*. *Scaphiopus* differs from *Pelobates* in the reduced dilatation of the diapophyses of the sacral vertebra, the strength and direction of other diapophyses, the cartilaginous 'xiphisternum,' the absence of a bony style, and the development of a 'cavum tympani and tympanum.' In all the contrasted characters *Pelobates* agrees with *Pelodytes*, and, if the family is to be divided, the two European genera should be combined and contrasted with the American. The eminent herpetologist who associated *Pelobates* with *Scaphiopus* was too much impressed at first with the special osteological character used, and neglected to make a detailed comparison which would have convinced him of its inferior value.

The Ranoidea are represented in Europe by only a single genus—*Rana*—although 8 of the 20 anurans belong to it.

Mr. Boulenger has paid much attention to the geographical distribution of the European species and has devoted a number of maps (6) to the exhibition of the range of the representatives of a family, genus, or of nearly related species or varieties. We may extend the view by a comparison of the European fauna based on Boulenger's figures with the North American, accept-

ing, therefore, the numbers given by Cope in 'The Batrachia of North America.'

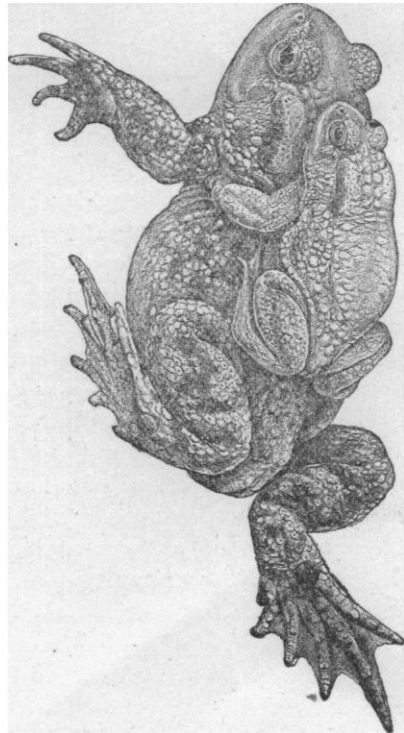
	Europe.	N. Amer.
DISCOGLOSSIDÆ		
Discoglossus	1	
Bombinator	2	
Alytes	2	
PELOBATIDÆ		
Pelodytes	1	
Pelobates	2	
Scaphiopus		2
Spea		2
UPEROLIIDÆ (CYSTIGNATHIDÆ or LEPTODACTYLIDÆ)		
Lithodytes		2
Syrhopus		4
BUFONIDÆ		
Bufo	3	10
HYLIDÆ		
Hyla	1	9
Pseudacris (Chorophilus)		6
Acris		1
Smilisca		1
ENGYSTOMIDÆ		
Engystoma		1
Hypopachus		1
RANIDÆ		
Rana	8	13

It will be seen from these columns that the North American fauna is much richer than the European. The chief differences, otherwise, are the absence of Discoglossids in America and the great development in North America of the Hylids—17 American against a single European species. There is no great disparity between the other families, although for each the American species are more numerous than the European. The families indicated as represented in North America and not in Europe do not really belong to the Anglogæan fauna, the species in question barely extending within the limits of the United States, the only notable exception being the *Engystoma carolinense*, which extends as far north as South Carolina and Missouri.

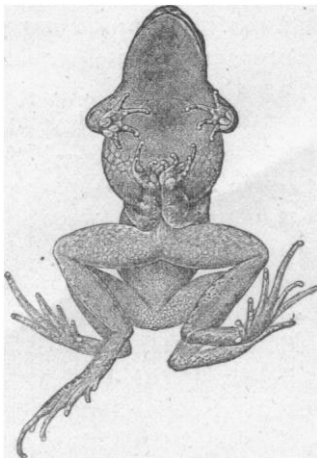
The chief interest to most lovers of nature will be in the accounts of the habits of

the species, and these, as a whole, are detailed more fully and with more discrimination than in any other work. Especially noteworthy are the descriptions of the courtship and oviposition of the species. The 'amplexation,' or mode of approach of the males on the females, is characteristic, and in main features is common to the members of a genus, so far at least as the European species are concerned. So generally in conformity with structural features has it been regarded that the principal modifications have been used to differentiate and diagnose certain groups. Attention was first called to the subject by A. Thomas in 1854, and two groups were named by Bruch, in 1863, *Plagioglena* and *Orthoglena*, and by A. de L'Isle, in 1877, *Alamplexes* and *Inguinamplexes*. But the want of correlation between such characters and structural ones is now evident. Mr. Boulenger (p. 2) well remarks: "How exaggerated the importance attached to this correlation, which, besides, holds good only for the European forms, is now apparent to all." Nevertheless, within

For example, Mr. Héron-Royer (Bull. Soc. Zool. France, 1890, 205) recognized 7 categories of amplexation—pectoral, axillary, supra-axillary, inguinal, axillo-in-



Amplexation of '*Bufo vulgaris*'

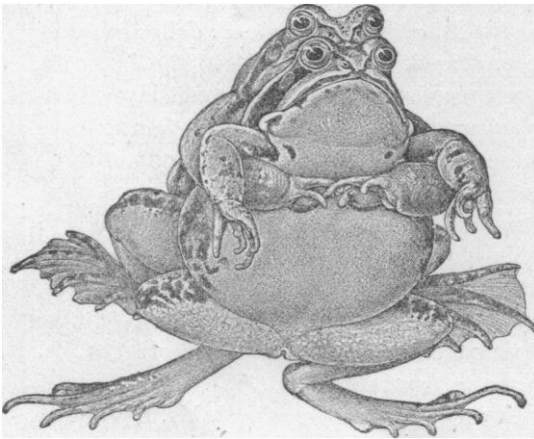


Amplexation of '*Pelodytes punctatus*'

certain limits, the species of a genus agree in their mode of amplexation; only a too strict taxonomy cannot be applied.

guinal, lumbo-pubic, and lumbar. Now, Mr. Héron-Royer recognized five European species of *Hyla*, which are considered by Mr. Boulenger to be varieties or variations of the single species *Hyla arborea*, and yet two of the nominal species are referred to one category (axillary) and three to another (supra-axillary). One of the European toads (*Bufo viridis*) has a pectoral amplexation, two (*B. vulgaris* and *B. calamita*) an axillary, and the common American species (*B. musicus* or *lentiginosus*), a supra-axillary habit. In fact, such differences may be simple expressions of the relative size of the male and female and must vary as do the sexes. But there is a sharp contrast between amplexation round the waist and

that behind or above the arms, and these two categories are the chief ones recognized by Mr. Boulenger. The former mode is exemplified by all the species of Discoglossids and Pelobatids; the latter by the Bufonids, Hylids and Ranids. Four kinds or degrees of amplexation are represented by admirable illustrations in Mr. Boulenger's work and are here reproduced. Among the Pelobatids the hands join on the pubic



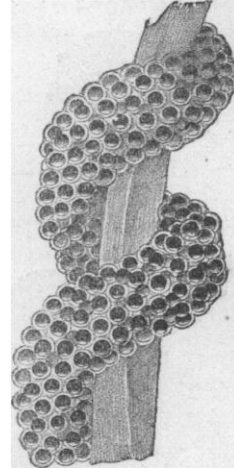
Amplexation of '*Rana arvalis*.'

region in *Pelobates*, while the forearms meet on the pubic region in *Pelodytes*. It will be in order now for some observer to tell us how *Scaphiopus* practices amplexation; the various accounts hitherto published fail to give the requisite information.

Every sojourner in the country must have noticed masses of transparent jelly-like spheres in the water, but none in the United States could refer such masses with certainty to the parent species. In Europe, however, such an identification can be made in almost every case, and Mr. Boulenger gives a synopsis for that purpose, and adds illustrations of the oviposition of seven species representing all of the five European families. Some of these illustrations are here copied.

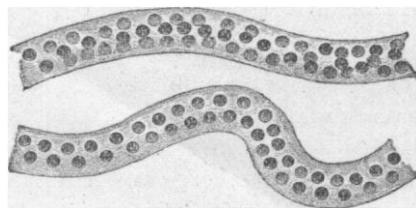
The tadpoles of the European anurans have also been described and figured, and

each species may be readily identified by means of an excellent analytical key (105-109). The tadpoles of *Rana*, for example,



Eggs of *Pelodytes*.

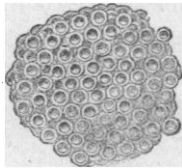
are differentiated *inter se* by the relative width of the interocular space, the series of labial teeth, and the form of the tail. Mr. Boulenger deduces the generalization that "the structural differences which separate the genera and species in their tadpole condition reflect, on the whole, pretty accu-



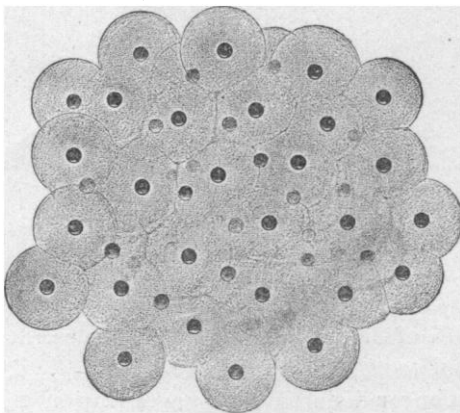
Eggs of *Bufo*.

rately the system based upon the perfect animals, although here and there the modifications are of unequal importance. We must bear in mind, however, that such a correspondence, if existing in the European Batrachians, is not universal. It is aptly added: "Larval forms such as the tadpoles are outside the cycle of recapitulation, the ontogeny being broken by the intercalation of the larval phasis."

Enough has been said to give some idea of the wealth of information given. As no other has had such opportunities of investigation as Mr. Boulenger, so no one has



Eggs of *Hyla*.



Eggs of '*Rana temporaria*.'

had greater capacity to use his material. Undoubtedly his monograph will long continue to be the standard of nomenclature. Nevertheless, there will be dissenters from some of the taxonomic ideas and some of the names adopted. For example, some may be disposed to differentiate the *Pelobates cultripes* from the genotype and call it *Cultripes provincialis* (with Cope) or *Cultripes cultripes*. Less likely will be the resurrection of *Ammoryctes* or *Epidalea*. Others too may assign higher value to forms designated as varieties of *Bombinator pachypus*, *Alytes obstetricans*, *Hyla arborea*, *Rana esculenta* and *Rana temporaria*.

Again, there may be differences of opinion as to various specific names. *Bombinator igneus* may be replaced by *B. bombinus* or possibly (but not probably) by *B. variegatus*. (The *Rana variegata* of Linnæus was

supposed to be a foreigner 'at large'—'*habitat in exteris regionibus*.'') For the *Bombinator pachypus* may be revised the name *B. salsus*. The toad may be called *Bufo bufo* or *B. rubeta*. The *Rana arvalis* may be deemed to be entitled to the Linnæan name *R. temporaria* on the ground that it was the species to which the name was limited in the Fauna Suecica. Then the *R. temporaria* of the Tailless Batrachians may be called *R. muta*, as by Camerano and Bedriaga. Finally, for the *R. agilis* the name *R. dalmatina* may be preferred. In reference to the last, Mr. Boulenger has noted, "the strict law of priority would require the adoption of this name * * *. However, this is one of those cases in which, it appears to me, conservatism is desirable." Mr. Boulenger adds: "Similar considerations have guided me in the naming of the two species of *Bombinator*, and I hope, in the interest of the stability of nomenclature, they will commend themselves to future workers."

But whether we agree with Mr. Boulenger or not in his views as to nomenclature, he certainly has given us a work which well deserves to be recognized as a standard and is alike meritorious for text as well as for illustrations. We may be allowed to hope that a companion volume on the remaining Amphibians of Europe will be published in time. From him who has given so freely, much will be expected.

THEO. GILL.

SKELTON LEAVES.

It has for a long time been known that the best method of skeletonizing leaves is to put them in a still pool containing moss, algæ or other living aquatic plants. In a few months, as a rule, all the softer portions of the leaf will disappear, leaving the vascular system perfectly clean from mesophyll and epidermis. The removal of the soft parts will take place more quickly if the leaves are killed before they are put in