# 刘建康

## 鱼类学和水生生物学文集

COLLECTED WORKS OF LIU JIANKANG ON ICHTHYOLOGY AND HYDROBIOLOGY

中国科学院水生生物研究所
淡水生态学研究中心 编

科学出版社

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北京

## 内 容 简 介

本文集选编了刘建康院士自20世纪30年代以来有关鱼类学和水生生物学研究的部分论著，包括鱼类形态解剖、鱼类发育与繁殖、鱼类生态与分类及其它水生生物学研究等。

本书可供鱼类学、动物学、渔业生物学、水生生物学及淡水生态学等相关领域的研究人员和管理人员、大专院校师生等参考。

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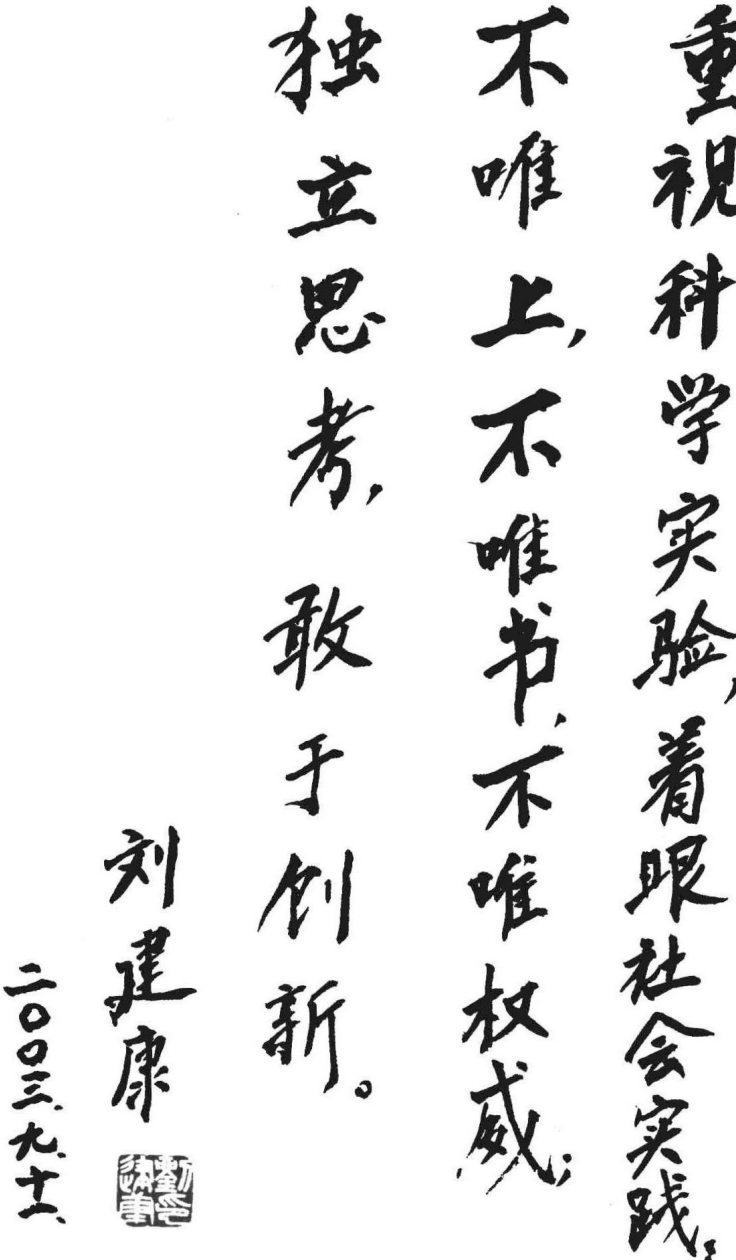
刘建康院士，鱼类学家、生态学家。1917年9月1日生于江苏吴江。1938年毕业于苏州东吴大学生物系，获理学学士学位。1947年获加拿大麦基尔大学哲学博士学位。1980年当选为中国科学院学部委员（院士）。图为刘建康院士青年时期的照片。




刘建康院士治学格言："重视科学实验，着眼社会实践；不唯上，不唯书，不唯权威；独立思考，敢于创新。"

# 目　录

## 鱼　类　学

## 水生生物学

# 鱼 类 学

# DISPOSITION OF THE EFFERENT BRANCHIAL ARTERIES ON THE CIRCULUS CEPHALICUS IN CHINESE FISHES OF CYPRINIDAE[1]

C. K. Liu

In 1899, Ridewood made an interesting research on the relation of the efferent branchial blood-vessels to the "circulus cephalicus" in a series of Teleosts, comprising 61 species belonging to 57 genera. Assuming that the condition found in *Clupea* and *Engraulis*, where the small circulus does not involve more than the first efferent artery of each side, to be the most specialized, he formulated the hypothesis that the specialization had proceeded on two lines: "firstly, by the circulus cephalicus involving the second, and later the third and fourth efferent branchial vessels; and secondly, by the progressive suppression in length of the median aorta, bringing about an approximation of the dorsal or proximal ends of the last three efferent branchial vessels on each side." Another line of specialization, independent of the two former, was the different degrees of specialization regarding this point, he classified the fishes he had examined into four main groups, containing three or four subgroups each. This artificial scheme, though sometimes resulting in the separation of closely related forms and the unnatural assemblage of heterogenous types, as the author himself was aware, nevertheless seems to be of utility for the purpose of subsequent reference. Following the work of Ridewood, Rosen (1912) repeated the observation on 4 Plectognaths, and from which he had reason to think that the specialization had proceeded independently within different groups of Teleostean fishes, and it appeared to him that Ridewood's research was of a phylogenetical value as far as it concerned the arrangement within a group. Dr. Wu (1932), in dealing with the morphological part of Chinese *Heterosomata*, noticed the degrees of specialization of this character classifiable into three main groups among 22 genera pertaining to 5 families. In order to understand more fully about the condition in Chinese Cyprinids, with a view to trace the possible phylogenetic relationship within this small group in the light of this character is the present investigation prosecuted.

This paper deals with the condition in 24 genera of Chinese Cyprinids, among which *Opsariichthys bidens*, *Ochetobius elongata*, *Elopichthys bambusa*, and *Luciobrama macroce-*

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1 原文刊载于 1939. Disposition of the efferent branchial arteries on the circulus cephalicus in Chinese fishes of Cyprinidae. Sinensia, 10: 143～146. 中国鲤科鱼类出鳃动脉在"头圈"上的排列方式。《中央研究院动植物研究所丛刊》第十卷 143～146 页。

*phalus* being the representation of *Leuciscinae*; *Parabramis terminalis*, *Hemiculter dispar*, *Parapelecus argenteus* and *Culter recurviceps*, of *Abramidinae*; *Gobio wolterstorffi*, *Rhinogobio ventralis*, *Fustis vivus* and *Saurogobio dabryi*, of *Gobioninae*; *Spinibarbus sinensis*, *Labeo decorus*, *Ageneiogarra imberbis*, *Percocypris pingi* and *Labeobarbus brevifilis*, of *Barbinae*; *Procypris rabaudi*, *Cyprinus carpio* and *Carassius auratus*, of *Cyprininae*; *Xenocypris argentea*, of *Chondrostominae*; *Acanthorhodeus barbatus*, of *Rhodeinae*; *Aristichthys nobilis*, of *Hypophthalmichthyinae*; and *Schizothorax sp*, of *Schizothoracinae*. Apparently the number of species examined in this study is rather few when compared with the numerous Cyprinids that inhabit our waters, yet it seems that a generalization can be arrived at therefrom not too prematurely.

It is Remarkable to find the monotonous situation of this character which prevails in all the foregoing members, with the only exception of *Saurogobio dabryi*. Invariably the first and second efferent branchial arteries on each side enter the circulus cephalicus separately, and the right and left suprabranchial arteries unite posteriorly to form the median dorsal aorta. The third and fourth ones unite after they emerge from their respective gill arches, then their common stem slopes backward towards the aorta, and opens into the latter a short distance behind the circulus in conjunction with its partner of the opposite side. Thereby a junction is formed immediately in front of the basioccipital process, where the dorsal aorta and the two common stems meet at one point. The coeliaco-mesenteric artery arises independently from the dorsal aorta behind the junction, and has no relation to either the branchial arteries or the circulus cephalicus. This condition, apparently found its position in Ridewood's Group B, Subgroup c, is consistent throughout the Cyprinids examined (except *Saurogobio*), allowing reasonable variations such as a slight decrease in the relative length of the common stem in *Aristichthys nobilis*[2] and of the dorsal aorta in front of the junction in *Gobio wolterstorffi*, which are insignificant and neglegible inasmuch as the general system is essentially not altered. Only *Saurogobio dabryi* exhibits some indication of specialization. The two suprabranchial arteries cease to unite into a common vessel, with the consequence that a median dorsal aorta is not existing anterior to the junction just mentioned. Naturally the circulus cephalicus now extends more posteriorly as compared with the normal type; and it follows that the common stems of the third and fourth pairs of efferent arteries open into the aorta immediately behind the circulus—a state somewhat resembles that of *Saccobranchus* as worked out by Ridewood, which he placed in Group C, Subgroup c. Since this species is approaching *Cobitidae* in certain respects, the writer suspected this type of disposition to be characteristic of or common in the Cobitids. But this presumption is soon disproved by the observation on *Leptobotia*

2 According to Ridewood, *Hypophthalmichthys nobilis* (=*Aristichthys nobilis*) has its third and fourth vessels opened into the aorta together (thus placed in Group B. Subgroup a), whereas the writer finds the common stem still present, though comparatively the shorter. The discrepancy must be attributed to the individual variations within the same species.

*elongata* and *Misgurnus anguillicaudatus*, as both of them, like *Cobitis taenia* in Ridewood's communication, have their efferent branchial arteries arranged after the manner of the normal type. To correlate this variation with *Cobitidae* is evidently a failure.

The writer is thus in a position to state that the disposition of the efferent branchial arteries on the circulus cephalicus in Chinese Cyprinids is at least fairly uniform. Occasionally there may be exceptions which deviate from the normal type, but these variations bear no phylogenetic significance regarding the evolution of the various subfamilies of *Cyprinidae*.

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# ON THE STRUCTURE OF THE "ADHESIVE APPARATUS" OF GLYPTOSTERNUM[3]

H. W. WU & C. K. LIU

*Glyptosternum fokiense* is a fresh-water cat-fish which finds its systematic position in *Sisoridae*. Being found abundant in the swift currents of Fukien, Kwangsi and Szechuan, this fish seems to inhabit only rapid waters, although its distribution in Tungting Lake had also been recorded. Like many of the hill stream fishes, *Glyptosternum* has its under-surface flattened and acquires a bottom habit of life. The generic name is given according to the nature of the thoracic region, where the skin is distinctly marked with some twenty or more longitudinal plaits (Fig.1). Collectively these corrugation on the chest have been known as an "adhesive apparatus" which is supposed to facilitate the fish in clinging itself to substratum. So far as we are aware, the histological nature of it is practically unknown, and it makes the subject to be dealt with in the present article.

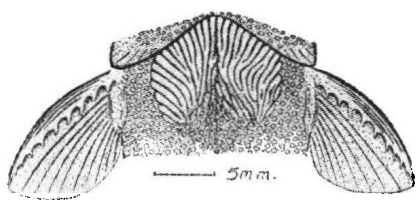


Fig.1 Ventral view of the thoracic region of *Glyptosternum fokiense*, showing the "adhesive apparatus"

The skin in question is fixed in Bouin's fluid. Paraffin sections, 6μ thick, transversal to the skin plaits are stained with Delafield's haematoxylin and eosin; Heidenhain's iron haematoxylin and Mallory's triple connective tissue stain are also used for comparison.

It consists as usual of two layers: epidermis and dermis. They appear to be clearly delimited, especially in the sections treated with the Mallory's, in which the former stained brilliant red and the latter blue. While the free surface representing the "adhesive apparatus" is distinctly marked with ridges and notches in the section, the dermis takes a gently wavy course alone and does not quite follow the outline of the epidermis. We do not consider the dermis as having something particular to do with the apparatus, and accordingly attention will be directed only to the epidermis (Fig.2).

The epidermis of the apparatus is composed of stratified epithelium. Its thickness at the ridged portions measures 72–94μ, at the notched regions, 47–54μ. Nothing like stratum granulosum or lucidum can be distinguished; the stratum germinativum passes directly to the single

3 原文刊载于 1940. On the structure of the "adhesive apparatus" of *Glyptosternum*. Sinensia, 11: 69～75. 文胸鱼吸着器的结构。

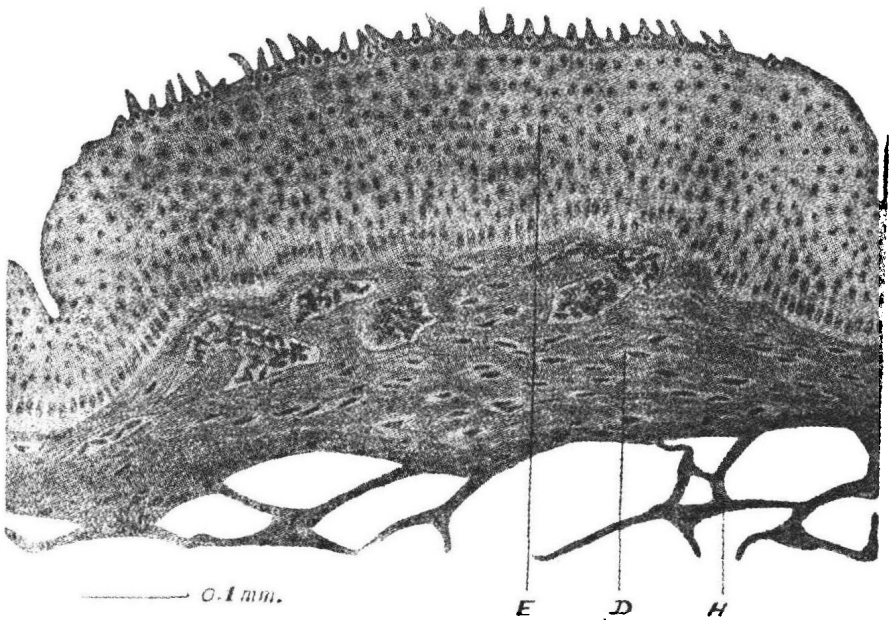


Fig.2 Cross section of a ridged portion of the "adhesive apparatus", cut transversally to the skin plaits. E, epidermis; D, dermis; H, hypodermis.

superficial layer of cells, which may be designated as the stratum corneum.

Thus the stratum germinativum constitutes the most parts of the epidermis. It consists of 8 to 10 cell layers. The deepest layer of which is composed of elongated pyramidal cells of about 20μ long and 3.6μ wide. In the center of each cell stands a nucleus, which is about 9μ in length but attains nearly the same width as the cell. It is bounded by a definite nuclear membrane, and is rich in nucleo-reticulum. The nucleolus, however minute, being only 1.5μ in diameter, is still distinguishable. Within this cell layer the nuclei range pretty evenly in a row (Fig.3, B). This basal layer is overlapped by 3 to 4 layers of elongated, spindle-shaped cells, which are so densely arranged that they are mutually interdigitating, and their nuclei come to lie at different levels, These cells do not differ much from the cells of the basal layer, except that their lengths reduced more and more as they pass from layer to layer upward, with their nuclei likewise shortened to proportion (Fig.3, L). Passing still further to the surface, the cells become irregularly polyhedral in shape, small at first, but larger in the succeeding layers. Some 4 to 5 layers of such cells are present immediately beneath the stratum corneum; those cells of the top layer measure about 15μ in length, 9μ in width. Within this zone, cells are separated from each other by intercellular spaces, which in turn are traversed by well-developed intercellular bridges (Fig.3, I). The nuclei of these cells are ovoid or spherical in shape, around 7μ in diameter. Nuclear membrane and nucleo-reticulum still persist in them (Fig.3, P). The nucleoli are only slightly the larger as compared with those of the deeper layers, about 1.8−2μ in diameter, but they show more affinity to the stain.

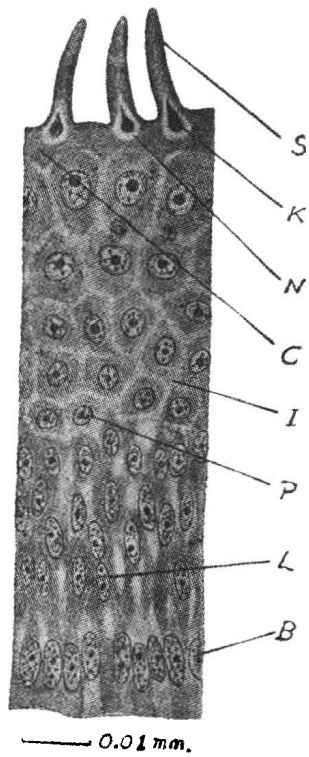


Fig.3 Epidermis of the "adhesive apparatus". B, nucleus of cell in basal layer of the stratum germinativum; C, cell of the stratum corneum; I, intercellular bridge between the polyhedral cells; K, karyosome of the cell in the stratum corneum; L, nucleus of the elongated cell of the stratum germinativum; N, space representing the position formerly occupied by the nucleus in the cell of the stratum corneum; P, nucleus of the polyhedral cell of the stratum germinativum; S, spinule of the cell of the stratum corneum.

It should be noted that the stratum germinativum occurred in the"adhesive apparatus" contains few goblet cells, which present in profusion in the skin taken from regions other than the apparatus.

While the foregoing layers show but little particularities of the apparatus, the stratum corneum is competent to characterize this structure. This stratum has only one single layer of cells. Owing to the disappearance of the intercellular spaces here, the boundaries of the cells, expect the free surface, are more or less in obscurity. Cells of this layer are in close contact with each other and with the cells below, having about half the length of, and the same width as the latter (Fig.3, C). Typical scale-like cells are wanting, and even the moderately flattened cells have been restricted along the margin of the notches. The distinctive feature of this layer is that the free surface of its cells is fused, thickened and keratinized, taking up acid fuchsin as well as hematoxylins. That practically every cell at the ridged portion bears a spinule, which is about 12−18μ long and 2.7−3.6μ wide at its base, seems to be of interest (Fig.3, S). Closer examination reveals that the protoplasm of this layer is dense relatively to the layer beneath. The spinule, stained same as the free border, is found to be a direct protrusion of the latter and is really a modified part of the cell wall. It is a blind tube filled with cytoplasm, and into its basal region extend a transparent pear-shaped space and an acute-oval structure. Both the space and the structure above mentioned seem to have their original site within the main cell body, approaching the free border, but later acquire an upright extension into the spinule. The clear space (Fig.3, N), which always refused to stain, represents in all probability the position formerly occupied by the nucleus. We allow ourselves to infer that the nucleus loses its membrane and reticulum when it enters the spinule. The acute-oval structure takes exactly the same stain as the free border, and is so deeply tinged that it always remains a prominent figure inside the vacant nucleus, with its tip

within the spinule and its round basal portion below (Fig.3, K). From its relative location it should be a nucleolus, but its enormous size, about 2.5–3.5μ in diameter of the basal portion and reaching one-third the length of the spinule, somewhat renders this designation less convincing. In explanation to this we remark that the nucleoli have increased both in size and staining capacity as they pass to the surface layers in the stratum germinativum; thus their aggrandizement is already working there, but reaches its maximum in the stratum corneum; and afterwards they elongate and push their way right up into the spinules. Less probably would be that this structure is formed by the localization and consolidation of the nucleo-reticulum, which ultimately accretes to the nucleolus and masks its distinction there. We are not at present in possession of a definite idea concerning the real nature of this structure, but it is our belief that whatever this structure may be, it seems to be intimately correlated with the cornification of the stratum corneum.

Cornification of epidermis is comparatively rare in fishes. Organs associated with cornified epithelium may be referred first to the "teeth" of *Cyclostomata*, in which the epidermis is cornified and invests the axial dermal papillae (Beard, 1888, 1889). The "contact organ" found on scales or fins of some *Poeciliidae* (spawning males only) possesses a dermal core, which is covered with somewhat cornified epidermis (Newman, 1097, 1909). Brief remarks should be made upon various structures which are purely epidermal in origin and formed through cornification. The"pearl organ" of *Cyprinidae* is a small tubercle formed by the cornification of the many-layered stratum corneum over a group of swollen cells of the Malpighian layer (Kimura & Tao, 1937). The "Deckplatte" in *Petromyzon* is a striated cuticular structure formed by the hardening of superficial protoplasm of the cells of the stratum corneum (Studnicka, 1897). In the adhesive disk of *Lepadogaster* the epidermis gives rise to a thick, non-cellular, cuticular plate upon its free surface (Guitel, 1888). The deciduous lips of *Parabramis* and many other *Cyprinidae* are consisting of dead cornified cells of the horny layer of the skin (Wu & Wang, 1932). It appears that none of them agrees with the present "adhesive apparatus" in the spinule formation.

Then we turn to the function of the present structure. It seems to be less adhesive than protective. Evidence from the deficiency of the goblet cells apart from the cornification and spinule-formation of the free border of the epidermis had led us to believe so. The chest of this fish is liable to subject to friction when it perches, as it used to be, on rocks or stones, and there is much need of a structure to protect this scaleless region against mechanical influence. We would admit that the spinules might act as numerous small pegs to help the fish resting more steadily upon the substratum under swift currents, but that this apparatus cannot subjectively effect an adhesion, as performed by the mouth of *Cyclostomata*, sucking disk of *Lepodogaster*, paired fins of *Sinogastromyzon*, and ventral fins of *Gobius* seems beyond all doubt.