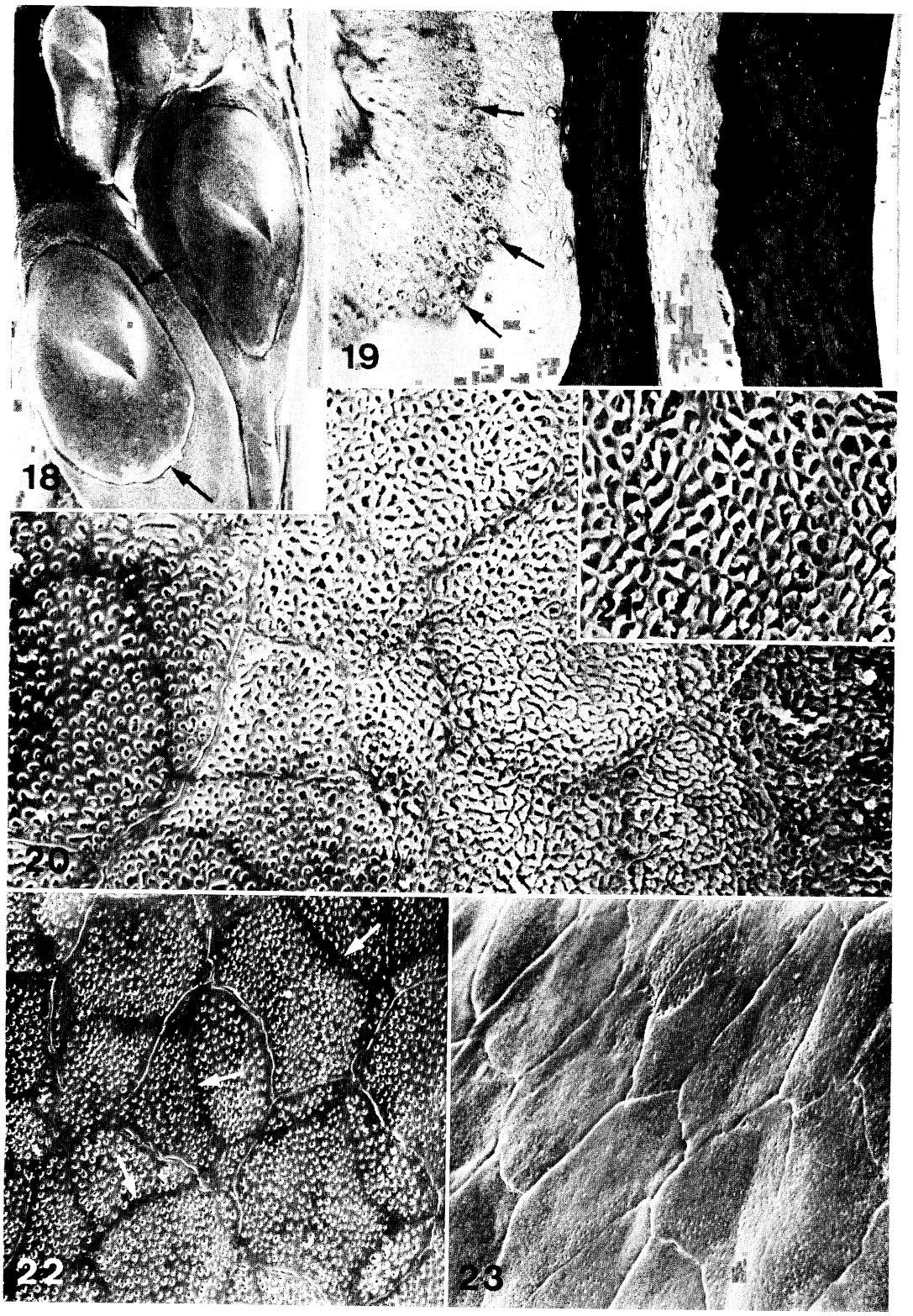
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apexes and increase the thickness of the keratinous layers with maturation, as have been described in *P. marinus* (Manion and Piavis, 1977). While the number of the keratinous layer in each tooth of the arctic lamprey is two, that of the latter species is three (Trott and Lucow, 1964; Manion and Piavis, 1977).

Histochemical investigation of the teeth of *P. marinus* shows that an increase in the degree of cornification is demonstrable from the young tertiary cap (cone) to the functioning primary cap (Sognnaes and Lustig, 1955). On the other hand, Trott and Lucow (1964) reported for the same species that the performic acid Schiff reaction for keratin stains three caps with equal intensity. Similarly, two cones of the arctic lamprey showed the same stainability by routine stainings such as azan trichrome.

With regard to dietary habits in several mammalian, avian, reptilian, and amphibian species that lack toothed jaws, some form of compensation such as keratinized spines takes place in the digestive system (Doran and Baggett, 1972 in *Tachyglossus aculeatus*; Krause and Leeson, 1974a in *Manis pentadactila*; Doran, 1975 in *Tachyglossus aculeatus* and *Tarsipes spenserae*; Krause and Leeson, 1974b in *Tachyglossus aculeatus* and *Ornithorhynchus anatinus*; Yoshie and Honma, 1976 in *Lepidochelys olivacea*; Altig, 1973 in several species of larval amphibians). In the case of lamprey, the teeth in keratinized nature, that is the same as that of the species mentioned above, seem to be highly specialized in histological structures. That is, the teeth consist of two or three keratinous cones, one upon the other, each of which being separated by the reticular layers of stellate cells. Moreover, there exists

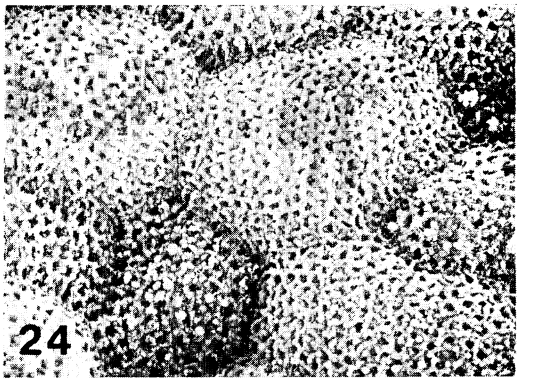

Fig. 24. The surface of the oral mucosa showing the swelling of epithelial cells equipped only with network-like microridges in the stage of prespawning adult. ×3500.

a marked rolling of the mucous membrane at the periphery of the primary horny tooth as it ends in oral mucosa (Sognnaes and Lustig, 1955; Trott and Lucow, 1964).

In the process of epithelial cornification, Takagi (1977) has mentioned that the microridges of the outermost cells transform into microrecesses (micropits) and then disappear with the progress of the degree of cornification. The surface of the primary cornified layer of the present lamprey is equipped with microridges, as seen in the surface of the keratinized esophageal spines of the Pacific ridley turtle (Yoshie and Honma, 1976), in addition to microrecesses. Therefore, the degree of cornification may be more advanced at the pointed terminal region than at the basal region.

Recently, an adult sea lamprey, *P. marinus*, which had completed dentition without cornification was reported (Manion and Hanson, 1977). Since the teeth of the abnormal

Figs. 18~23. Details of the teeth and nearby structure in the stage of prespawning adult. Fig. 18. A low-power SEM photograph of teeth. The tip of each tooth is sharp and curves toward the throat. Note the groove (arrows) between the tooth and the oral mucosa. ×30. Fig. 19. The sagittal section of a part of tooth. Note that the primary cornified layer is thicker than the secondary. Accumulation of keratin granules (arrows) is visible in the prekeratinous zone. Azan stain. ×250. Fig. 20. Surface of a transitional area from the basal part to the middle part of a tooth. The network-like microridges at the basal part undergo small recesses at the middle part. ×4000. Fig. 21. A high-power view of the basal microridges showing network structure. ×5000. Fig. 22. The middle part of a tooth. Note that the microridges are entirely replaced with small recesses. The flat bands (arrows) are replication of the cell border in the basal most stellate cells that have covered the cornified layer. ×2500. Fig. 23. The tip of a tooth. Each keratinized cell is flattened and retains only a small number of minute recesses. ×2500.

specimen consists of evaginations of the oral epithelium lacking keratinous layers, they speculate that the lamprey attaches itself to fish by suction alone and feeds by releasing lamphredin (Baxter, 1956; Manion and Hanson, 1977).

In *L. japonica*, as have been observed in *P. marinus* (Manion and Stauffer, 1970), the oral cirri in the ammocoete stage differentiate into branched papillae and further into truncated ones during early metamorphosis. This transformation may be attributed to hyperplasia of the epithelium, degeneration of superficial epithelial cells and/or reconstruction of the subepithelial connective tissue. In conjunction with the transformation mentioned above, the microvilli covering the oral mucosa converts into microridges in a labyrinthine pattern and finally into network-like microridges. It is clear that the free surface of the stratified squamous epithelial cells subjected to considerable abrasive abuse builds up characteristic ridge-like folds named microridges or microplicae (Lanzing and Higginbotham, 1974; Schliwa, 1975; Andrews, 1976; Takagi, 1977; Hunter and Nayudu, 1978).

Although demonstrative explanations of microridge formation are very few, the results obtained in this study reveal that the microridges are formed by the fusion among neighboring microvilli as was observed in the developing tonsilar epithelium of rabbit (Saito and Takagi, 1976).

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変態に伴うカワヤツメの口腔粘膜の走査電子顕微鏡的観察，とくに角質歯の形成について

吉江紀夫・本間義治

ヤツメウナギ類の角質歯の発生を微細構造的に解明する目的で，カワヤツメの変態前後の幼生と成体を用い，主に走査電顕により検索した．幼生の口腔内面は，樹状に分枝した多数の総状突起からなり，これら突起の表面は一面に短い微絨毛と少数の線毛束により被われている．総状突起は，変態に伴い数が減少し，先端がまるみをもつ円錐形の突起となる．これと平行して，口腔粘膜表面の微絨毛は，渦巻状から網目状の微小堤に変化する．角質歯の発生と萌出は，大眼期末期におこり，その表面は，成体同様に微小堤や小孔をそなえている．他の脊椎動物の消化器系にみられる角質化した突起と比較すると，ヤツメウナギの角質歯は構造上高度に特殊化したものと考えられる．

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