Nerves and Muscles Regulating Feather Follicle Movements in the Chicken[1]

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Summary. It was found that most feather follicles possess more than a single muscle system but only single nerve endings were observed in a feather follicle. It seems that muscles exist which antagonize each other. Anastomoses of nerves orginating from different sources and flowing of mixed nerves into the feather follicle could explain the antagonistic action of the muscles on the feather follicle.

In birds, some evidence exists that both parts of the autonomic nervous system influence feather follicle, since both sympathomimetics and parasympathomimetics affected feather follicles[4–6]. Moreover, a direct influence of the central nervous system on feather follicles also seems to exist, since anaesthesia[7,8], spinal cord transection[9] and state of feeding[10] affect feather follicles. Muscles which connect between feather follicles and the possibility of multiple muscle connections of follicles have been reported[11]. The present study was undertaken in order to define the nerves and muscles which control feather follicle movements.

Methods. For whole mount preparations, pieces of skin were removed from different areas of white Leghorn chickens, anaesthetized with sodium pentobarbital (30 mg/kg). These were stretched and fixed across 2 cm diameter glass tubes. After clipping of feathers to skin level, and punching small drain holes into the skins, the tubes were submerged into fixatives and stain solutions. Muscles[11], nerves[12,13] and blood vessels[14] were stained specifically or differentially[14]. Following staining, careful dissection of fat tissue was performed and, if necessary (to allow enough light to penetrate through the preparation), some of the stratum corneum of the epidermis was removed. The preparations were kept and photographed floating in benzylaldehyde solution.

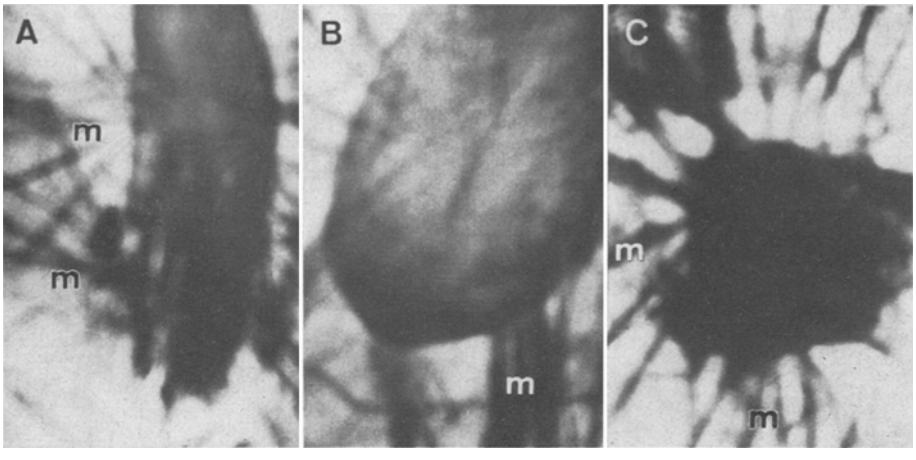

Fig. 1. Multi-directional muscles connected to feather follicle, in whole mount preparations. A) Two groups of radiating muscles, at different levels, are seen on the left side. B) Tip of feather follicle with muscles connected at various points. C) Cross section showing radiating muscles in all directions.

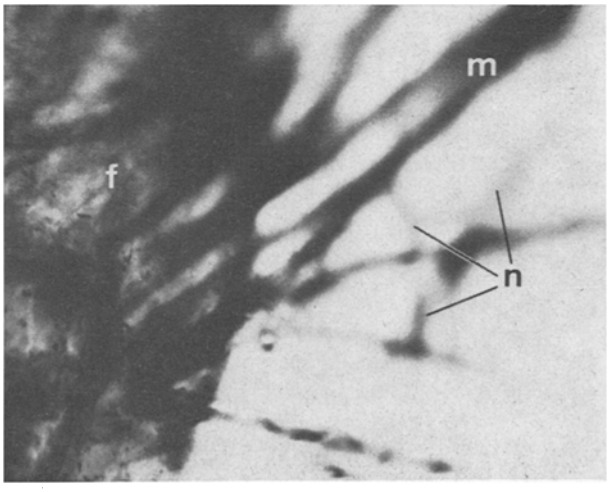

Fig. 2. Whole mount preparations showing nerves (n) entering into muscles (m) connected to follicle wall (f).

Sections (10 μm thick) of fresh skin, soaked in 30% sucrose solution, were prepared on a Sloe cryostat. The sections were affixed on slides by formaldehyde fumes, triple stained according to MALLORY[15] and mounted in aquamount.

Results and discussion. Chicken skin, being relatively thin, allows light to pass through and enables examination of details. On the other hand, different levels are observed at the same time, which makes the homogeneous focusing for photography difficult.

Figure 1 shows feather follicles and muscles originating from different sides of the follicle. One may see that a feather follicle is capable of being pulled in various directions and even make rotational movements, since muscles radiate in all directions, in 3 dimensions.

With the aid of ink injected into the blood stream of the chicken, the differentiation of nerves from blood vessels[11] was performed. Figure 2 shows nerve entering into muscles connected to a feather follicle. The ending of

a nerve fibre in a muscle fibre is seen in Figure 3, in a histological section.

In recent experiments[16], antagonistic nerve activity on feather follicle was described. In serial sections, never more than a single nerve was found to enter into the muscles of a feather follicle. On the other hand, when the intercostal nerves are observed in the whole mount preparation, their branches directed to the skin flow one into the other and appear to anastomose. Thus, each nerve which ends in feather follicle carries fibres from different source and may cause different effects at the same time. This finding can explain the fact that a wide range of factors influence the feather follicle and feather-skin connection. Among these factors are some which act by local application, such as temperature[17,18] and scalding agents[19]. On the other hand, some drugs act especially when applied parenterally, such as anaesthetics[4,6–8], sympathomimetics[4,5] and parasympathomimetics[16].

The specific action on the different nerve endings and the various muscles needs physiological-pharmacological investigation.

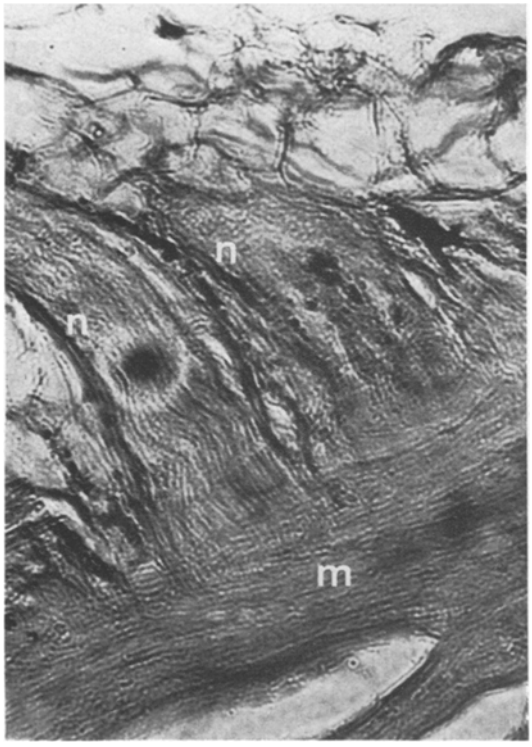

Fig. 3. Section showing the ending of a nerve fibre (n) in a muscle fibre (m) of feather follicle.

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DNA-Mediated Transformation in the Platyfish-Swordtail Melanoma System

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Summary. A genetic marker, the tumor gene *Tu*, which causes the formation of abnormal melanophores, the T-melanophores, in the skin of Xiphophorine fish has been transferred by donor DNA from a *Tu* genotype to recipient embryos lacking *Tu*. Abnormal melanophores which are identical to the T-melanophores of the donor genotype occurred only in recipients treated with *Tu*-DNA and not in those treated with *Tu*-free control DNA.

Genetic transformation – that is, the transfer of a genetic marker from a donor to a recipient organism by DNA and the phenotypic expression of this marker in the recipient – was first achieved in bacteria by Avery, MacLeod, and McCarty in 1944[3]. During the last two decades, numerous researchers have tried to show genetic transformation also in eukaryotic organisms[4]. Some researchers claimed to have succeeded[4,5], but the results they obtained may be open to some other interpretations than genetic transformation[6]. Most of the experiments suffered from the non-availability of a good genetic marker and a sensitive selective system. Both of these conditions are available in the platyfish-swordtail melanoma system[7].

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