TRANSFER OF PREMELANOSOMES INTO THE KERATINIZING CELLS OF ALBINO HAIR FOLLICLE

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INTRODUCTION

Pigmentation of hair is determined largely by the type and quantity of melanin granules[1] in the keratinized cells of the emerging hair. The synthesis of pigment takes place in melanocytes and subsequently the melanin granules are transferred into the differentiating medullary and cortical cells of the hair. A number of genes affect hair color in mammals by controlling both the synthesis and transfer of pigment.

Investigations of the melanocytes of the hair follicle with the electron microscope have demonstrated that the formation and structure of pigment granules differ according to the genotype of the animal (1, 2, 6, 8). In all pigmented genotypes, the synthesis of pigment granules begins with the production of a premelanosome which is a matrix

[1] The terminology used in this report is the one adopted by the 5th International Congress of Pigment Cell Biology held at the New York Academy of Sciences in 1961.

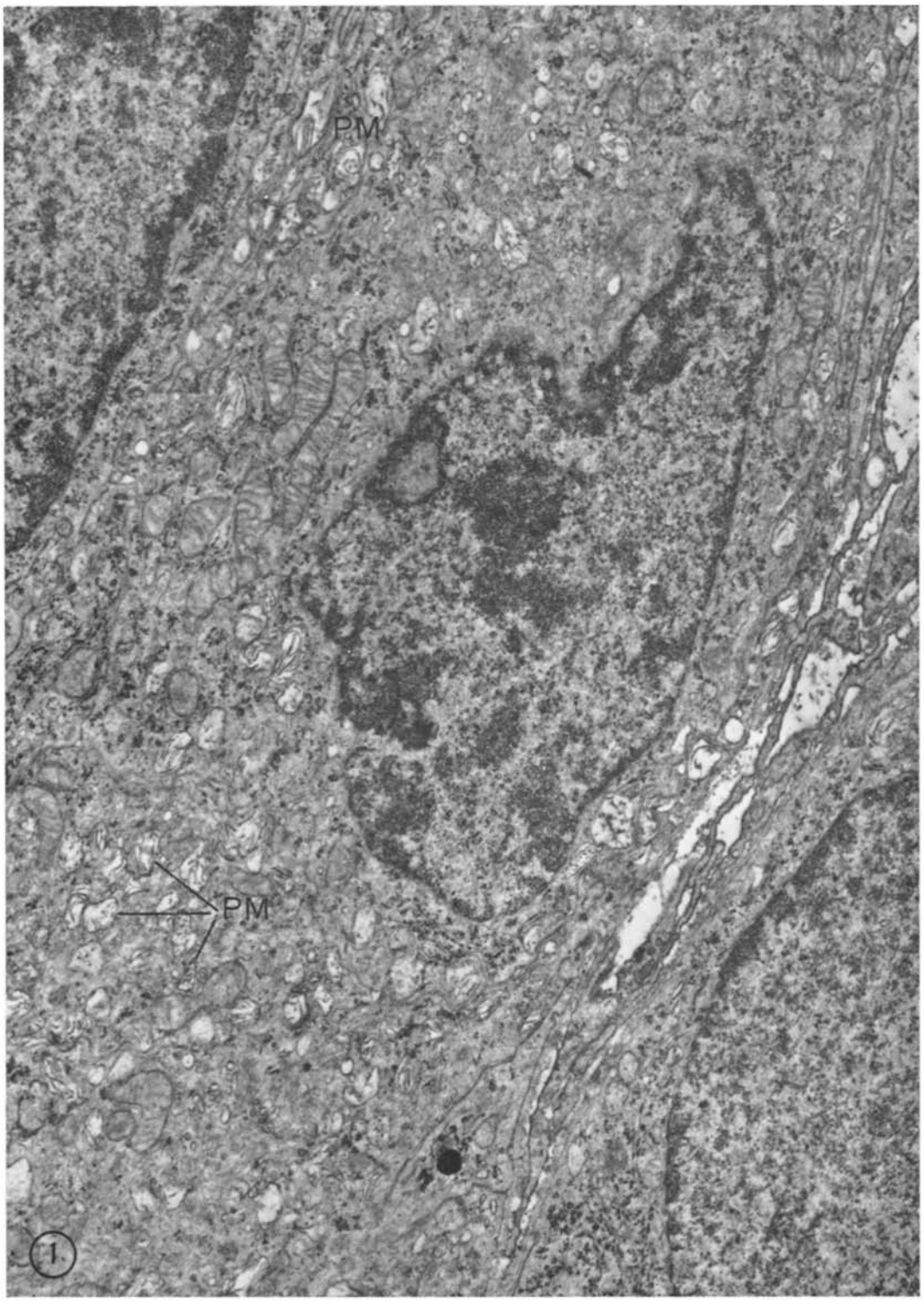

FIGURE 1 The major part of the electron micrograph shows a portion of an albino melanocyte. At the upper left and lower right corners, portions of keratinizing cells are seen. Numerous premelanosomes (*PM*), membrane-bounded and containing a fibrous matrix, are seen throughout the cytoplasm. × 19,000.

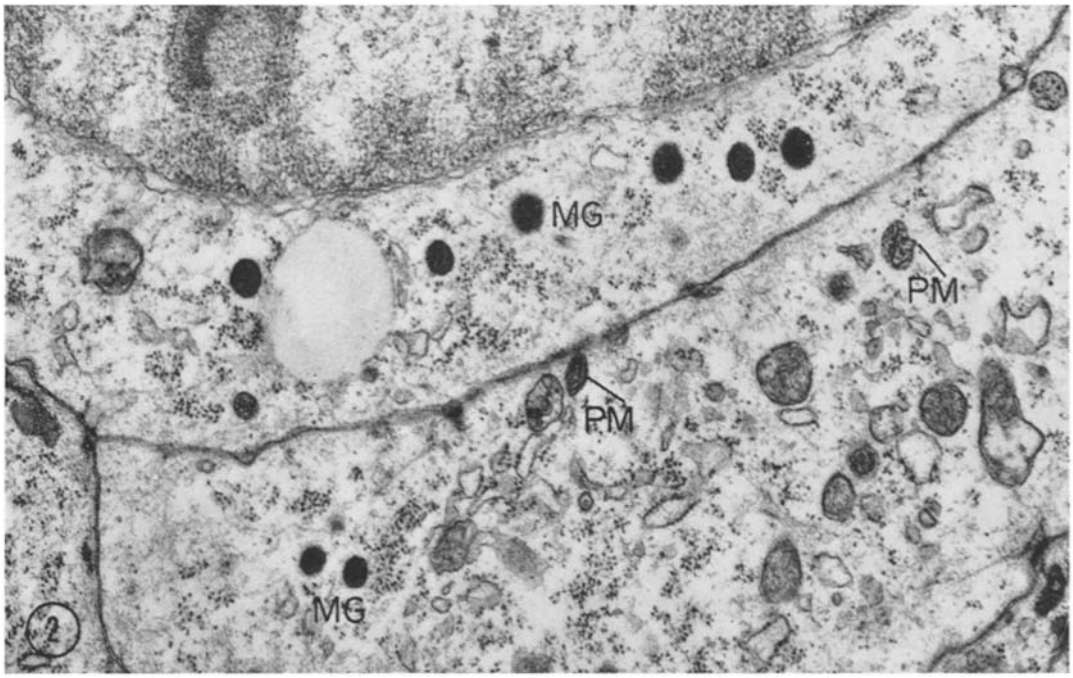

FIGURE 2 Portions of medullary cells showing premelanosomes (*PM*) which are membrane-bounded and contain an irregular, coiled fibrous matrix. The dense spherical granules (*MG*) are the differentiating products of the medullary cells. × 20,000.

of fibrous elements surrounded by a membrane. Subsequently, melanin polymer is deposited on the fibers, masking them to varying degrees. When the melanization of the fibrous matrix is complete, it is designated a melanin granule (10). The mature melanin granules are transferred from the melanocyte into the medullary and cortical cells of the hair follicle.

In the albino genotype, premelanosomes are formed but remain nonmelanized (1, 2) because of the blockage in the synthesis of melanin polymer (3). It is uncertain, however, whether the premelanosomes in the albino animals are transferred into the cells of the hair follicle (1, 2).

This report gives evidence that premelanosomes are transferred from menalocytes into differentiating cells of the hair follicle of the albino mouse.

MATERIALS AND METHODS

Small pieces of back skin from adult albino mice (40 days old) were immersed in ice cold 1% osmium tetroxide buffered to pH 7.4–7.6 with either veronal-acetate or phosphate (5, 7). After the tissues were fixed for 2 hr, they were dehydrated in and ascening series of ethanols and embedded in epoxy resins (4). Thin sections were doubly stained in uranyl acetate and lead citrate (9) and examined in an RCA EMU electron microscope.

RESULTS AND DISCUSSION

The melanocytes in the albino hair follicle cap the upper part of the dermal papilla. Premelanosomes, the most distinguishing product of these cells, are distributed randomly throughout the cytoplasm. These membrane-bounded, ovoid granules range in size from 0.2 to 0.5 μ and consist of fibrous elements which are either folded irregularly or arranged parallel to each other. In favorable sections, the fibers appear striated (Fig. 1).

Premelanosomes, identical to those seen in the melanocytes, occur in the differentiating cells of the hair follicle (Figs. 2–4). The differentiating medullary and cortical cells of the hair can be recognized by the presence of dense spherical medullary granules in the former and filament bundles in the latter (Figs. 2–4).

Since the premelanosomes are identical in both the melanocytes and the differentiating cells of the hair, and since premelanosomes are synthesized only in the melanocytes, it is inferred that these

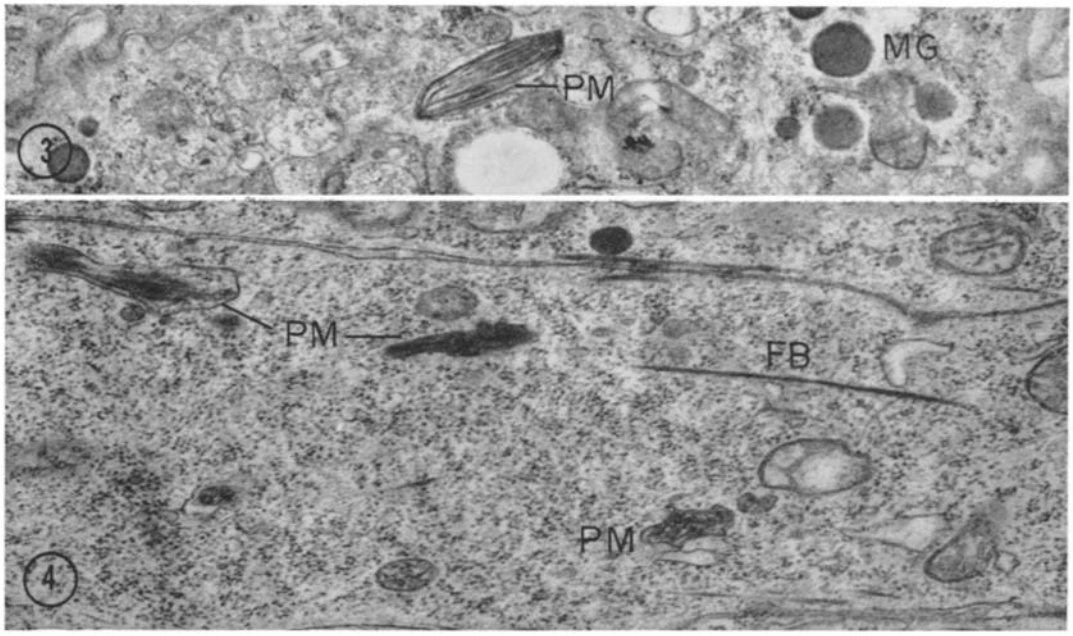

FIG. 3 Electron micrograph showing a premelanosome (*PM*) in which the fibers of the matrix are arranged parallel to each other. Dense bodies (*MG*) are the medullary granules. × 29,000.

FIGURE 4 Electron micrograph showing three premelanosomes (*PM*) in a cortical cell. The bundles of filaments (*FB*) are characteristic products of cortical cells. × 35,000.

granules are transferred into the cells of the hair follicle. Similar inferences related to the transfer of melanin granules into keratinizing cells of the hair and epidermis of animals with colored fur have been made from light and electron microscopic studies (12). The premelanosomes of the albino animals are nonmelanized and hence it is impossible to demonstrate them by light microscopy, but their characteristic fine structure allows their positive identification with the electron microscope.

There are different views concerning the mechanism of transfer of pigment granules into epithelial cells (11). According to one, the melanin granules are actively inoculated into the recipient cells by the dendritic processes of melanocytes. According to another view, the transfer is effected by phagocytosis of melanin granules by the epithelial cells. If additional membranes were seen around the premelanosomes, they would provide *prima facie* evidence for transfer by phagocytosis, but in the present study no such membranes were observed. Nor is there any convincing evidence for the other mode of transfer.

In the albino, even though the synthesis of "pigment" granules stops at the premelanosome stage, it is evident from the present study that there is no defect in the mechanism of transfer of premelanosomes into recipient cells.

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