PIGMENTATION IN THE REPRODUCTIVE SYSTEM IN PHEASANTS

R. J. Greb
South Dakota State University
Brookings, South Dakota

In studies on the effect of irradiation on pheasant ovaries (1-2), it has been noted that considerable variation exists in the concentration of pigment cell deposits around the various follicles. The gross appearance of ovaries shows that some are intensely pigmented, while some are very pale. Still others may show a portion of the ovarian area pigmented and other portions nonpigmented, producing a mosaic appearance for the ovary.

On microscopic examination of such ovaries, it is to be noted that the highly pigmented ovaries show a dense concentration of large melanocytes surrounding all the follicles. Such melanocytes are lodged in the stroma of the follicle, usually just outside the two thecal strata (Figure 1). Nonpigmented ovaries show an absence of such melanocytes in the stroma surrounding the follicles (Figure 2).

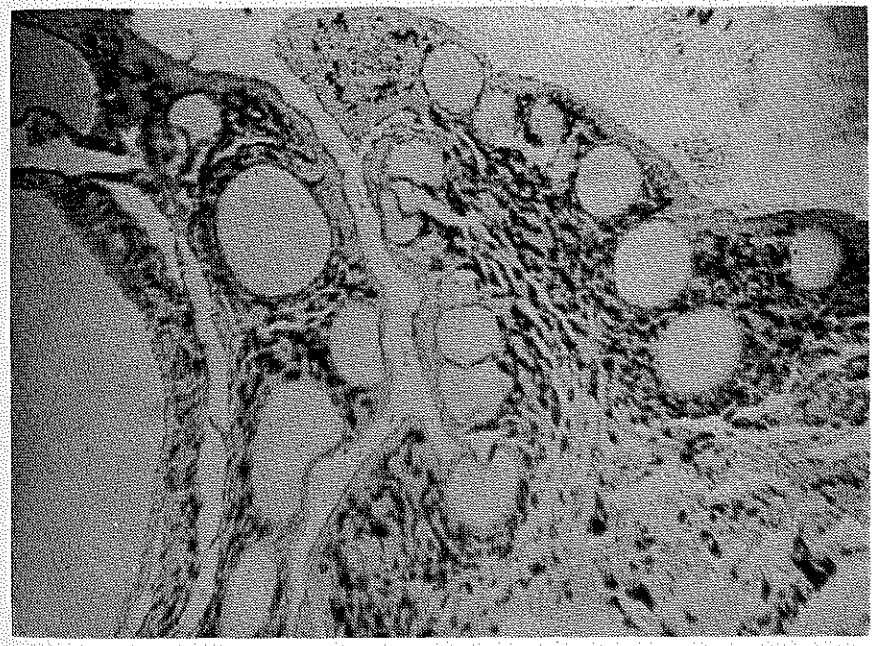

Figure 1. Section of pheasant ovary showing heavy concentration of melanocytes.

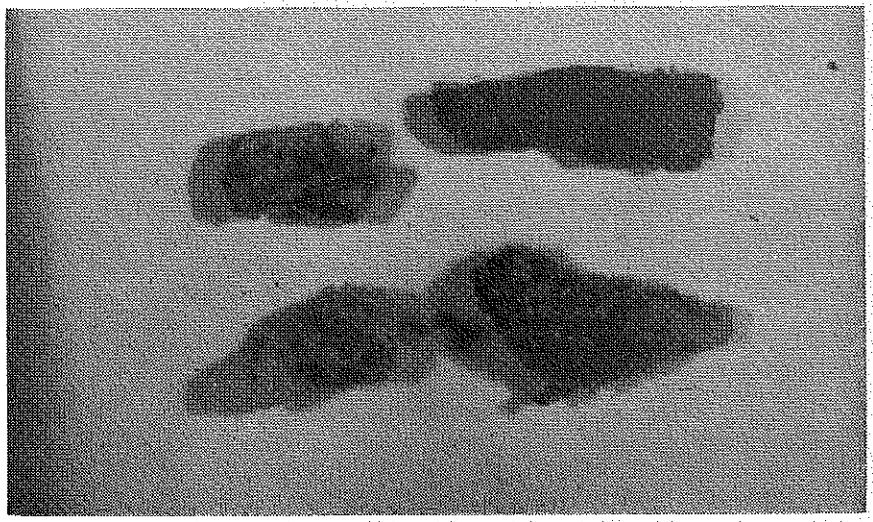

Figure 2. Pheasant ovaries showing pigmented and nonpigmented follicles.

Some of the slightly pigmented ovaries show melanocytes sparsely scattered through the stroma.

Older follicles with large oöcytes from such highly pigmented ovaries usually exhibit flat stroma cells with few or no melanocytes. It appears as though, as the oögonia increase in size, fewer and fewer melanocytes remain surrounding the follicles until in the final stages of growth, most of the melanocytes seem to have been "lost." At this point it is assumed that much of the yolk accumulation found in the late oöcyte comes from the cytoplasm of the surrounding cells. Included would be the components of the melanocytes. Particles of various sizes may be diffused from the surrounding cells into the construction of the yolk mass. According to Marza and Marza (3), the permeability of the follicle seems to change with time so that at the second phase amino acids and certain proteins are diffused into the yolk system. It is further noted that somewhat the same condition with respect to testicular mosaicism can be observed. Pheasant testes, may exhibit heavy concentrations of melanocytes among their interstitial cells and in their stroma, while other testes have sparsely scattered melanocytes, while still others may lack melanocytes entirely. A further study will have to be made with more intermediate stages to support this assumption. Any one ovary will have, during spring and early summer, many follicles with oögonia at different levels of development. It is now assumed that the follicular melanocytes are no doubt reduced to enzymes (diffusible materials) and are absorbed by the yolk-cytoplasm of the oögonium.

When adult plumage colors are examined, a very high correlation seems to exist between the dark plumage pattern of the animal and melanocytic concentrations in the ovaries. In a similar manner, animals with light plumage patterns show an absence of, or at best, a low level of melanocyte concentration surrounding their oöcytes.

Examination of the gonoduct system of pheasants further supports the premise that the mosaicism extends even beyond the ovary (Figure 3). Examination of large numbers of oviducts has shown that many display heavy concentration of melanocytes, some are moderately pigmented and other show practically no pigment. The coloration of the egg shell is here involved but that is another research project. Evidence here indicates that, since melanocytes do occur in large concentrations in the tissues surrounding a young follicle and seem to be essentially absent around the older follicles —in some ovaries, the melanin of the melanocytes and/or some vital components of them, perhaps in the form of some enzymes, are likely to be found transmitted directly to the yolk of the growing oöcytes (5). It should be possible to identify some of the same types of melanins, melanin components or precursors in the yolk-cytoplasm as occur in the melanocytes of the stroma. Studies on pigment granules (melanins) have been conducted by many workers according to Silvers (6). Pigments in such forms as the fishes, amphibia, reptiles, and aves have been analyzed.

Tests on the nature of eumelanin or brown granules and pheo-

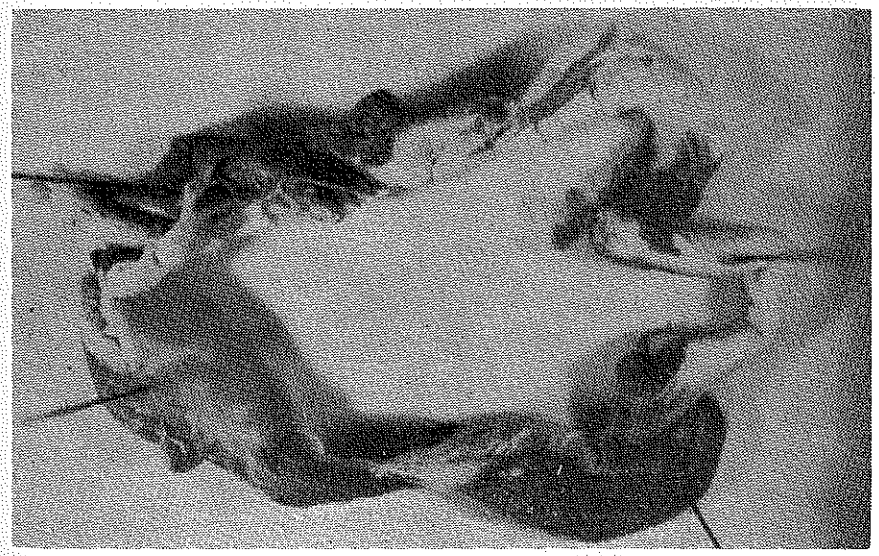

Figure 3. Oviduct of pheasant showing the mosaic nature of the pigmentation.

melanin or yellowish granules, have shown (7) that although there seem to be many variants in the hues of colors, the black and brown granules of these two are basic.

According to Fitzpatrick, et. al. (8) eumelanin is formed by the coupling of a quinonoid polymer, indole-5, 6,-quinone, with protein. The polymerization and coupling occur on the surface of the subcellular cytoplasmic granule - the anlage of the mature pigment granule. The quinonoid polymer is derived from the aminoacid tyrosine, by a chemical reaction catalyzed by the copper-containing enzyme tyrosinase, which is attached to the granule. Tyrosine seems also to be involved in the synthesis of pheomelanin.

The experiments of Clemo, Duxbury and Swan (9) with tyrosine and dopa labeled in the carboxyl group have shown that about one-sixth of the carboxyl groups of tyrosine and dopa are incorporated into melanin formed from them by enzymatic oxidation.

Studies by Thompson (10), Nicolaus and his co-workers (11), Cromartie and Mason (12), all seem to point to the fact that the melanins can be broken down into components or precursors of a nature that could be absorbed by the yolk of the follicle.

In genetic tests, individuals from oögonia from deeply pigmented ovaries would be expected to reflect the intensity of the melanin deposits in the coloring of the plumage, the iris, and some of the internal organs such as the ovary, testes, and/or others. Incomplete evidence bears this out.

It would also be expected that follicles with limited or no melanocytes would give rise to öocytes carrying few or none of the melanocytes' components found in heavily melanocyte infested follicles.

BIBLIOGRAPHY

1. Greb, Raymond J. 1955. Lethal X-ray Dose in Pheasants. Proceedings South Dakota Academy of Science, XXXIV:104.
2. Greb, Raymond J., and Walter C. Morgan. 1961. Treatment of Pheasant Ovaries with X-rays and Gamma Rays. Proceedings South Dakota Academy of Science, XL:112-118.
3. Marza, V. D., and E. Marza. 1935. Quarterly Journal Microscopic Science, 78:134-189.
4. Wilde, C. E. Jr. 1959. Cell Organism and Milleu. 17th Growth Symposium. D. Rudnick, ed. Ronald Press, New York.
5. Romanoff, Alexis L., and Anastasia J. Romanoff. 1949. The Avian Egg. John Wiley and Sons.
6. Silvers, Willys K. 1961. Genes and Pigment Cells of Mammals. Science, Vol. 134, No. 3476.
7. Russel, E. S. 1946, 1948, 1949, 1949. Genetics, 31; Genetics, 33; Genetics 34; and Genetics 34.

8. Fitzpatrick, T. B., A. Brunnet, and A. Kukita. 1958. The Biology of Hair Growth. Academic Press, New York.
9. Clemo, G. R., F. K. Duxbury, and G. A. Swan. 1952. Formation of Tyrosine Melanin. The Use of Carboxyl-labeled Tyrosine and Dihydroxyphenylalanine in Melanin Formation. Journal of the Chemical Society. Part 3, P. 3464.
10. Thompson, R. H. 1962. Melanins - Comparative Biochemistry. Vol. III, Part A, Chap. 13, pp. 727-753.
11. Nicolaus, R. A. 1955. Gazella chimical italien. 85, 659.
12. Cromartie, R. I. T., and J. Harley-Mason. 1957. Melanin and Its Precursors. Biochemical Journal. Vol. 66, August, p. 713.