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THE SHELL PIGMENT OF GOLDEN EAGLE EGGS

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The purpose of this note is to characterize the nature of the external pigmentation of the egg of the Golden Eagle (*Aquila chrysaëtos*), based upon our examination of the 16 eggs laid in our home by one of our normal, healthy Golden Eagles. The process of emergence from the cloaca was closely observed in five of these cases. Twice the egg was laid directly into the hand. The producer of the eggs has been isolated from sight and sound of other birds of prey throughout her conscious life. The eggs were laid between November 1964 and April 1971. They appeared normal both internally and externally and exhibited the full range of variability in color characteristic of the species as described by Bent (1961), Reed (1965), Godfrey (1966), and Brown and Amadon (1968).

The 1st, 10th, and 15th eggs were white and unmarked as a small percentage of Golden Eagle eggs normally are (Bent 1961). The shells of eggs 2–9, 11–14, and 16 were superficially splashed with blotches of color more brightly reddish than brown. They were typical of the species. This characteristic coloring matter has been universally assumed to be the secretion of pigment glands. We contend that, on the contrary, it is blood proper from the rupture of blood vessels in the oviduct or cloaca. Glandular pigments have been shown to fade with age (Thomson 1964). Blood is known to darken with age. According to Simpson (1965), blood turns from red to brown within about 24 hr and then darkens slowly. The deposits on extremely old Golden Eagle eggs are very dark (pers. obs.). In the case of Golden Eagle egg shells in the American Museum of Natural History collected before the turn of the century, the coloring matter is dark, approaching black. Blood deposits on 1964–65 Golden Eagle eggs on Featherland carry darker color than when first coagulated and somewhat darker than the deposits on 1969–71 eggs from same bird. Bacterial action will have rendered extremely old deposits hard and no longer the substance they were at the time of laying. Therefore, the origin of the pigment is probably impossible to determine by study of old eggs (pers. comm., E. J. Fennell, A. J. Beaton, and Dr. George Anderson).

Within 60 sec of emergence, the coloring matter on egg no. 13 was spread, smeared by thumb and finger, and stained them. In the case of egg no. 14, the coloring washed off as blood does under a tap flow.

In May 1970, the Official Analyst to the City of Vancouver and to the Attorney General of British Columbia, E. J. Fennell, and his staff applied the Takayama test for blood to several of the typical Golden Eagle eggs in our presence; the reaction was positive. This test for blood is more sophisticated than mere detection of hemoglobin, and is a confirmatory test often used in court cases (Fennell, pers. comm.). This test applied to the typical coloring incorporated into the shell of gull eggs was negative, though substances related to hemoglobin were present.

The 16th egg, typically color-splashed, laid 5 April

1971, emerged from the cloaca in our close view. During the emergence, we observed liquid blood on the margins of the cloaca. Within four seconds the egg was in Mrs. Hyndman's hand. The deposits were on and into the coating of moist mucus surrounding the shell. The coloring matter was still liquid, runny. It ran onto hands, and was washable in the manner of blood. Before coagulation, one blob was touched by a tissue swab which quickly soaked it up. The bottled swab and the intact egg were taken to the laboratory of Royal Jubilee Hospital, Victoria, B.C., within 20 hr, where we scraped coagulated blobs from the shell in the presence of technicians. Dr. George Anderson, lab director, examined both tissue and scrapings. Both contained red blood corpuscles, which were viewed by Drs. George Anderson and N. J. Ball, and one of us (C.C.H.). All observers agreed that they were blood proper. Later, at the University of Victoria, red corpuscles of fresh raven, gull, and owl blood were found to be similar to those of the eagle. Pigment gland or other glands which draw on the blood stream (with exception of the spleen) are separated from direct contact by the blood vessel walls, normally impenetrable to red corpuscles; "the blood cells remain in the blood vessels" (Kahn 1965). "The spleen is the only region, then, aside from the red marrow, in which they were formed, that the red corpuscles have direct contact with tissue cells, other than those that form the lining membrane of the blood vessels" (Martin 1923). Blood proper with its red corpuscles can only come from ruptured blood vessels or spleen (pers. comm., E. J. Fennell, Dr. G. Anderson).

In summary, we conclude that the reddish deposits typical of the Golden Eagle egg shell are in fact blood proper from hemorrhage, not the secretion of pigment glands.

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PROLONGED AND BISEXUAL INCUBATION BY CALIFORNIA OSPREYS

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In connection with studies on the reproductive status of the Osprey (*Pandion haliaetus*) in California, 10 nests at Eagle Lake in Lassen County were routinely checked during the nesting seasons of 1970 and 1971 between the end of March and mid-June to obtain information on nesting chronology. In addition, continuous surveillance was maintained for 2 days on seven of these nests and partial surveillance was maintained for one day on two nests at Lake Almanor in Plumas County in 1970 to record behavioral activity at nesting sites.

METHODS

Contents of the 10 nests at Eagle Lake, all in the tops of yellow pine stumps (*Pinus ponderosa*) approximately 5–8 m above the ground, were examined by climbing to them on an extendable aluminum ladder leaned against the nest trees and looking over the edge of the nests. The contents of each nest were checked up to a total of nine times during incubation: every other day until the first eggs were laid and while eggs were hatching, also once or twice in between. Incubating parents generally flushed from their nests as we approached within 15–45 m of the nest tree and returned at about the same distance as we departed. We made every effort to minimize our stay at the nests and managed to keep incubating parents off their nests for no more than 15 min, usually for about 5 min.

Observations in 1970 on behavioral activity at the seven nests at Eagle Lake were obtained from a blind between dawn and dusk on 18 and 20 May, and at the two nests at Lake Almanor by observing them from approximately 400 m with a spotting scope on 27 May.

RESULTS AND DISCUSSION

Nest contents were examined often enough in 1970 to obtain measurements on the duration of incubation in two nests. Three eggs were found in one nest on 2 May, and four were found when the nest contents were next examined on 21 May; one of these eggs hatched on 2 June, a second hatched on 7 June, a third hatched on 10 June, and a fourth failed to hatch. Even if the egg failing to hatch was among the first three eggs observed, the incubation period of the remaining two eggs had to be at least 31 and 36 days, respectively. One egg was found in the second nest on 29 April, and a second egg was found on 2 May; one egg hatched on 9 June, and the other hatched on 12 June. Presumably the eggs hatched in the order laid, thus they were incubated for at least 43 and 38 days, respectively.

Three eggs, freshly laid in each of three separate nests on 29 April 1971, were marked with permanent ink for identification. All three eggs hatched on 6 June, an incubation period of 38 days.

These incubation periods exceed those previously reported for North American Ospreys of 28–33 days (Bent 1937:361; Ames 1964:18), but compare with those reported for Eurasian Ospreys of 35–38 days (Dementiev and Gladkov 1951:340; England 1956: 49; Bannerman 1956:347; Brown and Waterston 1962: 137).

Day-long observations maintained on the seven nests at Eagle Lake in 1970 revealed that both sexes

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