GENERAL NOTES

Notes on the behavior of captive Great Cormorants.—General observations have been made on the maintenance activities of cormorants in the field (Lewis, The Natural History of the Double-crested Cormorant, Ru-Mi-Lou Books, Ottawa, 1929; Bartholomew, Condor 44:13–21, 1942 and 45:3–18, 1943; Stonehouse, Ibis 109:600–605, 1967; Owre, Adaptations for Locomotion and Feeding in the Anhinga and Double-crested Cormorant, Ornithol. Monogr. No. 6, A.O.U., 1967) and in captivity (Portielje, Ardea 16:107–123, 1927; Stolpe, J. Ornithol. 80:161–247, 1932; Kortlandt, Ardea 27:1–40, 1938). However, there has been little underwater observation of these birds and none in water bodies of the depth regularly used in the wild. I observed and filmed 2 juvenile Great Cormorants (*Phalacrocorax c. carbo*) kept in a large indoor pool, and noted particularly their feeding and plumage care behaviors.

Three fledglings were removed from nests on 25 June 1972, and kept in an outdoor cage (1.25 × 1.25 × 2.5 m) until 7 September, during which time one died. The remaining 2 were then moved to the pool and stayed in excellent condition up to their release on 2 October. The pool was a circular tank (15 m diameter × 3.5 m depth) and had many underwater viewing ports. The area was illuminated by bright artificial light for 11 hours per day; no sunlight was visible. At night, a weak light was left on at the side of the tank. Air temperature was approximately 16° C; water temperature was approximately 12° C. A raft with a perching branch attached provided a resting spot for the birds although they could also fly up to the rim of the tank. They were fed chopped herring (*Clupea harengus*) supplemented with vitamins, while caged, and live fish, mostly cunner (*Tautogolabrus adspersus*), while in the pool.

Surface swimming.—When entering the water, the birds usually jumped or flew down (feet first) from their perches (30 cm from water). Head-first dives were noted only during feeding frenzies which were initiated when fish were introduced while the birds were perched.

The cormorants, when entering the water quietly, swam around slowly, gently flapped their wings, and dipped their heads and necks in the water—undoubtedly to facilitate soaking. Surface swimming was executed by the alternate stroking of the legs at approximately 30° from the vertical. Steering was performed by the feet, although the tail appeared to be used in sharper turns. The head and neck were usually held in a relaxed S-shape except prior to diving, when the neck was straightened and the head angled slightly downward. The birds entered the water only to escape capture or to fish.

Diving.—There were 2 ways of submerging. Usually, the cormorant jumped clear of the water to dive in headfirst. To do this, its feet were brought forward and stroked down and back together, propelling the bird out of the water. The head and neck were pointed straight forward and then arched down to meet the water. Concomitant with the kicking of the feet was a quick depression of the tail, probably adding further vertical force. Just prior to the dive there was an audible exhalation and a dorsoventral flattening of the body, accomplished by angling of the elbows of the wings slightly outward and by some compaction of the plumage. In the second type of dive, the bird did not clear the water but lunged forward and down in a more quiet and graceful movement. This dive was noted only after extended bouts of fruitless fishing.

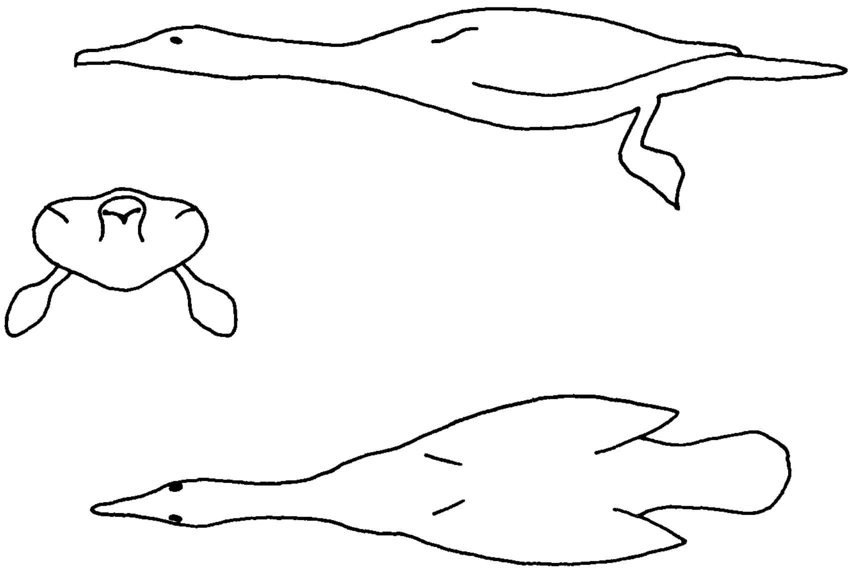

FIG. 1. Configuration of cormorant swimming underwater.

Once underwater, the cormorant usually proceeded downward at a 45° angle, although occasionally diving more steeply when a fish was sighted. The neck was held either straight forward or with a slight crook. The wings continued to be held slightly away from the body, acting as a down-forcing, planing surface, counteracting the upward components of propulsion and buoyancy. Propulsion was provided by the simultaneous kicking of the legs (Fig. 1), with which was integrated an up-and-down motion of the tail giving the bird's movement a slightly undulating appearance. Rates of kicking usually varied between 2 and 3 per sec although this could be doubled during a chase. Underwater speeds ranged from 1.5 to 2 m per sec. However, in one case, a bird was estimated to move at twice the speed of a mackerel (*Scomber scombrus*) it was pursuing; a mackerel is capable of approximately 3 m per sec in bursts (K. MacKay, pers. comm.). Directional control underwater was accomplished mainly with the feet and the long stiff tail (as noted by Stolpe, op. cit.) although, on very fast, sharp turns, the inside wing was angled out farther.

Braking involved primarily the feet; however, for quick stops, the wings were partially extended and the tail opened and brought up over the back.

When surfacing, the cormorant usually rose slowly, using its buoyancy. If, however, a large fish was caught for which the other bird was competing, a powered ascent was used, in which case the legs were stroked alternately as in surface swimming.

At the end of a feeding session and just prior to leaving the water, the bird rapidly shuffled its wings over its back and wagged its head and neck underwater. This possibly results in some beneficial rearrangement of the feathers. Finally, it raised its upper body clear of the surface, flapped its wings vigorously, and left the water.

Feeding.—The cormorants caught fish after a direct chase in which no special tactics were used. The neck was held in a slight S-shape, allowing maneuvering of the head when grabbing the prey. In all cases, the cormorant took the fish to the surface and swallowed it headfirst. If prey was not visible, the bird would cruise along the bottom, investigating hiding places such as drain holes.

Drying.—On leaving the water, the bird flapped its wings periodically for about 10 min. As drying took place, actual flapping became less frequent and the wings were gently waved in a characteristic outspread position. Body-shaking, head-shaking, head-flicking, and tail-wagging were regularly noted at this time (terminology from McKinney, Behaviour 25:120–220, 1965). Shivering was occasionally observed.

Preening.—Preening began once the concerted flapping had subsided. This behavior, which could last as long as 30 min, was usually associated with the drying procedure; the water would understandably cause feather matting. Completely dry birds preened less and with reduced intensity.

The neck and breast were invariably preened first. The neck was held erect and beak inserted down into the lower neck feathers, which were pushed, nibbled, and finally stroked into place. The bird worked in the same way down the breast, belly, and sides, often dislodging much down. Following this, the bird reached along the underside of its wings to stroke the individual primaries and secondaries, although all were not treated in a given session. The head was next twisted around to reach the back, the feathers of which were preened in a similar manner to those of the breast. The rectrices were treated like the wing feathers. Preening at the base of the tail often involved its deflection to one side, possibly associated with release of oil from the uropygial gland. There was apparently no widespread distribution of oil during any given preening bout. After this procedure, the cormorant rubbed its head over its back and under its wings. Although the various sections of the body were initially treated in this order, some areas were preened several times. Body-shaking then ensued, followed by a slow settling of the feathers into place.

Scratching.—The neck was lowered and stretched to one side and the nearest foot brought up to scratch the ear area. This behavior was not necessarily associated with preening.

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Adaptiveness of foraging in the Cattle Egret.—Heatwole (Anim. Behav. 13:79–83, 1965) and Dinsmore (Am. Midl. Nat. 89:242–246, 1973) have shown that Cattle Egrets (*Bulbulcus ibis*) feeding in close association with cattle catch insect prey at a significantly higher rate and expend less energy than do those foraging alone. The purpose of this study is to confirm their results and to evaluate the adaptiveness of the Cattle Egrets' site tenacity about a cow's head and muzzle, and their defense of cows against conspecifics.

Observations were made of egrets foraging with black angus cattle over a Bermuda