THE LIFE HISTORY OF SCOPUS UMBRETTA BANNERMANI C. GRANT IN NATAL SOUTH AFRICA.[1]

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Plates VI–IX.

THE Umbrette, *Scopus umbretta*, described first by Gmelin in 1789, is one of the most characteristic birds of African streams but until 1914 no sub-species had been proposed. In that year Kelsall suggested (Ibis p. 225) that the South and East African forms might be separable and so in the same year, 1914, Claude Grant in the 'Bulletin of the British Ornithological Club' separated the South and East African form as *Scopus umbretta bannermani* with the type locality Mt. Leganisho, Kenya colony.

This subdivision seems well warranted since the South and East African form possesses a decidedly longer wing, ranging in adult specimens between 295 and 334 mm. while that of the West African one ranges between 246 mm. and 263 mm. One specimen recorded from Portuguese Guinea seems to be intermediate since the wing measures 285 mm. (Ibis 1924, p. 210). The typical area in which *Scopus umbretta umbretta* seems to occur is in Sierra Leone.

The specimens collected and recorded from various parts of Africa and previous to 1914 determined as *Scopus umbretta* undoubtedly largely referable to *S. u. bannermani* and a study of these would probably throw a good deal of light on the actual distribution of the two sub-species and show additional specimens illustrating intergradation.

Although the sub-species of *Scopus* have received only a little attention from a taxonomic standpoint the same cannot be said for the family which it represents.

Owing to the peculiarities of the *Scopidae* there has been considerable debate as to the exact position of the family in relation to other families of Ciconiiformes. According to various

[1] The work here recorded was carried on under the direction of Dr. A. A. Allen of Cornell University, as part of the requirement for the degree of Doctor of Philosophy.

students it has been placed closer to the Storks than to the Herons but owing to many heron-like characters other competent students have placed it closer to the Herons. A careful consideration, even tabulation of the various characteristics of the *Scopidae* does not clarify the situation except to point to the impossibility of placing *Scopus* with either the Storks or the Herons.

Throughout most discussions there is frequent mention of *Balaeniceps rex* in connection with *Scopus* and a comparison of characters shows a distinct similarity between the two, a relationship between these two families closer than is that of either family to the Storks or the Herons. Reinhart (Ibis 1862, pp. 160–175) compares *Scopus* and *Balaeniceps* to *Cancroma*, but as later authors have shown, the resemblance is entirely superficial.

Throughout the various discussions as to the position of *Scopus*, a great many characters, both external and internal are invoked in order to show relationship, but so many exceptions exist that most conclusions are invalidated by the work of later authors who have brought to light similar characters in widely separated groups. The most constantly held, and logical conclusion is that *Balaeniceps* and *Scopus* are not distantly separated, and that the present position of the *Scopidae*, that is between the Storks and the Herons and close to *Balaeniceps*, is the most tenable.

A review of the various arguments based on anatomy, or a discussion of the embryology and anatomy is not within the scope of the present paper, that of a life history.

Relationship as Suggested by Life History. An attempt to cast some light on the relationship of *Scopus* through peculiarities in nidification seems justified since in all groups of birds there seems to be a close adherence to a general, often common, type of nest. Exceptions exist as for instance in tree-nesting Ducks, or ground living Weaver-birds but even where exceptions do exist there usually remain features which are common to the group, or certain traits are retained.

The nest of *Scopus* (for detailed account see later pages) bears no resemblance to that of a Heron. To compare the two nests is as logical as to compare the nest of a Dove with that of an Oriole or Weaver-bird. The Heron nest so far as I am aware is never a stout or complex structure—in fact the tendency seems to be

UPPER.—NEW NEST OF THE HAMMERHEAD (SCOPUS UMBRETTA), TWELVE FEET, ELEVEN INCHES BY TWELVE FEET FIVE INCHES.
LOWER.—ADULT HAMMERHEAD ON TOP OF NEST.

toward an exceedingly fragile or at least sketchy nest, while the nest of *Scopus* is large and rather complex.

Stork nests with their large mass, deep center depression, and even their location, that is, on a large and rugged support, much more nearly resemble the nest of *Scopus* even at a superficial glance. A thoughtful consideration of the structure of a *Scopus* nest suggests at once a Stork nest with the sides elevated to an exaggerated degree, and then continued to the point of being covered over.

The nest is most commonly placed in the fork of some fairly large tree not far from a stream and very frequently it overhangs the water. During the early stages of nest building sticks, cornstalks, roots and other suitable materials are placed in the fork of a tree until a broad and fairly solid foundation has been built. The sides of the nest are then added to until they begin to approach each other at the top. The inner part of the nest, that is the portion immediately surrounding the nest cavity, is well made and presents a smooth surface on the inside. It is never of the haphazard structure which the lose material on top of the nest suggests. The spaces between the material composing the sides of the nest are filled with mud, so that this part of the structure is exceedingly solid. Up to this point the nest bears a resemblance to a Stork nest, but here the resemblance ends for construction continues until the nest is closed over on all sides except for the entrance passage. The completion of the nest requires several weeks after the Stork-like stage has been reached, and is carried out by roofing over the entire structure. The roof is carelessly made, sticks and other odds and ends are merely placed one on top of the other until the huge and ungainly mass resembles a stack of flood drifted debris left in the tree by receding water.

In attempting to ascertain the process by which the *Scopus* or Umbrette was led to the building of such a structure it seems reasonable to suppose that originally the nest was Stork-like but that through the impulse to build the sides higher the nest became roofed over. In fact the instinct which would lead to this result is still very much in evidence, for the birds continue to bring nest material and add to the nest, long after it might be considered completed. In fact throughout incubation and even during the

growth of the young the parents continue to add material to the nest.

This impulse to continue additions to the nest is probably responsible for a habit which is so commonly observed, namely, that of placing old bones, rotting meat, pieces of hide and fecal matter on top of the nest. It is not at all difficult for a human to conceive of a state of mind resulting from two conflicting impulses, the one to bring food and the other to bring nesting material, sometimes being compromised with the result that material unfit for either purpose is brought to the nest and allowed to remain there.

Another item of interest in discussing possible bases for a consideration of the phylogenetic status of *Scopus* is the color of the eggs. These are white, the only variation being due to the brown stains from mud carried into the nest on the feet of the parent and from fecal matter. Since the shape and color of eggs is so often a character indicative of relationship the fact that Storks lay white or cream colored eggs is strongly suggestive of a possible relationship between *Scopus* and the Ciconiidae. Since the nest of *Scopus* is completely covered, the white color of the eggs is not as valuable a character as it might otherwise be, but upon consideration of the possible origin of the closed nest the fact is still worth recording.

The presence or absence of powder-down patches in the possible allies of *Scopus* has been frequently mentioned in the literature, as has been the occurrence of such patches in widely diversified groups, as certain Parrots, some Goatsuckers, Tinamous, *Mesites*, etc. On the other hand it is more significant in attempting to link *Scopus* to the Herons, that *Scopus* does not at any time show evidence of powderdown patches, and such a lack is more important in showing that there is no relationship with the Herons, a group which so consistently possesses these patches. On the other hand, contrary to statements which link *Scopus* and the Storks because of this common lack, itis obvious that the condition is of no significance here.

The evidence which has been brought forward in this discussion is not conclusive. It is suggestive, however, of the closeness of the relationship between *Scopus* and the Storks. Before making a decision it would seem advisable to await knowledge which could probably be obtained in the most satisfactory form from a study

UPPER.—YOUNG HAMMERHEAD, ABOUT SEVENTEEN DAYS OLD. OCTOBER 25, 1925.
LOWER.—SAME BIRD. NOVEMBER 16, 1925.

of the embryology of these groups with especial emphasis on Scopus and Balaeniceps.

THE LIFE HISTORY OF *Scopus umbretta bannermani* IN NATAL, SOUTH AFRICA.

On every permanent stream of water in Natal one is apt to find a large, umbre-brown bird, disheveled in appearance, wandering about or silently standing near the water's edge. If alert, the bird seen from a distance resembles in size and body shape, a Black-crowned Night Heron. The head, however, will in all cases reveal the fact that the bird belongs to a distinct group; for this character plus the color, a monochrome and unattractive brown, is an infallible distinguishing characteristic. No other bird in Africa possesses so few characteristic color markings and yet is so easy to identify almost up to the limit of visibility. The head resembles a much blunted, almost worn out pick-axe with the curve pointing downward. This appearance results from the fact that the shape of the crest approximates that of the bill, and this is the character which gives the head its double ended effect.

This bird, *Scopus umbretta bannermani*, Umbrette, Hammerkop, or Mud Lark, is one of the most interesting birds of South Africa, not only to the ornithologist and to the white man but to the native also. This is well illustrated by the wealth of legends relating to it that is found among the natives, and by the fact that all the natives and most of the white inhabitants know the bird by at least one name. According to Sclater[1] the Dutch sometimes call the Hammerkop, "Paddevanger," or "toad-catcher," probably the most appropriate name next to Hammerkop or, in other words, Hammerhead. According to this authority the native names are as follows: Utekwane, by the Amaxosa; Itegwane, by the Zulus; and Machanoka by the Transvaal natives. Amongst the Zulus the nomenclature seems to vary, some calling the bird Utekwane and others Itegwane.

Amongst the Zulus the Hammerkop is considered a bird of evil omen and is greatly feared, while the Raven is considered innocuous, and the Owl only slightly ominous. According to Robert Godfrey[2]

[1] The Fauna of South Africa. Birds, Vol. IV, p. 52.
[2] Blythswood Review, Vol. II, No. 23, November 1925.

"The Kafir boys are told by their parents that, if they put their hand into this bird's nest, the bird will come out and cut off their hair, and, using it after the fashion of a sorcerer will be able to work them harm. On this account the native boys are afraid to put their hands into the nest, though some are bold enough to set fire to it. In Blythswood a Hammerhead was once brought to me with a broken wing; it had paid this penalty through neglecting to budge out of the way of a superstitious passer-by.

"When rain is scarce, the boys kill one of these birds, tie a string around its legs, and hang it on a tree, head downwards; this gives the old people great hope that the rain will soon come. In Basutoland the Hammerhead is immune from harm as it is believed to go about with the lightning."

The Zulus, like the Basutos, believe in the association of this bird with the lightning and firmly believe that to kill one will bring the lightning down upon their kraal. Failing this, they believe that they are apt to be struck dead by lightning while out in the fields, and at best the killing of one of these birds is supposed to bring disease either to the cattle or to the family. A variation of the rain-making qualities of the bird appears occasionally amongst the Zulus but in this case the effect of killing the bird, irrespective of subsequent treatment, results in a violent deluge which, if only a comparatively minor affair, merely dissolves the house and its foundations (not difficult where houses are constructed of unbaked earth or loosely bound thatch grass); if a major punishment or reaction, the hills melt down and slide into the valleys. It is interesting to note that in most superstitions of this kind there is usually an alternative, and comparatively mild, infliction which may be visited on the transgressor!

Although some of the superstitions are without any visible foundation, there is a possibility that many of them have originated either directly or indirectly from certain nesting habits of the bird. If this is the case one may at least understand the distinct, though somewhat feeble, attempts of the natives to explain the results of tampering with the nests.

Distribution.—The local distribution of the Hammerhead is controlled by only one apparent factor, the presence of a permanent water supply and the coincident food supply. Although the bird

seems to prefer somewhat open country, broken at intervals with thick bush and scattered trees, it may be found at a considerable distance from such localities and has been reported to place its nest on the ground or on cliffs.[1] The writer has never had the fortune to find nests either on the ground or on cliffs but has found them in isolated trees standing near streams and at the opposite extreme, in thick "bush" (a wooded area composed of trees tangled together with a dense mass of vines). In no case has the nest been found closer to the ground than six feet (the nest in bush) nor over thirty feet above the ground.

The Hammerhead may be found about the lagoons that are formed where the streams and rivers flow into the sea, along the inland reaches of these streams, and on the high table lands back from the coast. The climate varies considerably at the different levels but in each station the birds seem to be successful in maintaining their numbers.

They are not found abundantly in any locality, the greatest number seen at one time being seven. This was observed from a train window, the birds having congregated on the shore of a lagoon formed by the damming of a river through sand thrown up by waves and tides.

Ordinarily the birds are solitary and pairs are rather infrequently seen except during the mating season and then only for short periods of time. A passing pair of birds will occasionally drop down and vociferously visit with a resident pair but this social intercourse lasts only a few minutes.

In general the birds (speaking of the species as a whole) may be said to exist over the greater part of Africa, their presence being largely limited by suitable local conditions. They are found also in Arabia and Madagascar.

The following account of the life history of the Hammerhead deals solely with observations made along the coastal belt, and almost entirely in that portion between the mouth of the Umzumbe river, where it empties into the Indian ocean, and a point approximately eighteen miles inland. It includes also observations made on the Umnambite stream from its junction with the Umzumbe river at the Umzumbe Mission station, to its source, a distance of

[1] Stark and Sclater.

four or five miles. Umzumbe Mission station, the center from which the work was carried on, can best be indicated by a point sixteen miles north and east of Port Shepstone.

This area is in the thorny, scrubby, bush territory which follows the lower coastal belt and may reach 2000 ft. altitude, but its extent depends upon rainfall and temperature. Above this thorn-bush area the nature of the country changes and is composed of rolling, grass-covered hills with dense forest cover in the protected valleys and gorges. Along the shore and stretching back not over a mile or two in most places, the thorn-bush is bounded by a belt of country characterized by heavy growths of *Strelitzia, Carissa grandiflora,* and a small palmetto. The *Strelitzia* is frequently found in patches further inland but not associated with the other two plants, and where found inland in abundance, is generally directly exposed to the sea breezes.

The area under observation during the compilation of these data was approximately eighteen miles long and at the widest point, not over six miles in width. Only a small part was given careful survey and kept under close observation, this special district being approximately fifteen square miles in extent, and covering the junction of the Umzumbe and Umnambite, part of their courses and three subsidiary tributaries. The Umzumbe river, though never dry, is a small stream (in Natal called river), and the tributaries and the Umnambite itself, although permanent, are mere brooks.

The rainfall in this area amounts to between twenty and thirty inches a year, delivered for the most part during the summer months of October, November, December, January and February. The winter months are dry, rainfall being slight.

Light frosts are occasional during the winter months but the days are warm, while in summer the highest personally observed temperature was 109° F. in the shade. This was extreme, however, and very unusual, and the temperature seldom rises higher than 95°.

Nesting sites in the area under observation were plentiful, considering the available supports or cover, and numbered fifteen altogether. Of these seven were at one time or another found to contain young Owls or comparatively fresh down showing that they had been used as nesting places by Owls. Four nests had been used

UPPER.—YOUNG HAMMERHEADS ABOUT A WEEK OLD. OCTOBER 13, 1925.
LOWER.—ADULT PERCHED NEAR THE NEST.

neither by Owls nor the original builder so far as evidence and information could be found, and only four were in use by the proper occupants. In other words, in this area the total number of Hammerheads to be found numbered only four pairs, and from actual observation of the birds one would be inclined to state that there were only two pairs in the entire area.

Dividing the number of nests by the pairs of birds gives, as an average number of nests to each pair, a fraction less than four. Owing to the fact that old nests are frequently destroyed by small boys and that three of these pairs of birds were nesting on native locations one would probably find a higher average number of nests to the pair than here stated. On the private property of the mission station one pair of birds had apparently built seven nests and were rearing a brood in one, while four of the nests were occupied or had been occupied by Owls. The ownership of only one of these nests can readily be questioned and, eliminating the one doubtful nest, we have an average of six nests to a pair, or a possible twenty-four to the four pairs. A careful check in other localities was not made at this time but in previous years, before undertaking careful observations, it was casually noticed that invariably the number of nests far exceeded the apparent number of birds. These previous observations cannot be checked for exactness, but the discrepancy between birds and nests was obvious. The earlier facts were observed on the Ifafa river and on the Amamzimtoti.

The Hammerhead is fortunately on the protected list. The natives, at present at least, are afraid to molest it and will probably continue to be at least wary for some years to come. There seems to be no immediate danger of extinction in any part of its range, a condition which it is hoped may continue.

Nest Building.—Observations on the four pairs of Hammerheads in the vicinity of the Umzumbi mission station indicate that a new nest is built each year. This is contrary to the general belief that the nests are used year after year. Two nests occupied by these birds were known to be new, one was observed while under construction, and from the appearance of the others it was surmised that they also were new. The new nests have a somewhat fresher appearance than the old ones, owing to the fact that in the old nests the material is invariably compacted through the effects of

use, weather and the ravages of insects in the material itself. New nests do not appear to be new, in fact the nest which was observed under construction was for a few days supposed to be old and broken-down. This appearance of age is due to the fact that dead sticks, corn stalks, corn cobs, old pieces of reeds, etc., are used, in nest building, and all or most of these materials have already been weathered thoroughly throughout the previous winter and when placed on a nest do not offer the usual evidence of having been recently gathered.

Old nests are rich collecting grounds for the entomologist. Beetles, cockroaches and many lesser insect inhabitants are present in the nest material as well as scarlet, gray-legged millipedes which are rather uncommon in other localities. These arthropods are doubtless attracted by the shelter afforded them in the interstices of the nest, and possibly by the abundant food supply originating either directly or indirectly from the filthy nesting habits of the original occupants or of the secondary occupants, the Owls.

Two common beliefs which are prevalent among both white and black inhabitants of the country, appear to be erroneous, judging by the limited quantity of evidence collected in this one locality. One of these beliefs is that the nest is partitioned off into compartments, each compartment having a separate exit. Where it is believed that only one compartment is present the belief that there is more than one exit or entrance is still commonly held, and in the case of the Zulus, has resulted in a proverbial comparison of the Hammerhead to a man who is hard to catch or pin down in conversation, i. e. "as slippery as an eel," for it is said that cutting off his escape in several directions still leaves him a remaining means of escape. This condition was not observed either at Umzumbe or elsewhere and it has possibly resulted from finding an occasional nest built on top of one or more old nests, although even this condition has not been observed by the writer.

A more common belief is that the nests are always built to present the entrance toward the East. This also has not been verified. Those nests examined at Umzumbe were constructed without regard to the cardinal points of the compass; in fact, two nests built in the same tree, and in all probability by the same birds, faced in opposite directions.

LEFT.—YOUNG HAMMERHEAD SHOWING REMAINS OF NATAL DOWN ON CREST.
RIGHT.—PAIR OF HAMMERHEADS JUST AFTER COURTSHIP ANTICS.

In the fifteen nests which were found in this vicinity, plus a few others which had been observed several years previously, only one opening and one chamber were present.

The outside dimensions in one nest were twelve feet eleven inches horizontal circumference at the point of greatest diameter, and twelve feet five inches vertical circumference at the point of greatest diameter. These measurements, which are those of an average nest still in use were obtained in the case of the horizontal circumference, not far from the top; while the vertical measurement was taken around the center of the nest. (The older and deserted nests become smaller through the compacting of material.) The most typically shaped nests are commonly built in the vertical or nearly vertical crotch of a tree, and are therefore top-shaped, with the small end pointing downward. These nests were invariably strong enough to support a man's weight and seemed impervious to moderate rain.

The inside dimensions are as follows: the entrance is nine inches wide and seven inches high, and curves downward from the nest chamber in such a way that it opens to the outside at a point on the lower surface of the nest well below the greatest bulge; the chamber is twenty-nine inches from entrance to the back of the nest, while the width is twenty and one-half inches; the depth of the nest chamber at the center, where it is greatest, is twelve inches. The entire chamber is of a roughly flattened or depressed egg shape. The entrance to the nest is marked off from the chamber proper by a slight elevation constructed where the opening commences the downward turn.

The nests are composed of a wide variety of material, limited apparently only by the size and carrying qualities. Lumps of mud, corn cobs, waste paper, old socks, an old gourd somewhat larger than an indoor baseball, part of a Zulu matsha or skin apron, portions of some old wool underwear, an occasional bone, reeds, sticks, roots, etc. were found in two nests.

The presence of so much in the way of personal property probably accounts in part at least for many of the superstitions. A superstitious native who believes that the possession of some of his personal property by a witch will enable that individual to bewitch him or cause his death, would naturally be alarmed upon seeing a

discarded article of clothing being carried off by this sombre bird. A habit observed in the case of the two nests carefully studied would be even more alarming to a savage. For some unknown reason these birds at the time of incubation or shortly thereafter commence collecting cattle, and other, excrement, some of which is apparently human excrement, and not only the excreta itself but also corn cobs and pieces of paper, etc., to which portions of excreta still cling. This habit was observed in both of the nests which were kept under careful observation and appeared not on one occasion only, but in several instances. The nests at this time assume a definite odor of human excrement, and, in one instance, when reaching down into the nest blindly and groping about feeling for the eggs, a hand was accidently pushed into excreta which, though probably the bird's, undoubtedly bore a strong resemblance to human excrement. In this connection, there is of course the possibility that the bird's excrement has the odor and appearance characteristic of human faeces, which might explain the apparent habit of gathering the latter, but it could not explain the abundant evidence furnished by the sticks, corncobs, paper fragments, etc. Probably most of this type of filth is a combination, coming from the birds and from other sources.

The existence of this filthy condition may explain why the natives refuse to meddle with a nest still occupied by the birds, and may also explain their belief that tampering with the birds brings about disease or other calamity. On one occasion the writer slipped while climbing in the vicinity of a nest and scraped his arm on the rough bark of a tree. The scrape resembled that resulting from a fall onto hard ground, *i. e.* was merely a superficial abrasion. This abrasion was at once carefully washed in fresh water and half an hour later was painted with iodine after a second thorough washing. A few days later, and lasting for some days, there was a decided inflammation, pus formation and slight soreness under the arm-pit. This may have been simply a coincidence but it is interesting as pointing toward a possibility. At any rate, if this material is of human origin, during a bad epidemic of any intestinal disease it would probably be advisable for a Zulu who had worked about a nest to exercise more than Zulu care in regard to cleanliness before eating, especially where the hand is used in place of spoons or other utensils.

Presence of Owls in the Nest.—The species of Owl found occupying the nests is invariably the Cape Barn Owl, *Tyto alba affinis*. From the evidence pointing toward the conclusion that a new nest is built each year it is probable that the Owl simply makes use of an old nest. On the other hand, this habit of the Owls may account for the building of the new nest. In all cases but one, the Owls in possession of the nest had reared their young by early September to a stage which would permit them to maintain their nest against an invader even in the absence of the parent, and with the parent present, could without a doubt drive off the rightful owner, should it attempt to reoccupy the nest. Since with *Scopus*, September and October are the usual months for nesting it is conceivable that the Owls are responsible for the habit of building a new nest each year. Where the Cape Barn Owl is not as numerous and where it is scarce, these nests may be used by the original owner in succeeding years.

Courtship.—Courtship commences at least by the time of nest building, and probably shortly before; in one case courtship started as early as July first and lasted for a considerable time. In one case, the only case in which a nest was watched during building, two weeks passed without any work being added to that previously completed, possibly due to the nest having been examined and somewhat changed. When discovered, this nest was apparently only half completed and, according to a native who resided near this spot, had been under construction for two weeks, thus dating the commencing of the nest as the first of July or the last of June. Although two weeks elapsed without any work having been done on the nest it was complete, or nearly so by August 30. In other words, this nest required almost six weeks of active work for completion, during which time courtship continued. The nest contained four eggs on September 18, one recently laid. From observations on one other nest, it is probable that all work is frequently carried on in a rather haphazard fashion.

During the construction of the nest and after the eggs have been laid, courtship continues, taking place most frequently early in the morning and in the evening and sometimes during the day. This activity consists in a duet of loud, shrill calls which can sometimes be heard almost half a mile away, accompanied by a raising and

lowering of the wings. While the wings are raised and lowered they are steadily vibrated and a few slow steps are taken. At the conclusion of a courtship episode copulation may or may not take place. The act of copulation is somewhat more prolonged than in the case of the domestic fowl, and, during the process the male balances himself on the female by the use of his wings, and remains upright. Apparently the bill is not used as an aid to maintaining balance. The process of courtship and copulation has been observed from a distance of fifteen feet taking place on top of the nest.

Courtship takes place along the banks of the streams but the conclusion of the act, copulation, has not been observed in these localities though it doubtless takes place. Upon one occasion a visiting pair of birds approached the nest, one of them alighting. The three birds then performed the antics usually associated with courtship while the fourth continued to sail about the tree as though undecided as to what to do. After a few minutes two of the birds flew away leaving the original pair at work on top of the nest.

Egg Laying.—The usual laying time seems to be in October or the latter part of September; Sclater, however, mentions a set of eggs obtained in May, while a nest containing four eggs, one of the four nests in the Umzumbe region, was discovered by August 30. Since two weeks are required for completing a set of eggs, it is probable that this pair of birds commenced laying about the middle of August.

The eggs, which are 47 x 35 mm., are at first pure white, showing in bright light, when unblown, a faint pinkish suffusion, probably due to coloring imparted by the contents. The surface, though not rough, is dull rather than glossy and, when left in the nest a few days, the egg becomes a muddy white, smeared with dirty marks obviously a result of the parent's muddy feet being placed upon them. The eggs have a tendency to sink into the floor of the nest and, on this account, the first set found was at first thought to consist of old, infertile, Owl's eggs. These were allowed to remain simply because the nest was already occupied by the Hammerhead and on the chance that they might be fresh Owl eggs belonging to a pair that had been driven out of the nest by the rightful owners. It was intended to keep track of the results of the incubation pro-

vided it was carried on, or to note the treatment accorded the supposedly foreign eggs.

Incubation.—During the laying of the eggs and the early stages of incubation courtship continues. Apparently for about a week after incubation commences, copulation may take place, but two weeks later it has practically ceased. The incubation period is about twenty-one days although, owing to the fact that the nest is a closed structure, it was found difficult to determine the exact commencement of incubation and the first hatching. The incubation period was determined by the removal of an egg from a nest containing a full complement, and the later discovery of a fresh egg which showed that it had been laid about five days previously. On September 28, this egg had already hatched and the down of the chick was dry, but the chick was probably not over three days old.

The young, at hatching, are covered with fine down as in young domestic chicks, but differ from them in color. The head, neck, wings, flanks, sides and all ventral portions are very light gray, almost white. The rest of the surface, from the tail to the scapular region, is dark gray. The legs and feet are pink and the bill black.

Development.—During early incubation the parents continue to bring sticks, etc., to the nest. Both seem to be present at times and, when they arrive with no new material they generally alight on top of the nest where, for a minute or two, they rearrange the materials. Occasionally one will arrive at the nest flying at a lower level and swoop up into the nest entrance with no preliminary steps.

During the early stages of development, or about two weeks after hatching, the parent birds added not only more excrement to the nest but also several varieties of other odorous objects. Bones of an antelope which had died not far from the nest seemed to be in greatest favor, also loose fragments of meat and skin. In addition to these fragments the decomposing bodies of frogs appeared, and, in one instance, the body of a still fresh, recently hatched Nile monitor. The presence of the frogs and Nile monitor might be explained by the supposed food habits, but it is difficult to understand the presence of the rest of the material. Possibly the birds are not averse to eating carrion but no evidence of this was obtained at any time, nor has the writer ever seen mention of such a habit in the literature.

A nest opened October 12 contained three young, the largest showing some signs of a crest. These could not have been over twelve days old as the nest was opened at noon on September 30 and three eggs were present. Judging by the young previously studied, it is probable that these chicks, when first observed, were six days old. It will be assumed for the sake of chronological arrangement, that this is the case, but in subsequent statements as to age it is to be understood that the chronology may be inaccurate to the extent of a few days, but not more than six at most.

At six days of age the young showed signs of a crest, were pearly gray and dark gray as in the case of those already described, and were too weak to walk although the oldest or largest one was able to crawl by using the wings. They exhibited no fear and could be handled without the slightest sign of alarm. After a few minutes exposure to the breeze, which was warm, they commenced to shiver and were returned to the nest.

On October 23, at the age of sixteen days, the quills of the wing were well developed, the crest plainly in evidence, and they were showing signs of pugnacity. The smallest of them had disappeared. The nest was being covered by the adults with all manner of filth, excrement, antelope flesh, etc.

On October 29, that is, at the age of twenty-three days, the head and neck were feathered, the primaries, secondaries, and tertials were sprouting as were also the tail feathers. The wing covert areas, back and lower surface were still down covered. When handled the chicks made slight sounds and, after being replaced in the nest were able to call quite loudly.

By November 3, twenty-seven days after hatching, the wing feathers had grown so that the tips of the primaries were one and one-half inches long. The crest feathers were well developed, bearing, at their tips, the stringy, grayish, natal down. The tail showed considerable growth although the quills were still in evidence. The larger individual showed considerable activity, moved readily about in the nest, tried to dodge and raised the wings up over the back when disturbed. The legs and feet were pale, grayish blue.

Two days later the nest was even more liberally covered with filth. November 5, when twenty-eight days old, the larger bird was wide awake, and when placed on top of the nest showed interest

in objects thirty or forty feet distant, and frequently peered over the edge. When alarmed or curious it was able to raise its crest; the voice was well developed and, if the bird took alarm so that its pugnacity was aroused, it reared back, opened the bill widely, spread the rami or appeared to do so, and, at any rate, managed to present an alarmingly large oral cavity.

The parents seemed to be more and more shy and were seldom seen about the nest.

By November 14 the young showed changes most conspicuously in the tail which showed bands of purplish brown iridescence. The bands were three in number at this date while only two days later four bands were present. The young were able to use their wings freely, to stand and walk about, though, for the most part, they still rested on their tarsi.

On November 21, when forty-four days or almost seven weeks old, the first bird left the nest before he could be examined. The other individual, probably the smaller of the two, showed six bands of color on the tail, and also showed a well-developed sense of fear. The white down tips of the crest feathers showed plainly, but, at a distance, it would be impossible to distinguish the young from an adult bird. Two days later this bird showed seven bands of color in the tail and on November 26, about seven weeks after hatching, it left the nest.

So far as could be discovered the young do not return to the nest for some time at least, after leaving, and probably, like most birds, never return. One frequently hears reports to the effect that these birds roost in their nest after the nesting season is over, but no evidence leading to that conclusion was collected during these studies; on the other hand, no evidence positively disproving such a theory is at hand.

Feeding Habits.—Unfortunately practically no data have been secured on this important phase of the life history. The birds were so scarce as to make it inadvisable to collect them.

One young bird, when several weeks old, regurgitated seven frog or toad larvae, one shrimp-like crustacean, and twenty-four winged termites.

On November 9 four birds, probably a family although it is not known whether or not the male helps in rearing beyond aiding in

nest-building, were observed in an open field feeding on what seemed to be these same termite species.

Only one other observation bearing on feeding habits was made. In January two adult birds were seen feeding along the river margin, apparently on "tadpoles." At each successful capture their heads would be thrown backward and upward with a jerk while swallowing.

An object which looked like a toad was captured and was repeatedly bitten or pecked and washed in the river. After watching this procedure for several minutes an attempt was made to frighten the birds into dropping their prey but they flew away carrying the object with them.

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