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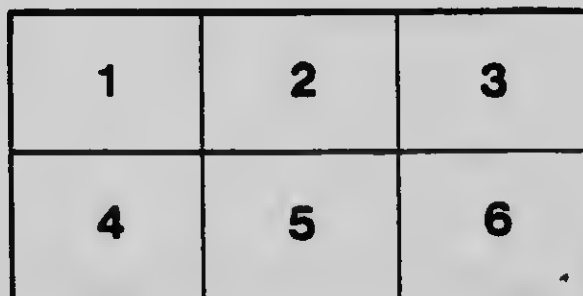
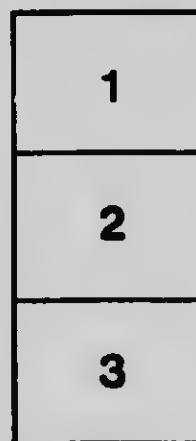
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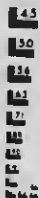
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THE EYES OF THE BURROWING OWL

WITH SPECIAL REFERENCE TO THE FUNDUS OCULI

BY

CASEY A. WOOD, M.D.

CHICAGO, ILL.

CONTRIBUTIONS TO ANATOMICAL AND PHYSIOLOGICAL RESEARCH,
PUBLISHED BY THE UNIVERSITY OF CHICAGO, IN HONOUR OF
THE DEPARTMENT OF ANATOMY, JUNE 11, 1919.



From
DR. CASEY WOOD
The Kingscote
Stanford University P. O.,
California

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Of all the Strigiformes there is none so interesting from the standpoint of the visual apparatus as that widely distributed New World group—the Burrowing Owls. These birds are found (as the typical species, *Speotyto cunicularia*) throughout the pampas regions of Central South America and occasionally farther south; and are well known, as a subspecies, in Florida (*Speotyto c. floridana*), the West India Islands, and on the plains and in the valleys of North America (*Speotyto c. hypogæa*) as far north as British Columbia.

Of the numerous subspecies may be mentioned also the small, pale-brown, insectivorous, Short-Winged Burrowing Owl (*Speotyto c. brachypiera*) inhabiting the island of Santa Margarita, Venezuela; and the Haitian form—*Speotyto c. dominicensis*. The Florida Owl is also seen in the Bahamas. Although smaller than the typical species, it has larger feet and bill; the plumage is, on the whole, darker, with clear white spots.

All Burrowing Owls are comparatively small (less than 11 inches in length), but this peculiarity is not so noticeable on account of their unusually long, bare legs. Their habits are said to be mainly diurnal, but observations of the North American species by the writer incline him to the belief that they are essentially nocturnal animals, like most owls. Burrowing habits seem to be common to all the species.

Burrowing owls have a dull-brownish, spotted, and barred plumage; the middle of the chest is white and is partly encircled by a plainly marked buff-brown collar. The head is rather flat and small, the facial disks are not well defined, the bill is short, and the wings are relatively undeveloped, so the bird is able to fly only short distances.

The food of these owls consists almost entirely of mice, gophers, and similar mammals, as well as of small reptiles and insects. Of these a family of owls, commonly ten in number, will consume enormous quantities; each member disposing of his own weight of pabulum in twenty-four hours!

According to Knowlton and Ridgway (1) the Burrowing Owl is more or less migratory, and after a return to its usual habitat mates (probably for life) and then arranges its underground nest. The contour of these nesting burrows varies; they are usually about 15 inches wide and from 5 to 10 feet in length. They enter the ground in a diagonal direction for a few feet and then turn at an angle either to the right or to the left. The nesting chamber (12 to 18 inches in width), placed at the highest part of the burrow, is mostly lined with dry dung, but sometimes with hair, feathers, or dried grass. The eggs are six to twelve (generally eight) in number; their color, when unsoiled, is glossy white.

It must be remembered that while the great majority of these owls dig their own burrows, many of them, especially the northern varieties, make use of the abandoned holes of certain mammals, notably of the prairie dog, fox, badger, skunk, and ground squirrel. Doubtless in the latter instances the Burrowing Owl may enlarge or otherwise alter the size, length, and other dimensions of the newly acquired hole.

The Burrowing Owl is not over-clean in his habits; the nesting chamber and the remainder of the burrow are often filthy and foul smelling.

The writer has studied the habits of the North American and Florida subspecies, with special attention to the eyes and eyesight of the bird. From these observations he concludes that this owl, like all the others, is a true night bird, adapting itself with but slight success to daylight conditions. In spite of the fact that Bendire and Hudson refer to the animal as a diurnal owl, their accounts of its habits really bear out the writer's contention of a nocturnal animal with fairly good day vision, yet distinctly embarrassed, uncertain, and confused when the eyes are exposed to bright sunlight. Stress is laid by a number of observers upon the fact that this owl is seen at all times of the day standing guard, often on a little mound of earth in front of his burrow entrance, forgetting that, as a much

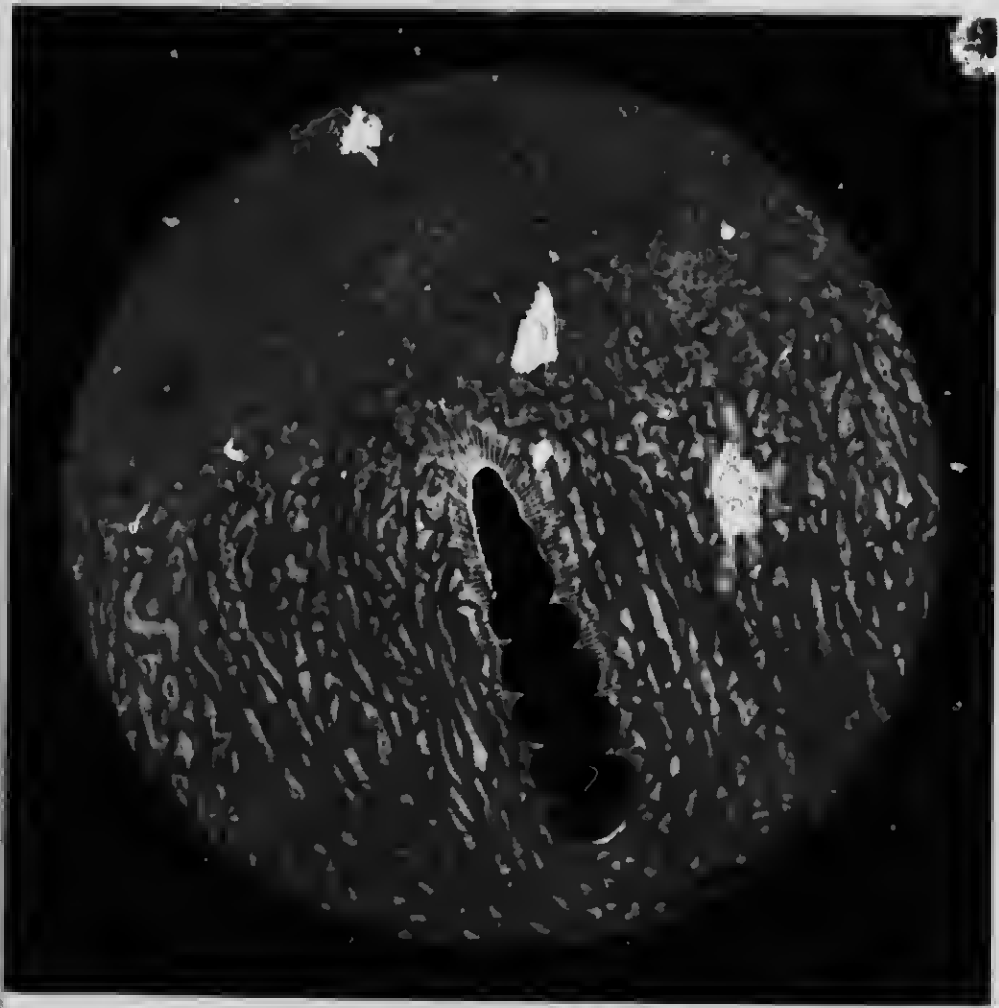
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The Fundus Oculi of the Burrowing Owl—*Speotyto cunicularia hypogaea*.



more interested householder, he also watches from the same post all hours of the night!

Bendire gives the best account of their habits as observed by a daylight student of their habits:

"When not unduly molested, they are not all shy, and usually allow one to approach them near enough to note their curious antics. Their long, slender legs give them a rather comical look—a sort of top-heavy appearance. Should you circle around them they will keep you constantly in view, and if this is kept up it sometimes seems as if they were in danger of twisting their heads off in attempting to keep you in sight. *They hunt their prey mostly in the early evening and throughout the night, more rarely in the daytime.* As soon as the sun goes down they become exceedingly active and especially so during the breeding season."

As one result of a rather extensive study of the visual apparatus of this interesting owl, the writer has never seen anything to convince him that the bird ever performs an act requiring distinct diurnal vision. Certainly the northern bird is decidedly nocturnal, occasionally using his eyes, but at a disadvantage, during daylight hours.

This conclusion is confirmed in a noteworthy fashion by a comparison of the fundus oculi of this owl with the same picture in owls entirely nocturnal in their habits, and indeed with certain other evidence (especially that they all show orange or reddish fundi) constantly found in night animals.

These facts have been fully stated by G. Lindsay Johnson (2) as regards the mammalia; and by the writer (3) for the avian eye.

As in all owls, the eyeballs are set well in front and surrounded by more or less plainly marked, uniform and complete facial disks (that probably act as reflectors into the eye of the diffused and faint rays of evening light).

Strigiform eyes more closely than those of any other order resemble human eyes; and they preserve, as in man, about the same relation to other facial organs and are so placed as to obtain binocular vision *in front*. Structurally, of course, birds' eyes are quite different, especially in the morphology of the eyeball, in the possession by the owl of a pecten instead of retinal vessels, in the covered optic nerve and in many other particulars which it is not proper to specify here.

Slonaker (4) and the writer (5) have pointed out that all the owls are exceptions to the rule that the retinal area of distinct vision

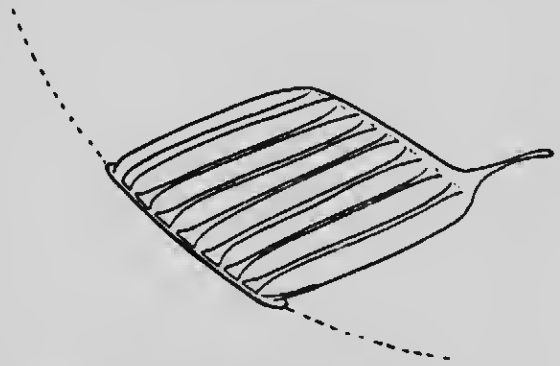
is in birds with a single fovea placed above and towards the *nasal* aspect of the optic nerve entrance. The owls possess a single, deep fovea encircled by a round, sharply defined area located above and on the *temporal* side of the optic disk. This arrangement closely approaches the binocular maculæ of man.

The writer gives to the owls a class by itself in describing these aræ and affirms that the temporal *monomacular fundus* is found almost exclusively in the owls.

In conjunction with Arthur W. Head, F. Z. S., the South American Burrowing Owls in the London Zoological Gardens were closely studied and examined with the ophthalmoscope. In addition, the interior of the eyeball both of that type and of several North American individuals were examined by the writer in prepared specimens.

The ophthalmoscope in particular shows the fundus oculi of *Speotyto cunicularia* to be that of a typical nocturnal animal. The picture of this bird's background is well shown in the accompanying colored plate, painted by Head and faithfully reproduced here. The *ocular fundus* of this species is irregularly round, as in all the owls, and in prepared specimens these details show distinctly.

The single, temporal, oval *macular region* lies above and about a disk length and a half from the upper end of the papilla. In the center of the macula is the fovea—a dark pigmented spot with fine granules arranged cap-like above it. Outside this, again, is the ovoid circumference of this region, incompletely edged with fine dots. These are more numerous distributed below the macula than above it. Connected with the macular region is a light-colored and rather broad band that extends horizontally to the center of the visible background. It is unevenly divided into two strips by a parallel arrangement of minute pigment dots.



Lateral View of the Pecten of the Burrowing Owl—*Speotyto cunicularia hypogæa*. × 9.

Seen from above, the relatively small *pecten* closely resembles a disarticulated, acuminate leaf, the stem representing the spinous projection immediately above the lowest terminal convolution. The light double folds of the marsupium slope backwards and cover most of the optic entrance; they meet above in a uniform, very narrow, slightly undulating crest whose posterior end projects half the height of the underlying coil well into the vitreous cavity. An extension upwards of the long axis of the disk cuts the retinal band at the junction of the inner and second fourth, making an infulapapillary angle of, perhaps, 40° .

This interesting owl is especially subject, like other Strigiformes, to pathological variations in the fundus picture after confinement and domestication. Both Head and the writer examined a number of individuals that undoubtedly exhibited choroidal disease and other pathological changes. Rejecting these, the general color of the fundus of this species is found to be dull-orange, mottled and blotched in its upper half with deep orange-red. Choroidal vessels are plainly visible, covering all the lower part of the eyeground, just as in the Tawny Owl. The well-defined macular area is seen within the outer half of the fundus, a little above the upper extremity of the optic disk. It is distinguished from the surrounding choroid by a collection of minute pigment granules or dots with a bright, white spot in their center.

The *optic disk* is white and of oblong shape, slightly rounded at the ends. From its edges run a few short nerve fibers that form a complete fringe about the visible papilla.

The *pecten* is decidedly larger in proportion to bodily measurements than one finds it in most of the larger owls, especially larger than in the Tawny Owl. It extends well forward into the vitreous, and its lower half appears very massive and of a dark brown color. The pectinate convolutions are plainly seen and the anterior or upper half is more delicate in structure, being perforated where it joins the disk. Here it forms a dark network on the surface of the nervehead, where, also, a few red granules mingle with the chocolate-brown texture of the *pecten*.

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