September wasumaw - eeseek.
seven oodzook.
shaking hands; see memet.
shoot, to, hod-thoo.
shoot, to, an arrow perpendicularly, ow-the-je-arra-thunum.
shoulder; see mamegemethin.
singing su-au-thou.
sitting hados-do-ding.
six bashedtheek.
sixteen; see *six.*
sleep puth-u-auth.
smoke poss-thee.
sneezing midy-u-theu.
snow; see corrasoob.
sore throat anaduck.
sorrow corrasoob.
spear; see han-nan.
spoon hanamait.
spruce traw-na-soo.
spruce rind sou-sot.
standing king-abie.
stars io-ush-zath.
stockings gosset.
stone ou-gen.
stooping hedy-yan.
sun kuis; deu-is (?).
swimming tu-wid-yie.
teeth outhermay; see botonet.
ten shansee.
ticklas gothieget.
thirteen; see *three.*
thigh ite-ween.
tongue me-ma-za.
tow or *oakum;* see *oakum.*
thread me-roo-pish.
three shendeek.
throwing; see pug-a-thuse.
thumb boo-it, poorth; see stioeena.
thunder pe-to-tho-risk.
trap, a, jib e-thun, shabathooret.
twelve; see *two.*
twenty atho-onut.
twenty-two; see *two.*
twine me-roo-pish.
two adjieich.
vessel adothe.
walk, to, bay-sot; wooth-yan.
walking stick chee-thing.
warming yourself obosheen.
watch, a, kuis.
water ebauthoo.
wild goose yew-one.
willow-grouse zosweet.
wind tis-eu-thun.
woman eemommoos.
wood adi-a.b.
woodpecker shebohowit.
yawning ii-be-ath.
your, in: "your head;" see keathut.

The Eye, Ocular Muscles and Lachrymal Glands of the Shrew-mole (Blarina talpoides Gray).

By John A. Ryder.

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As far as I am aware, the minute anatomy of the eyes of the American Soricidæ or shrew-mice has been but little studied. Recently I have had an opportunity to obtain the eyes of the short-tailed shrew-mole, *Blarina talpoides,* and thinking their anatomy might present something novel, they were cut into series of sections. These disclosed the peculiarities to be mentioned later.

The eyes were dissected out, and, as the sequel proved, together with the uninjured lachrymal glands and ocular muscles.

The eye and gland together measured 2.5 mm. in the longest diameter, and about 1.5 mm. thick, and nearly 2 mm. wide. The form of the whole mass was that of a depressed oval. So far as the evidence goes, that can be derived from the sections, it indicates that the ocular muscles do not reach the skull, and that the eyes are no longer under the control of the same kind of a muscular mechanism as is found in other mammals. In fact, the tendons and muscles of the snout seem to completely cover the skull in the region of the orbit. Indeed so slight is the attachment of the eyes to the skull, that in removing the skin from the head but little difficulty is found in removing the eye-ball and lachrymal gland with the former. In *Scalops*, our common mole, this happens with still less difficulty.

The whole eye-ball in *Blarina* measures 0.9 mm. in diameter or considerably less than one-twenty-fifth of an inch. The lens is well developed and is very large in proportion to the whole eye-ball, measuring more than half the diameter of the latter. Consequently there is but little aqueous humor, and also but little vitreous, since the lens fills nearly the whole of the chamber of the ball. The cornea is thin, very convex, and approximates the lens anteriorly. At the edge of the cornea there is no thickening of the sclerotic, such as occurs in the eyes of other vertebrates as a result of the development of the ciliary muscles or apparatus of accommodation. This apparatus is obviously very rudimentary and defective, from which it may be inferred that the power of adjustment of the lens for different ranges of vision is poorly developed in *Blarina*.

There is a retinal coat of pigment and a choroid coat, which latter extends for a little distance over the optic nerve. The thickness of the sclerotic, choroid and retinal layer of pigment taken together is not over a fourth of the total thickness of the retina, thus showing other strong contrasts in respect to the development of the tunics of the eye-ball in other forms of vertebrates.

The total thickness of the retina is nearly a third of the total diameter of the eye-ball, and is developed as far forward as the ciliary region, though it is thickest a little behind this point. The usual number of layers are discernible in the retina, and it is perforated as usual by the very slender and diminutive optic nerve, which is only .07 mm. in diameter. The retina is therefore developed as usual, though the rods and cones were not well enough preserved in my materials to be certainly made out. At any rate, it is clear that such an eye may still be more or less functional as a visual organ even though obviously degenerate in some respects. The number of retinal elements is absolutely and relatively much less, however, than in a larger eye where the arc covered by the retina is part of a larger circle than in Blarina. There is a well-defined iris and pupil.

The lachrymal gland is many times larger than the entire eye ball. Its duct opens into the conjunctival cavity.

The muscles of the eye consist, first, of a choanoid muscle or retractor of the ball. It is inserted upon the sclerotic in a circular manner near

the entrance of the optic nerve ; it extends back and its origin is lost in the connective tissue of the lachrymal gland. No definite account of the recti muscles or of the oblique muscles can be given here. All that my sections disclose is the fact that muscles which are apparently the homologues of the recti are inserted upon the sclerotic nearly as far forward as the ciliary region. These muscles, like the choanoid, pass backward to arise from the connective tissue of the lachrymal gland with which they blend and in which they become lost, or they join a relatively thick muscular tunic composed of voluntary muscular fibres which invests nearly the whole lachrymal gland.

This muscular investment of the lachrymal gland suggests that the function of such a muscular apparatus is to compress the tear gland and force its secretion over the eye-ball, and to thus wash away any dirt which may find its way under the very much reduced eye-lids, the opening in which is scarcely half a millimetre wide.

The foregoing brief sketch of the anatomy of the eyes of one of the commonest of our American shrew-mice suggests much in the way of further study. The remarkable and apparently voluntary mechanism for compressing the tear gland is evidence distinctly against the conclusion as respects at least our North American shrews, reached by Mr. Darwin in regard to the Tucu-tuco or *Ctenomys* of South America, in which case he suggests that the repeated irritation and inflammation of the eyes of these burrowing rodents, due to the dirt or sand which found its way beneath the lids, would aid in rendering the eyes inefficient, and in the course of generations abortive, as they are sometimes found to be. It is clear that if the interpretation of the function of the muscular investment of the tear gland in *Blarina* here suggested is correct, that in this case, at least, there is a direct and very special structural provision by which irritation from the presence of sand or dirt in the eyes, as a consequence of a burrowing habit, may be guarded against in the most efficient manner conceivable.

That the eye of *Blarina*, as a whole, has suffered from degeneration may be inferred with certainty from the diminutive size of the eye-ball and optic nerve, and the evidence furnished by the muscles suggests that while the eye-ball is no longer rotated in precisely the manner which obtains in other forms, it is clear that there are ocular muscles, and that the eye is capable of adjustment for the direction of vision, though it is evident that the muscles which effect such an adjustment no longer arise directly from the skull, as in all other normal forms of the eye of vertebrates. The extra tunic of voluntary muscular fibres investing the lachrymal gland seems to be something which has been superadded to the optic apparatus of *Blarina*, which, like the relatively large lachrymal gland itself, is really an indication of specialization to meet the requirements of special conditions of life.