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## Origin of Species *Eucrangonyx mucronatus*

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## ORIGIN OF SPECIES *EUCRANGONYX MUCRONATUS*

L. S. Ross

The relation of the blind species of any order of animal life to those having developed eyes is an interesting problem and one that is not yet fully solved. Many observations have been made by various naturalists, the greater number of whom believe that a process of evolution has been effected by the absence of light acting upon forms originally with normally developed eyes. Semper, in his "Animal Life as Affected by the Natural Conditions of Existence," questions the influence of the absence of light in effecting the atrophy of visual organs. Some of his objections are fully answered by Packard in his "Cave Fauna," and the probability is that the results of further investigation will tend to prove the direct effect of absence of light upon atrophy of organs of sight.

The differences in the morphology of subterranean forms as compared with surface forms indicate the action of one or more factors in their evolution. Various degrees in the deterioration of the eyes point to the probability that in some cases the time spent by the species in the darkness is much less than that spent by others, and perhaps the possibility that some may be affected more readily than others. As time passed eyes no longer used began to atrophy, in some species the optic lobes persisting and nerves and eyes disappearing while in others the lobes and nerves atrophied and the eye persisted.

Packard refers to the effects of a life in total darkness as being:—

"1. Total atrophy of optic lobes and optic nerves, with or without the persistence in part of the pigment or retina and the crystalline lens (*Caecidotaea*, *Crangonyx*, *Chathonius*, *Adelops*, *Pseudotremia*).

"2. Persistence of the optic lobes and optic nerves, but total atrophy of the rods and cones, retina (pigment), and facets (*Oronectes*).

"3. Total atrophy of the optic lobes, optic nerves, and all the optic elements, including rods and cones, retina (pigment), and facets (*Anophthalmus*, *Scoterpes*, and ? *Anthrobia*)."

[Written in 1902]

Packard places *Eucrangonyx* in the list of those affected as in the first group evidently by an oversight as he describes the *Eucrangonyx* from Mammoth cave as having the optic lobes developed.

Why the difference between the various orders and genera in this respect? Is there any relation between the size of the brain in various genera and species and the persistence or atrophy of the optic lobes? In *E. mucronatus* the nerve has atrophied and the eye has disappeared with the exception of a few lemon yellow pigment cells while the optic lobes persist. Since the species is so readily carried by even a slow current of water it is possible the change of habitat from the light of the surface to the darkness of the subterranean streams may have been quite sudden instead of by slow stages. In that case some individuals probably had no chance to return to the light or even to the twilight and their eyes became useless. Deterioration began in the course of a few generations probably and by isolation and heredity the characteristic became fixed. Atrophy was the result of disuse and not of natural selection as it was neither advantageous nor especially disadvantageous to possess eyes in total darkness or to be without them. The principal factors involved in the production of special sense organs or even additional sensory setae, as in *Cruregens fontanus* and *Calliopius subterraneus* (Chilton), were use and natural selection. The struggle for existence is as true a factor in underground streams as in the surface streams. The numbers between whom the struggle is carried on is small because of the relative meagerness of the food supply. The large size of the eggs and the small number of young produced are results of this struggle.

An elongation of form or of appendages is a characteristic of many subterranean animals, probably a result of a life in darkness. Comparison of the surface *Asellus* with the subterranean *Caecidotaea*, of *E. mucronatus* with *E. gracilis* shows difference of form. The slender form is of assistance in locomotion in the small underground streams. The finding of specimens of *E. mucronatus* in so many wells indicates that they must be widely distributed in the small subterranean streams as well as in the larger ones: since it is impossible that they or their eggs should in any way find entrance into the wells from the surface. Experiments made with specimens in the flowing water show that they are carried by a slow current even as they are not very vigorous swimmers only on occasion and for only short distances. Evidently they may be carried by the underground streams toward lower

levels even though those streams flow quite slowly. The elongated form is of assistance in such places. The fact that *E. mucronatus* is carried by a slow current seems to indicate that possibly the species was derived from a surface form that has been carried down into the earth by the sinking of the water and that it has not found its way into underground channels by entrance at springs and such openings working its way against the current. The fact that many specimens have been collected at the openings of tile drains after a period of rains points toward this explanation of their origin.

So far as I have been able to learn the distribution of *E. mucronatus* seems to be limited to a comparatively small area. It has been collected at Normal, Illinois and from various wells in Champaign, Illinois. Undoubtedly it exists in other parts of the state where the conditions are similar to those at Normal and Champaign. Prof. Eigenmann of Indiana University who has studied blind forms of animal life so extensively does not know of its occurrence there but Prof. W. P. Hay reports its occurrence near Irvington, Ind. Prof. H. Garman of Lexington, Ky., who has studied the blind crustaceans of Kentucky has met with it rarely and thinks it improbable that it occurs in any states south of Kentucky. The species has not been reported from Iowa. Some specimens apparently vigorous were placed in a well in Des Moines in August, 1902, but were all dead in two or three days. Probably there is a sufficient chemical difference in the water to render it unfit for them.

The probability is that the species is limited in its distribution to central Illinois and to regions where the geological conditions are very similar. So far as is known it is not found outside the drift area. The experiments with specimens in currents of water indicate a possible origin by the ancestral form being carried into subterranean streams. Another possible method by which they found their way from surface to underground streams is that as the moraine material was shoved and carried southward during the advance of the great ice sheet, some streams and ponds containing species of *Eucrangonyx* and other crustacea were buried effecting isolation of the species. As a necessary result the former stream ceased to exist but the continual melting of the ice would keep the drift and the covered soil supplied with sufficient water for the existence of some of the crustacea. It is not difficult to conceive of some of the entomostraca being forced underground at the same time furnishing a partial supply of food. As in some

modern glaciers, there probably was a growth of vegetation on the glacier near its southern limit affording a source of food supplies to be carried down through openings in the ice into the ground moraine, and into the drift material at its southern extremity.

The conclusion drawn by various investigators that blind subterranean forms have had their origin in caves and since the glacial epoch does not seem to be justified by the facts of distribution. Prof. H. Garman has given various illustrations of distribution of blind species in subterranean streams—tile drains and springs far from any caves in which they could have had their origin. In Science, Vol. XX No. 508, page 240, Prof. Garman says:

“But I must beg leave to dissent from the conclusions which have been drawn from this proof, (Geology of Green River region and southern Indiana) as to the recent origin of the blind animals. Conditions requisite to the development of eyeless animals are present in most parts of the United States.”

It is somewhat difficult to determine how large the channel of a subterranean stream must be before it can be called a cave. An opening large enough for the free movement and life activity of the species of fish or insect or crustacean need not of necessity be large enough to be dignified by the name of cave and yet be large enough to give the animal practically the same environment it would have in a large cave. Evidently the writers upon subterranean life when referring to caves have always meant the caverns large enough for human exploration. I can find no proof of the connection between the existence of such caverns and the development of blind animals. However, if the cave be measured according to the size of its inhabitant, if it be considered a cave when large enough for the normal activity of the animal, then it is quite reasonable to me to suppose a connection exists between the presence of caves and the evolution of some blind animals. *E. mucronatus*, *Coecidotaea stygia* are in channels and chambers underground that give them sufficient room and that are to all intents and purposes caves so far as the crustacea are concerned. If the eyes are of no further use to the animal, atrophy partial or entire is the usual result. Whatever may have been the method of passage the species from which the blind crustacea were derived evidently found their way into subterranean streams and caves, or were carried in by water currents, shutting them out from the light thereby making their eyes useless.

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