to the plea to "Save Our National Parks" by urging their Senators and Congressmen to oppose the Upper Basin Project. The fact that the proposed dam is above the dinosaur "burial ground" and that the reservoir would enable thousands to see the grandeur of the canyon, instead of the few who see it now, seems to have no effect upon the "saviors" of our national parks who give westerners, the people who know our parks and are most eager for their protection and proper use, no credit for not wanting them spoiled.

California does not tell these nature lovers about the Colorado River Compact, which assigns to the Lower Basin States a fixed amount of 7.5 million acre-feet of water annually—not 50 percent of the current flow—and makes the Upper Basin assume the shortage, if any, that, without storage, the Upper Basin must absorb in low water years. Obviously farmers and townspeople in the Upper Basin will look with disfavor and distrust upon any scheme decided by "experts" to appropriate most of the water that *originates* on their lands for the use of those on the farms and in the cities of California. Opposed to such "experts" are some of the best irrigation engineers in the world, U.S. Bureau of Reclamation engineers, and others who have examined and recommended the locations for dams and reservoirs.

There is no doubt of the sincerity of the wildlife conservationists, but the complete conservation picture should be presented to the public, and the water rights of the people of the upper states should be protected. This does not necessarily mean the loss of an area of great importance in a national park.

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13 June 1955

A. D. Moinat renders a service in pointing out the basic conflict of regional interests involved in the Upper Colorado problem—a complication, but by no means the only one, that may be unfamiliar to many whose attention is fixed on the single Dinosaur National Monument issue.

My communication to which he refers was actually concerned with more elementary aspects of this and other problems of policy, namely, the physical and biological facts that are amenable to scientific study. I do not for a moment propose that scientists take over the normal legal and political operations whereby policies are determined. I am trying only to urge that those whose business it is to shape policy do not work blindly or in willful disregard of cold facts. Charge and countercharge, claim and counterclaim are not substitutes for competent studies in field and laboratory.

If the advantage of having the scientific facts in hand when large public issues are being settled is not self-evident, surely the benefits that scientists have conferred upon our civilization entitle them to contribute, within the field of their special competence, toward the solution of such issues.

Incidentally, I have avoided taking either side of the Upper Colorado issue, although quotations from my writings have been used as ammunition and, doubtless, as targets. I do not have sufficient firsthand information to judge the relative merits of the contending parties. What I am insisting on is a more rational approach to costly public enterprises. First get the facts, then hammer out the solution. Such a program can injure no one, except those on shaky ground. Given all the facts possible, policy-makers need not fear that they will ever be faced with technologic unemployment.

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21 July 1955

"Sunglasses" in Two Anoline Lizards from Cuba

In a number of lizards belonging to the families Lacertidae, Teiidae, and Scincidae and in *Cordylosaurus* (Gerrhosauridae) and *Lanthanotus* (Lanthanotidae), there is present in the lower eyelid a transparent or semitransparent "window" that permits some degree of vision when the eye is closed. This condition is thought to be a stage in the evolution of the "spectacle" found in certain genera of the Lacertidae, Teiidae, and Scincidae and in most geckos, all pygopodids, all xantusiids, and all snakes; in these the whole lower eyelid is transparent and fused to the upper lid as a permanent immobile protective cover for the eye.

In the course of study of the West Indian members of the genus *Anolis* (family Iguanidae), it was found that two closely related allopatric forms on Cuba have just such a semitransparent "window" as has been repeatedly described in lacertids, teiids, and so forth. In *Anolis lucius* three black-bordered semitransparent scales form most of the window Fig. 1); in *Anolis argenteolus* only two black-bordered semitransparent scales are involved (Fig. 2). In both forms the area of the lid window is small enough that, in a fully open eye, the window is completely concealed in a fold of the lower lid.

This appears to be the first record of such a condition in the family Iguanidae (although we believe that the phenomenon is commoner in lizards than the present published records indicate); moreover, the occurrence of a lower eyelid window in those anoles is also of interest for an ecological reason.

Barbour and Ramsden (*1*) found *A. lucius* in the vicinity of limestone cliffs, usually crawling about on the rocks at the entrance of caves. They record that although *A. argenteolus* also occurs on limestone it is found much more often than *lucius* on the trunks of trees or on the sides of buildings but usually only near outcroppings of limestone rock. More specific information is provided by Rodolfo Ruibal (University of California, Riverside) who has collected *A. lucius* in Camaguey, Cuba. He writes (*2*): "It is very typical of limestone cliffs and caves. However, like all animals it is sometimes found away from its 'typical' habitat. In caves it certainly is found anywhere in the twilight zone and of course runs out into the sun-lighted zone as well."

Two large recent collections of *A. lucius* have been made in caves; and both E. T. Willis (*3*), collecting in Oriente, and Wilfred T. Neil (*4*), collecting in Matanzas, were very much impressed with the geckolike appearance and actions of the species and their obvious adaptation to the twilight zone. The specimens collected by Willis were found on the cave walls 75 to 100 feet below the surface of the ground. Those collected by Neil were in the twilight zone, clinging upside down to the ceiling.

The Anolinae are typically diurnal, sight hunters in which vision plays a great part also in their sexual display and territoriality. Garth Underwood (*5*) has called attention to the adaptation of *Anolis* for an active diurnal arboreal life by his discovery of two foveae in the retinas of three Jamaican species of the genus. Only two species within this very large genus are suspected of having a partly cave habitat and a partly crepus-

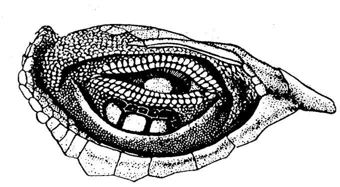

Fig. 1. Eye of *Anolis lucius*.

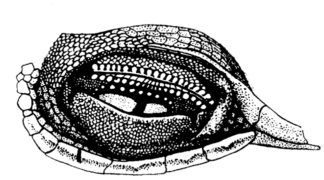

Fig. 2. Eye of *Anolis argenteolus*.

cular habitat. We think it is significant that these two species should also be the only ones with eyelid windows. (We have examined for this character every species of *Anolis* in the collections of the American Museum of Natural History and of the Museum of Comparative Zoology).

It is not to be expected that members of a genus specially adapted to diurnal habit could assume a semicrepuscular habitat without ophthalmological modifications. The retinas of *A. lucius* and *argenteolus* have not yet been examined, but we suspect some modification of the retina for greater sensitivity in dim light. The lid windows show that at least the superficial portions of the eyes are modified.

Walls (*6*) has argued that the function of lid windows and spectacles in Squamata is always protection against abrasion. They furnish protection against the soil in the case of burrowers, against sand in deserticolous forms, and in the case of small nocturnal forms they shield against hazards obscurely seen. But, whatever their value elsewhere, in the present instance none of these suggestions seem to apply. These anoles are neither burrowers nor deserticolous. They are partly crepuscular, but their lid windows would not be advantageous under crepuscular conditions; whether or not the windows are transparent in life (we have not seen live specimens of these species), these small slitlike multipaned windows with black borders must significantly limit the transmission of light. They must transmit more light than an opaque lid but obviously much less than the open eye. Thus they could not be used in the semidarkness of caves where restriction of light entering the eye would be meaningless if not deleterious.

It is to be emphasized that eyelids in tetrapods always have *two* functions: to guard the eye against foreign objects and against excess light. The lid windows in many lizards and the spectacles in other lizards and in snakes are large, round, and fully transparent; the original ability to limit or exclude light *by a lid* has been lost in these cases. The lid window in the Cuban anoles must be functionally very different.

If the effect of the anole lid window is to limit light entering the eye, then it must function not in the dimness of cave entrances (where maximum light utilization would be needed) but in the daylight outside caves. It may function, as Underwood (*7*) has emphasized to us, as a substitute for pupil mobility, since the general run of diurnal lizards have an iris that is very little responsive to changes in illumination.

We suggest therefore that the lid windows of these Cuban anoles function not, as in Walls' hypothesis, as protective "goggles" but as the equivalent of "sunglasses." They do protect, but they protect against the fierce light of the Antillean sun.

We must confess that in this comparison of lizard eyelid windows to sunglasses we have been preceded by Robert Mertens, who reports (*8*) that the desert-dwelling lacertids of the genus *Eremias* (in which some sort of lid window is frequently present) habitually shut their eyes when resting briefly in the full sun. He figures in one species (*E. u. undata*) just such a window formed of black-bordered scales as we have discovered in the Cuban anoles. Mertens explicitly compares this condition with the protection afforded by a "dunkle Brille" and further says of the black borders of the window scales that their meaning probably lies in protection against too strong and therefore damaging light.

Nor is Mertens' the earliest suggestion of this sort. Plate (*9*), discussing the eyelid windows of *Chalcides* and *Eremias*, commented: "Es ist dies wohl ein Mittel um all zu grelles Licht abzublenden." It seems probable to us that this explanation, which has been arrived at several times independently, may be the valid functional explanation of a number (although by no means all) of the many instances of eyelid windows in lizards (*10*).

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20 June 1955

Effect of Size and Number of Brain Cells on Learning in Larvae of the Salamander, Triturus viridescens

To date relatively few studies have been made on learning in salamanders. In the Mexican axolotl, the snapping reflex was inhibited (*1*), and hearing has been investigated by classical conditioning techniques (*2*). Larvae of *Amblystoma paroticum,* when placed in a dry T-maze, learned a position habit, with return to water serving as reward for the correct response (*3*); however, Colorado axolotls (*Amblystoma tigrinum*) were unable to form this simple association. Recently it was shown that the strongly negative reaction of Mexican axolotls to blue light can be converted into a positive response by offering food (*4*).

Table 1. Number of trials required to reach criterion of learning and number of errors

Chromosome number	Code number	Positive stem of maze	Trials to criterion	Errors
Diploid	B	R	54	6
	C	R	30	9
	F	L	41	11
	G	L	30	10
		Mean	39	9
Triploid	A	L	76	25
	D	L	87	32
	E	R	126	41
	H	R	212	78
		Mean	125	44

In the newt, *Triturus viridescens,* and in other amphibians, the normal diploid chromosome number can be increased to the triploid by suppression of the second maturation division as a result of subjecting fertilized eggs to a temperature of 36°C for 10 minutes (*5*). The increase in the number of chromosome sets from two to three produces a proportionate increase of about 50 percent in the size of the cells. There is no increase, however, in the over-all body size of the triploid larvae; therefore, the number of cells must be reduced to about two-thirds of the normal to compensate for the larger cell size (*6–8*). Photographs of corresponding sections of the forebrain of a triploid and a diploid animal clearly show that the area of the transverse section is the same in both, but that the nuclei of the brain cells of the triploid are larger and fewer in number. Actual cell counts have not been made so far.

The purpose of this study (*9*) was to test the suggestion (*7*) that the smaller number and/or larger size of the brain cells of the triploid salamander larvae may affect their learning ability. The learning task was that of a simple position habit in a Y-maze. The animals were placed in the stem of the maze and prodded lightly on the end of the tail with a small blunt probe. This stimulation was repeated as many times as was necessary (usually only twice) to cause the animals to swim the length of the stem and to make a turn at the choice point. For half of the animals, turning right constituted a positive response that was rewarded by a 1½-minute rest period; for the remaining half of the animals, turning left was the positive response. A negative response produced a