

tween plant composition and animal species at the test site, the authors agree with Dice (1931) that the use of plant species as indicators must be used with caution because habits of animals as well as growth of plants differ from region to region.

Soil Texture

The texture of the soil is an important influencing factor, especially for burrowing animals (Table II). Antelope squirrels, grasshopper mice, little pocket mice, long-tailed pocket mice and Merriam's rats were most abundant at the test site where average penetrability of the soil was more than 50 cm and there were relatively few rocks larger than approximately 3 cm in diameter. Hardy found little pocket mice in slightly gravelly soil, long-tailed pocket mice in rocky and gravelly soil, Merriam's rats in all types but the most gravelly soil, chisel-toothed rats only in gravelly and fine soils, and canyon mice where rocks were present. Burt found little pocket mice predominantly in sandy soil of the low desert, long-tailed pocket mice chiefly on rocky, barren slopes, and indicated that each of these 2 species of mice apparently is restricted to its peculiar set of soil conditions. Hall (1946) notes that in Nevada the long-tailed pocket mouse almost everywhere lives in stony ground, and the little pocket mouse is found more often on the firmer soils of the sloping margins of the valleys. Davis and Robertson maintain that grasshopper mice probably are common throughout the Desert Scrub Association, particularly in sandy soils. Reynolds (1958) found that the majority of soils occupied by Merriam's rats are alluvial. Hardy states that shallow soil with an underlying hardpan is a satisfactory habitat for these kangaroo rats. Huey (1942) notes that Merriam's rats avoid rocky situations.

Our studies show the chisel-toothed rats, canyon mice and deer mice to be most abundant where average penetrability of the soil was less than 30 cm and rocks larger than 3 cm were abundant.

Investigations at the test site have been concerned primarily with the ecology of the valley floors where most atomic testing has occurred. Further sampling of foothills surrounding mountains needs to be done. This is likewise true for other less extensive plant community complexes such as washes and ridges where biotic and edaphic conditions differ. Such studies should be made on a year-round basis to provide additional population data and information on distribution from a seasonal aspect.

SUMMARY

Trapping records of rodents of eight species over a 16-month period in 5 desert shrub communities at the Nevada Atomic Test Site disclosed the following:

1. The greatest numbers of species occurred in the *Grayia-Lycium* and *Coleogyne* communities. Fewest were found in *Larrea* and *Lycium*.

2. Total plant cover or average height of plants analyzed separately apparently was not directly correlative with species occurrence and animal abundance. However, total cover and average height analyzed together were closely correlated with species occurrence and animal abundance.

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TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION THROUGH THE KERATINOUS LAYER OF REPTILE SKIN (SERPENTES AND SAURIA)

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Introduction

Much research has already been made on the sun radiation transmission of different wavelengths through reptile integuments. Two methods of measuring have been mainly used. First, the measurements of radiation transmission through the whole skin were made on freshly killed animals (Bodenheimer 1954, Bodenheimer *et al.*

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1953, Hunsaker *et al.* 1959). Second, other authors measured the quantity of light reflected by integuments (Norris 1958, Hutchison and Larimer 1960). These studies showed that ultra-violet (U.V.) is very strongly absorbed. Visible and infra-red (I.R.) are also widely blocked.

Knowing the energy content of solar radiation, some authors calculated the heat gain which results from different wavelength absorption. They showed therefore

an interesting relation between habitat and skin reflectivity in different lizard species (Hutchison and Larimer 1960).

However results obtained by all these authors seem to us to be subject to criticism from the point of view of methods used. Indeed, in the case of Bodenheimer, Bodenheimer *et al.*, and Hunsaker, measurements were taken by measuring light absorption through the whole skin of some reptiles, that is to say, through epiderm and derm. In this manner, it is not possible to know the part taken by each of the 2 tissues in light absorption. Does absorption take place chiefly at the level of keratinous layer or at the level of the derm? We cannot know this by working on whole skins. This method gives only a relative indication of the true protection which reptiles possess to protect themselves against strongly injurious radiation.

Norris and Hutchison and Larimer used an entirely different method and measured reflectivity in different parts of the spectrum in different lizard species. They showed the existence of a very high absorption in U.V. (90%). But, again, it is not possible with this method to know the part of the radiation which reaches living epiderm or derm; one cannot decide at which level the radiation is absorbed.

To obtain a more precise idea about reptile skin permeability to radiation and especially to know the respec-

tive absorption of each cellular layer, we decided to carry out some experiments with the keratinous layer (exuvia) alone.

Material and methods

The exuvia can easily be obtained when reptiles are molting.² Pieces of exuvia are placed between two small frames of plexiglass. These frames are placed in quartz cisterns of a Beckmann spectrophotometer. Measurements are taken across these dry samples between 270 to 2000 m μ with intervals of 50 and 100 m μ according to the regions of the spectrum. Generally, we have made transmission measurements across fragments coming from the ventral face and from the dorsal face of the body.

Results

Fourteen reptile species belonging to 7 families have been studied. Exuvia obtained after desquamation are usually not very highly colored. The color is indicated in the list below.

² We are indebted to Mr. Van den Bergh, Director of the "Jardin Zoologique d'Anvers" and to Mr. Descarpentries, Administrator of the "Vivarium du Jardin des Plantes" in Paris, for most of the material used.

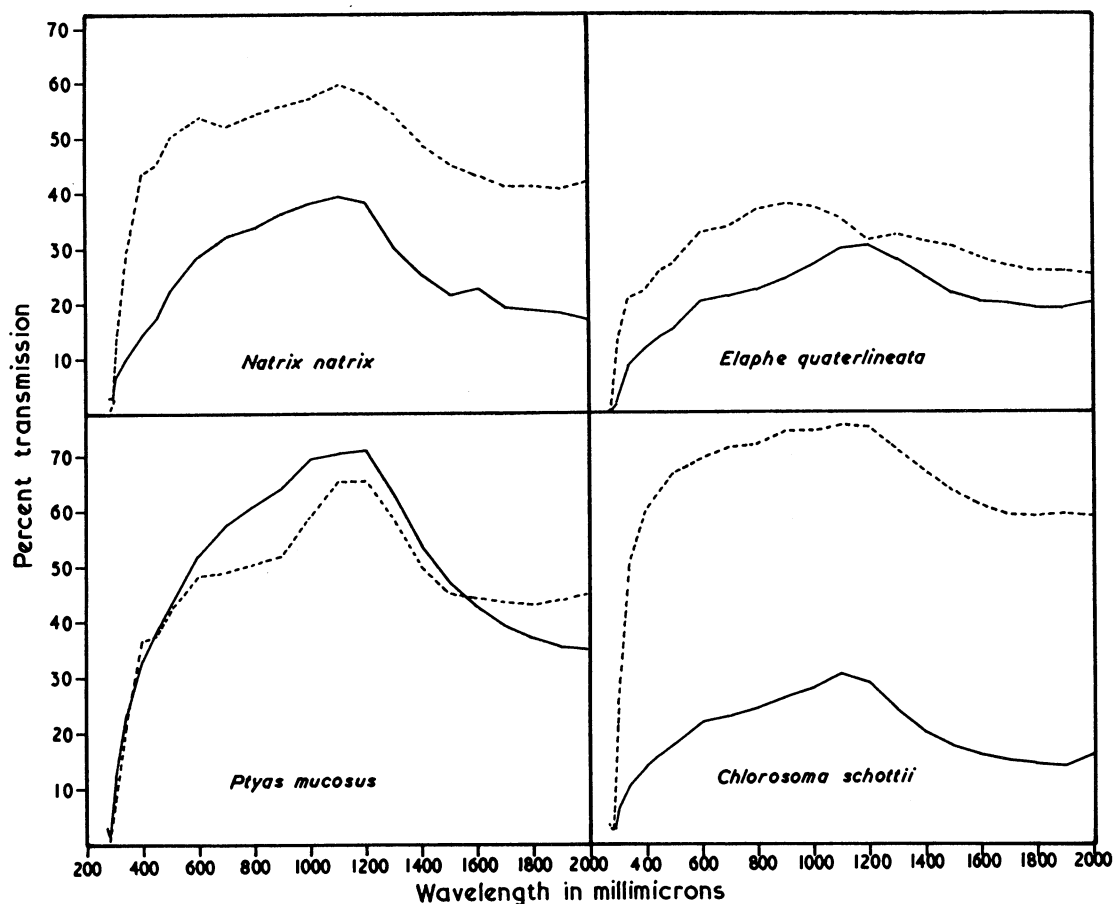


FIG. 1. Transmission through keratinous layer of reptile skin. Solid lines, dorsal integument; broken lines, ventral integument.

| List of species studied | | | | | |
|--|------------------|--------------------------------|--|-----------------------|---|
| Name | Color of exuvia | | | | |
| | d = dorsal face | | | | |
| | v = ventral face | Curve of transmission see fig. | | | |
| SERPENTES | | | <i>Pseudoboa trigemina</i> (Dum. and Bibr.) v not colored d pale yellow v pale yellow 3 | | |
| Family Colubridae. | | | SAURIA | | |
| <i>Natrix natrix</i> Lacépède | d brown | 1 | Family Lacertidae. | d white spotted brown | 3 |
| | v not colored | | <i>Lacerta muralis</i> (Laur.) | v not colored | |
| <i>Elaphe quaterlineata</i> (Lacép.) | d brown | 1 | Family Varanidae. | | |
| <i>Ptyas mucosus</i> (L.) | d black | 1 | <i>Varanus komodoensis</i> Ouwens | d brown | 3 |
| | v white | | | | |
| <i>Chlorosoma schottii</i> (Schlegel) | d brown | 1 | Family Tejidae | | |
| | v not colored | | <i>Ameiva ameiva</i> (L.) | d pale yellow | 3 |
| | | | | v pale yellow | |
| | | | <i>Tupinambis nigropunctatus</i> Spix | v pale yellow | 4 |
| | | | Family Scincidae | | |
| Family Pythonidae. | | | <i>Tiliqua scincoides</i> (White) | d pale yellow | 4 |
| <i>Python sebae</i> Gmelin | d brown | 2 | Discussion | | |
| | v brown | | A first conclusion to be drawn in examining different absorption curves is that U.V. is very strongly absorbed (chiefly between the wavelengths of 270 to 280 mμ). This phenomenon is common to all the species studied, although they came from different regions in the world. It exists at the level of the keratinous part of the dorsal face and of the ventral face. | | |
| <i>Python reticulatus</i> Schneider | d brown | 2 | | | |
| | v brown | | | | |
| <i>Aspidites melanocephalus</i> Krefft | d brown | 2 | | | |
| | v brown | | | | |
| Family Boidae. | | | | | |
| <i>Boa canina</i> L. | d not colored | 2 | | | |

Discussion

A first conclusion to be drawn in examining different absorption curves is that U.V. is very strongly absorbed (chiefly between the wavelengths of 270 to 280 mμ). This phenomenon is common to all the species studied, although they came from different regions in the world. It exists at the level of the keratinous part of the dorsal face and of the ventral face.

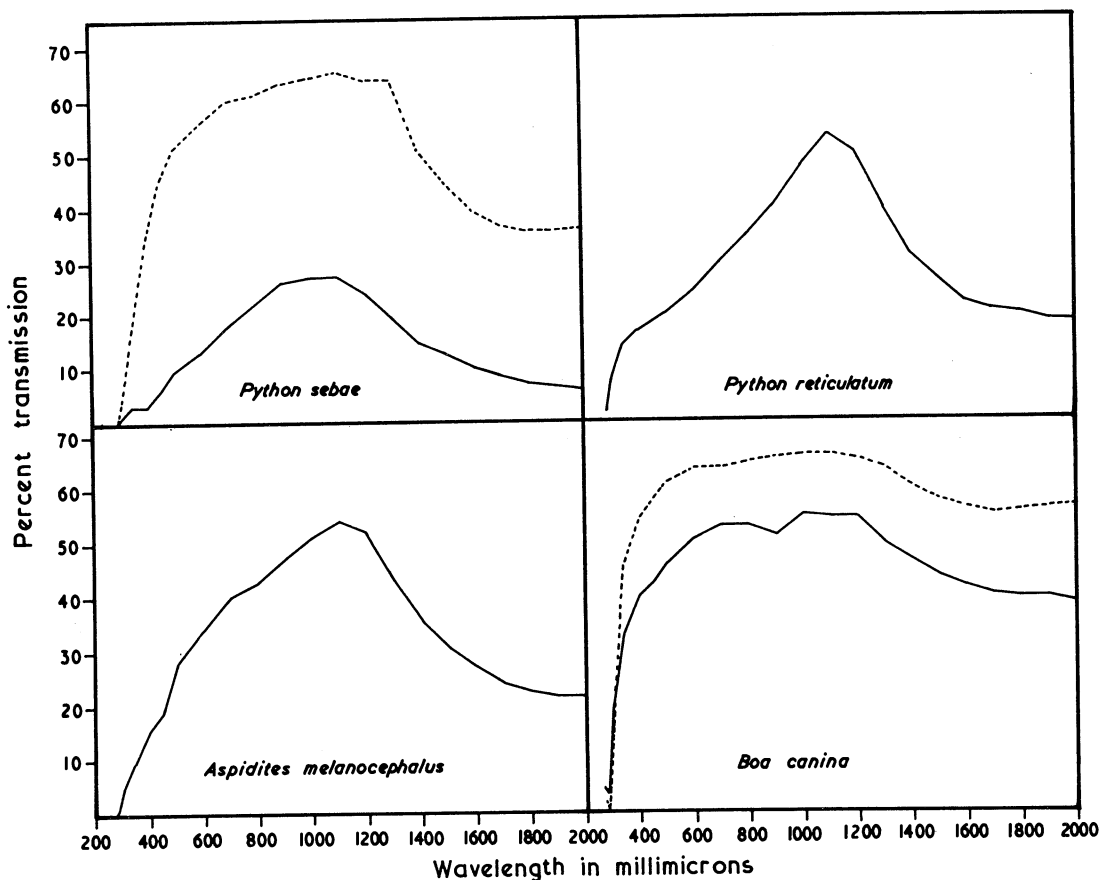


FIG. 2. Transmission through keratinous layer of reptile skin. Solid lines, dorsal integument; broken lines, ventral integument.

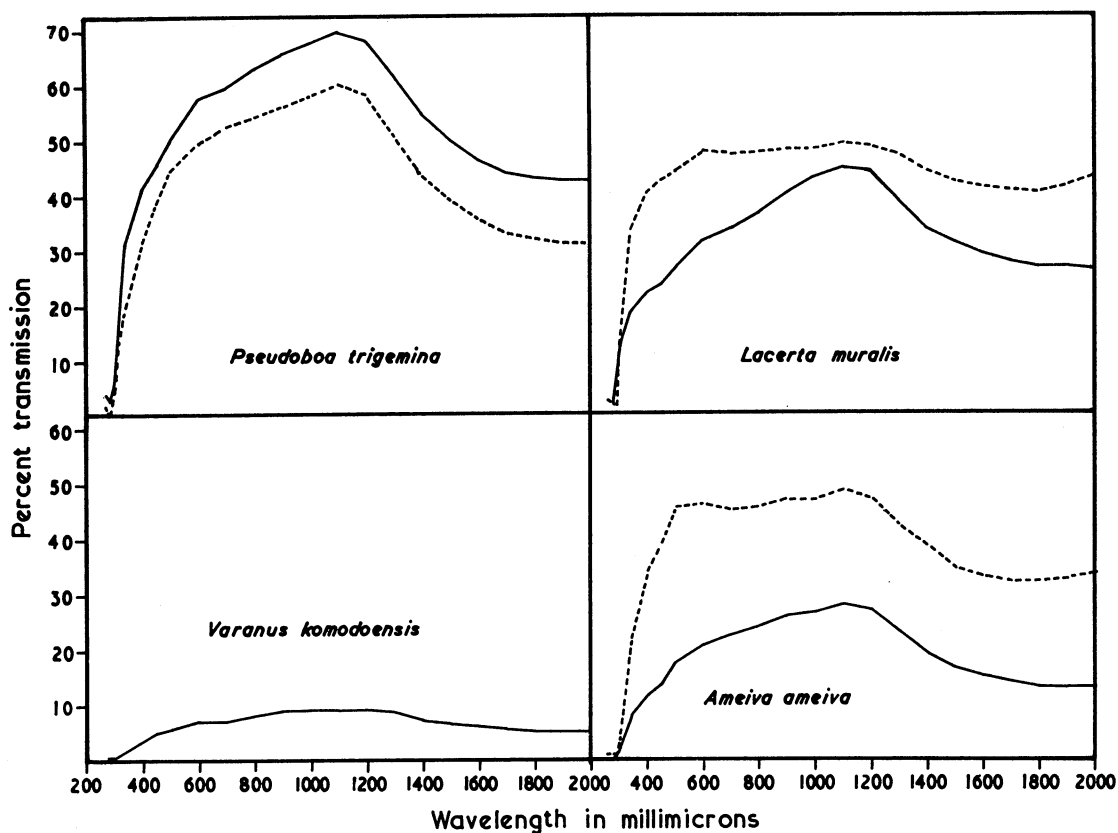


FIG. 3. Transmission through keratinous layer of reptile skin. Solid lines, dorsal integument; broken lines, ventral integument.

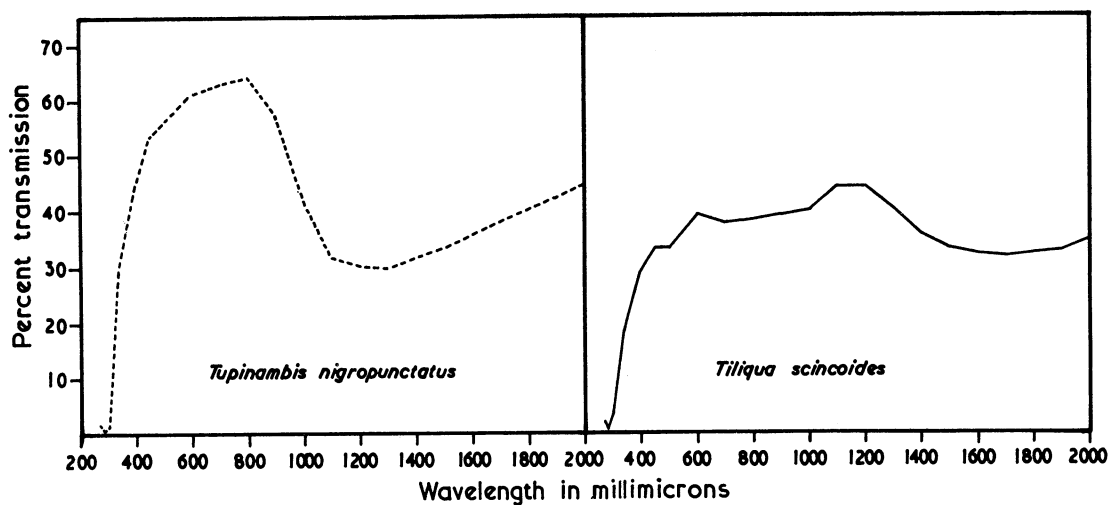


FIG. 4. Transmission through keratinous layer of reptile skin. Solid lines, dorsal integument; broken lines, ventral integument.

The visible part of the spectrum is also strongly absorbed (average 40 to 60%), and I.R. as well, for which absorption is generally more important.

Different transmission curves are nearly identical except for one species which distinguishes itself strongly from the others. This is *Varanus komodoensis* whose exuvia has a transmission always lower than 10% in all

wavelengths studied. This phenomenon can be explained when we compare the thickness of its exuvia with those of other species. For instance, *Boa canina* exuvia has a thickness of about 10 μ while those of *Varanus komodoensis* is about 50 μ . Evidently, transmission is weaker.

We also notice that, in most species, transmission is less important at the level of the dorsal body face than at that

of the ventral. Two species are an exception and present the inverse phenomenon: *Ptyas mucosus* and *Pseudoboa trigemina*. Hutchison and Larimer established a similar fact: reflectivity is more important at the dorsal face than at the ventral face (two exceptions: *Sauromalus o. obesus* and, partly, *Sceloporus magister*). Since heat gains at the level of the reptile ventral face are principally due to conduction (Saint-Girons 1956), it does not appear that this higher transmission is disadvantageous for the animal.

It does not appear to us possible to calculate the heat gain of different species of reptiles studied as proposed by Hutchison and Larimer because data in the literature with regard to sun radiation do not take into account animal habitats (in forest, for instance). On the other hand, in rocky places, infra-red radiation of great wave lengths exists, emitted by the sun-warmed rocks. In the same way, grass has an albedo of 20 to 30% (Nicolet 1957). In order to calculate correctly the heat gain in an animal, we should know the intensities of these different wave lengths at the level of different cellular layers of the skin. In view of the limited physical and biological data at our disposal, it is not yet possible to consider these different factors.

Conclusion and summary

We can conclude from the results presented here that the protection given by the keratinous part of reptile epiderm is rather important. It is complete in U.V. of wavelength 270 to 280 m μ and it is also very important in I.R. (transmission of less than 50% between 1300 to 2000 m μ) in the most species. In this manner, living epiderm and derm are well protected against radiation of 270 to 2000 m μ .

Résumé

Des mesures de la transmission du rayonnement de longueur d'onde de 270 à 2000 m μ ont été effectués au

niveau de la partie cornée de la peau des Reptiles (exuvie). Elles ont montré que l'U.V. de 270 à 280 m μ était totalement arrêté. Une grande partie de l'infra-rouge et du rayonnement visible était aussi arrêtée (50% environ chez la plupart des espèces). La transmission est toujours plus faible au niveau de la face dorsale qu'au niveau de la face ventrale (sauf 2 exceptions).

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Editor's note

Your Zoological Editor has tried diligently not to involve ECOLOGY in the tiresome polemics that have burdened many other journals with debates about the terms and the concepts of "density-dependence" and "density-independence." With the publication of Smith's paper in Vol. 42, however, we were brought to the brink of total involvement. Ever since then rebuttals and counter-rebuttals have been coming to me, going to reviewers, coming back to me, and going to the authors with comments and criticisms.

I see no way for Andrewartha finally to settle the issue because he is in the awkward position of defending a negative proposition of the type that elementary logic

tells us is unprovable. Nevertheless, I would not deny him the right to reply to criticism of his work. I had hoped to mediate the dispute and obtain one clear-cut reply from Andrewartha that would end the matter. But the pursuit of this goal has been painfully slow and time has run out. I am editing my last lot of copy and do not want to leave the new editor in the midst of a dilemma of my creation.

The two replies that follow represent the latest version of Andrewartha's reply to Smith and Smith's comments on the reply. They are published just as received from the authors.

LaMont C. Cole

DENSITY-DEPENDENCE IN THE AUSTRALIAN THRIPS

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Smith (1961) re-analyzed some of the data published by Davidson and Andrewartha (1948b) and reached conclusions that differed from ours. Smith's conclusions are not acceptable because they depend on three epistemological errors.

Smith argued that any population that is controlled by a density-dependent factor exhibits a small variance:

therefore all populations that exhibit small variances are controlled by density-dependent factors. More particularly he showed that the population of *Thrips imaginis* that we studied exhibited a smaller variance at some times of the year than at others; therefore, he said, this population of *Thrips imaginis* was controlled by a density-dependent factor for the nine months of the year when