

CHAMELEONS—A STUDY IN ADAPTATION AND IN ORNAMENT

BY KARL P. SCHMIDT

CHIEF CURATOR, DEPARTMENT OF ZOOLOGY

SHORTLY before World War II, a living specimen of the remarkable lizard known as the common chameleon, native to the borders of the Mediterranean, reached the Museum as a gift from Dr. Georg Haas, my colleague in herpetological studies at



PORTRAIT

The East African Mountain Chameleon, *Chamaeleo bitaeniatus hoehneli*.

the Hebrew University in Jerusalem. The chameleon of North Africa and Palestine is the species known to classical antiquity and is the typical chameleon in the sense that it was the first of the numerous species to become known to the learned world.

Our specimen lived for nearly two years in the laboratory of the Division of Reptiles. Its structure and behavior were so extremely interesting that it served the peculiar function of arming us against such Philistine visitors as are unable to understand the lifelong interest of the zoologist in animals, and think of him as being in some way abnormal. In the chameleon are combined a marvelous capacity for color change, goggle eyes focusing separately on the proffered spider and on the visitor, slow motion stalking of prey as it moves along a twig with tong-like feet, and the contrast of the lightning shot of the projectile tongue that picks up a spider at 10 inches' distance when the lizard itself is only 6 inches long. Our laboratory chameleon proved, in fact, to be as interesting to the casual visitor from any walk of life and any age as it was to the zoologist himself. We were often rewarded, after a demonstration of the chameleon, with the remark, "No wonder you are interested in studying such creatures."

Our Jerusalem chameleon had been six weeks en route by ordinary mail, and in spite of the ability of reptiles to survive long fasts, arrived in so emaciated a condition that we were fortunate to be able to nurse it back to normal activity. With the establishment of world-wide air transport

systems, zoologists could not fail to think of the new facilities for the acquisition of strange small creatures from the far corners of the earth, and by way of setting an example, the Museum had obtained a few West Indian reptiles by this means in 1944. Remembering our chameleon especially, no traveler to Africa who had any contact with the Museum escaped the request to try a shipment of chameleons by air express to Chicago.

The first successful shipment, marked by the safe arrival of 27 chameleons at the Museum on June 25, 1948, resulted from a request to Mr. Harry Hoogstraal, who is attached to the staff of the Naval Medical Science Group of the University of California African Expedition. Mr. Hoogstraal, of the Museum staff and recently leader of the Museum's Philippine Expedition of 1946-47, is on loan to the Naval Medical Science

Group to conduct certain special projects.

The chameleons were desired for critical studies of behavior such as have proved extraordinarily fruitful in university research programs, but they do not represent an engagement of the Museum in the field of

animal behavior. The Museum's interest lies in making use of its knowledge of the world fauna to fertilize and vary the studies of the specialists in this relatively new field of study, and in maintaining a contact of its staff of naturalists with such researches. The chameleons now available are being studied by Dr. Bernard Greenberg of Roosevelt College, whose training has the background of studies with the late G. K. Noble of The American Museum of Natural History in New York and with Professor W. C. Allee of the University of Chicago. He is assisted by Miss Mary Weaver, of Glen Ellyn, a student at Carleton College, who is a volunteer at the Museum for the summer months.

As to the chameleons themselves, they represent the subspecies *Chamaeleo bitaeniatus hoehneli* of the mountains of Kenya Colony, East Africa, one of a series of forms found on high mountains from Abyssinia to the Ruwenzori. Almost identical in scale characters and head-form from specimen to specimen, there were no two alike in coloration when they were removed from their shipping crate.

EMOTION—LIKE A BLUSH

Mottled brown, plain brown, solid livid green, gray with yellow stripes on each side, almost black, boldly red spotted, and various combinations of these patterns and colors were represented. Still more remarkable, each chameleon may change its color from hour to hour and from day to day. It is

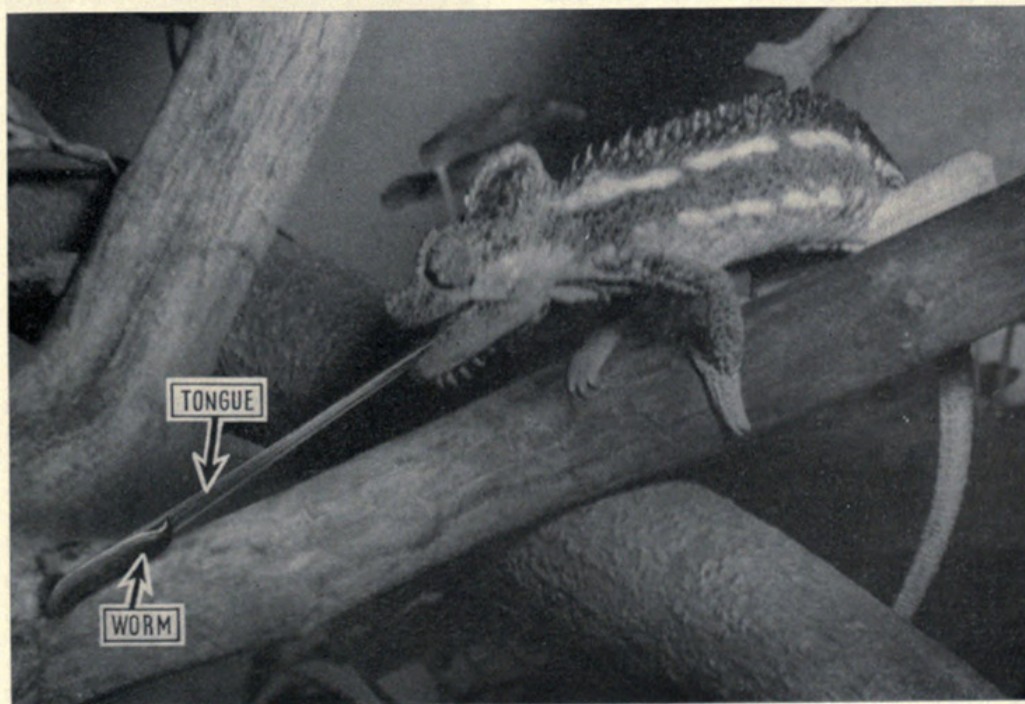


Photo courtesy Chicago Daily Tribune

PHENOMENAL TONGUE

Chameleons are "dead shots," and "quick on the trigger" with their projectile tongues when prey crosses their otherwise slow path. Just as quick was a newspaper photographer, Mr. Robert Mackay, who by instantaneous action was able to make this remarkable picture before the end of the jiffy in which the body-long tongue vanished with its quarry.

thought that these color changes (from which the word "chameleon-like" in the sense of "changeable" is derived*) are governed in part by background resemblance and in part by emotional reactions such as anger and fear. Actually, much remains to be learned and recorded about the factors that govern such elaborate color change.

One of the most evident features of living organisms is their adjustment for particular

by reason of their rough soles and sharp incurved claws.

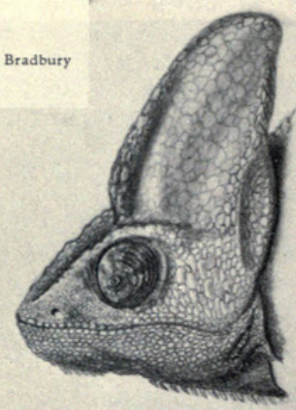
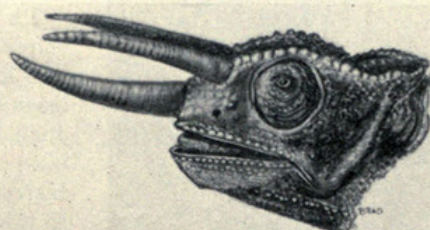
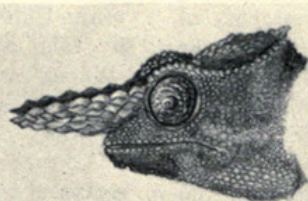
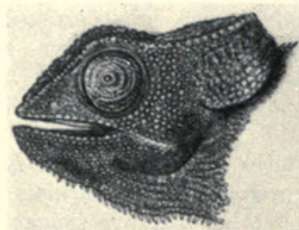
SLOW MOTION AS NORMAL PACE

The tendency to develop extreme slowness of movements is found widespread among arboreal mammals like the sloths and certain lemurs; in the chameleons it is developed into a fixed mode of locomotion that is extraordinarily effective in the animal's

ornamentation, sometimes found in both sexes, sometimes only as male structures, and often variously recombined from species to species. Thus there is variation in the size of the scales of the sides, which may be uniformly granular or plate-like or mixed; the scales along the middle of the back may be low or raised or sculptured, and along the mid-line of the chin and belly they likewise often are found to

Variation in the Fundamental Chameleon Type Has Gone to These Extremes

Drawings by Margaret G. Bradbury



Chamaeleo dilepis of West Africa

Chamaeleo fischeri of Tanganyika

Chamaeleo jacksoni of Kenya

Chamaeleo calyptratus of Arabia

modes of life, and one of the principal modes of evolution has been the hereditary fixation of such adjustments in whole groups and their progressive further improvement and elaboration. Secondly, any great evolutionary adjustment may be the starting point for a whole new series of species that run the gamut of minor variation on the theme of the major adaptation.

The chameleon group supplies an elaborate yet extremely clear example of these two principles of evolution. The whole chameleon organism is focused in sharp adjustment to its place of life, to the availability of abundant insect food, and to its mode of feeding. Entry into bushes and trees commonly carries with it striking adjustments, such as grasping hands like our own, or prehensile tails, like those of the spider monkey. Sure enough, here in the little chameleon we find the neat combination of a flexible tail (too valuable to be fragile and easily lost like that of so many lizards) and the most curious grasping hands and feet. Each foot has five digits, and these are firmly united into bundles respectively of two and three. In the interest apparently of symmetry, the two-toe bundle is on the outside in the front foot (i.e. in the "hand") and on the inside in the hind foot. These two bundles of toes oppose each other as a most effective pair of tongs for grasping a twig or small branch. They are effective for climbing on larger branches

principal activity, namely its search for the often wary insects and spiders that form its food. Any last-minute rush to secure its prey is made unnecessary by the extremely effective projectile tongue, which has a sticky tip. This organ may be shot out, with a motion too rapid for the eye to catch, to a distance considerably greater than the length of the chameleon's body, and with almost unfailing accuracy.

To what extent the separate operation of the eyes is an adaptation to the chameleon's mode of life is not clear, but their large size and apparently binocular use, evidenced by the accuracy of measurement of the distance to which the tongue is to be shot out, are clearly correlated with daylight hunting in which eyesight is the principal sense employed.

All these characters apply completely to every one of the 80-odd species of chameleons, and even to the curious little *Rhampholeon* of central Africa, in which color change is largely given up in favor of dead-leaf "protective resemblance," and to the two bizarre Madagascan genera, *Brookesia* and *Leandria*. Madagascar, by the way, has about half the species of the genus *Chamaeleo* including a two-foot long giant form. Arabia has two species, Peninsular India one, and Africa the rest.

Equal in interest to the functional adaptations for a specific mode of life, from the standpoint of the origin of species, are the characteristics by which the species of so compact a group are found to be distinguished. The useful characters above outlined are those of the family Chamaeleontidae. The characters that distinguish the separate species seen to be mainly "useless"—they consist in a bewildering array of

vary greatly—being elongate and beard-like in the Kenya chameleon. High finned crests may be developed either on the back or on the base of the tail. There are very characteristic head shapes, from concave above to fantastically helmeted. Most striking of all is the development of forwardly directed horns—there are one-horned, two-horned, three-horned, and even four-horned chameleons, most with smooth horns, but some with scaly horns.

FIELD FOR RESEARCH

It is expected that when the behavior of chameleons is studied by modern methods that these "ornamental" characters will be found to have some significance in the life of the species, in species recognition, sex-recognition, or, in combat between males.

Behavior studies of our Kenya chameleons may begin at an appropriate beginning, namely at birth. Two days after their arrival in Chicago, and while we were discussing the provision of suitable sand or earth for possible egg-laying, one of the females gave birth to thirteen living young.

Less than a minute after birth, each had wriggled out of its foetal membranes and immediately climbed upon the nearest object, often its own mother. Unfortunately, the mother seems to lack parental instincts for she promptly detached her clinging babies with vigorous swipes of the hind legs.

Although of edible size, the young aren't eaten or harmed, even when climbing over the very jaws of the older chameleons. At birth, they are fully equipped with the extraordinary patterns of locomotion and feeding typical of this remarkable lizard, and are able to fend for themselves without a

*The use of the name "chameleon" for the little iguanid lizards from the southern United States (and sometimes for a species from Cuba) is of course similarly derived from the ability to change color; but to be "chameleon-like" is scarcely to be a chameleon. Zoologists much prefer to use the term "anole" for these American lizards which often have been sold for a few cents apiece at pet shops, circuses, county fairs, etc.

(Continued on page 6, column 3)

COCAINE IN SOUTH AMERICA SOLD LIKE CHEWING GUM

By HUGH C. CUTLER
CURATOR OF ECONOMIC BOTANY

Drug plants and narcotics are usually associated with the Orient, yet a large part of the people living in the Andes of Ecuador, Peru, Bolivia and near-by countries of South America use cocaine daily. The cocaine plant is one of the New World cultivated plants which were studied by the Museum's Desloge 1948 Peruvian Botanical Expedition.

Most species of the genus *Erythroxylon* are natives of South America, while a few others grow in Africa and southeastern Asia. However the drug is obtained from the Peruvian and Bolivian species, *Erythroxylon coca*, cultivated for this purpose. Like rubber, tapioca and cashews, cocaine is now grown in the East Indies from New World seed. By careful handling and by selection of high drug-yielding varieties, the amount of cocaine alkaloids in the leaves of the East Indian plants has been increased so that they now yield nearly twice as much as leaves taken from average plants in South America. This case is similar to the history of rubber in the Orient. Improvements in culture methods and plant-breeding in rubber made in the Far East now yield larger quantities of more uniform and cheaper rubber than the methods in use in the New World.

PROCESSED LIKE TEA

The cocaine plant is cultivated and harvested much like tea. Nursery-grown seedlings are transplanted to terraces on the moist slopes of semi-tropical valleys. The leaves are picked when they are fully grown. Unlike tea, the terminal clusters of leaves and the very young ones are not taken. After picking, the leaves are spread out to dry in the sun and are turned every hour. In parts of the Andes, a barefooted worker stamps on the leaves when they are fresh. This flattens the leaves and bruises them slightly so that they dry quickly. During the rainy season the leaves are dried in special sheds on bamboo racks below which a low fire is kept burning. When the leaves are completely dry they are tightly packed in homemade sacks or pressed into small bales.

Most of the cocaine leaves produced in South America are used locally. A large part of any marketplace is occupied by vendors of the leaves. So general is the use of the leaves that many big farms pay a large part of wages with such leaves. The leaf-chewing habit is spreading in South America. During the recent Chaco War between Bolivia and Paraguay, leaves were distributed to the Bolivian soldiers and now the Indians of the Chaco have learned the habit. Improved transportation, by trains and trucks, has allowed many workers to

learn about the use of the leaves and made it easier to secure them. On the other hand, an increasing number of natives abandon the habit after they are educated or after they work awhile in the larger towns. Increased labor costs and the spread of plant diseases in the cocaine plantations have raised the cost of the leaves. The increased cost often discourages the habit. But since chewing the leaves deadens the pangs of hunger, workers buy less food and become weak and susceptible to disease.

'MAGICAL USES'

Most of the leaves grown in the New World are chewed. Only a limited amount is devoted to extraction of cocaine used in medicine, especially as a local anesthetic.



SOCIAL COMMENTARY

As shown in this picture, cocaine leaves are sold openly like any other commodity in all the Andean market places. This scene is in Cochabamba, Bolivia. Also sold are pellets of lime or ash to chew with the leaves—the alkaline helps to release the drug.

Some leaves are used in making tea and in the preparation of soft drinks. An interesting use of the leaves in the area visited by the Desloge Peruvian Botanical Expedition is in divining the location of lost or stolen property. A medicine man casts the leaves onto a smooth piece of ground or on flat stones and then tells, from the pattern in which the leaves fall, where the property can be found. The medicine man is usually paid in leaves.

To chew the leaves several are placed in the mouth and a small piece of lime or ashes mixed with clay is added. The leaves are moved slightly with the tongue and teeth but usually are kept as a quid between the teeth and the cheek. The

SUMMER MOVIE PROGRAMS FOR CHILDREN

Two more of the Raymond Foundation's free summer programs of motion pictures for children remain to be given on the first two Thursday mornings of August.

The entertainments will be given in the James Simpson Theatre of the Museum at 10:30 A.M. Children are invited to come alone, accompanied by parents or other adults, or in groups from clubs and various centers. Admission is free. Following are the dates and titles of the films:

August 5—THUNDERING WATERS

Niagara Falls.

Also a cartoon.

August 12—SIMBA

African pictures taken by the Martin Johnsons.

Story told by Harriet Smith.

lime and ashes are alkaline and help to release the drug. Using an alkali in this fashion is a very old trick, for it was practiced in South America long before Columbus arrived. We know this because in prehistoric burials of coastal Peru we often find small gourds with ashes or lime associated with the bags which contain the cocaine leaves. In northern Peru some of the pottery figures of men are shown wearing these bags or taking cocaine leaves.

The use of an alkali with a drug plant is not restricted to South America. Betel nut chewers of the Orient usually chew lime with their nuts. When the Spaniards conquered Mexico, the Indians chewed tobacco mixed with lime to keep them from feeling hunger and thirst on long journeys. And in northern South America and the West Indies, ground seeds of a mimosa-like tree, *Piptadenia peregrina*, are mixed with ashes and snuffed.

FORBIDDEN TO WOMEN

The use of cocaine leaves is a male prerogative. While the common Indian of the Andean highlands is rarely without a quid, the women rarely ever enjoy the pain- and fatigue-dulling solace of the leaves. "For men only" was a common rule for drug plants in many regions.

The black drink or cassine tea of our southeastern United States Indians which is shown in Case 54 of Hall 25 could not be imbibed in some tribes if a woman even saw the pot in which it was prepared. In the jungles of the upper Amazon, women were put to death if they saw the ceremonies surrounding the drinking of a solution of caapi, the narcotic containing *Banisteria Caapi*. And even among our own people in the United States, one realizes upon reflection, only certain forms of nicotine can be enjoyed by women, for social custom limits the use of pipes and cigars to men only.

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Members are requested to inform the Museum promptly of changes of address.

RANK-AND-FILE BIRDS DOMINATE RESEARCH

The occasional discovery of species new to science adds zest to the museum researcher's work, but more frequently his enthusiasm is jogged when least expected by less spectacular though often more important discoveries. For an ornithologist, it may be the receipt of specimens in a phase of plumage either proving or disproving the existence of a previously described form. Sometimes a single specimen collected far beyond the known range of its kind opens up unexplored avenues of research that may lead to an entirely new concept of its relationships. And not infrequently the routine process of studying a general collection in the course of its identification discloses bits of information that collectively add much to our knowledge of the bird life of a region.

A MEXICAN COLLECTION

Such was the case with a collection of 342 birds from the state of Guerrero, in southwestern Mexico, which is the basis of a report soon to be published by the Museum. Since the birds of Guerrero have received the attention of competent investigators for many years past, this small collection was at first regarded merely as a desirable though not particularly interesting addition to the Museum's representation of Mexican bird life. Methodical identification of the 109 species and geographical varieties in the collection revealed none

new to science, but interest quickened when it was found that fifteen of the birds had not previously been reported from the Mexican state of Guerrero.

Nine of these were migrants. They serve to emphasize both the need for continued field work in southwestern Mexico and the extent to which various races of North American species are brought together in winter by the funneling effect of the Isthmus of Tehuantepec. An interesting by-product of this study was the accumulation of data suggesting that the pre-breeding activity of female reproductive organs lags far behind that of males in spring but finally undergoes much more rapid development. Clues to an explanation of the phenomenon of migration may eventually be found in the refinement and elaboration of similar correlations between physiological development and various aspects of the seasonal cycle.

BEARING ON EVOLUTION

Collections from areas inhabited by intermediate populations, or birds that combine the characters of two or more related varieties, are of special interest to the zoogeographer and student of evolution. The Guerrero collection repeatedly reflected the influence of elements from the diverse Mexican faunas and those of Central America. For example, analysis of the range and affinities of Godman's Euphonia, a colorful little tanager never before reported in Guerrero, shows that it is intermediate between the white-vented and Lesson's Euphonia and that it is actually a geographical variant or sub-species of the latter rather than a distinct species, as has been supposed since its discovery in 1889.

A study of Guerrero roadrunners produced evidence, by inference, that an intermediate population exists in the adjacent state of Oaxaca. Similarly, two distinct races of burrowing owls, and those of several other species, were found to merge in Guerrero, resulting in a population that can be allocated to either race with equal justification. Information such as this—which increases our understanding of bird distribution and genealogy, the extent of individual variation and modification of populations by related forms—attracts no headlines but is one of the more important products of museum research.

EMMET R. BLAKE

Associate Curator of Birds

Gift to Museum Library

The Library of the Museum has received a collection of several hundred books, pamphlets, and periodicals on entomology, as a gift from the family of the late Charles V. Riley, through his daughter, Miss Thora Riley, of Washington, D.C. Mr. Riley died in 1895. The collection has a high historical value and makes a notable addition to the resources of the Library.

STAFF NOTES

Mr. Miguel Covarrubias, one of Mexico's most noted artists, who is also an ethnologist and archaeologist of note, has been elected to the staff of the Department of Anthropology as Research Associate in Primitive Art. Mr. Covarrubias recently was in Chicago and spent considerable time in conference and studies with members of the Museum department. In addition to his other accomplishments he is especially well-known as an expert in primitive art, and as a writer and teacher. . . . Mrs. Dorothy Foss of the Department of Zoology has been promoted from Assistant, Division of Anatomy, to Osteologist. . . . Mr. John W. Moyer, Chief of the Division of Motion Pictures, is the contributor of the illustrated article on taxidermy in the recent new edition of the *Encyclopedia Americana*, and is a contributor also to the latest edition of the *Encyclopaedia Britannica* and the *Britannica Junior*. The articles are illustrated with photographs taken in this Museum. . . . Mr. Clifford H. Pope, Curator of Reptiles, reports favorable conditions for salamander studies at Mountain Lake, Virginia, the summer station of the University of Virginia. He is actively engaged in examination of salamander distribution as governed by altitude in drainage systems in this region. . . . Dr. Sharat K. Roy, Chief Curator of Geology, and Mr. Arthur G. Rueckert, Staff Artist, made a survey of eastern museums in connection with projects for the Department of Geology.

CHAMELEONS—

(Continued from page 4)

learning period. At their first feeding attempt, the babies were able to project the sticky tongue a full inch and a quarter, a greater distance than their body length, and hit the target accurately. Small spiders, flies and tiny insect larvae form their present diet.

Preparations are being made for more such broods, from several other expectant female chameleons.

Viviparous production of young is well-known in several species of chameleons in temperate South Africa, and is reported for montane species in East Africa, presumably for the very species in question. Most chameleons, however, lay eggs, depositing them in excavations in the soil. Needless to say, the production of tiny replica chameleons adds to the combination of fascinating interest and charm of the first Chicago chameleon colony.

Brief survey tours of the Museum, suited to a visit of one or two hours but possible in thirty minutes for those who have to skim through in a hurry, are outlined, with charts, in the latest Museum General Guide.



Schmidt, Karl Patterson. 1948. "Chameleons---A Study in Adaptation and in Ornament." *Bulletin* 19(8), 3-6.

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