FIG. 1. Crystalline pigment obtained from the mycelium of *A. boydii* (polarized light).

in acid solution, and in chloroform and benzol in very strong acid solution. Aqueous alkaline solution dissolved the pigment, producing a violet precipitate. The yellow pigment of the medium is not soluble in organic solvents.

The reactions presented by both pigments are shown in Table 1.

The reactions presented by the mycelial pigment show that it belongs to the group of quinone pigments. A more detailed study of the conditions in which this pigment is produced, as well as its chemical composition, is in progress.

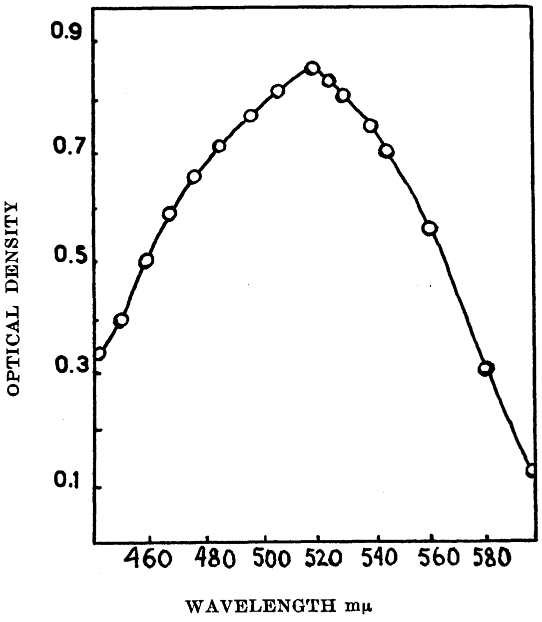

FIG. 2. Absorption spectrum of the mycelial pigment of *A. boydii* dissolved in chloroform. Data obtained with a solution containing 2 mg/ml, the thickness of the absorption cell being 1 cm.

TABLE 1

Reagents	Mycelial pigment	Pigment of the medium
Acetic acid	Red with green fluorescence	Not changed
Sulfuric acid	Blue-violet	Reddish
Ethanol-ammonia	Purple	Not changed
Acetic anhydride	Deep-red	Not changed
$FeCl_3$	Olive-green	Brown-red
Bromine	Yellow	Orange-yellow
Acetic anhydride $+ H_2SO_4$	Brown-red, forming a gelatinous precipitate	Not changed
Zn + NaOH	Color discharged	Color discharged
Br + NaOH	Color discharged	Color discharged

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The Coloration of the Tail Tip of Young Fer-de-Lances: Sexual Dimorphism rather than Adaptive Coloration

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An interesting example illustrating the complexity of adaptive coloration in animals recently came to our attention with the birth of a brood of fer-de-lances (*Bothrops atrox*). In some individuals of this brood, as is typical for this species and for other pit vipers of the family Crotalidae, the last inch or so of the tail is a brilliant sulfur yellow, except for the very tip, which is dark. The general appearance is that of a yellow worm with a black head. In a number of instances recorded in the literature, which we shall cite, captive individuals have been observed to set the tail twisting and writhing when food is offered. Various authors have suggested that in these forms the tail tip serves as a lure attracting lizards, frogs, or toads to within striking distance of the snake.

The first mention of this adaptation seems to be that of Ditmars (*4*), who described the color of the tail and the tail wiggling behavior of the copperhead (*Agkistrodon contortrix*) and suggested its possible value in luring frogs. Henry (*6*) actually observed young of the hump-nosed pit viper (*A. hypnale*) attract small lizards in this manner and kill and eat them. According to Pycraft (*9*), the same manner of tail wiggling is exhibited by juveniles of the copperhead, the cottonmouth (*A. piscivorus*), and the fer-de-lance. Additional observations substantiating the idea that the bright tail serves as a lure are reported by Neil (*8*) for the copperhead, and by Allen (*1*) for the Mexican moccasin (*A. bilineatus*). The latter account includes an excellent photograph of the typical tail lure position of young Mexican moccasins and in addition observations of frogs struck and eaten after having been attracted to the wiggling tail tips. Cott (*3*) briefly discusses the bright tail tip in these pit vipers among those characters which lure prey to the most dangerous part of their enemy.

Actually successful luring of prey by the use of the tail has thus been observed only in two species, *A. hypnale* and *A. bilineatus.* There are, however, strong indications that the same phenomenon occurs in the two North American moccasins, *A. contortrix* and *A. piscivorus.*

The situation is even less well known in the neotropical pit vipers of the genus *Bothrops.* An excellent opportunity presented itself on September 27, 1949, when a fer-de-lance from the state of Veracruz, Mexico, gave birth, as mentioned, to 20 young in the laboratory. In this litter there was marked sexual dimorphism in the color of the tail tip. Only in males was the tail tip a uniform brilliant yellow. In females the terminal third of the tail was only slightly lighter than the rest of the tail (see Fig. 1). Of the eight females one had a dull yellow tail tip, but even in this individual, dark dorsal blotches were clearly discernible on the tail down to the very tip. If the tail tip of young fer-de-lances serves to attract prey, as Pycraft (*9*) suggests, why should the tail of one sex show the color adaptation while that of the other does not? Apparently here is a sexual character which, oddly enough, disappears before maturity.

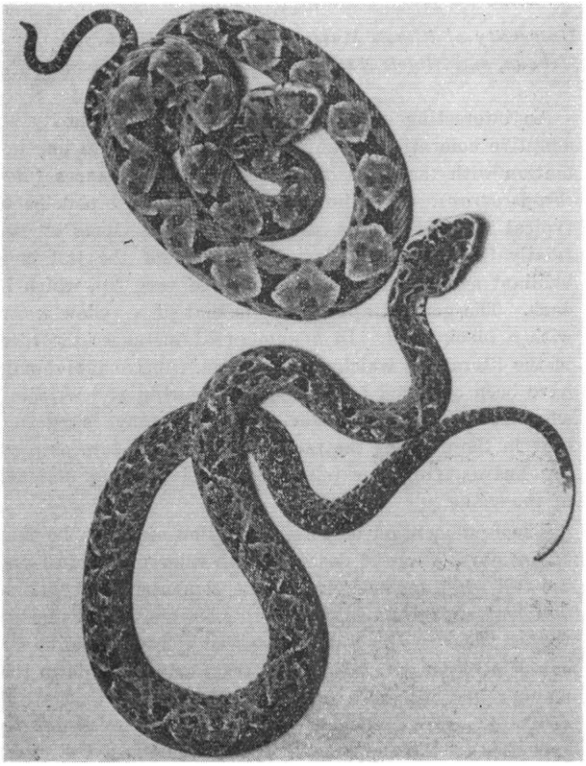

FIG. 1. Four-week-old fer-de-lances of both sexes, showing the bright yellow tail of the male (at the bottom). Photo by Charles L. Scott.

It has been called to our attention that the occurrence of such a sexual difference in a single litter could be due to a simple sex-linked recessive character. Sex determination in *Bothrops atrox* is probably of the XX-XY type, with the female exhibiting the heterogamety.[1] If such is the case and the dark tail tip is due to a simple sex-linked recessive character (x), the yellow tail tip being due to its dominant allele (X), mating of an xx male with an Xy female would result in a brood of yellow-tailed males (Xx) and dark-tailed females (xy).

Preserved young from two other litters were available for study. The males all had yellow tail tips and the females all dark tail tips. This is in contrast to the situation in *A. contortrix* and *Bothrops nummifer,* in all of which the young of both sexes have bright yellow tail tips. Data concerning these specimens are given in Table 1.

It seems highly unlikely that three randomly selected broods of fer-de-lances would all have the specific parentage required for the situation described. If the genetic explanation as given were the correct one, the parental genotypes necessary to give the recorded litters are only one assortment of the six possibilities. Assuming that the genes in question are present in equal frequencies in natural populations, the probability that the specific mating necessary to give the recorded broods would occur three times in succession is less than 0.5 out of 100. Preponderancy of one or the other of the genes would further reduce the probability. Our original premise that the difference in tail color is a case of sexual dimorphism seems to be the simplest explanation.

The feeding habits of the young fer-de-lances were observed with great interest. In the beginning several of them were kept with a litter of young timber rattlers (*Crotalus horridus*), all of which were almost twice as large. Three times the young fer-de-lances attempted to eat rattlesnakes, but in each case the victim, though overcome, could not be swallowed by their smaller assailants. Small frogs (*Acris gryllus* and *Hyla crucifer*) were eaten readily. Though the tail was held up at times and though in the dark the tail tip of the male was very much in evidence, there was no well-marked tail wiggling such as described in the *Agkistrodon.* If the tail were of any use in luring the frogs it was not evident to us. Several days later a young female fer-de-lance tried to eat a slightly larger male but could not swallow it. The next day the same female ate a Dekay's snake (*Storeria dekayi*). This variation in diet, including prey not attracted to wormlike lures, could conceivably be associated with the failure of the bright tail to develop in both sexes.

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[1] All of the reptiles which have been carefully studied have shown the XX–XY type of sex determination with heterogamety in the female. Evidence is presented by Nakamura (7) that such is the case in two species of the genus *Trimeresurus.* The latter genus and *Bothrops* are so closely related that some authors consider them as one and the same genus.

TABLE 1

COLOR OF TAIL TIP OF JUVENILE PIT VIPERS

Source of specimens*	Yellow		Dark		Total
Bothrops atrox					
Tihuatlan, Veracruz, Mexico (UIMNH)	♂	12	♂	0	
	♀	0	♀	8	20
Guatemala (CAS)†	♂	2	♂	0	
	♀	0	♀	3	5
Port Utria, Colombia (USNM)	♂	13	♂	0	
	♀	0	♀	13	26
Bothrops nummifer					
Portillo Grande, Yoro, Honduras (CNHM)‡	♂	13	♂	0	
	♀	17	♀	0	30
Rio Indio headwaters, Panama (ANSP)	♂	8	♂	0	
	♀	7	♀	0	15
Pueblo, Nuevo,Honduras (UMMZ)	♂	3	♂	0	
	♀	1	♀	0	4
Orizaba, Veracruz, Mexico (USNM)	♂	2	♂	0	
	♀	2	♀	0	4
Agkistrodon contortrix					
Eleven miles northwest of Frederick, Frederick County, Maryland (UIMNH)	♂	3	♂	0	
	♀	2	♀	0	5
Two and a half miles east of Lamb, Hardin County, Illinois (INHS)	♂	6	♂	0	
	♀	4	♀	0	10
Three miles north of Valmeyer, Monroe County, Illinois (INHS)†	♂	2	♂	0	
	♀	0	♀	0	2
Three miles north of Effingham, Effingham County, Illinois (INHS)	♂	2	♂	0	
	♀	3	♀	0	5

* The following abbreviations are used for the institutions from which specimens were examined: ANSP, Academy of Natural Science of Philadelphia; CAS, Chicago Academy of Sciences; CNHM, Chicago Natural History Museum; INHS, Illinois Natural History Survey; UIMNH, University of Illinois Museum of Natural History; UMMZ, University of Michigan Museum of Zoology; USNM, U. S. National Museum.

† Probably not the complete litter.

‡ Mixture of several litters.

The scanty information available concerning the food of the several juvenile agkistrodons with bright tail tips in both sexes suggests a preference for frogs and small lizards. To illustrate, using information pertaining to one of the better-known forms, Chenoweth (*2*) writes that a litter of young copperheads ate cricket frogs (*Acris gryllus*) and a single anole (*Anolis carolinensis*), but steadfastly refused baby mice. That the latter is not always strictly the case is obvious from Gloyd's (*5*) statement that "At ages of two to three weeks some of the young fed upon small mice." The jumping viper, *Bothrops nummifer*, which has a bright tail in young of both sexes, may not fit into this scheme, as the only known food items of juveniles are crickets and grasshoppers. However, in none of these instances is the food of juveniles under natural conditions definitely known.

It would be very presumptuous to base definite conclusions on such scanty information. The data available do suggest that:

1. Pit vipers of which the young may depend on prey attracted to worms have bright-colored, wormlike tail tips in both sexes and exhibit the typical tail wiggling activity.
2. In those in which the young in one or both sexes lack the yellow tail tip, and exhibit no typical tail wiggling behavior, the food may be more generalized.

Although these generalizations are far from confirmed, they should be called to the attention of persons having the opportunity to gather pertinent information.

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Molybdenum Deficiency in Dunkirk Silty Clay Loam

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In 1939 Arnon and Stout (*2*), using culture solutions, obtained evidence that molybdenum is an essential element. Molybdenum deficiencies in crop plants grown on soils in Australia, New Zealand, and Europe have been reported, but the writer knows of no similar deficiency in the Americas except in serpentine barren soils of California (*5*). Response to molybdenum was also obtained in New Jersey in pots in the greenhouse as a result of dipping seed pieces of potatoes in dilute solutions of molybdenum (*1*). Davies and Mitchell (*3, 4*) did pioneer work on molybdenum deficiency in cauliflower. The latter noted marked differences in varietal susceptibility to whiptail. Wessels (*7*) had previously noted varietal differences on acid soils on Long Island, New York. He did not get symptoms of whiptail when a susceptible variety was grown on similar acid soils in the greenhouse. For the Long Island soils used, he found that the range of soil reaction for maximum cauliflower production was between pH 5.5 and 6.6. Yellowing and whiptail were found in soils below pH 5.5.

On October 8, 1949, the writer observed a cauliflower strain trial conducted by Paul Work and George Elle near Ithaca on Dunkirk silty clay loam, a productive and extensive soil type. Replications on the higher part of the plot showed marked whiptail in varieties of the Super Snowball type and practically none on strains of Improved Holland Erfurt (Snowdrift). A weather station located within one mile of the plot indicated a deficiency of 2.68 in. of rainfall (departure from normal) for the months of June through October. A considerable part of one rain of 2.43 in. on August 29 probably ran off the higher part