against respective sound-pressure levels, a sigmoid function is strongly indicated. This conforms with the previous finding of Frings and Frings (*2*) of a sigmoid relationship between seizure incidence and intensity of a pure tone. A monotonic, negatively accelerated function is suggested when percentages of wild jumping reactions are plotted against sound-pressure levels. Chi-square tests show that the 110- and 130-db groups differ significantly at the 0.02 level or better with respect to frequencies of fatal convulsions, fatal and nonfatal convulsions together, and wild jumping reactions. Clearly, incidence of audiogenic reactions in DBA/1 mice is directly related to intensity of stimulation with white noise.

A final observation of interest is that none of the mice convulsed at 110 db in the present situation, although very high frequencies of seizures are obtained with sound pressures between 80 and 90 db with the bell-tub method (*4*). This is most probably due to differences in the frequency components of the stimuli used in the present study and in bell-tub experiments. One complex sound is not necessarily as effective as another complex sound, even though both have the same intensity.

References and Notes

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Social Aggressiveness in an Amphibian

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Problems of aggression have long occupied man, and they still appear to be in the forefront of importance. As one aspect of the total picture, the phenomenon of territoriality has attracted a large measure of interest from biologists in recent years, ever since it was effectively described by Howard (*1*) in birds. More recently, various workers have provided information on the extensiveness of territoriality, discussed the variations in its manifestation, indicated some of its functions, and refined our concept of it. Its significance as a feature of social behavior, as a regulator of population density, as an evolutionary factor operating in selection and in gene spread, and as a factor in promoting social well-being in various ways have all been shown or suggested by these investigations. Even so, much remains to be learned about it.

By territoriality is meant the defense of an area from invasion by another of the same species. This concept seems to be the most useful one and is generally accepted by workers in touch with its study. That some of the earlier, more restricted definitions are not adequate in the light of more recently gained information has been pointed out by several people over a period of years, as reviewed by Nice (*2*). Territoriality and the related phenomenon of maintenance of a home range were clearly separated by Burt (*3*), and their significant differences seem to allow no further confusion of the terms.

Among nonhuman animals, territoriality has been most intensively, as well as extensively, studied in birds, partly because of the ease of observation. However, it is known to be exhibited also by some species in other groups of animals—invertebrates, fish, reptiles, and mammals (*4*). To my knowledge, there had been no reported evidence of its occurrence in amphibians until Martof's suggestion (*4*) that a weakly developed sort of territoriality is exhibited by calling males of the frog *Rana clamitans* in breeding groups. The principal purpose of this paper is to report that a well-developed, aggressive territoriality is clearly demonstrated by the nonarboreal South American frog, *Phyllobates trinitatis* Boulenger. In the coastal mountains of northern Venezuela, this frog is common in the small streams about the Venezuelan Estación Biologica de Rancho Grande, near Maracay. Here, I observed it from Sept. 1951 to Jan. 1952 (*5*).

Territorialism was most frequently seen in adult females, which reach 28 mm in head-body length. They are a little larger than males and more brightly colored. The females have stations along the edges of streams, where each feeds in the daytime in a limited area, its home range, and seeks shelter, when alarmed, in a small opening beneath the rocks. Most of the home range, including the shelter site, is maintained as a territory from which the resident frog attempts to drive off intruders of the same species, usually with success.

The first aggressive act by the resident is usually a hopping approach to the intruder and a challenge, in which the bright yellow throat is exhibited and slowly pulsated. If the intruder does not retreat, the resident female makes a quick jump over the intervening few inchs and alights directly on the other animal, uusually on its back or head. In most instances, this is sufficient stimulus to cause the attacked frog to jump away, but sometimes the intruder will stand her ground, even to the point of defending herself. Then ensues an actual wrestling bout of several seconds, until one of the pair retreats or is pushed off the rock on which encounters often take place.

Only rarely was territorial defense identified in an adult male, but it was found to be carried out by young frogs, even by some that had only recently metamorphosed. The phenomenon was not associated with breeding or with the site of egg-deposition. Rather, it was a defense of feeding grounds and shelter (home) site. It was not a rare occurrence but was seen repeatedly, exhibited by many individuals, obviously being a regular part of daily life. For example, on 19 Oct., in one period of 2.5 hr spent watching a small stream along 7 m of its length, five frogs were seen to defend their territories in the manner just described. On 22 Oct. at the same place, on the other hand, it was 2.5 hr before the full aggressive pattern was seen, although challenging behavior had occurred earlier.

A specific example of territoriality may be cited in the actions on 4 Oct. of a female, which had been watched in her territory on previous days as well. A subadult frog landed about 4 cm from her at the end of a jump. For 3 or 4 min the adult sat facing the young frog, with head elevated and anterior body raised high on straightened forelegs, slowly pulsating her orange-yellow throat through an amplitude of several millimeters. The smaller frog remained quiet. Then the resident jumped on the intruder, which made a short leap, dislodging the adult. Two more jumping attacks followed in rapid succession before the intruder hid beneath a rock. In a short time, the young frog came out and was quickly attacked again. This time its retreat carried it outside the territory of the resident female, and no further attack was seen.

References and Notes

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Oxidation of Indoleacetic Acid by an Extracellular Enzyme from *Polyporus versicolor* and a Similar Oxidation Catalyzed by Nitrite

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During an investigation in this laboratory concerning the action of the fungus *Polyporus versicolor* on lignin and various related phenolic compounds, it was noted that the culture filtrate was able to oxidize rapidly indole-3-acetic acid (IAA). Further work (*1*) was therefore done to characterize this enzyme and its reaction. The enzyme preparation was obtained by growing the organism for a 10-day period at 28°C in flasks of Dion's medium (*2*) on a rotary shaker and then dialyzing the culture filtrate for 9 days against daily changes of distilled water at 4°C. One-milliliter portions of this dialyzed filtrate, containing 1.20 mg of dry solids, were generally employed in the various experiments.

Measurements of gas exchanges in the Warburg apparatus at 37°C showed that 1 mole O_2 was used and 1 mole CO_2 was formed per mole of IAA during the reaction. This corresponds with the data reported for the IAA oxidase of pea seedlings (*3, 4*), bean roots (*4*), and pineapples (*5*). The enzyme from *P. versicolor* showed optimal activity at about *p*H 4.5, compared with *p*H 6.5 for the enzymes from peas and beans and *p*H 3.5 for the enzyme from pineapples. Attempts were made to concentrate this fungus enzyme by methods used for other IAA oxidases, but precipitation by addition of 40 vol of acetone (*6*) inactivated and dialysis (*3*) failed to precipitate the enzyme. Heating for 10 min at 100°C effected complete inactivation. The reaction had a Q_{10} of 2.0 from 27° to 37°C. Riboflavin at a concentration of 10 µg/ml or higher produced no oxidation of IAA under the usual lighting conditions. The Q_{O_2} on various indole derivatives at a level of 10 µM was as follows: IAA, 153; indole-3-butyric acid, 68; indole-3-propionic acid, 28; and indole-3-acetaldehyde, 29 (see Fig. 1 for typical curves and conditions used). Phenylacetic acid, DL-tryptophone, DL-β-phenylalanine, indole, skatole, and indole-3-acetamide were not oxidized.

Hydrogen peroxide does not seem to be involved in the reaction, as is shown by the failure of either puri-

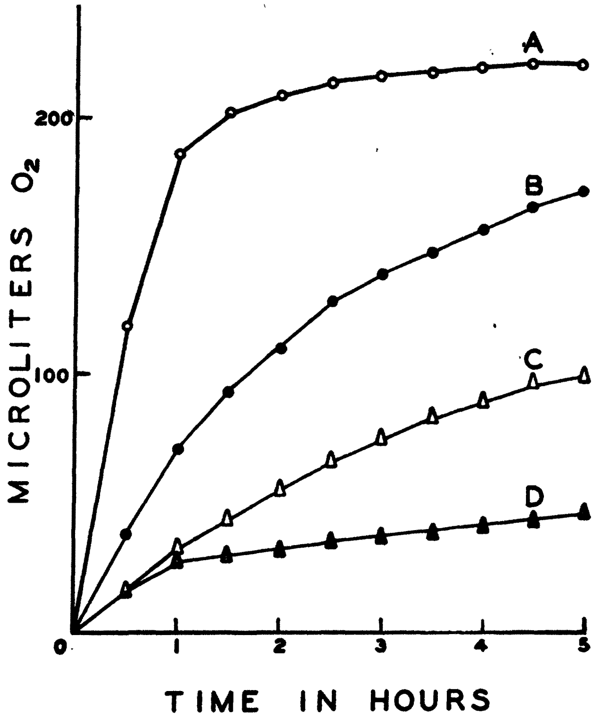

Fig. 1. Oxidation of (*A*) indole-3-acetic, (*B*) indole-3-butyric, and (*C*) indole-3-propionic acids present as the sodium salts, and of (*D*) indole-3-acetaldehyde by 1 ml of dialyzed culture filtrate of *P. versicolor*. Warburg vessels contained 10 µM substrate, 0.5 ml of M/5 sodium acetate buffer at *p*H 4.73, distilled water to 3.0 ml, and 0.1 ml of 25 percent KOH in center wells. Temperature, 37°C; gas phase, air.