identified as 9-oxodec-2-enoic acid, known as queen substance (*8*), by its identical retention time value compared to synthetic queen substance (*9*) when submitted to analysis by gas chromatography. In later experiments the foregoing identification was confirmed when synthetic queen substance was found to be attractive to drones in quantities of 0.1 mg per assay tube. A reconstituted mandibular gland lipid complex was considerably more attractive to drones than individual fractions were.

In addition to demonstrating communication by chemicals between drones and queens, these experiments provided evidence indicating multiple mating attractants that may have synergistic action. The attractant chemicals are apparently specific for the species; no other insects were observed to be attracted to the queens or queen extracts. Mating attractants from the queen probably will be useful for surveying drone populations in extensive areas to determine the genetic origin, flight distribution, and flight range.

The remarkably large size of the mandibular glands of the queen bee, relative to other social Hymenoptera, may be explained in part by the important function they serve in mating activities. Chemical communciation between queens and drones on mating flights provides an efficient mechanism permitting rapid, multiple mating of the queen with a minimum exposure to predators (*10*).

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Effect of Monochromatic Rearing on the Control of Responding by Wavelength

Abstract. The wavelength of a discriminative stimulus exerted no control over the behavior of ducklings raised in a monochromatic environment. Stimulus control was established, however, when responding was reinforced in the presence of one wavelength and not in the presence of another.

When a response is reinforced in the presence of a stimulus, the response is more likely to occur when that stimulus is presented again. Changes in the physical parameters of the controlling stimulus yield orderly changes in the probability that the response will be emitted; to the extent that behavior is invariant under these changes, stimulus generalization is said to occur.

The conditioning procedures traditionally employed in the study of stimulus generalization have in common that a response is reinforced in the presence of a discriminative stimulus (S^D) but differ as to whether responding is also explicitly extinguished in the presence of one or more additional stimuli (S^Δ) prior to generalization testing. Because the home-cage environment of the experimental subjects is rarely controlled, it is unclear whether all conditioning procedures do not perforce involve some extinction of responding to the relevant stimulus property. Perhaps the traditional gradient of stimulus generalization would not be obtained if the stimulus environment were controlled to preclude such differential reinforcement of responding.

Six Peking ducklings, deprived of water for 22 hours, served individually in daily sessions lasting from 1 to 2 hours. Four of these ducklings (birds 1 to 4) were raised in monochromatic light: their wire-mesh home cages were located in an icebox (3 by 2 by 2 feet) illuminated by a sodium lamp (589 mμ). The walls of the box were white (reflectance approximately 0.8) and had a luminance of approximately 1 ft-lam. The remaining two ducklings (birds 5 and 6) were maintained in similar cages located in the experimental room. Four 200-watt tungsten filament lamps, located 3 feet from the cages, provided approximately 1 ft-ca of illumination.

The experimental space was a 12 inch-cubicle painted flat black and illuminated solely by light transmitted through a translucent Plexiglas disk, 1.5 inches in diameter, mounted 8 inches above the floor. A force of 12 or more grams applied to this disk (key) constituted a response and served to control the presentation of water reinforcement through an opening in the wall directly below.

During all of the conditioning sessions, the key was transilluminated only by monochromatic light (589 mμ). During both conditioning and testing the luminance of the response key was changed during a 3-second blackout every 30 seconds so that it varied randomly over a range of 10^{-4} to 10^{-1} lam.

During the first experimental session for each duckling the response of pecking the monochromatic key was conditioned by making the presentation of water contingent upon responses that

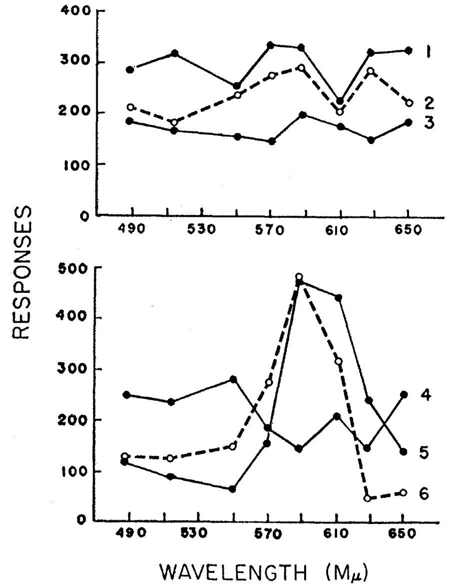

Fig. 1. Stimulus generalization gradients for individual ducklings. Birds 1 to 4 were raised in a monochromatic environment; birds 5 and 6 were not.

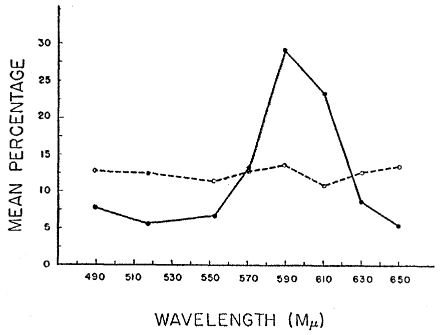

Fig. 2. Mean normalized stimulus generalization gradients. The broken line represents the mean gradient for the four birds raised in a monochromatic environment; the solid line represents the mean gradient for the two birds raised in an environment whose chromaticity was not controlled.

increasingly approximated pecking. In the following three sessions, reinforcement was contingent upon the first response that occurred after a variable interval of time; this interval had a mean, initially, of 30 seconds and was progressively lengthened to 180 seconds. After a total of 15 conditioning sessions, a high constant rate of responding was maintained, and this rate was independent of the intensity of the key illumination.

In the following session a test for stimulus generalization was conducted: three reinforcements were presented for responses in the presence of the training stimulus (589 mμ) and then, during the remainder of the session, no more reinforcements were presented and each of eight different wavelengths, including 589 mμ, was projected in irregular order onto the key. These test wavelengths were produced by interposing gelatin filters between a tungsten filament lamp and the response key. Stimulus wavelength and intensity changed concurrently every 30 seconds during the 3-second blackout.

The number of responses emitted at each wavelength during the test session for each subject is shown in Fig. 1. Figure 2 shows the mean stimulus generalization gradient for each of the two groups of animals; individual gradients were normalized and averaged. Wavelength exerted no systematic control over response emission for birds 1 to 4, which were raised in monochromatic light. For those birds raised in white light (5 and 6) the number of responses emitted at each wavelength was a function of the difference in millimicrons between the conditioning and test stimuli.

In a second experiment, it was demonstrated that ducklings raised in a monochromatic environment could be conditioned to respond differentially to stimulus wavelength. Initially the subjects were trained to respond in the presence of a key illuminated with the variable-intensity, 589 mμ stimulus of the first experiment. An identical conditioning procedure was employed. Then followed 15 sessions of conditioning with reinforcement contingent upon the completion of a fixed number of responses. Finally, a multiple schedule (*1*) was introduced in which a second stimulus (610 mμ) was alternated randomly with the training stimulus (589 mμ). In the presence of the new stimulus (610 mμ), reinforcement was contingent upon a pause (that is, cessation of pecking) of 45 seconds; in the presence of the training stimulus (589 mμ), reinforcement was contingent upon completion of 20 responses. For both subjects, there was a marked decrease in the rate of responding in the presence of the stimulus correlated with reinforcement for not responding within the first session in which reinforcement was differentially correlated with wavelength (*2*).

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Parotoid Secretions of Indonesian Toads

Abstract. A preliminary study of the parotoid secretions of *Bufo melanostictus* and *B. asper* shows that a methanol extract is rich in digitalis-like bodies (bufodienolides) and that an acid extract contains indolethylamine derivatives.

During the last three decades we have been studying the pharmacological properties of the constituents of 14 species of toads (*Bufo*) (*1, 2*). Church (*3*) recently reported that the erythrocytes of *Bufo melanostictus* in Java increased in size continuously throughout the life of the animal. He attributed this observation to the unchanging climatic conditions of the tropical Indonesian Archipelago. Through the cooperation of Church, who was then at the Institute of Technology, Bandung, we obtained small supplies of the dried parotoid secretions of two species of Javanese toads—*B. melanostictus* and *B. asper*. A preliminary study of each specimen was made by the same procedures employed previously (*2*). *Bufo asper* is the larger of the two; the longitudinal axis of its parotoid glands is perpendicular to the body axis (*4*). *Bufo melanostictus* is not only common in Java, but also is indigenous to Canton, China (*5*), Assam, India (*6*), and Bangkok, Thailand (*7*). Van Gils (*8*) isolated melanobufagin from the parotoid secretion of this species.

The sample from ten specimens of *B. melanostictus* weighed 91 mg and that from three specimens of *B. asper*, 27 mg. Both samples were easily pulverized, and grayish in color. A methanol extract of the venom from *B. melanostictus* was diluted to 1:10,000, and infused at the rate of 1 ml per minute into the femoral vein of two etherized cats. Electrocardiograms were recorded from Lead II. Sample tracings are shown at the top of Fig. 1. Like any active digitalis-like substance, the extract produced slowing of heart rate, P-R prolongation, inversion of T wave, ventricular rhythm, bundle branch block, and ventricular fibrillation. The electrocardiographic changes of the second cat were similar. The high potency of the as yet unidentified bufodienolides was indicated by the small lethal dose (LD): one was equivalent to 0.855 mg of the dried parotoid secretion per kilogram of body weight, and the other, to 0.709 mg/kg. The lower half of Fig. 1 is the result of an experiment with the methanol extract of the venom of *B. asper*, demonstrating its digitalis-like action electrocardiographically. The dilution was 1:20,000. Two cats succumbed to doses equivalent to 0.721 and 0.618 mg/kg.

Another extract was made with 0.1N HCl (*2*) and an aliquot was tested for color reactions. The venom extract of *B. melanostictus* reacted with *p*-dimethylaminobenzaldehyde (*9*) to give a dark green color, slightly greener than that produced by serotonin. The addition of Steensma reagent (*10*) resulted

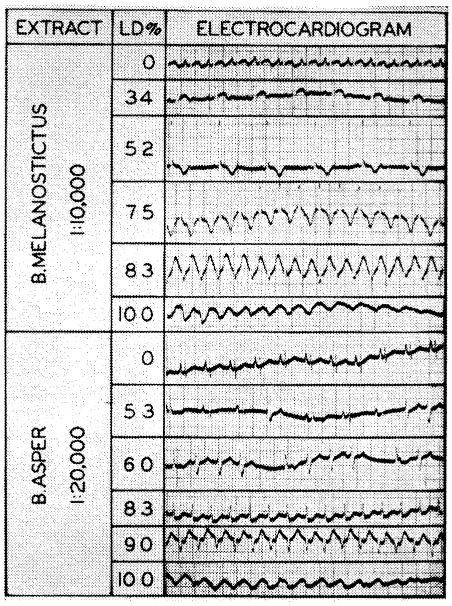

Fig. 1. Electrocardiographic changes produced by extracts of toad venom.