(Peckhams), *Aphonopelma* sp. (Araneae); *Chelifer cancroides* (L.) (Chelonethida); *Leiobunum ventricosum* (Wood) (Phalangida); *Odontobuthus doriae* (Thorell), *Diplocentrus* sp., *Uroctonus* sp., *Vejovis spinigerus* (Wood) (Scorpionida); *Mastigoproctus giganteus* (Lucas) (Uropygi); and *Limulus polyphemus* L. (Merostomata). Also tested were the internal prosomal apodeme of *Eremobates* sp. (Solpugida) and the ventral nerve cord, ganglia and mesenteries of *Phoxichilidium femoratum* (Rathke) (Pycnogonida). As positive control the movable cheliceral finger of *Eremobates* sp. was used; as negative control a piece of muscle from *Limulus*. For dissolution in warm NaOH, we used endosternites from *Amblyomma americanum, Argiope argentata, Leiobunum ventricosum, Centruroides vittatus* (Say) (Scorpionida) and *Limulus polyphemus* with the same positive and negative controls.

It is our conclusion, based on currently accepted methods for chitin determination, that chitin is absent from the endosternite of chelicerates[7,8].

Zusammenfassung. Die Endosternite von 18 Arten aus den drei lebenden Klassen von Cheliceraten wurden nach der Methode von van Wisselingh auf Chitin geprüft, wobei alle Proben negative Ergebnisse für die echten Endosternite ergaben. Nur die innere prosomische Apophyse einer Solpugide enthält Chitin.

B. CUTLER and A. G. RICHARDS

1747 Eustis Street, St. Paul (Minnesota 55113, USA); and Department of Entomology, Fisheries, and Wildlife, University of Minnesota, St. Paul (Minnesota 55108, USA), 8 July 1974.

[7] Paper No. 8721, Scientific Journal Series, Minnesota Agricultural Journal Series, Minnesota Agricultural Experiment Station, St. Paul, Minnesota 55108, USA.

[8] We wish to thank the following for providing specimens for this study: D. B. RICHMAN, Florida; P. J. CLAUSEN, E. F. COOK, W. S. HERMAN, and R. D. PRICE, Minnesota; M. H. MUMA, New Mexico; and J. K. HALLAN, Texas.

The Effect of Chemical Stimuli from Conspecifics on the Behavior of *Haplochromis burtoni* (Cichlidae, Pisces)

Behavioral responses of fish to chemical stimuli produced by conspecifics are well known (see, for example, PFEIFFER[1], TODD[2]). They have, however, rarely been investigated within the otherwise extensively studied family of Cichlid fish (KÜHME[3], MYRBERG[4]). This project was undertaken to analyze the effect of chemical stimuli, produced by conspecifics in a reproductive state, on the behavior of males of the African Cichlid fish *Haplochromis burtoni*.

The two stimuli used were: 1. water in which a gravid female has lived alone, 2. water in which a courting male has lived alone. Water in which no fish has previously lived was used as a control.

The experimental set-up consisted of 7 identical 60 liter aquaria. 4 were used for the test fish. The 5 th contained a single gravid female, the 6th a single male, courting the gravid female from which it was chemically, but not visually, isolated. Only individuals clearly in a reproductive state were selected. In order to ensure this, the specimens had to be replaced several times in the course of the experiment. The 7th aquarium provided the control water. The temperature was maintained in all aquaria at 26° ± 1 °C. The nets and buckets used for the manipulation of fish and water were boiled and dryed after each use to avoid contamination. The test fish were 6 adult males (7 in the gravid female situation) averaging in size approximately 15 cm long and 60 g. Before the beginning of the experiment, they were isolated from conspecifics for 10 days, with 10 young blinded Tilapia (HEILIGENBERG and KRAMER[5]). The same individuals were observed in all 3 experimental situations. The behavior recorded was that directed toward the Tilapia. Each fish was observed $1^1/_2$ h at the same time everyday.

The experiment started with a 5-day observation period. On the 6th day, 4 l of water from either the gravid female, courting male, or control water tank were syphoned into the experimental tank. These different stimuli were presented in a random order to the fish, and their source was unknown to the observer. The syphoning started at the beginning of the observation and lasted 40 min. The observations continued for 5 days to record possible long-term after-effects.

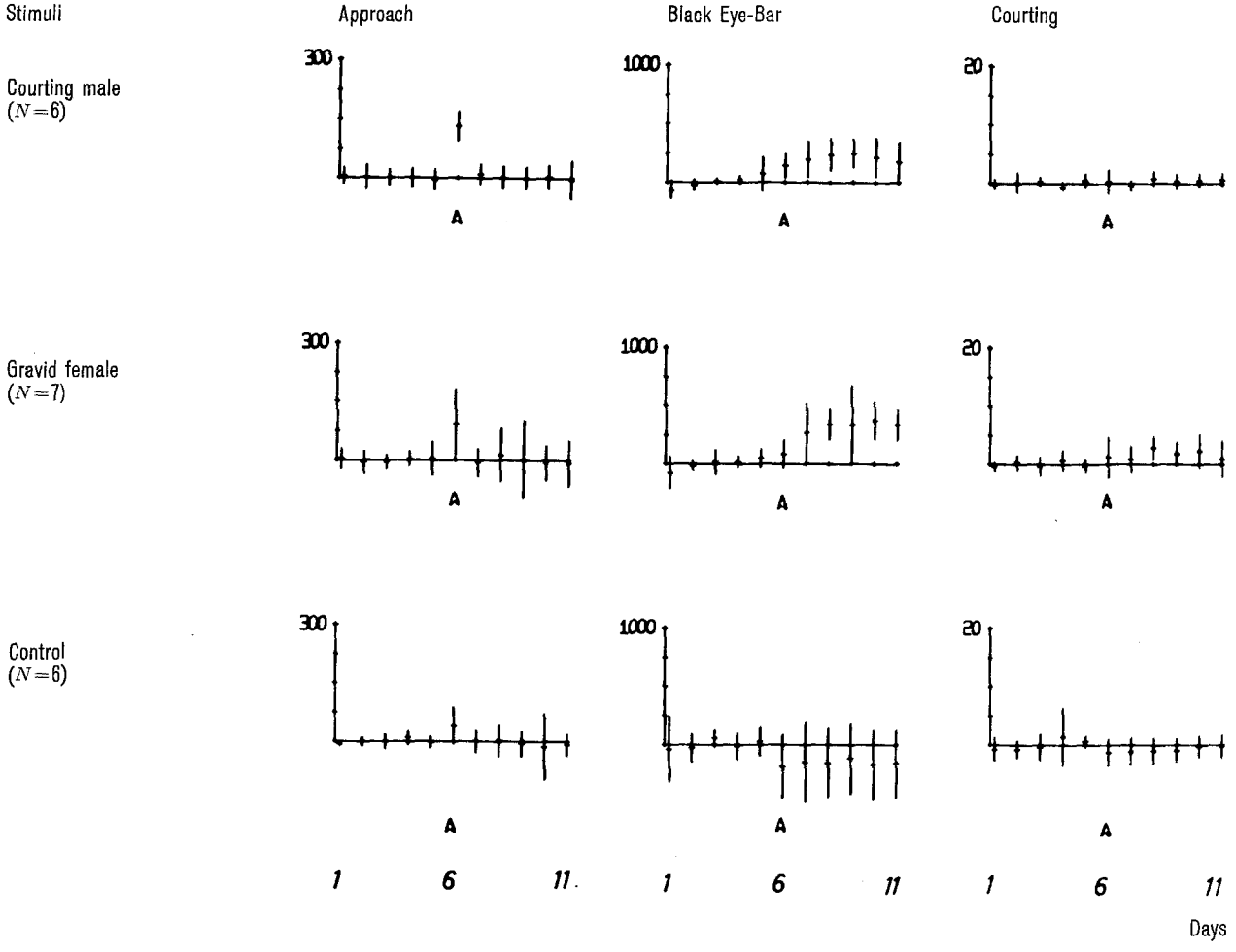
The observer, sitting behind a blind, recorded 8 behavior patterns, using a keyboard paper-tape punch (time resolution 0.5 sec) for subsequent computer evaluations (FERNALD and HEINECKE[6]).

The behavior patterns referred to are described as follows: *approaching*: the fish swims towards a Tilapia and stops nearby. *Courting*: the fish quivers sideways near a fish. This movement is normally directed to a conspecific female. *Leading*: the fish swims ostentiously, wagging its tail, in front of a fish. This is also normally directed to a conspecific female. *Attacking*: the fish bites or chases the Tilapia. *Digging*: the fish carries big amounts of gravel away from a preferred site of the aquarium. This results in a deep pit, normally used as 'spawning site'.

The greatest effects of the chemical stimuli were reflected in 3 behavior patterns: *approaching* and *courting* the Tilapia, where each occurence was recorded as single event; the presence or absence of the territorial *black eye-bar* (LEONG[7]) was scanned every 5 sec and the presence recorded as single event.

To measure the effect of the 2 stimuli, the rates of behavioral events on the 6th day and during the 5 post-test days were compared with those of the 5 pre-test days, defined as base-line activity, for each fish. For this, the data of each individual fish were normalized by subtracting the mean of an activity during the 5 pre-test days from every value of the activity observed in this fish. The mean values of these differences in all fish, and 3 times their standard error, were then plotted (see Figure) (since the intraindividual variances of the means for the 5 pre-test days were smaller than half the interindividual variances, they have been neglected in the presentation of the results).

[1] W. PFEIFFER, Experientia *19*, 1 (1963).
[2] J. H. TODD, Scient. Am. *224*, 98 (1971).
[3] W. KÜHME, Z. Tierpsychol. *20*, 688 (1963).
[4] A. A. MYRBERG JR., Z. Tierpsychol. *21*, 53 (1964).
[5] W. HEILIGENBERG and U. KRAMER, J. comp. Physiol. *77*, 332 (1972).
[6] R. FERNALD and P. HEINECKE, Behaviour *48*, 268 (1974).
[7] C.-Y. LEONG, Z. vergl. Physiol. *65*, 29 (1969).



Changes in rates of behavioral events during and after stimulation. The mean values of the differences, and 3 times their standard error, of the fishes' observed values to their own baseline (day 1 to 5) mean, are here plotted. The arrow indicates the day (6) the fish were exposed to courting male, gravid female and control water.

A short-term effect is seen on day 6 for the behavior *approach* of fish presented with gravid female or courting male water. The weaker increase occuring in the controls seems to show an effect of the syphoning itself. Long-term after-effects also are seen: fish exposed to gravid female or courting male water show an increase in the appearance of the *black eye-bar*, during the 5 post-test days. In addition, fish receiving gravid female water were *courting* more (long term effects were also seen in *leading*, *digging* and *attacking*). On the contrary, the controls show a decrease in the presence of the *black eye-bar* and *courting* which is not as strong as the increase observed in the 2 other situations.

These results show a clear influence of conspecific chemical stimuli on the behavior of this species. Further experiments are under way to examine whether these stimuli are sensed through olfaction or gustation. Of further interest are questions of specificity and of the relationship between visual and chemical communication systems.

Zusammenfassung. Isolierte Männchen von *Haplochromis burtoni* (Cichlidae, Pisces) reagieren auf chemische Reize sexuell aktiver Artgenossen. Reize beider Geschlechter führen zu einer kurzzeitigen Zunahme der Häufigkeit des Verhaltens «*Sichnähern*» und zu einer langanhaltenden zusätzlichen Schwärzung des *Augenstrich-Musters*. Die Reize des Weibchens haben darüber hinaus einen geringfügigen fördernden Einfluss auf einige andere Verhaltensweisen.

M.-Dominique Crapon de Caprona[8]

Max-Planck-Institut für Verhaltensphysiologie, Abteilung Mittelstaedt, D-8131 Seewiesen/Obb. (German Federal Republic), 13 August 1974.

[8] Acknowledgments. I am most grateful to Dr. A. Etienne and Dr. R. D. Fernald for their encouragement during this work, to Dr. H. Mittelstaedt for providing space and financial support, to Dr. W. Heiligenberg and H. Scharstein for their kind suggestions and their help in the computer programming. This paper is a part of a doctoral thesis undertaken at the Ecole de Psychologie et des Sciences de l'Education, Geneva, Switzerland.