

Results and discussion. In Figures 1 and 2 are shown the chick ERGs taken at several intensities of light stimuli between 0.3 and 80 joules (J) on the 21st day of incubation, 1-day-old and 6-day-old after hatching. For comparison of the amplitude of the c-wave in the developing chick, the ERG was recorded with a constant light intensity at 20 J. As seen in Figure 1, the c-wave is found in the embryonic chick at the 21st day of incubation. The amplitude of the c-wave shows no significant differences between the 21st day of incubation and newly hatched chicks, whereas an increase in the c-wave amplitude was observed during 10-day-old chicks (Figure 3).

The influence of body temperature on the c-wave in the developing chick might be important as well as the

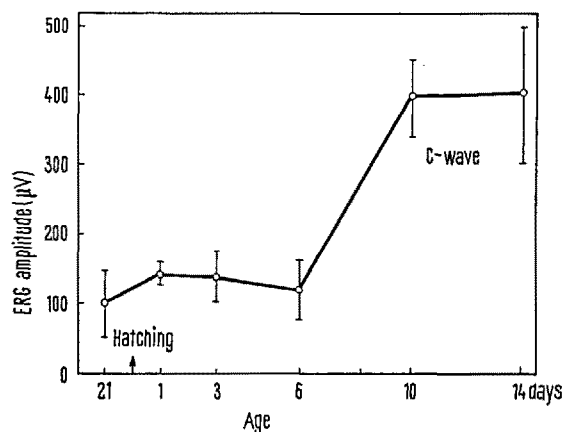


Fig. 3. The amplitude of the c-wave of White Leghorn chicks as a function of the age of the bird. The results are obtained from 5 chicks in each developing chick. The ERG was recorded at the rectal temperature of 33–36°C in between 1-day-old and 6-day-old chicks; 38–40°C in 10-day-old and 14-day-old chicks; up to 30°C in the 21st day of incubation.

a- and b-waves⁴. In our experience, the c-wave was readily affected by decreased body temperature. Furthermore, the c-wave markedly depressed by deep nembutal anesthesia⁵. The present results on the occurrence of the c-wave in the chick ERG do not agree with the previous papers^{2,3} (see also a review article by ROSE and ELLINGSON⁶). Difference might be attributable to recording conditions, i.e. decreased body temperature, anesthesia, etc. The first recordable c-wave with the eye of the chick embryo in situ is not yet demonstrated. However, it is noteworthy to point out that GOTO⁷ states that PI component firstly appears in an isolated chick eyeball on the 8th day of incubation, and that the waveform of the ERG completes itself on about the 19th day of incubation before hatching⁸.

Zusammenfassung. Elektroretinographische Untersuchungen wurden in situ während des Wachstums von Küken ohne Narkose ausgeführt. Die c-Welle des ERG trat direkt vor der Ausbrüte und bei frisch geschlüpften Küken in Erscheinung.

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⁴ T. OOKAWA and T. TATEISHI, *Experientia* 26, 277 (1970).

⁵ T. OOKAWA, *Poultry Sci.*, in press.

⁶ G. H. ROSE and R. J. ELLINGSON, in *Developmental Neurobiology* (Ed. W. HIMWICH; Charles C. Thomas Publisher, Springfield and Illinois 1970), p. 402.

⁷ M. GOTO, *J. physiol. Soc. Japan* 12, 67 (1950).

⁸ Grateful acknowledgment is made to Prof. I. HANAWA, Gifu University School of Medicine, Department of Physiology, for his kind guidance in this investigation. The authors are also indebted to the Goto Hatchery Ind., Gifu City, for the supply of the White Leghorn embryonic and hatched chicks.

Zur funktionellen Bedeutung der räumlichen Anordnung des Kristallkegels zum Rhabdom im Auge der Trachtbienen (*Apis mellifica* L.)¹

Wie unsere Untersuchungen der Ultrastruktur des Bienenauges zeigen, zeichnen sich die 4 Teile der Kristallkegel innerhalb eines Ommatidiums durch eine unterschiedliche elektronendichte Granulierung aus, deren Stärke in Richtung Rhabdom zunimmt. Sie ist in Querschnitten unmittelbar oberhalb des Rhabdoms am stärksten ausgeprägt (Figur 1). Wie im Schema der Figur 2 gezeigt, konnten wir im Auge der Trachtbienen mindestens 6 «Grundmuster» deutlich unterscheiden, wobei die Identifizierung der Typen 1–4 leicht, die der hellen und dunklen Kristallkegel (Typ 5 + 6) schwieriger ist. Die Verteilung dieser Kristallkegel-Typen in der Retina lässt bislang keine Unterschiede erkennen, ausser dass oft benachbarte Kristallkegel dasselbe Muster aufweisen, das in gleicher oder entgegengesetzter Richtung orientiert ist.

Zur Zeit wird an Jung- und Trachtbienen geprüft, ob das Granulierungsmuster der Kristallkegel altersabhängig ist. Die bisherigen Untersuchungen sprechen dafür, dass es sich um eine besondere cytologische Differenzierung handelt, die für das im Bienenauge entstehende Reiz-

muster – Analyse des polarisierten Lichtes^{2,3} im Sinne einer unterschiedlichen Lichtabsorption und/oder optischen Drehung von Bedeutung sein dürfte. Mit allem Vorbehalt – die Abhängigkeit der optischen Eigenschaften der Kristallkegel von der Art ihrer Granulierung ist noch unbekannt – müsste dann das von v. FRISCH⁴ durch die Untersuchungen von GOLDSMITH⁵ und SCHLOTE⁶ auf 4 Felder reduzierte Sternfolien-Modell wieder auf 8 erweitert werden. Die vorliegenden anatomischen und geometrischen Beziehungen von Kristallkegel und zugehörigem Rhabdom würden allerdings viel mehr Kombinationsmöglichkeiten der Ommatidien untereinander

¹ Mit Unterstützung durch die Deutsche Forschungsgemeinschaft.

² H. LANGER, *Verh. dt. Zool. Ges. Göttingen* 1966; *Zool. Anz., Suppl.* 30, 195 (1967).

³ T. H. WATERMAN, *Am. Scientist* 54, 15 (1966).

⁴ K. v. FRISCH, *Tanzsprache und Orientierung der Bienen* (Springer Verlag, Berlin 1965).

⁵ T. H. GOLDSMITH, *J. Cell Biol.* 14, 489 (1962).

⁶ FR. W. SCHLOTE; zit. nach K. v. FRISCH (1965).

bieten als das von v. FRISCH und AUTRUM^{4,7} entwickelte Modell.

Dafür sprechen 2 morphologische Merkmale des Ommatidiums: Erstens, die 4 Einheiten des Kristallkegels sind zum viergeteilten Rhabdom versetzt, so dass rein geome-

trisch die Projektion des Kristallkegels das Rhabdom in 8 Felder aufteilt. Zweitens, die Isolierung der Retinulazellen durch einen extrazellulären Raum und Pigmentzellfortsätze (Figur 3) ist in elektrophysiologischer Hinsicht⁸ ein weiteres Indiz dafür, dass die durch die Struktur

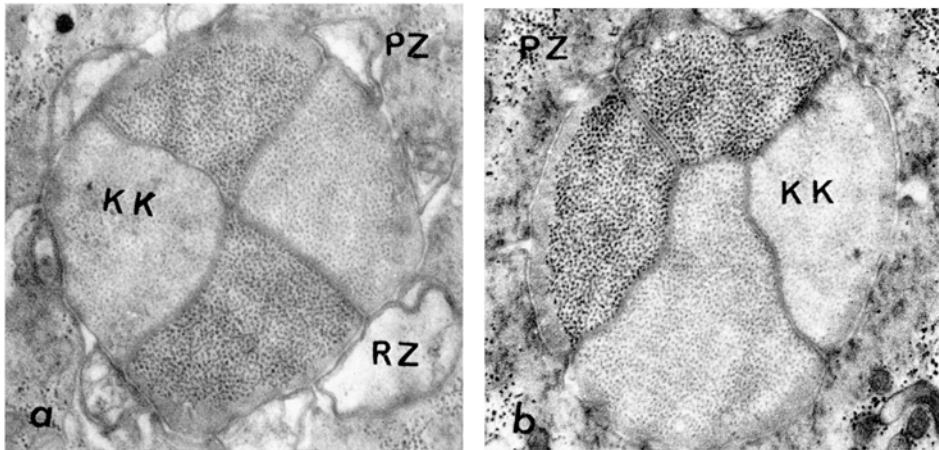


Fig. 1. Ultrastruktur von zwei Kristallkegeltypen im Querschnitt, vgl. mit Figur 2, Typ 2 und 3. KK = Kristallkegel; PZ = Pigmentzelle; RZ = Retinulazelle (a + b). $\times 19600$.

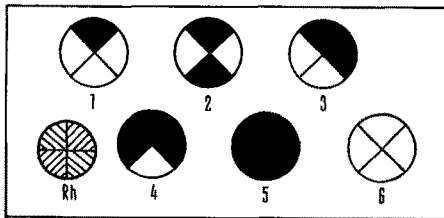


Fig. 2. Schematische Darstellung von 6 Kristallkegeltypen im Querschnitt. Übergangsformen wurden nicht berücksichtigt. Rh = Schema eines Rhabdoms in der geometrischen Orientierung zu den Kristallkegeln.

der Kristallkegel bedingte variable Lichtabsorption zur unterschiedlichen Stimulierung innerhalb eines Rhabdomers führt und in den beiden dazugehörigen Retinulazellen als 2 gesonderte Informationen weitergeleitet wird. Die strukturelle Differenzierung der Kristallkegel in 6 verschiedene «Grundtypen» verbunden mit der Organisation der einzelnen geschlossenen Rhabdome lässt, was die Lichtperzeption betrifft, wenigstens 4-, 6- oder steilere Erregungsmuster innerhalb einzelner Ommatidien entstehen. Die Kombinationsmuster mehrerer Ommatidien bleiben vorerst unberücksichtigt. Unter diesen Voraussetzungen dürfte den 8 Desmosomen, die den einzigen direkten Kontakt der Retinulazellen unter-

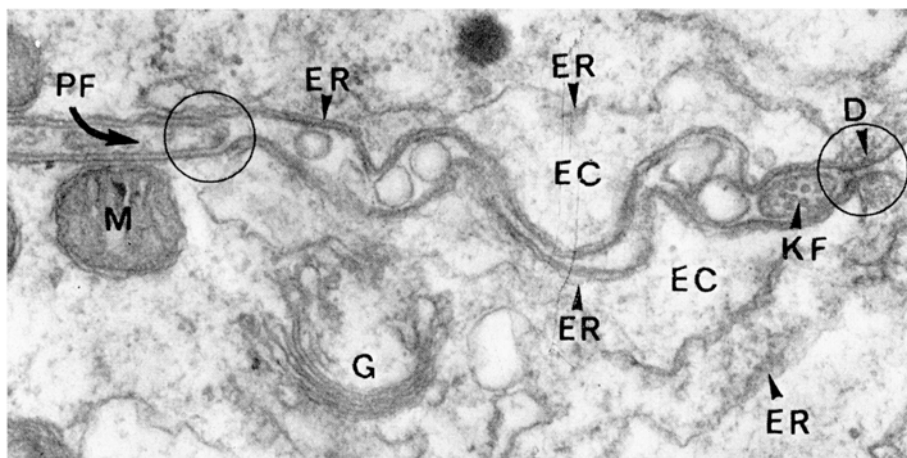


Fig. 3. Ausschnitt von zwei benachbarten Retinulazellen eines Ommatidiums. D = Desmosom; EC = endoplasmatische Cisternen; ER = endoplasmatisches Retikulum; G = Golgi-Apparat; KF = Kristallkegelfortsatz; M = Mitochondrium; PF = Pigmentzellfortsatz. $\times 45800$. Beachte 1. die Separierung der RZ durch den extrazellulären Raum, den PF und den KF, 2. die Anordnung von D und KF, 3. das zwischen PF und D parallel zur Zellmembran verlaufende ER.

einander darstellen, eine reizkontrollierende und -regulierende Funktion (in beiden Richtungen) zugesprochen werden. Ähnlich könnten die morphologischen^{9,10} und elektrophysiologischen^{7,11} Befunde anderer Autoren gedeutet werden. Inwieweit die 4 den Desmosomen benachbarten Kristallkegelfortsätze daran physiologisch beteiligt sind und welche Bedeutung dem in allen Retinulazellen dicht an der Zellmembran gelagerten endoplasmatischen Retikulum (Figur 3) zukommt, sei zur Diskussion gestellt.

Summary. The granular material found in the 4 sectors of the crystalline cone of varying electron density possibly causes a different absorption of incident polarized light. As the quadrants of the crystalline cone are rotated against the quadrants of the rhabdom, we can conclude that each rhabdomere may be stimulated by light of

different physical qualities consequently providing a 4- to 8-fold pattern in the rhabdom of the ommatidia.

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⁷ H. AUTRUM und H. STUMPF, *Z. Naturforsch.* 5b, 116 (1950).
⁸ E. FLOREY, *Lehrbuch der Tierphysiologie* (Georg Thieme Verlag, Stuttgart 1970).
⁹ A. PERRELET und F. BAUMAN, *J. Microscopie* 8, 497 (1969).
¹⁰ F. G. VARELA und K. R. PORTER, *J. Ultrastruct. Res.* 29, 236 (1969).
¹¹ S. R. SHAW, *Vision Res.* 9, 999 (1969).

Release of Endogenous Pyrogen in Cats by Staphylococcal Enterotoxin B

Staphylococcal enterotoxins A and B exhibit pyrogenicity which is similar in many respects to that of bacterial endotoxins^{1,2}. In fact, although totally different chemically, these toxins share to some extent the ability to produce a wide variety of effects³. Endotoxins (and a number of other agents) can cause fever by the release of an endogenous pyrogen^{4,5}, which can be demonstrated by transferring sera to normal recipients from donors given endotoxin. Such transfers cause fever with a rapid onset and short duration in either normal or endotoxin tolerant recipients. Tolerance does not develop with repeated transfers. The experiments reported below suggest the presence of such an endogenous pyrogen in the blood of cats during the peak of fever caused by enterotoxin B.

Materials and methods. Highly purified staphylococcal enterotoxin B was supplied by Dr. M. S. Bergdoll (Food Research Institute, University of Wisconsin, Madison, Wisconsin, USA). Commercial, nonpyrogenic saline was used for flushes. All containers, syringes, needles, etc. were either of the commercial, nonpyrogenic, disposable type or were sterilized in dry heat at over 175°C for at least 2 h.

Temperature was recorded automatically in the retroperitoneal space of essentially unrestrained cats which were also prepared chronically with a jugular venous catheter^{1,6}. All injections were made at 10.00 h. Room temperature was maintained at 75 ± 2°F.

5 h after a donor cat was administered enterotoxin i.v., it was anesthetized with ether. A sterile, carotid-arterial catheter was implanted. Heparin (1000 units) was injected via a saphenous vein, and the animal was exsanguinated through the catheter. After centrifuging the blood, a portion of the plasma was tested for sterility, and the remainder was stored at 4°C. (In some experiments heparin was omitted, and serum was collected.) Plasma from 2 donors was pooled when necessary to provide enough material for multiple injections. After incubating at 37°C for 1 h, 10 ml/kg of plasma was given i.v. to an enterotoxin-tolerant recipient which had shown no pyrogenic response when tested 1-4 days earlier with the same dose of enterotoxin that had been given to the donor. Responses were plotted with time (1 in = 1 h) on the abscissa and temperature change from the (baseline) temperature at the time of injection (1 in = 1°F)

on the ordinate. The area, in square inches, between the curve and the baseline temperature for the 2-h period after transfer was measured with a planimeter to give a thermal response index (TRI). A negative TRI indicates a net fall of temperature after injection. Each sample of plasma was tested in 1-3 recipients, and the average TRI was determined for each sample.

Results. As controls, plasma samples were obtained from donors which had been made tolerant by repeated injections of enterotoxin. The results are summarized in the Table. As indicated, these donors had little or no fever at the time they were anesthetized. The recipients tended to develop small decreases in temperature. (Saline solution produces very similar responses under comparable conditions.) In contrast, non-tolerant donors

Pyrogenic responses of enterotoxin-tolerant recipients to plasma collected from donors 5 h after injection of 1.5-2.0 µg/kg enterotoxin B

Status of donors	No. of samples ^a	Donor fever °F ^b	Recipient fever TRI ^c
Enterotoxin-tolerant	4	0.5 (0.2 to 1.6)	-0.81 (-1.20 to -0.01)
Enterotoxin-sensitive	10	3.8 (1.5 to 4.9)	1.54 (-0.70 to 4.01)

^a Each sample consisted of plasma from 1 or 2 donors. ^b Mean (range) of temperature change from baseline, immediately preceding blood collection. ^c Mean (range).

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³ H. SUGIYAMA, *J. infect. Dis.* 116, 162 (1966).
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⁵ E. S. SNELL and E. ATKINS, in *The Biological Basis of Medicine* (Eds. E. E. BITTAR and N. BITTAR; Academic Press, New York 1968), vol. 2, p. 397.
⁶ U. K. SHETH and H. L. BORISON, *J. Pharmac. exp. Ther.* 130, 411 (1960).