OOKAWA and TATEISHI[1]. In addition, the author often observed the 2 components on the *b*-wave during the course of rapidly decreased body temperature as well as gradual cooling[1]. The double *b*-component, which is clearly evidenced during pentobarbital infusion, has been reported on the developing chick[2–4], and it has photopic and scotopic properties.

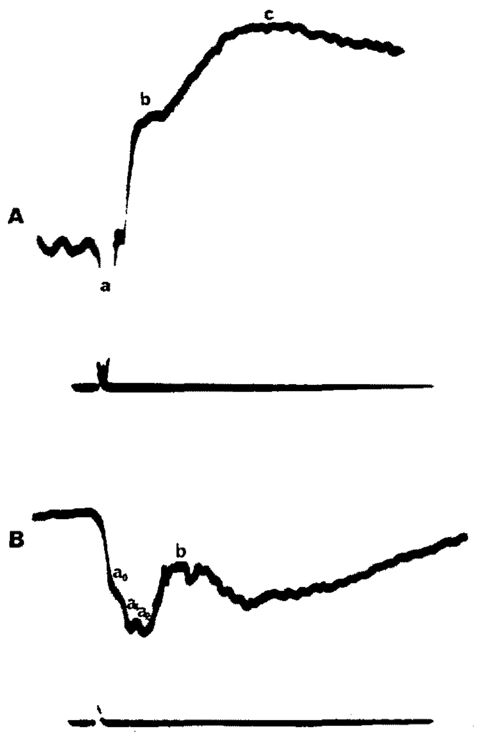

Fig. 2. ERG recordings from a 14-day-old chick at the rectal temperature of 39.2 °C (A) and 22.5 °C (B), respectively. For the details see the text.

COBB and MORTON[5] found that the human ERG showed several rhythmic wavelets on the ascending phase of the *b*-wave. Similar oscillations have been found in many species, and have been designated as the 'oscillatory potential' by YONEMURA[6]. YONEMURA et al.[6,7] mentioned that the rhythmic wavelets in the bird's ERG are similar in waveform to the oscillatory potential in mammals. The minor components superimposed on the ascending phase of the *b*-wave were also reported on the bird's[3,8] ERG. The a_2-wave and the double *b*-wave component observed in the chick in the present experiment may be comparable to a part of the rhythmic wavelets or the oscillatory potential[9].

Zusammenfassung. Mit der Abnahme der Körpertemperatur verminderte sich gleichzeitig die Amplitude der *b*- und *c*-Wellen des ERG. Zwei kleinere, von den *a*- und *b*-Wellen abgespaltene Komponenten wurden während der Abkühlung festgestellt, während nach Wiederherstellung der Hypothermie das ERG die normale Wellenform registrierte.

T. OOKAWA[10]

Department of Physiology, Gifu University School of Medicine, Tsukasa-machi 40, Gifu-City (Japan),
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The Ontogenetic Development of the c-Wave in the Chick ERG

In the mouse ERG, there is no appreciable c-wave in the youngest animals, whereas it becomes very predominant in the 21st postnatal day[1]. In the youngest chick, the absence of the c-wave is reported by WITKOVSKY[2], though he suggested that one unexplored possibility is that the c-wave may be present in older chicks by analogy with findings in rats[1]. Recently, BLOZOVSKI and BLOZOVSKI[3] reported that the c-wave appears at 6 days old in the hatched chick. In the present investigation, the authors observed that the c-wave was seen just before and after hatching.

Materials and methods. 40 White Leghorn chicks (Goto-201 and -202 line) were used for this experiment. The head of the embryos were exposed by a removal of a portion of the shell. The beak and external acoustic meatus of the chick was fixed with a holder. During the ERG recording, body temperature of the bird was kept as normal as possible, using a thermoregulator. The body temperature was checked by a thermistor placed in the rectum (about 1 cm from the cloaca). Under local anesthesia (Benoxil, Osaka), upper and lower eyelids, the nictiating membrane and the upper edge of the orbit were cut. General anesthesia was not employed in this experiment.

The ERG was recorded with an electrode (platinum-ball) attached to a contact lens, and the reference electrode of a steel needle was inserted into the exposed orbit. The ERG was registered with a dual-beam oscilloscope (Nihon-Koden, VC7) and photographed. The upper beam of the oscilloscope was used for displaying an ERG response and the lower one for the sign of photic stimulus. A comparision was made simultaneously between penwriter records (Nihon-Koden, 4 channel system) and those obtained from the above-mentioned oscilloscope, and it revealed no significant differences in the waveform. The ERG was recorded with a time constant of 2 sec on the oscilloscope and of 1 sec on the penwriter record. An upward displacement in the record was taken

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as being positive for corneal electrode. The xenon flash discharge lamp (Nihon-Koden, MSP-2R) was used as the light source, and it was placed on the optic axis at a distance of about 70 cm from the eye. The stimulus intensity was expressed by the discharge energy of the xenon lamp. The ERG was recorded after 1 to 3 min of dark adaptation. The amplitude of the c-wave was measured from the baseline to the peak of the c-wave.

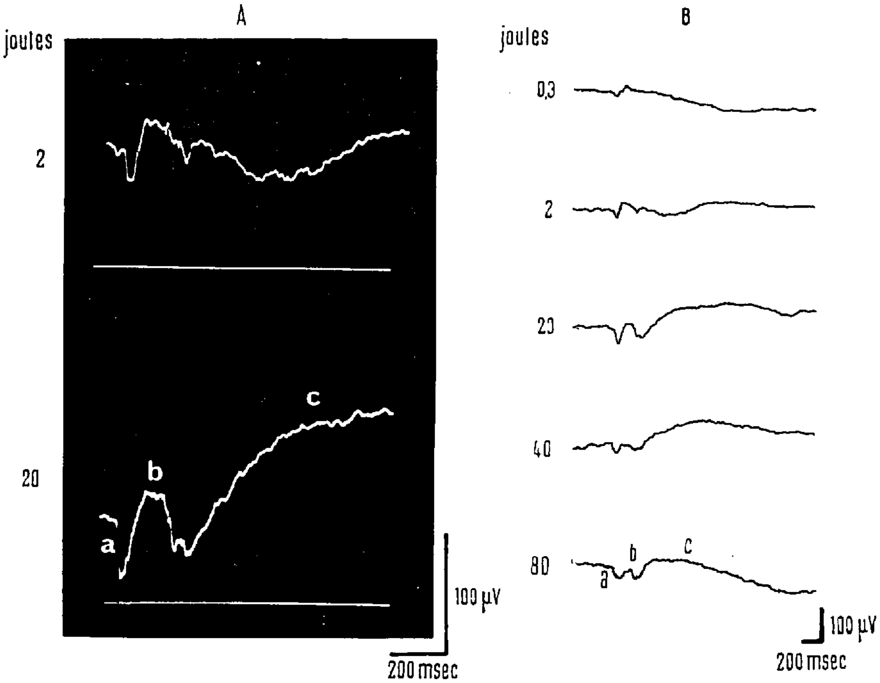

Fig. 1. The ERG pattern in a chick embryo at the 21st day of incubation at different intensities stimuli (joules). The ERG was simultaneously recorded with the oscilloscope (A) and the pen-writer (B). Body temperature was finally determined at the end of records, and it was 32.5 °C.

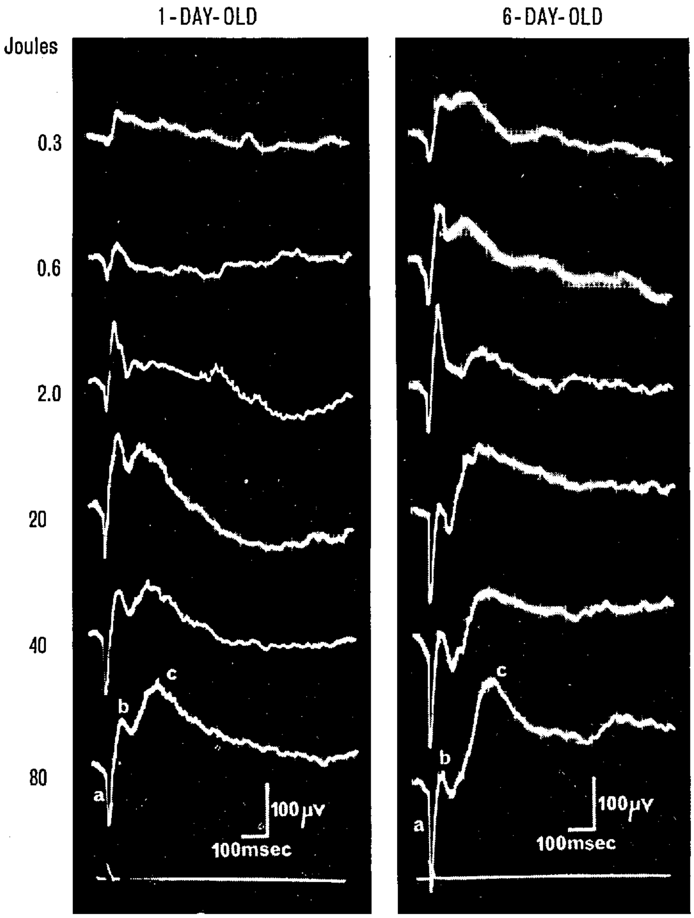

Fig. 2. ERG pattern at different intensities stimuli (joules) in 1-day-old and 6-day-old chicks. These ERGs are obtained from 1 chick in a series of experiments at the rectal temperature of 34–36 °C in each bird.

Results and discussion. In Figures 1 and 2 are shown the chick ERGs taken at several intersities 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 a- and b-waves[4]. In our experience, the c-wave was readily affected by decreased body temperature. Furthermore, the c-wave markedly depressed by deep nembutal anesthesia[5]. 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 ELLINGSON[6]). 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 GOTO[7] 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 hatching[8].

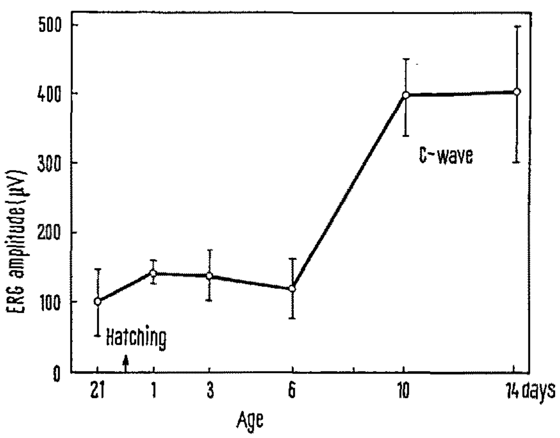

Fig. 3. The amplitude of the c-wave of White Leghorn chicks as a function of the age of the bird. The results are obtained from 5 chicks in each developing chick. The ERG was recorded at the rectal temperature of 33–36 °C in between 1-day-old and 6-day-old chicks; 38–40 °C in 10- day-old and 14-day-old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

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.

T. OOKAWA and K. TAKAHASHI

Department of Physiology, Gifu University School of Medecine, Tsukasa-machi 40, Gifu (Japan),
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Zur funktionellen Bedeutung der räumlichen Anordnung des Kristallkegels zum Rhabdom im Auge der Trachtbiene (*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 Trachtbiene 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 Reizmuster – 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. FRISCH[4] durch die Untersuchungen von GOLDSMITH[5] und SCHLOTE[6] 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

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