Relation Between the Chick Electroretinogram and Body Temperature

A number of papers have been reported concerning the electroretinogram (ERG) of the developing chick[1–6]. While the authors made ERG studies of pre- and postnatal stages of the chick[7], the influence of decreased body temperature on the ERG would seem to be important. However, as far as our references are concerned, these effects on the chick's ERG has not yet been fully examined. This is a report of a marked correlation between the ERG and the rectal temperature which has been observed in this laboratory.

Methods. 102 White Leghorn chicks, aged from 1 to 3 days and the embryonic age ranging between 16 and 21 days of incubation, were used. For the purpose of decreasing body temperature, chicks were placed in the room of 15–17 °C. Body temperature was checked by means of a thermister placed in the rectum. The ERG was recorded with a platinum-ball electrode attached by a contact lens. The reference or ground electrode was steel needle, inserted into the exposed orbit. Under local anesthesia (Benoxil), both eyelids, the nictiating membrane and the upper edge of the orbit were resected. General anesthesia was not employed in this experiment to avoid abnormal patterns of the ERG. The ERG was recorded after several minutes of dark adaptation. During the record of the ERG, the bird was kept in an absolutely dark shielded room. The ERG was registered with a dual-beam oscilloscope (Nihon-Koden, VC7) and photographed. The upper beam of the oscilloscope was used for displaying a response obtained through the pre-amplifier with a time constant of 0.2 sec, and lower for the mark of photic stimulus. A xenon flash lamp (Nihon-Koden, MSP-2R) paralleled with the optic axis, was used. The distance between the photostimulator and the eye was about 1 m. The energy of the discharge was 20 J. An upward displacement in the record was taken as positive for corneal electrode. The measurements of the recorded responses on the film were made with the help of the enlarger. The amplitude of the *a*-wave was measured from the baseline to the trough of the *a*-wave, while the amplitude of the *b*-wave was measured from the trough of the *a*-wave to the maximum amplitude of the *b*-wave. The *c*-wave was not taken into account. The preparation of the chick for experimentation and the apparatus were described in more detail elsewhere[7].

Results and discussion. Figure 1 shows a typical ERG obtained from a 3-day-old chick under the influence of gradual decrease of body temperature. It is clear that the *b*-wave decreases with decreasing rectal temperature, while the amplitude of the *a*-wave is unaffected (Figures 1 and 2). When the ERGs are superimposed, they are similar. In most cases the rectal temperature readily decreased until it became 25 or 24 °C when the birds were exposed to a cooling room at the temperature of 15–19 °C, but no further depression of rectal temperature was

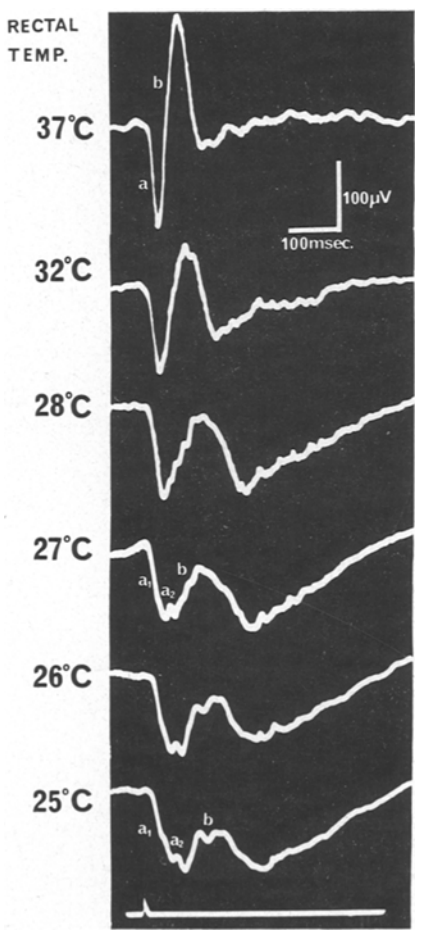

Fig. 1. Influence of gradual decrease of rectal temperature on ERG in a 3-day-old chick. These ERGs are obtained from 1 chick in a series of experiment.

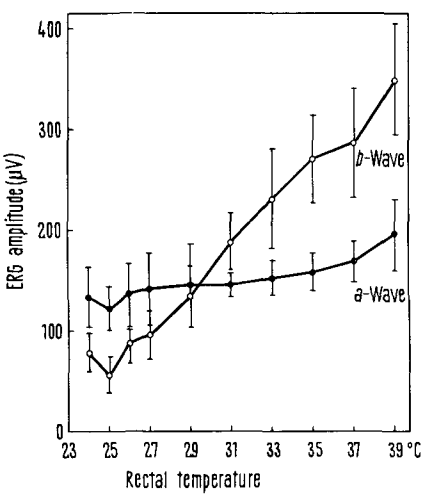

Fig. 2. Influence of gradual decrease of rectal temperature on the amplitude of the *a*- and *b*-waves. The results were obtained from five 3-day-old chicks.

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attained. As seen in the Figures 1 and 3, we always obtained in the *a*-wave 2 negative deflections at the rectal temperature between 27 and 28 °C. Each peak latency was measured from the onset of the stimulus to the trough. In the chick embryo of 18 days, the peak latency was 30–50 msec for the first deflection (a_1), and 80–120 msec for the second (a_2). In 3-day-old chicks, the latency of the first is similar to that of 18 days of incubation, but the latency of the second is shorter (45–90 msec). Two *a*-waves called a_1 and a_2 waves have been reported in mammals[8–10] and frogs[11]. The evidence from depth recording in the frog indicates that the a_1 is from the receptors while the a_2 is from the inner nuclear layer[11]. In the chick, GARCIA-AUSTT and PATETTA-QUEIROLO[2] have already mentioned that the *a*-wave was often broad and quadrangular with a notch in its midpoint on the chick embryo of 18 days. Further evidence is provided by WITKOVSKY[4] who demonstrated that cornea-negative activity could be divided into 2 components, a_1 and a_2 waves, in the chick embryo. It is of interest that the division between a_1 and a_2 waves could be accentuated by repetitive light stimulation[4]. Two negative deflections obtained in the present experiment may be comparable to the a_1 and a_2 waves, though the further analysis remains to be investigated.

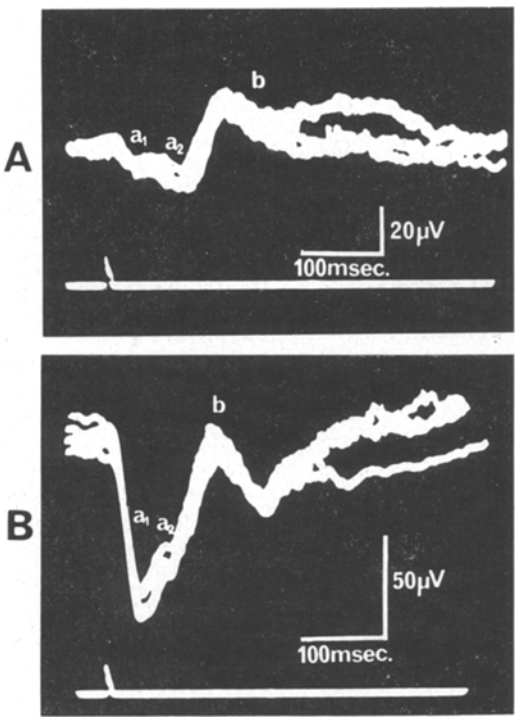

Fig. 3. Effect of decrease of body temperature on ERG in a chick embryo at 18 days of incubation (A) and in a 2-day-old (B). 4 successive sweeps have been superimposed in A and B records at the rectal temperature of 28 °C, respectively. The stimulus was given at the point marked by the bottom record in every case.

In addition, we often observed the 2 components on the *b*-wave during the course of decreased body temperature, as could be seen in Figure 1 at the rectal temperature between 25 and 26 °C. Similar double *b*-waves have been reported in the chick anesthetized with pentobarbital[4,5]. Since it has been shown in the previous[7] as well as the present study, that double *b*-wave was never observed under normal conditions, it is suggested that these might be caused under the abnormal conditions induced by a decreased body temperature or anesthesia. Changes in the pattern of the *b*-wave comparing with that in vitro will be reported in the subsequent paper[10,12].

Zusammenfassung. Untersuchung der Beziehung zwischen ERG und Körpertemperatur bei Küken ergab Abnahme der *b*-Wellen bei Verminderung der Rektaltemperatur, ohne Beeinflussung der Amplitude der *a*-Welle.

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The Inhibitory Effect of Sodium on the Contraction of Frog's Heart Perfused with Sucrose Solution

Frog's heart continues to beat spontaneously and to respond to electrical stimulation for 5–6 h if perfused with half isotonic solution of sucrose at 18–20 °C[1–7]. At higher temperatures (25–32 °C), the heart does not beat unless 0.1–0.2 m*M* sodium pyrophosphate (PP) or PP with 0.05–0.2 m*M* adenosinetriphosphate (ATP) is added to the sucrose solution[8]; addition of sodium salts of PP and ATP introduces sodium up to 1.2 m*M* in the sucrose solution. The beneficial effect of PP and ATP is not due to sodium, since addition of an equivalent quantity of sodium chloride or more (up to 2.4 m*M*) produces no such effect; the beneficial effect is therefore due to PP and ATP parts of the molecules. At still higher temperatures (37–38 °C), PP and ATP become ineffective and the heart beats for 1–2 h if sodium citrate (0.8 m*M*) is added to the sucrose solution. Addition of equivalent quantity or more (up to 3.6 m*M*) of sodium chloride produces no beneficial effect.

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