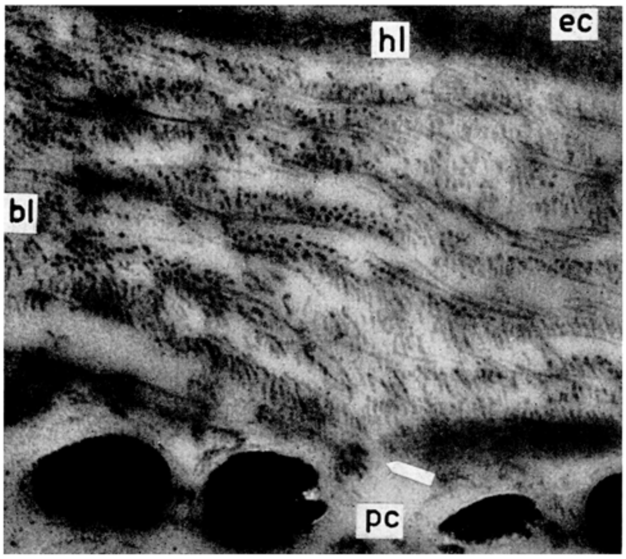

Fig. 1. *Basement lamella* (32000 : 1): ec = epidermal cells, hl = hyaline layer, bl = basement lamella with crosswise arranged collagenous fibrils at (↓) communicating with pigment cell (pc).

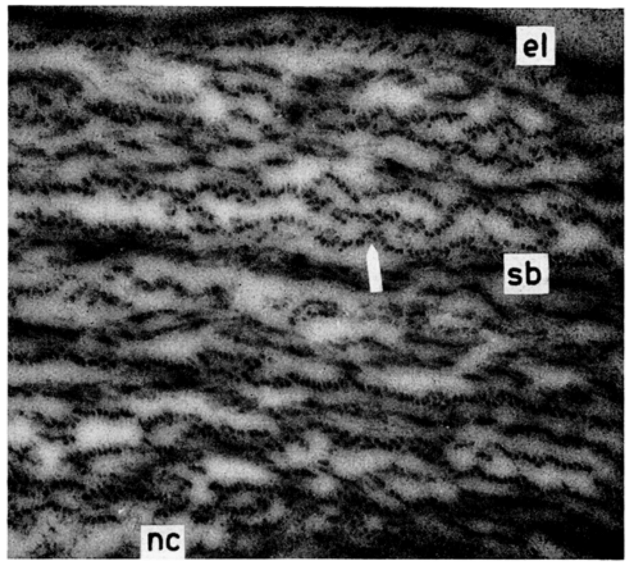

Fig. 2. *External sheath of the notochord* (32000 : 1): el = external layer with circular fibrils. The plies of the sheath body (sb) appear slightly folded (↓) and are composed of several layers of fibrils. The internal boundary is marked by epithelial cells of the notochord (nc).

Zusammenfassung. Auf Grund von elektronenmikroskopischen Beobachtungen wird nachgewiesen, dass die Basalmembran der Epidermis und die äussere Chordascheide im Schwanz von *Xenopus*larven eine übereinstimmende Feinstruktur besitzen; sie ist gekennzeichnet durch orthogonal angeordnete Kollagenfibrillen.

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Beat to Beat Analysis of the Radiocardiogram

In radiocardiography the impulses from the precordial detector are usually fed into a ratemeter with a direct-writer (PRINZMETAL, CORDAY, SPRITZLER, and FLIEG[1], VEALL, PEARSON, HANLEY, and LOWE[2], PIETILÄ and HAKKILA[3]). The inertia of this type of recording makes it difficult to register correctly rapid changes in radiation intensity such as the dilution of a radioactive indicator in determinations of cardiac output. The inertia of the ratemeter makes it impossible to record correctly the changes in the radioactivity of the radiocardiogram during individual heart cycles. The disadvantages of the ratemeter can be avoided if the impulses from the detector are recorded on a tape recorder running at a high speed (BERNE, HALLBERG, and LINDELL[4]). The magnetic tape can then be analyzed when running at low speed, using an ordinary scaler. In this way the activity, during time intervals corresponding to 0.075 sec at the original recording, may be correctly counted. This type of recording, which allows a 16-fold stretching of the time axis, is free of inertia and will accept up to 10^7 impulses/min. The record may be analyzed repeatedly using different counting intervals, if this is desirable. Moreover, using a double printer, recording alternate intervals, the system can be fully automatized.

Such a tape recorder was used in the present experiments. It has 3 channels, one of which was used to record the pulses from a precordial scintillation detector. Another channel was used to register the pulses from a scintillation detector through which arterial blood was sucked at constant speed. This record was used to calculate cardiac output (BERNE et al.[4]). The R waves of the electrocardiogram were fed into the third channel of the tape recorder. The experiments were carried out in anaesthetized dogs, lying on their right side. The precordial detector was placed over the heart from above with the help of fluoroscopy. The collimation was such that the detector 'saw' the whole heart and as little as possible of the surrounding tissues. Arterial blood, for the determination of cardiac output according to the indicator dilution technique, was drawn from a femoral artery. Radioactive potassium iodide (I^{131}) in saline solution was injected intravenously in doses of 10 μC.

In the semiautomatic analysis of the record in this study, the first R wave after the injection started the counter. As many 0.075 sec intervals as possible were counted between the R waves. An indetermined time interval (< 0.075 sec) preceding each R wave was omitted in the record (Figure 1).

The records from an experiment are shown in Figure 1. It may be seen that there is a decrease in the radioactivity recorded by the precordial detector about 0.1 sec after the R wave in the electrocardiogram. This decrease is a regular phenomenon and it is fairly constant for 3 heart cycles, during the passage of the radioactive bolus through

[1] M. PRINZMETAL, E. CORDAY, R. J. SPRITZLER, and W. FLIEG, J. Amer. med. Assoc. *139*, 617 (1949).
[2] N. VEALL, J. D. PEARSON, T. HANLEY, and A. E. LOWE, Radioisotope Conf. *1*, 183 (1954).
[3] K. A. PIETILÄ and J. HAKKILA, Cardiologia *36*, 97 (1960).
[4] E. BERNE, L. HALLBERG, and S. E. LINDELL, Scand. J. lab. clin. Invest., in press (1961).

the right heart. Some seconds later similar changes in radiation intensity are recorded as the injected I^{131} passes through the left heart. The heart did not move out of the field seen by the detector during any phase of the heart cycle, as judged by fluoroscopy. The decrease in radioactivity occuring during systole must therefore represent radioactivity leaving the heart, i.e. the stroke volume. The mean stroke volume could be calculated from the measurement of cardiac output, according to the indicator dilution principle, and was found to be 18.6 ml. It was thus possible to calibrate the systolic decrease in radioactivity in ml blood. The radioactivity recorded by the precordial detector at the end of systole should represent the amount of blood remaining in the volume 'seen' by the detector. With the collimation used, this radioactivity was confined mainly to the heart, at least during the passage of the radioactivity through the right heart. If, during the 3 heart cycles studied, the concentration of radioactive iodine is assumed to be evenly distributed between the blood leaving the heart with each systole and that remaining in the heart, then it should be possible to calculate the volume of blood remaining in the right heart at the end of systole. In the present experiment, the volume of blood in the right heart at the end of systole was calculated to be 12 ml. Similar calculations might be made for the left heart. Here, however, more of the radioactivity seen by the detector at the end of systole is likely to come from blood outside the half of the heart studied. If this objection is neglected, then the amount of blood remaining in the left heart at the end of systole may be estimated to be 12 ml.

For comparison, the tape record was also analyzed in 0.75 sec intervals without any correlation to the R waves, as described in a previous paper (Figure 2).

The radiocardiogram has been used in measurements of circulation times, such as the minimal pulmonary circulation time (WASER and HUNTZINGER[5]). This is the time between the entrance of the radioactive bolus into the right heart and its entrance into the left heart (A-A in Figure 1). Obviously these points can be more accurately assessed in this record than in Figure 2.

Zusammenfassung. Ein 3-Kanal-Magnetbandgerät ist für die gleichzeitige Registrierung von Electrocardiogramm und Radiocardiogramm verwendet worden. Die Methode ermöglicht das Studium der Veränderungen des Blutvolumens des Herzens während eines Schlagcyclus. Dadurch können Schlagvolumen und Residualvolumen der beiden Herzkammern getrennt gemessen werden.

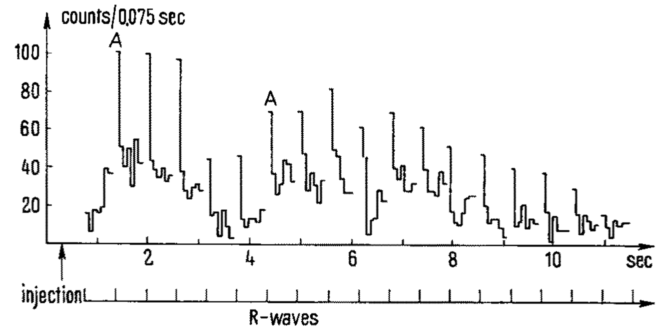

Fig. 1. Radiocardiogram recorded synchronously with the R waves of the electrocardiogram. A-A points of entry of radioactive blood in right respectively left heart.

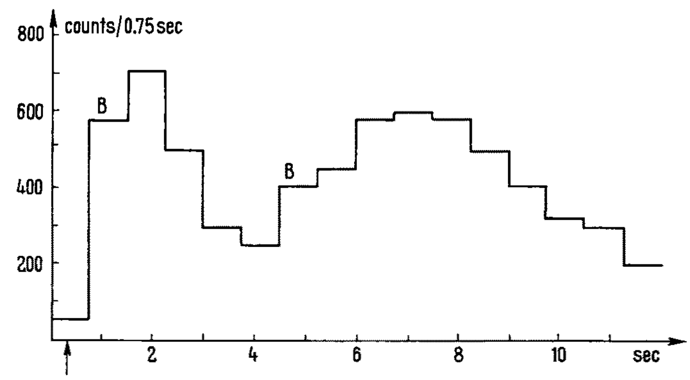

Fig. 2. Radiocardiogram of Figure 1 recorded independent of R waves of the electrocardiogram. B-B points of entry of radioactive blood in right and left heart respectively.

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Departments of Radiotherapy, Internal Medicine and Clinical Physiology, Sahlgren's Hospital, University of Göteborg (Sweden), May 15, 1961.

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Atypische Wundheilungsvorgänge in der Haut von Großschmetterlingsraupen

Schnitt- und Brandwunden in der Haut werden bei vielen Insekten durch akkumulierte Blutzellen, die aus der Leibeshöhle stammen, provisorisch verschlossen[1]. Auch unter Brandstellen in der Haut von Mehlmottenraupen bildet sich in zahlreichen Fällen vorübergehend eine «Blutzellenhaut»[2]. Im Zuge eigener Untersuchungen an Schnittwunden in der Haut von Saturnidenraupen liessen sich nunmehr in Abhängigkeit von der Operationsart 2 verschiedene Formen der Wundheilung feststellen: die erste trat bei fast allen nach aussen hin offenen Hautwunden auf, die zweite vorwiegend bei den Hautdefekten, die nach aussen hin durch die Kutikula (Ku) abgedeckt blieben; solche entstanden zum Beispiel durch die Ablösung von Flügelanlagen an der Hypodermis.

Die erste bei Lepidopteren übliche Form der Wundheilung verläuft ohne Akkumulation von Blutzellen an der Wundstelle (Figur 1a, Wst). Die Wundränder (Wr) werden durch Muskelkontraktion einander genähert; von dort bis zur Segmentgrenze (S) lockert sich sodann der hypodermale Zellverband auf. Die einzelnen, azidophilen und grosskernigen Hypodermiszellen (Hyz) schwellen basalwärts an und schieben sich über die Wundfläche hinweg. So entsteht an dieser ein lückenhafter Zellbelag, der erst in der nächstfolgenden Mitosenperiode der Hypodermis (Hy) wiederum zu normaler Zelldichte ergänzt wird.

Die zweite Form der Wundheilung, bei Lepidopteren bis jetzt noch nicht bekannt, beginnt kurz nach der Ope-

[1] V. B. WIGGLESWORTH, J. exp. Biol. *14*, 364 (1937).
[2] H. BRAEMER, Wilh. Roux' Arch. Entw.-Mech. Org. *148*, 362 (1955).