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A NEW METHOD FOR RECORDING THE RHYTHMIC ACTIVITY OF ADDUCTOR OF LARVAE OF FRESH-WATER MUSSEL (GLOCHIDIA).

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The glochidia of fresh-water mussel (*Anodonta cygnea* L.) are larvae of small size (length 500—700 μ, width 300—380 μ approximately). The rhythmic motor activity they display consists of repeated contraction and relaxing of the adductor muscle adhering to the two valves of shell. The technique usually adopted in previous works for investigating rhythmic activity and its suscepti-

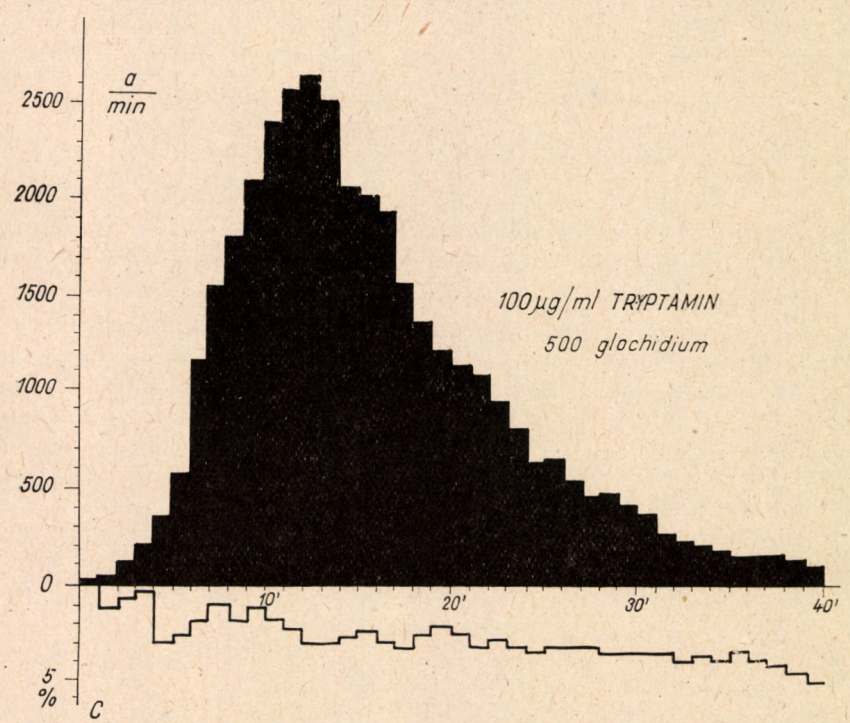

Fig. 1. Reactions of many animals measured simultaneously upon the application of 100 μg/ml tryptamine. Abscissa: time, ordinate: frequency of contractions (a/min). On the ordinate of downward direction the percentages of closed glochidia are marked.

1. ábra. Nagy számú állat együttes reakciója 100 μg/ml triptamin adására. Abszcissza idő, ordináta a kontrakciók frekvenciája (a/min). Lefelé irányuló ordinátán a bezárt glochidiumok %-os arányát tüntettük fel.

bility to various substances consists in counting the actions of glochidia per minute under binocular microscope before and after the application of various substances (LÁBOS, SALÁNKI 1963, LÁBOS, SALÁNKI and S.-RÓZSA 1964). This method is most time saving for it furnishes data on great number of animals in a single run of experiments *(Fig. 1)*, on the other hand, however, it is not suitable for investigating the single actions separately. It does not allow either of studying the activity of single individual in the function of time. A further disadvantage of this method is that in case of rhythmic activity of great frequency the number of animals in the single groups had to be reduced to perform measurements with required accuracy, because countings at full numbers of animals by direct observation could not be made precisely.

The distribution of action in time of a single glochidium may be investigated with secundum accuracy by closing when a contraction is observed the circuit of an electromagnetic signal which registers on a sooty paper. Neverthe-

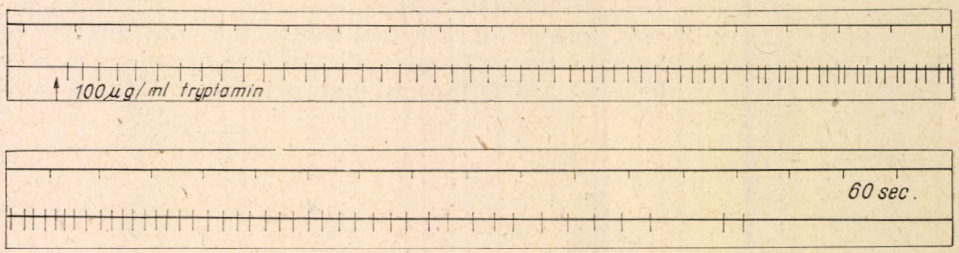

Fig. 2. Registration of the rhythmic contractions of a single glochidium. During the microscopic observation the circuit of the electromagnetic signal is closed when a contraction is observed

2. ábra. Egyetlen glochidium ritmikus kontrakcióinak regisztrálása. A mikroszkópos megfigyeléskor elektromágneses szignál áramkörét zárjuk, ha kontrakciót észlelünk

less, this procedure is suitable only for registering the number of contractions and frequency, and its accuracy cannot be increased over a certain degree because the circuit has to be closed by the investigator himself. Another disadvantage of the method is that it is not automatic *(Fig. 2)* and requires constant observation.

An automatically registering method which reflects satisfactory the mechanical movement of adductor within the limits of possibility would considerably increase the usefulness and objectivity of experimental results.

Material and methods

In this present work an attempt is made to devise a new method which would meet the above requirements. The description of this method is given in the followings. The glochidium magnified 50 times is projected with a suitable projector. For this purpose a Zeiss profileprojector 320 is used having the advantage of producing only a minimum increase in temperature of the bathing fluid of glochidia during illumination. The picture is projected to a selenium-photocell of 1 mV/Lux sensibility through an opaque glass. A single closure

of the glochidium under the above condition of projection is equal to 0.1—0.5 Lux change in illumination. The output of photo-element is connected with screened cable to the input of the RC amplifier suitably dimensioned. Under these conditions a more or less differentiated picture of the input is obtained on the output. The output of RC amplifier is led to the vertical plates of cathode-ray tube and a film is taken from the screen on the fluctuations of potential corresponding to changes in shadow.

In *Fig. 3* the block diagram of photo-electric registration is seen. An illuminant and a projection table illustrate the projection apparatus (1). The photo-element placed on the projection table (2) is connected to the

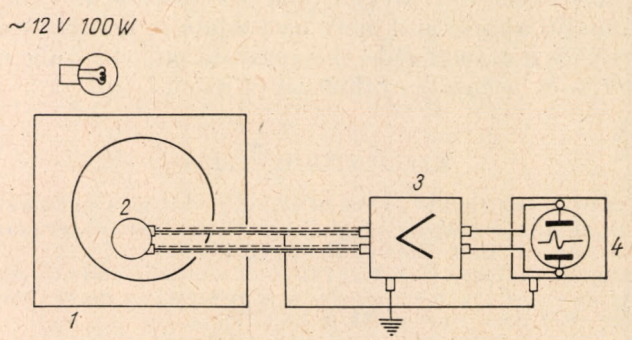

Fig. 3. Block diagram of photo-electric registration
1 = the table of Zeiss profileprojector 320. 2 = photocell in glass shade;
3 = amplifier; 4 = cathode-ray tube

3. ábra. Fotoelektromos regisztrálás tömbvázlata
1 = Zeiss profilprojektor 320 vetítőasztala; 2 = fényelem árnyékolt búrában;
3 = erősítő; 4 = katódsugárcső

amplifier (3). The output of amplifier is conducted to the vertical plates of cathode-ray tube. In *Fig. 4* the photo of the apparatus is given.

The impulse recorded by this method is illustrated in *Fig. 5*. The magnitude of upward deflection corresponds to about 0.5 Lux. Oscillation of 50 Herz originates from the projector lamp and supplies a time-signal of 20 msec. Contraction and relaxing of the animal are indicated by upward (increase in illumination) and downward deflections (decrease in illumination) respectively.

Overswinging and repeated return originates from the 0.75 sec time constant of the amplifier.

Discussion

This method is most advantageous for registering at a constant film-speed the actions during a longer period and for examining accurately the distribution of actions in time. This method is completely automatic. It registers the process of the single actions in time, and the refracter state of adductor is also measurable if suitable excitation is applied. The disadvantage of the method is that it does not record the longitudinal changes of adductor

on the film but the fluctuations of potential which is proportional to changes in shadow of the projected picture of glochidium provided the linearity of both photo-electric cell and amplifier is good.

Summary

A method is devised for registering objectively with photoelectric apparatus the small movements (< 0.5 mm) of 0.5 mm great animals. The larva of fresh-water mussel *(Anodonta cygnea* L.) was the object of these studies, and the rhythmic movement of their adductor was registered with the above method The advantages and disadvantages of methods applied so far for registering the rhythmic motor activity of glochidia are discussed. This photo-electric method is automatic, simple and more up to date in many respects than previous procedures, for it ensures objective registration, which allows of obtaining new data and a more accurate evaluation of results.

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ÚJ MÓDSZER TAVIKAGYLÓ-LÁRVÁK (GLOCHIDIUMOK) RITMIKUS ZÁRÓIZOMTEVÉKENYSÉGÉNEK OBJEKTIV REGISZTRÁLÁSÁRA

Lábos Elemér

Összefoglalás

0,5 mm-es állat 0,5 mm-nél kisebb mozgásainak objektív fotoelektromos regisztrálására írunk le módszert. Az objektum tavi kagyló *(Anodonta cygnea* L.) lárvája, melynek ritmikus záróizommozgását fenti módszerrel objektíve lehet regisztrálni. Összehasonlítottuk a glochidiumok motoros ritmikus tevékenységének vizsgálatára eddig alkalmazott módszerek előnyeit és korlátait. A fotoelektromos módszer automatikus, egyszerű és a régebbi eljárásainknál sok tekintetben korszerűbb, mert objektív regisztrálást biztosít, ami új adatok szerzését és az adatok pontosabb értékelését teszi lehetővé.

НОВЫЙ МЕТОД ОБЬЕКТИВНОЙ РЕГИСТРАЦИИ РИТМИЧЕСКОЙ ДЕЯТЕЛЬНОСТИ ЗАПИРАТЕЛЬНОЙ МЫШЦЫ ЛИЧИНОК (ГЛОХИДИЕВ) БЕЗЗУБКИ

Элемер Лабош

Описывается метод объективной фотоэлектрической регистрации движений меньше чем 0,5 мм животного размера 0,5 мм. Объектом исследования служили паразитические личинки беззубки. (Anodonta cygnea L.), ритмическое движение запирательных мышц которых этим методом можно объективно регистрировать. Были сравнены преимущества и недостатки методов, применяемых до сих пор для исследования моторной ритмической деятельности глохидиев. Фотоэлектрический метод является автоматическим, простым и более современным, чем методы, применяемые до этого, потому что обеспечивает автоматическую регистрацию, которая дает возможность получить новые данные и более точную оценку результатов.

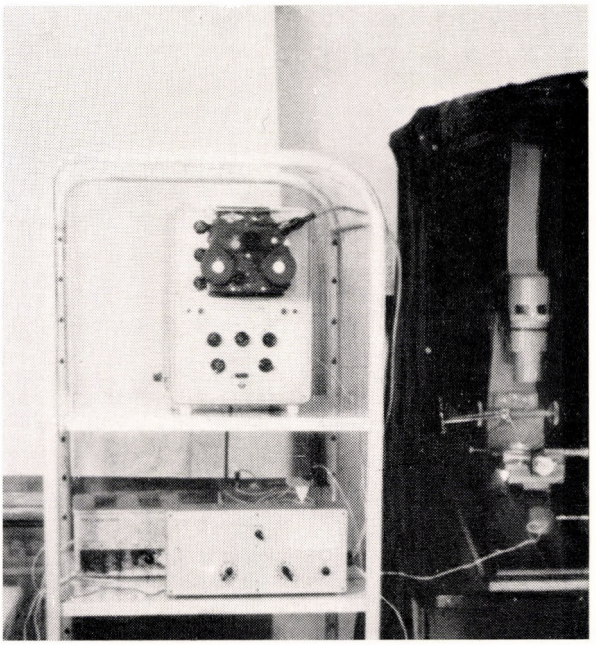

Fig 4.

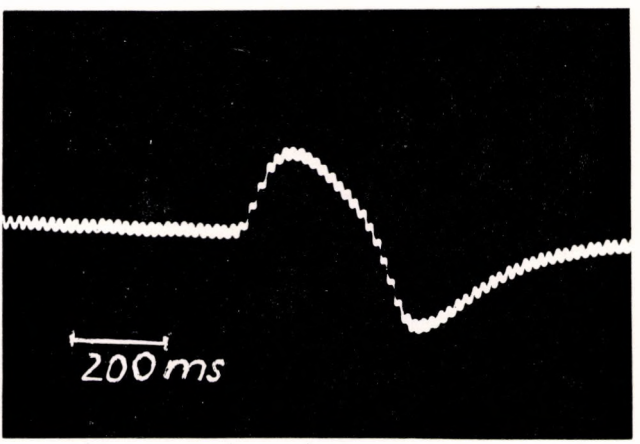

Fig 5.

Fig. 4. Photograph of the equipment
1 = profileprojector; 2 = amplifier; 3 = oscilloscope with photokymograph;
4 = photocell

4. ábra. A berendezés fényképe
1 = profilprojektor; 2 = erősítő; 3 = oszcilloszkóp fotokimográffal
4 = fényelem;

Fig. 5. Photo of reaction in movement of a single glochidium taken by way of photoelectric registration. Time constant: 0.75 sec.
Upward deflection indicates contraction (increase in illumination), downward deflection relaxing (increase in illumination). Both are distorted by amplification. Oscillation of 50 Hz originates from the projection lamp and supplies a time signal of 20 msec.

5. ábra. Egyetlen glochidium mozgásreakciójának fotoelektromos regisztrálással készült képe. Időállandó: 0,75 sec.
A felszálló szár a kontrakciót (megvilágításnövekedést), a leszálló szár az ernyedést és az erősítő visszabillenését együttesen jelenti. Az utolsó visszatérő vonal az erősítőből ered. Az 50 Hz hálózati ingadozás a vetítőlámpából ered, és egyben időjelzésül szolgál: 20 msec.