gegenüber denen der Männchen sind. In diese Monate fällt die Embryonalentwicklung und die Geburt der Jungen. Es ist anzunehmen, daß die Weibchen während dieser Zeit sowohl infolge ihres körperbehinderten Zustandes wie auch infolge ihres oft auffälligen geselligen Beisammenseins in den Wochenstuben größeren Gefahren ausgesetzt sind als die Männchen, womit die oben gemachte Feststellung von der höheren Verlustziffer im weiblichen Geschlecht seine Erklärung finden würde.

M. EISENTRAUT

Zoologisches Museum Berlin, den 28. Februar 1947.

Summary

(1) The greatest age of *Myotis myotis* hitherto ascertained by means of the marking method, is 12 years.

(2) The annual loss, observed with striking regularity, amounts to 40%.

(3) It is remarkable that in the first years of control the number of losses of females is far higher than that of males. This observation coincides with the ascertained fact that the reported number of females found dead is nearly double the corresponding number of males.

(4) According to the notifications of dead animals found the months most rich losses are May and June. Evidently the females are particularly exposed to peril by the development of the embryo which takes place at that time, and by the breeding of their young ones.

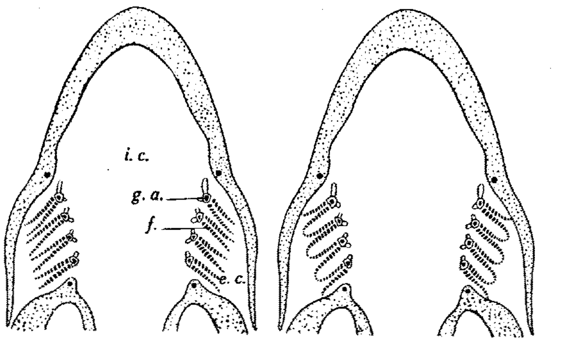
The mechanism of movement of the gill-filaments in Teleostei

Our knowledge of the structure of the gills and of the way, in which the gill-elements function in Teleostei, is mostly of older date and has not yet been adapted to the results of the recent physiological investigations of the respiration of these fishes.

It is a well-known fact, that every gill-bar bears a double row of filaments (gill-plates of the first order), the two hemibranchiæ. The filaments of both hemibranchiæ of a gill alternate with each other. Every filament ist supported by a piece of skeleton, the gill-rod, which is connected with the visceral arch. The filaments are movable through the action of small muscles in the sense of an adduction of the filament-tips of the two hemibranchiæ, which belong to one gill. The exchange of carbonic acid and of oxygen takes place in the blood-lacunæ of the thin lamellæ (gill-plates of the second order), which are placed on both sides of the filaments, nearly perpendicular to the surface.

The small muscles, which move the filaments, are described as adductor muscles. They really act as adducting powers for the filament-tips of the two hemibranchiæ of a gill. Several authors (RIESS[1], WOSKOBOINIKOFF[2], ELFRIEDE SCHÖTTLE[3]) ascribe to these adduction movements of the filament-rows of a gill a significance for the renewal of the water during breathing and for the propulsion of the blood through the vessels of the gill-filaments. ELFRIEDE SCHÖTTLE[3] (1932, p.10) even speaks of fanning movements (fächelnde Bewegungen) of the gill-filaments in the *Gobiiformes*, to which the action of these adductor muscles should contribute. According to RIESS the blood of the arteria branchialis should be pushed by the heart-power only as far as the branches of the filaments. By a successive contraction and relaxation of the adductor muscles the afferent vessels for the filaments should be closed and opened alternately, which would cause the current of the blood through the filaments. It is evident, that these authors start from the supposition, that the adductor muscles have a rhythmical action, in which contraction and relaxation follow each other continuously.

When we have a look at the figures of a horizontal section of the branchial region in a Teleost in the different textbooks of zoology and comparative anatomy (GEGENBAUR[1], p. 226; BOAS[2], p. 511; HERTWIG[3], p. 526; CLAUS-GROBBEN-KÜHN[4], p. 919; NEAL and RAND[5], p. 247; PARKER and HASWELL[6], p. 86) we always see a wide aperture between the filament-tips of the posterior hemibranchia of one gill and the anterior one of its immediate successor in the schemes (fig. 1*a*). As early as 1932 WOSKOBOINIKOFF[7] concluded that in living Teleostei the filaments of two successive branchial arches shut off the slits between these arches. Only in this way there is a maximum of contact between the respiratory water and the blood in the lamellæ; the respiratory water is now forced to pass only through the small slits between the lamellæ (fig. 1*b*). If there



a *b*

Fig. 1. Schematic diagram of a horizontal section of the head of an osseous fish. *a* Wrong reproduction of the position of the filaments during quiet respiration (after BOAS, 1922). *b* Correct reproduction of the position of the filaments during quiet respiration.

g. a. gill-arch. *f.* filament with lamellæ. *i. c.* inspiratory cavity. *e. c.* expiratory cavity.

should be a wide aperture between the filament-tips, the greater part of the respiratory water would flow away without having passed the lamellæ. Under these conditions the difference in quantity of oxygen of the water before and after passing the gills (the utilization of the oxygen) should be low. On the contrary VAN DAM[8]

[1] A. RIESS, Der Bau der Kiemenblätter bei den Knochenfischen. Arch. Naturgesch., 47. Jg., *1* (1881).

[2] M. W. WOSKOBOINIKOFF, Apparat der Kiemenatmung der Fische. Zool. Jb., Abt. Anat. Ontog. *55* (1932).

[3] SCHÖTTLE, ELFRIEDE, Morphologie und Physiologie der Atmung bei Wasser-, Schlamm- und landlebenden *Gobiiformes*. Z. wiss. Zool. *140* (1932).

[1] C. GEGENBAUR, Vergleichende Anatomie der Wirbeltiere mit Berücksichtigung der Wirbellosen, 2. Bd., 1901.

[2] J. E. BOAS, Lehrbuch der Zoologie, 9. Auflage, 1922.

[3] R. HERTWIG, Lehrbuch der Zoologie, 15. Auflage, 1931.

[4] CLAUS, GROBBEN und KÜHN, Lehrbuch der Zoologie, 10. Auflage, 1932.

[5] H. V. NEAL and H. W. RAND, Chordate Anatomy, 1939.

[6] PARKER and HASWELL, A Textbook of Zoology, 6th édition, 1943.

[7] M. W. WOSKOBOINIKOFF, Apparat der Kiemenatmung der Fische. Zool. Jb., Abt. Anat. Ontog. *55* (1932).

[8] L. v. DAM, On the utilisation of oxygen and regulation of breathing in some aquatic animals. Diss., Groningen 1938.

found in the eel and the trout a utilization of 80%; and according to HAZELHOFF[1] this value amounts to an average of 62% in some other Teleostei. Without knowing WOSKOBOINIKOFF's publication, VAN DAM[2] concluded in the same way from the value of the utilization of the oxygen, that the wall separating the inspiratory and the expiratory cavity must be a wall without big slits.

In perfect agreement with these conclusions are the results of experiments on *Tinca tinca*, carried out by Mrs HOFDIJK-ENKLAAR (Zoological Laboratory of the University of Groningen; not published). By looking under the gill-cover in the phase of expiration it is possible to watch the position of the filament-tips. Mrs HOFDIJK-ENKLAAR found, that in this phase of the respiration the filament-tips of one hemibranchia and those of the successive one of a following branchial arch lean against each other. As in the inspiratory phase the gill-cover lies close to the body, it is not possible to observe the filaments during this phase of breathing. It was necessary to make a small circular opening in the gill-cover in order to observe the filament-tips during both phases of breathing. A bit of transparent celluloid was inserted in the little circular hole to prevent, that the pressure relations in the expiratory cavity should change. Mrs HOFDIJK-ENKLAAR could observe that in quiet respiration the filament-tips of one hemibranchia and those of the successive one of the next gill touch each other during inspiration as well as during expiration.

It was also noticed, that in apparently clean water a normally breathing fish opens the gill-clefts at regular intervals, e.g. 8 times to 50 breathing movements. It makes so-called coughing movements. If small fragments of defilement (small filaments of filtering paper, a large quantity of detritus, etc.) are added to the water, these coughing movements become more frequent. In his investigations concerning the respiration of the Teleostei KUIPER[3] observed these abnormal respiratory movements which he rightly interpreted as coughing movements. In his detailed study (1907) he accurately describes the sequence of opening and closing of mouth and gill-cover during the coughing movements.

Mrs HOFDIJK-ENKLAAR could observe through the celluloid window of the gill-cover, that during the coughing movements the gill-clefts open for a moment by the adduction of the filament-tips of the hemibranchiæ belonging to one gill. Inspired particles are coughed out either in a forward or in a backward direction. In both cases a strong current of water is produced, which cleans the gills. The filaments, bridging the gill-clefts, part from each other.

In the same way mechanical stimulation of the mucous membrane of the inspiratory cavity as well as of the expiratory one causes the opening of the gill-clefts.

Afterwards I found, that exactly the same adduction-movements could be called forth in stimulating the filaments of a freshly decapitated fish with an electric current. In such a test-object the position of the filaments is still the same as in the living animal. It was even possible to study the movements of the filaments in a transversely cut gill. In this manner a better insight could be obtained in these movements. As soon as we bring a just decapitated fish in a fixation-liquid, the wide clefts between the successive gills appear. It is evident, that the figures in the different textbooks are derived from dead and fixed material. In the living and normally breathing animal the gill-clefts are bridged by the filaments (fig. 2).

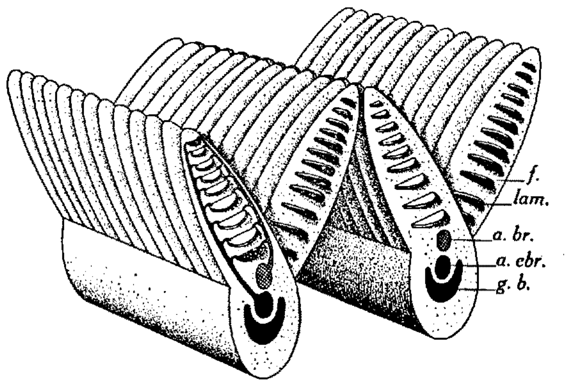


Fig. 2. Schematic diagram of the position of the filaments and the lamellæ in the living animal showing the blood-circulation in the filament.

f. filament. *lam.* lamella. *g. b.* gill-bar. *a. br.* arteria branchialis. *a. ebr.* arteria epibranchialis.

As we study the coughing movements in the above mentioned way, it appears, that the opening of the gill-clefts during these movements occurs actively, that is to say by the action of the adductor muscles. We found two types of adductor muscles (fig. 3 and 4). The muscles of the two types act in a different way. A muscle of the first type, as it is found e.g. in *Esox lucius* moves the hole filament. The filament pivots in the syndesmosis between gill-rod and gill-bar (fig. 3).

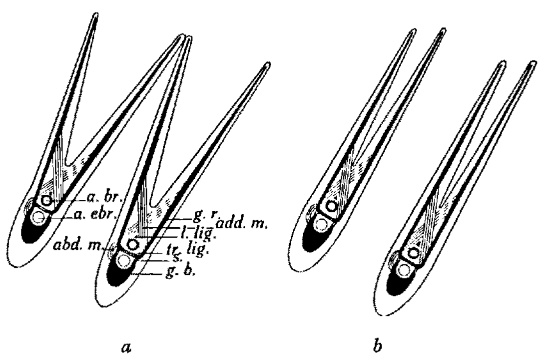


Fig. 3. Schematic diagram of a section through two successive gills with adductor muscles of the first type: *a* during quiet respiration; *b* during the coughing movements.

g. b. gill-bar. *g. r.* gill-rod. *s.* syndesmosis between gill-rod and gill-bar. *tr. lig.* transverse ligament between the bases of the gill-rods. *l. lig.* longitudinal ligament. *a. br.* arteria branchialis. *a. ebr.* arteria epibranchialis. *add. m.* adductor muscle. *abd. m.* so-called abductor muscle.

A muscle of the second type however, as it is met with in *Tinca tinca* e.g., only straightens the slightly curved endings of the filaments (fig. 4). In both cases however the filament-tips of the two hemibranchiæ of a gill approach each other, and the gill-clefts open. The

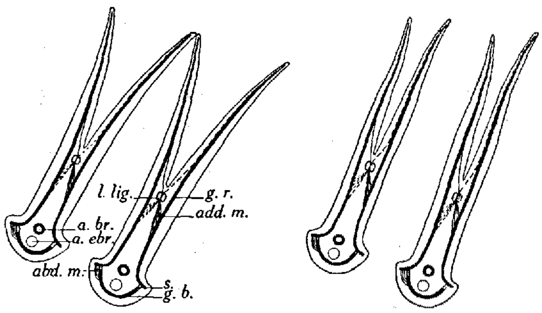
[1] E. H. HAZELHOFF, Über die Ausnützung des Sauerstoffs bei verschiedenen Wassertieren. Z. vergl. Physiol. *26*, 3. Heft (1938).

[2] L. v. DAM, On the utilisation of oxygen and regulation of breathing in some aquatic animals. Diss., Groningen 1938.

[3] T. KUIPER, Sul mecanismo respiratorio dei pesci ossei. Rend. d. R. Acc. dei Lincei, I. sem., Serie 5a, *15*, fasc. 7.° (1906); Sur le méchanisme respiratoire des poissons osseux. Arch. ital. de Biol. *45*, fasc. 3 (1906); Untersuchungen über die Atmung der Teleostier. Arch. ges. Physiol. *117* (1907).

filaments are brought back again in their original position by elastic powers which are evoked by the adduction-movement.

It is not probable that the thin sheet of muscle-fibers at the base of the oral hemibranchia of every gill, the so-called abductor muscle which is only present in a number of fishes, acts as an abducting power and should help to bring the filaments back again in their normal position. The function of these "abductor muscles" must be another one.



a *b*

Fig. 4. Schematic diagram of a section through two successive gills with adductor muscles of the second type: *a* during quiet respiration; *b* during the coughing movements. Indications as in fig. 3.

So it is settled from the above mentioned observations that the adductor muscles only have a significance for the cleaning of the gills. The adduction movements are of no importance for the circulation of the blood (RIESS[1]), nor for the renewal of the respiratory water (WOSKOBOINIKOFF[2], ELFRIEDE SCHÖTTLE[3]).

J. HUBERTHA BIJTEL[4]

Zoological Institute of the University of Groningen (the Netherlands), January 7, 1947.

Zusammenfassung

Bei ruhiger Atmung sind die Kiemenspalten der Teleostier sowohl während der Ein- wie während der Ausatmung dadurch verschlossen, daß je zwei einander zugekehrte Filamentreihen der angrenzenden Kiemen sich mit ihren Filamentspitzen berühren. Nur durch die ganz feinen Spalten zwischen den Lamellen der Filamente hindurch kann das Atmungswasser vom Ein- zum Ausatmungsraum strömen.

Die Zusammenziehung der Adduktormuskeln bringt die Spitzen der Filamente zweier auf einem Kiemenbogen stehenden Filamentreihen zur Adduktion, und zwar entweder durch die Drehung des ganzen Filaments oder durch die Streckung seines freien Teiles. Ein- und Ausatmungsraum stehen dann durch breite Spalten miteinander in Verbindung.

Diese Kontraktion der Adduktormuskeln tritt bei den Hustbewegungen auf, sowohl beim Husten nach vorne wie auch beim Husten nach hinten. Die Muskeln haben also eine Bedeutung für die Kiemenreinigung und spielen weder bei der Bewegung des Blutes durch die Kiemengefäße (RIESS, 1881, WOSKOBOINIKOFF, 1932) noch bei der Erneuerung des Atmungswassers (ELFRIEDE SCHÖTTLE, 1932) eine Rolle.

[1] A. RIESS, Der Bau der Kiemenblätter bei den Knochenfischen. Arch. Naturgesch., 47. Jg., *1* (1881).

[2] M. W. WOSKOBOINIKOFF, Apparat der Kiemenatmung der Fische. Zool. Jb., Abt. Anat. Ontog. *55* (1932).

[3] ELFRIEDE SCHÖTTLE, Morphologie und Physiologie der Atmung bei wasser-, schlamm- und landlebenden Gobiiformes. Z. wiss. Zool. *140* (1932).

[4] A detailed description of these investigations will appear in Arch. néerland. Zool. *8* (1947).

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PRO LABORATORIO

Au sujet de la mesure des modifications de l'adrénalino-sécrétion

De nombreuses méthodes ont été décrites pour mesurer les modifications de la sécrétion d'adrénaline. Parmi les techniques employées, celle de TOURNADE présente l'avantage de permettre, grâce à la dérivation de la circulation veineuse surrénale d'un Chien dans la veine jugulaire d'un congénère surrénalectomisé, une inscription continue des modifications de l'adrénalino-sécrétion; on enregistre, dans ce but, la pression artérielle de l'animal receveur ainsi que le volume de sa rate. Cette méthode présente cependant l'inconvénient de n'être pas d'une sensibilité extrême, l'adrénaline subissant une forte dilution dans la circulation générale du Chien receveur avant d'exercer son action.

D'autres méthodes s'adressent au prélèvement direct du sang veineux surrénal que l'on fait agir ensuite sur des préparations telles que l'intestin isolé ou sur certains domaines circulatoires. Lors de l'application de ces techniques, le prélèvement du sang veineux surrénal s'accompagne cependant de certains inconvénients pouvant influencer défavorablement la sécrétion d'adrénaline. Contentons-nous de signaler à ce propos la méthode, souvent utilisée, du prélèvement d'un échantillon de sang dans la veine lombo-surrénale, après l'occlusion momentanée de la veine surrénalo-cave, réalisée par une traction exercée sur un fil placé sous cette veine. Cette occlusion change provisoirement la direction du sang veineux surrénal qui, au lieu de se diriger directement vers la veine cave inférieure, reflue, dans ces conditions, vers la veine lombo-surrénale formant cul-de-sac. Il est évident que la traction exercée, peu avant le prélèvement du sang surrénal, par le fil placé sous la veine surrénalo-cave, peut troubler momentanément les conditions de fonctionnement de la surrénale et déterminer certains réflexes qui peuvent avoir leurs répercussions sur la sécrétion adrénalinique.

Voulant, pour certaines expériences actuellement en cours, éviter ces inconvénients et désirant disposer en même temps d'une méthode très sensible permettant de déceler des modifications même légères de la concentration du sang veineux surrénal en utilisant directement ce sang tout en ne lui faisant subir aucune dilution préalable, nous avons appliqué la technique suivante: chez un Chien, anesthésié à la morphine-chloralosane,