

**CENTRIFUGAL ACTIVITY IN THE OLIVO-COCHLEAR BUNDLE:
A SINGLE UNIT ANALYSIS FROM A FEEDBACK SYSTEM**

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Centrifugal fibres to the cochlea come from both superior olives, as shown by Rasmussen (1946, 1960).

Recent histological evidence indicates that the olivo-cochlear fibres end in the organ of Corti in the region of the hair cells and afferent endings. That this is true for the crossed efferents is also suggested by the findings of Galambos (1956) that electrical stimulation of the crossed olivo-cochlear fibres inhibited the action potential at the round window. The argument is strengthened by my findings that such electrical stimulation increases the cochlear microphonics and the resting potential at the round window (Fex, 1959, 1962). Using microelectrode recording I also found that such stimulation inhibited activity in primary auditory single neurons (Fex, 1962).

In the present experiments decerebrate cats were used. In one series the vestibulo-cochlear anastomosis and part of the cochlear nerve were exposed by opening the cochlea. Stimulating electrodes were placed in the crossing of the olivo-cochlear bundles. The vestibulo-cochlear anastomosis was probed with micropipette electrodes and single unit activity was recorded. Fibres were classified as crossed olivo-cochlear fibres when showing action potentials as response to shocks in the floor of the fourth ventricle. Whether activated by electrical stimulation of the ipsilateral cochlear nerve or by acoustical stimulation of the contralateral ear crossed olivo-cochlear fibres responded as a rule with a low regular firing rate without initial bursts. In this series the highest firing rate at the beginning of a train of impulses was 9 impulses during 100 msec.

Most crossed olivo-cochlear fibres tested in this respect gave graded responses to sound. Several of them had a dynamic range of approximately 30 db or less but some had a dynamic range of at least 60 db. A linear relationship between impulses/sec and sound pressure in db was found.

A well defined threshold within ± 3 db was found for every unit that could be tested. Most of the units were not activated at sound pressures of less than 40 db SPL and many needed pressures above 60 db SPL to be activated. Two units were activated by a 4.000 c/s tone at approximately 15 db SPL.

A best frequency determinable within 10%, or less, was found in almost every unit tested. Crossed olivo-cochlear fibres in the basal fascicle of the vestibulo-cochlear anastomosis generally responded to higher tone frequencies presented to the contralateral ear than did the fibres in the apical fascicle.

This indicates that afferents and efferents from homotopic cochlear points in opposite cochleas are connected.

Signs of interaction between auditory inflow of the two sides were found in crossed olivo-cochlear activity. In several fibres single shocks applied to the ipsilateral cochlear nerve were followed by single impulses only when the shocks were given during presentation of tone pips, to the contralateral ear.

The results, presented in full details elsewhere (Fex. 1962) permit the conclusion that the auditory afferent fibres and the crossed cochlear efferents together from a feedback system within the auditory system. To approach the question as to which ear dominates the activation of the crossed efferents a second series of experiments was performed on decerebrate cats with both ears intact. The site of the crossing of the olivo-cochlear bundles between the facial genu in the floor of the fourth ventricle was probed with micropipette electrodes. Stimulating electrodes were placed in, or close to, the vestibulo-cochlear anastomosis of the one ear, through the internal auditory meatus. Single units were found that were driven by the electrical stimulation. When activated by sound, most of these fibres showed the characteristics of crossed olivo-cochlear fibres. In all fibres that could be acoustically activated from both ears the best frequency was the same for both sides of stimulation. Further results of this unfinished study indicate that the crossed efferents are activated mainly through the ear to which they run.

In a third series of experiments the vestibulo-cochlear anastomosis was again studied. In these cats the crossed efferents were cut between the facial genu. Stimulating electrodes were stereotactically placed in the S-shaped olivary nucleus. Single fibres in the anastomosis were found that could (1) be driven by electrical stimulation of the ipsilateral superior olive, (2) be activated by electrical stimulation of the ipsilateral cochlear nerve and (3) be activated by acoustical stimulation of the contralateral ear. Such fibres were classified as uncrossed olivo-cochlear fibres. The main characteristics of the crossed efferents — low and regular firing rate, well defined threshold, well defined best frequency — were shared by most of the uncrossed efferent fibres, but differences between the two groups were also found. The study is still under progress.

L'ACTIVITÉ CENTRIFUGE DANS LES FAISCEAUX OLIVO-COCHLÉAIRES: UNE ANALYSE UNIQUE À PARTIR D'UN SYSTÈME «FEEDBACK»

Le chat décérébré est utilisé pour cette étude des fibres des faisceaux olivo-cochléaires au niveau de l'anastomose vestibulo-cochléaire. Les fibres sont activées par stimulation électrique du nerf auditif homolatéral et par stimulation acoustique de l'oreille controlatérale. Presque toutes les fibres en répondant aux sons donnent des décharges régulières et dispersées, ayant des seuils d'excitation bien définissables et des spécificités aux diverses fréquences; il existe cependant des différences entre les fibres olivo-cochléaires croisées et non croisées.

Les fibres olivo-cochléaires croisées dans le faisceau basal de l'anastomose vestibulo-cochléaires répondent d'ordinaire aux sons de fréquences plus hautes que les fibres dans le faisceau apical. Le principe général est indiqué que les fibres afférentes et les fibres efférentes des points cochléaires homotopographiques dans les cochlées opposées sont jointes.

Les fibres efférentes croisées ont une augmentation de leur disposition à répondre à la stimulation électrique du nerf cochléaire homolatéral quand des sons sont présentés à l'oreille controlatérale.

Les résultats présents et antérieurs nous amènent à la conclusion que les deux faisceaux olivo-cochléaires croisées se partagent dans un mécanisme complexe de feedback.

L'activité a été enregistrée dans les fibres efférentes croisées chez des chats ayant les deux oreilles intactes. Les résultats préliminaires indiquent que l'oreille recevant ces fibres domine dans l'excitation de celles-ci.

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