THE OLFACTORY MUCOSA IN LIVING MAN

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We have studied the olfactory mucosa in man since two years. The first difficulty we met was to obtain living tissue. In the cadaver it proved to be the simplest procedure to take out the whole ethmoidal cell bloc. We have given the details of this procedure in a preceding article (see ref.). In the living the problem is much more complicated. The only way to obtain the particular tissue was to enlarge the elevation of the septal mucosa as far as the cribriform plate during a septoplasty. If done properly this technic is without any danger. However, only in 50% of the biopsies there was olfactory mucosa present and the superficial epithelium was often not included.

To my knowledge such a study on living tissues has not been done before. This olfactory mucosa is to be recognised by its three types of cells, the presence of glands of Bowman, the absence of a real basal membrane for the greater part and the presence of many nervous fibres. Coloration with Alcian Blue and with PAS was negative with the exception of the coloring of the secretion from the glands of Bowman (in the glandular canal) of some rare cells of these glands and of the epithelial surface (secretion coming also from the glands of Bowman?)

We have also set forward the hypothesis that the olfactory epithelium may change to a respiratory epithelium or at least to a transitional epithelium by chronic infection. All this has been published with photographic illustrations and we will not insist here on the subject.

At this moment we should like to show you the present state of our studies concerning the research of enzymatic activities of the olfactory mucosa. We have taken frozen sections from the living individual. As in the above mentioned studies we think it is more interesting to make comparative studies between olfactory mucosa and respiratory mucosa. So we have brought into comparison eleven enzymatic activities in olfactory mucosa with the same in the respiratory mucosa to my knowledge. These studies have been done before only on the cadaver.

Technic

The pieces of tissue without any bone or cartilage were put in an empty receptacle surrounded with ice. Within 15 min. these pieces were frozen by submerging in propane during 1 min. Sections of 10 μ thickness were made in the cryostat at minus -10°F. We have colored three sections with haemalun-eosin in order to confirm the presence of olfactory tissue and to study it more easily. We have been looking for the following enzymatic activities. Here they follow with their specific color reaction:

Oxydative enzymes	Color reaction
— DPNH diaphorase (NAD) (oxydo-reductase)	Barka, modified from Scarpelli
— TPNH diaphorase (NADP) (oxydo-reductase)	id.
— Glucose 6 phosphate dehydrogenase	TPN linked dehydrogenase modified from Nachlas
— Lactate dehydrogenase	DPN linked dehydrogenase modified from Nachlas
— Succinic dehydrognase	Barka, modified from Nachlas.
Phosphatases	
— Alkalin phosphatases	Simultaneous coupling AZO Dye method using α — naphtyl phosphate
— Acid phosphatase	Gomori method
— 5 Nucleotidase	Wachstein and Meisel
— ATP ase	Lead method (Wachstein and Meisel)
— Glucose - 6 - phosphatase	Wachstein and Meisel.
Non specific esterases	
α — naphtyl method for esterase	Barka

We have classified the enzymatic activities on the ground of the topographical localisation: respectively in the epithelium, in the glands and in the excretory canals, in the blood vessels and in the connective tissues. Also we have valuated this activity, attributing to it one to three crosses. So we obtained a comparative tabulation between the respiratory and the olfactory mucosa. From this resulted the following tabulation:

Comparative and topographical tabulation of some enzymatic activities of the respiratory and the olfactory mucosa from the living subject.

	Epithelium		Glands		Blood vessels		Stroma	
	R.M.	O.M.	R.M.	O.M.	R.M.	O.M.	R.M.	O.M.
DPNH	+++	+++	+++	+++	+	++	±	±
TPNH	++	++	++	+	±	+	±	±
Gl 6 ph dehydro	+++	+++	+++	+	±	+	±	—
Succin dehydro	±	±	+++	±	+	±	+	±
Lactate dehydro	++	+++	+++	++	+	++	—	+
Alkal phosph	—	—	±	—	—	—	—	—
Acid phosph	+++	±	+++	±	+	±	+	—
5 Nucleo	—	—	—	—	+	++	++	+
Gl 6 ph	±	—	±	±	±	±	+	—
ATP ase	—	—	+	±	±	+±	++	±
Non spec. est.	+	+	+	+	+	+	+	+

R.M. = respiratory mucosa
O.M. = olfactory mucosa.

RESULTS

We can conclude from this tabulation:

1. Firstly that we have found on the olfactory mucosa a distinct enzymatic activity in the epithelium and in the glands of Bowman for DPNH, TPNH, glucose 6 phosphate dehydrogenase, lactate dehydrogenase and non specific esterase (Figures 1 to 5).
2. Secondly that we have found a clear difference in enzymatic activity between the respiratory and the olfactory mucosa for succinic dehydrogenase and acid phosphatase;

For succinic dehydrogenase the glands of Bowman (Figure 6) are only weakly reactive in counter distinction to the glands of the respiratory mucosa (Figure 7).

For acid phosphatase the olfactory epithelium and the glands of Bowman (Figure 8) are only weakly reactive in counter distinction to the epithelium and the glands of the respiratory mucosa (Figure 9).

In this stage of our studies we cannot yet draw conclusions but we think it might be interesting to mention the results. We only want to stress the fact that acid phosphatase reveals the enzymatic activities of the nucleus and of

Figure 1.
Olfactory mucosa. DPNH diaphorase strongly positive in the epithelium, in the blood vessels and in the glands of Bowman (obj. 10 : 1, 160 x). (This section and all the other sections were first studied with haemalun-eosin coloration).

Figure 2.
Olfactory mucosa. TPNH diaphorase positive in the epithelium and in the glands of Bowman (obj. 10 : 1, 160 x).

the lysosomes, the succinic dehydrogenase that of the mitochondries. Now we shall have to test the other enzymatic activities of the nucleus, the lysosomes and the mitochondries and to localise more precisely these activities.

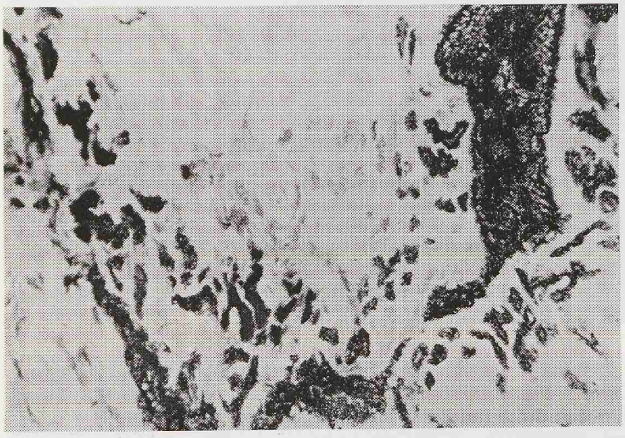

Figure 3.
Olfactory mucosa.
Glucosa 6 phosphate dehydrogenase strongly positive in the epithelium and in the glands of Bowman (obj. 10 : 1, 160 x).

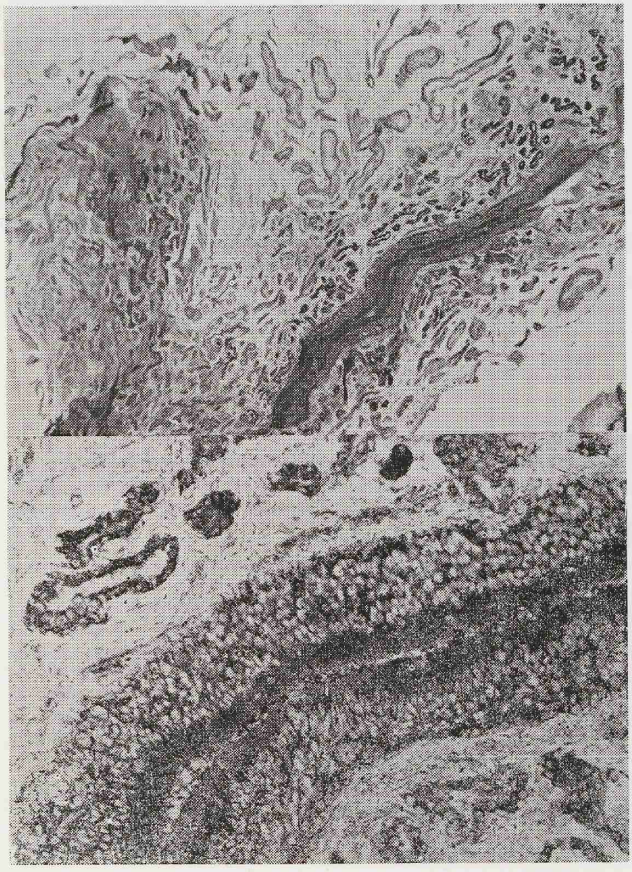

Figure 4.
Olfactory mucosa.
Lactate dehydrogenase strongly positive in the epithelium, the glands of Bowman and the blood vessels.
(obj. 4 : 1, 64 x and obj. 25 : 1, 400 x).

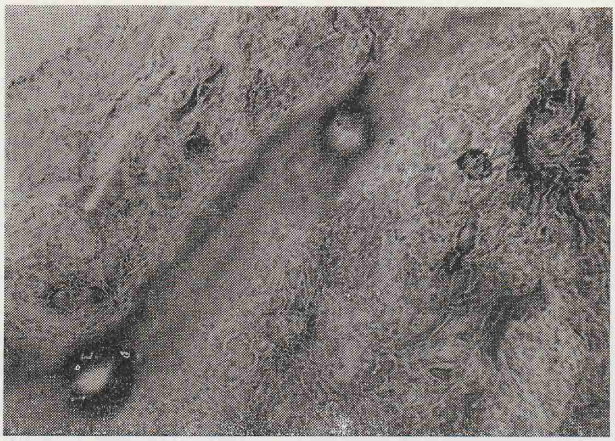

Figure 5.
Olfactory mucosa.
Non specific esterase
(α naphtyl acetate)
positive in the
epithelium and the
glands of Bowman
(obj. 10 : 1, 160 x).

Figure 6.
Olfactory mucosa.
Succinic dehydroge-
nase very weakly
positive in the glands
of Bowman (in the
lower part of figure)
in counter distinction
of the respiratory
mucosa (see Figure 7)
(obj. 10 : 1, 160 x).

Figure 7.
Respiratory mucosa.
Succinic dehydroge-
nase strongly positive
in the glands in
counter distinction of
the olfactory mucosa
(see Figure 6)
(obj. 4 : 1, 64 x).

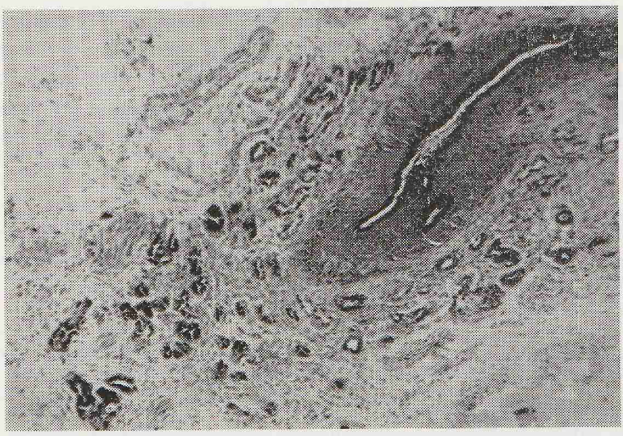

Figure 8.
Olfactory mucosa.
Acid phosphatase weakly positive in the epithelium and the glands of Bowman in counter distinction of the respiratory mucosa (see Figure 9) (obj. 10 : 1, 160 x).

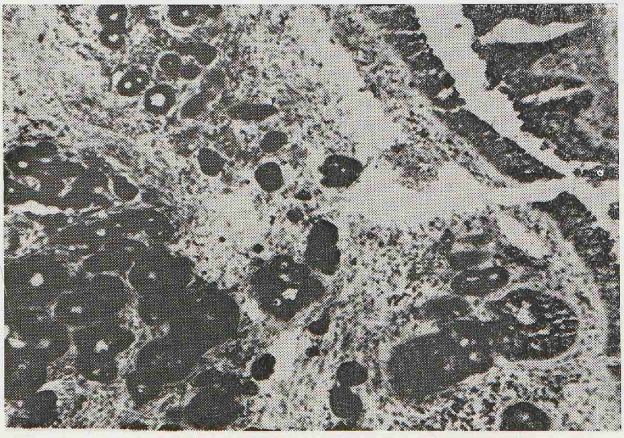

Figure 9.
Respiratory mucosa.
Acid phosphatase strongly positive in the epithelium and the glands in counter distinction of the olfactory mucosa (see Figure 8) (obj. 10 : 1, 160 x).

SUMMARY

This paper deals with the present state of the author's histochemical studies of the human olfactory mucosa.
After having described his technics, the author gives his results obtained in material taken from human cadavers.
A personal method of obtaining biopsies from the olfactory mucosa in the living is then presented and the first conclusions are discussed. Until now his method has enabled him to study the olfactory mucosa in twenty persons by various fixation and coloring technics and to start an investigation of the enzymatic actions by means of frozen sections.

RÉSUMÉ

L'auteur expose l'état actuel de son étude histochimique de la muqueuse olfactive chez l'homme.
Il donne, pour débuter, ses résultats obtenus à partir de prélèvements sur cadavres après avoir décrit ses techniques de prélèvement et de fixation.

Il donne ensuite les premières conclusions de son étude sur la muqueuse olfactive du sujet vivant, après avoir expliqué sa méthode, personnellement mise au point, pour obtenir de telles biopsies. Ces dernières lui ont permis d'étudier à ce jour vingt sujets vivants où les muqueuses olfactives ont été traitées avec différent fixations et colorations et d'ébaucher une étude de recherche des enzymes à partir de coupes congelées.

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