Results

The pathohological changes in the nasal mucosa (fig. 27) after exposure to sulphur dioxide can be classified as 7 categories ; inflammation and cellular infiltratron , thinng and atrophy , oedema , desquamation , increased vascularity, hyperplasia and dysplasia .

The inflammation , oedema , thinng and atrophy were seen mainly in the respiratory epithelium , while hyperplasia and dysplasia were the main pathological feature in the olfactory epithelium .

Group I(30 minute daily exposure):-

Subgroup A (one week exposure): The main pathological findings were the inflammation and the oedema. Thining and atrophy were seen in 3 specimens and desquamation in 2 with no hyperplasia or dysplasia.

Subgroup B(two week exposure): Nearly like subgroup A with decrease in oedema and appearance of hyperplasia in all specimens.

Subgroup C(one month exposure): The main finding was thining and atrophy with nearly absence of oedema and inflammation.Hyperplasia is present constantly in all specimens with one specimen showing dysplasia.

Group II(60 minute daily exposure):-

Subgroup A: The main finding was increased vascularity with inflammation

Subgroup B: The hperplasia became moderate to marked with presence of inflammation and oedema.

Subgroup C: Thining and atrophy were mild to marked.The hyperplasia was present markedly and one specimen showed mild dysplasia.

Group III(120 minute daily exposure):-

Subgroup A: Inflammation was marked to sever with marked oedema and increased vascularity.*SubgroupB:* Inflammation is less than subgroup A with marked hyperplasia.

Subgroup C:Hyperplasia was sever and dysplasia was mild to marked.

The statistical study was planed in three directions;comparing each group with the control ,comparing the three main groups together,and comparing the summations of the subgroups together i.e.subgroups A(IA,IIAandIIIA),subgroups B(IB,IIBandIIIB)and subgroups C(IC,IIC,IIIC).

Inflammation and cellular infiltration were seen in the three test groups , mainly in subgroups A and B . Cells were swollen and vaculated with widened intercellular spaces . The submucosa showed dilated capillaries with polymorphonuclear leucocytic infiltration (fig.28) . Four specimens in B subgroups showed end arteritis obliterans with plasma cells , lymphocytes and fibroplasts .

Tables 4, 5 and 6 show the statistical paterm of such change in each group compared to control group .

Severity	Group I		Control		Total	
	number	percent	number	percent	number	percent
No change -ve	3	25	4	80	7	41.2
+ve	5	41.7	1	20	6	35.3
2 +ve	4	33.3	-	-	4	23.5
3 +ve	-	-	-	-	-	-
4 +ve	-	-	-	-	-	-

Table (4) Inflammation and cellular infiltratron in group "I" versus control

Severity	Group II		Control		Total	
	number	percent	number	percent	number	percent
No change -ve	3	25	4	80	7	41.3
+ve	3	25	1	20	4	23.5
2 +ve	5	41.7	-	-	5	29.4
3 +ve	1	8.3	-	-	1	5.9

severity	Group III		Control		Total	
	number	percent	number	percent	number	percent
No change -ve	4	33.3	4	80	8	47.1
+ve	1	8.3	1	20	2	11.8
2 +ve	3	25	-	-	3	17.6
3 +ve	2	16.7	-	-	2	11.8
4 +ve	2	16.7	-	-	2	11.8

Table (6) Inflammation and cellular infiltratron in group "III" versus control

The severest changes were seen in subgroup A of group III and the least changes were seen in subgroup C of group III .

The difference between the inflammatory changes in groups I , II and III (table 7) is not statistically significant (P value > 0.05) , while the difference between subgroups A , B and C (table 8) is statistically highly signifant (P value < 0.01) . This significance was directed towards group A i.e. one week total period of exposure.

severity	Group I		Group II		Group III		Total	
	number	Percent	number	Percent	number	Percent	number	Percent
No Change - ve	3	25	3	25	4	33.3	10	27.8
+ ve	5	41.7	3	25	1	8.3	9	25
2 + ve	4	33.3	5	41.7	3	25	12	33.3
3 + ve	-	-	1	8.3	2	16.7	3	8.3
4 + ve	-	-	-	-	2	16.7	2	5.6

table(7)Comparison between inflammatory changes in groups I,IIand III

$\chi^2 = 9.03667$ P> 0.05 (non significont)

severity	Group A		Group B		Group C		Total	
	number	Percent	number	Percent	number	Percent	number	Percent
No Change - ve	-	-	-	-	10	83.3	10	27.8
+ ve	2	16.7	5	41.7	2	16	9	25
2 + ve	5	41.7	7	58.3	-	-	12	33.3
3 + ve	3	25	-	-	-	-	3	8.3
4 + ve	2	16.7	-	-	-	-	2	5.6

Table(8)Comparison between inflammatory changes in subgroups A,B andC

$\chi^2 = 38.5$ P<0.001 (highly significant)

Thining and atrophy of the surface epithelium were present in 19 specimens . When comparing each group with control group as regard thining and atrophy, the difference was not statistically significant in group II ($\chi^2 = 4.95833$ and P> 0.05) and group III($\chi^2 = 1.51786$ and P>0.05).The difference was significant in group I ($\chi^2 = 7.96875$ and p<0.05)------(table 9).

severity	Group 1		Control		Total	
	number	percent	number	percent	number	percent
No change -ve	3	25	5	100	8	47.1
+ve	3	25	-	-	3	17.6
2 +ve	4	33.3	-	-	4	23.5
3 +ve	2	16.7	-	-	2	11.8
4 +ve	-	-	-	-	-	-

Table (9) Thining and atrophy in group (I)versus control

$\chi 2 = 7.096875$ P<0.05 (Significant)

However , the comparison of this type of pathological changes doesn't give significant difference neither when comparing groups I , II and III together (table 10) nor when comparing subgroups A,B and C together (table 11).

severity	Group I		Group II		Group III		Total	
	number	Percent	number	Percent	number	Percent	number	Percent
No Change - ve	3	25	5	41.7	9	75	17	47.2
+ ve	3	25	4	33.3	3	25	10	27.8
2 + ve	4	33.3	2	16.7	-	-	6	16.7
3 + ve	2	16.7	1	8.3	-	-	3	8.3
4 + ve	-	-	-	-	-	-	-	-

Table (10) Comparing thining and atrophy in groups I,II and III

$\chi^2 = 9.49412$ P>0.05(non-significant)

severity	A		B		C		Total	
	number	Percent	number	Percent	number	Percent	number	Percent
No Change - ve	8	66.7	7	58.3	2	16.7	17	47.2
+ ve	3	25	3	25	4	33.3	10	27.8
2 + ve	1	8.3	2	16.7	3	25	6	16.7
3 + ve	-	-	-	-	3	25	3	8.3
4 + ve	-	-	-	-	-	-	-	-

Table (11)Comparing thining and atrophy in subgroups A,B andC

$\chi^2 = 10.84706$ p> 0.05 (non -significant)

Oedema of the nasal mucosa(fig. 29) was another pathological

subepithelial oedema(fig. 30) which was associated with increased vascularity . Oedema was apparent mainly in subgroup A especially in group III . However , highly significant difference was observed only when comparing subgroups A,B and C with each other (table 12) and not when comparing groups I and III (table 13).

severity	A		B		C		Total	
	number	Percent	number	Percent	number	Percent	number	Percent
No Change - ve	-	-	4	33.3	12	100	16	44.4
+ ve	7	58.3	8	66.7	-	-	15	41.7
2 + ve	3	25	-	-	-	-	3	8.3
3 + ve	2	16.7	-	-	-	-	2	5.6
4 + ve	-	-	-	-	-	-	-	-

Table (12)Comparing oedema in subgroups A, Band C

$\chi 2 = 31.6$ P<0.001 (Highly significant)

severity	Group I		Group II		Group III		Total	
	number	Percent	number	Percent	number	Percent	number	Percent
No Change - ve	6	50	5	41.7	5	41.7	16	44.4
+ ve	6	50	6	50	3	25	15	41.7
2 + ve	-	-	1	8.3	2	16.7	3	8.3
3 + ve	-	-	-	-	2	16.7	2	5.6
4 + ve	-	-	-	-	-	-	-	-

Table (13)Comparing oedema in groups I ,II and III

$\chi 2 = 7.32500$

specimen were found in subgroup A , three in subgroup B and one in subgroup C . When group I was studied statistically versus control the difference was not significant as regard desquamation ($\chi^2 = 1.42611$ and $P > 0.05$) .

The difference was also non - significant when comparing both groups I , II and III and subgroups A , B and C .

In 22 specimens the subepthelial layer showed numerous blood vessels which were dilated in some of them(Fig. 31) .

When comparing this type of pathological change in each group versus control group (table 14,15 and 16) , the difference was statistically significant only in group III ($\chi^2 = 17$ and $P < 0.01$ i.e highy significant)

severity	Group I		Control		Total	
	number	percent	number	percent	number	percent
No change -ve	9	75	5	100	14	82.4
+ve	2	16.7	-	-	2	11.8
2 +ve	1	8.3	-	-	1	5.9
3 +ve	-	-	-	-	-	-
4 +ve	-	-	-	-	-	-

Table (14) Increased vascularity in group I versus control

$\chi^2 = 1.51786$ $P > 0.05$ (non- significant)

severity	Group II		Control		Total	
	number	percent	number	percent	number	percent
No change -ve	5	41.7	5	100	10	58.8
+ve	1	8.3	-	-	1	5.9
2 +ve	3	25	-	-	3	17.6
3 +ve	2	16.7	-	-	2	11.8
4 +ve	1	8.3	-	-	1	5.9

Table (15) Increased vascularity in group II versus control . $\chi^2 = 4.95833$ $P > 0.05$ (non - significant)

severity	Group III		Control		Total	
	number	percent	number	percent	number	percent
No change -ve	-	-	5	100	5	29.4
+ve	5	4.7	-	-	5	29.4
2 +ve	5	41.7	-	-	5	29.4
3 +ve	1	8.3	-	-	1	5.9
4 +ve	1	8.3	-	-	1	5.9

Table (16) Increased vascularity in group III versus control $\chi^2 = 17$ $P < 0.01$ (Highyly significant)

When comparing increased vascularity in groups 1 , 2 and 3 (table 17) the difference was statistically singificant towards group 3III($\chi^2 =$ 17.63095 and $P < 0.05$) . The difference was also significant when comparing subgroups A , B and C together ($\chi^2 = 18.991667$ and $P <$ 00.05).The significance was towards subgroups C (table 18) .

severity	Group I		Group II		Group III		Total	
	number	Percent	number	Percent	number	Percent	number	Percent
No Change - ve	9	75	5	41.7	-	-	14	38.9
+ ve	2	16.7	1	8.3	5	41.7	8	22.2
2 + ve	1	8.3	3	25	5	41.7	9	25
3 + ve	-	-	2	16.7	1	8.3	3	8.3
4 + ve	-	-	1	8.3	1	8.3	2	5.6

Table (17) comparing increased vascularity in groups I , II and III. $\chi^2 = 17.63095$ $P < 0.05$ (significant)

severity	A		B		C		Total	
	number	Percent	number	Percent	number	Percent	number	Percent
No Change - ve	2	16.7	4	33.3	8	66.7	14	33.9
+ ve	1	8.3	6	50	1	8.3	8	22.2
2 + ve	5	41.7	1	8.3	3	25	9	25
3 + ve	2	16.7	1	8.3	-	-	3	8.3
4 + ve	2	16.7	-	-	-	-	2	5.6

Table (18) Comparing increased vascularity in subgroups A , B and C

$\chi^2 = 18.91667$ $P < 0.05$ (significant)

The pseudostratified columnar ciliated epithelium of the nose is composed of one layer of cells . When trying to count the rows of cells , stratification was found in many specemens (fig. 32) . In addition , there was loss of cilia and change in the shape of cells to become nearly polyhydral . So , the condition can be considered as hyperplasia (fig. 33).

This finding was much more apparent in olfactory epithelium with increase in number of progenetor cells and Bowman's glands(fig.34).

The hyperplasia was present in 26 specimens. When it was studied statitically in each group versus control group (tables 19,20 and 21) , the difference was significant in groupII ($\chi^2 = 6.9630$ and $P < 0.05$) and group III ($\chi^2 = 10.11905$ and $P < 0.05$) but not singificant in group I ($\chi^2 = 6.29630$ and $P > 0.05$) .

severity	Group I		Control		Total	
	number	percent	number	percent	number	percent
No change -ve	4	33.3	5	100	9	52.9
+ve	1	8.3	-	-	1	5.9
2 +ve	6	50	-	-	6	5.9
3 +ve	1	8.3	-	-	1	5.9
4 +ve	-	-	-	-	-	-

Table (19) Hyperplasia in group I versus control

$\chi^2 = 6.29630$ $P > 0.05$ (non - significant)

severity	Group II		Control		Total	
	number	percent	number	percent	number	percent
No change -ve	4	33.3	5	100	9	52.9
+ve	-	-	-	-	-	-
2 +ve	4	33.3	-	-	4	23.5
3 +ve	4	33.3	-	-	4	23.5
4 +ve	-	-	-	-	-	-

Table (20) Hyperplasia in group II versus control

$\chi^2 = 6.9630$ $P < 0.05$ (significant)

severity	Group III		Control		Total	
	number	percent	number	percent	number	percent
No change -ve	2	16.7	5	100	7	41.2
+ve	1	8.3	-	-	1	5.9
2 +ve	1	8.3	-	-	1	5.9
3 +ve	4	33.3	-	-	4	33.3
4 +ve	4	23.5	-	-	4	23.5

Table (21) Hyperplasia in group III versus control

$\chi^2 = 10.11905$ $P < 0.05$ (Significant)

The severest hyperplastic changes were present in group III (120 minute daily exposure) especially in subgroup C (1month total period of exposure) . Statitically , when comparing group I,IIand III together (tables 22) the difference was significant towards group III ($\chi^2 = 15.25455$ and $P < 0.005$) and when comparing subgroups A,B and C together (table 23) the difference was highly significant towards subgroup C ($\chi^2 = 37.12121$ and $P < 0.01$).

severity	Group I		Group II		Group III		Total	
	number	Percent	number	Percent	number	Percent	number	Percent
No Change - ve	4	33.3	4	33.3	2	16.7	10	27.8
+ ve	1	8.3	-	-	1	8.3	2	5.6
2 + ve	6	50	4	33.3	1	8.3	11	30.6
3 + ve	1	8.3	4	33.3	4	33.3	9	25
4 + ve	-	-	-	-	4	33.3	4	33.3

Table (22) Hyperplasia as compared in groups I ,II and III. $\chi^2 = 15.25455$ $P < 0.05$ (Significant)

severity	A		B		C		Total	
	number	Percent	number	Percent	number	Percent	number	Percent
No Change - ve	10	83.3	-	-	-	-	10	27.8
+ ve	1	8.3	1	8.3	-	-	2	5.6
2 + ve	1	8.3	6	50	4	33.3	11	30.6
3 + ve	-	-	5	41.7	4	33.3	9	25
4 + ve	-	-	-	-	4	33.3	4	11.1

Table (23) Hyperplasia as compared in subgroups A , B andC. $\chi^2 = 36.12121$ $P < 0.01$ (highly singificant)

Another important morphological change was found in 6 specimens which is dysplasia (fig. 35) . The epithelium became cuboidal with many intracellular changes . The most important change was the deeply stained nuclei with pleomorphism and increased mitotic activity which gives it the apperance of a malignant nucleus (fig. 25 and 27) . There was loss of cilia with only remnant of microvilli . Basement membrane was intact .

The dysplasia was present only in subgroups C and mainly in group III (table 24).

severity	Group III		Control		Total	
	number	percent	number	percent	number	percent
No change -ve	8	66.7	5	100	13	76.5
+ve	1	8.3	-	-	1	5.9
2 +ve	1	8.3	-	-	1	5.9
3 +ve	2	16.7	-	-	2	11.8
4 +ve	-	-	-	-	-	-

Table (24) dysplasia in group III versus control.

When comparing dysplastic changes in groups I , II and III (table 25) the difference was non-significant ($\chi^2 = 6.6$ and $P > 0.05$) but when comparing the same change in subgroups A , B and C (table 26) the difference was found to be significant towards subgroups C ($\chi^2 = 14.4$ and $P > 0.05$) .

severity	Group I		Group II		Group III		Total	
	number	Percent	number	Percent	number	Percent	number	Percent
No Change - ve	11	91.7	11	91.7	8	66.7	30	83.3
+ ve	1	8.3	1	8.3	1	8.3	3	8.3
2 + ve	-	-	-	-	1	8.3	1	2.8
3 + ve	-	-	-	-	2	16.7	2	5.6
4 + ve	-	-	-	-	-	-	-	-

Table (25) Comparing dysplasia in groups I ,II and III

$\chi^2 = 6.6$ P >0.05 (non - significant)

severity	A		B		C		Total	
	number	Percent	number	Percent	number	Percent	number	Percent
No Change - ve	12	100	12	100	6	50	30	83.3
+ ve	-	-	-	-	3	25	3	8.3
2 + ve	-	-	-	-	1	8.3	1	2.8
3 + ve	-	-	-	-	2	16.7	2	5.6
4 + ve	-	-	-	-	-	-	-	-

Table (26) comparing dysplasia in subgroups A , B andC

$\chi^2 = 14.4$ P < 0.05 (Significant)

Figure (27) The normal olfactory mucosa of mouse (H and E x 400)

Figure (28) Respiratory epithelium showing oedema and inflammatory cellular infiltrating cells in the subepithelial layer (H and E x 400).

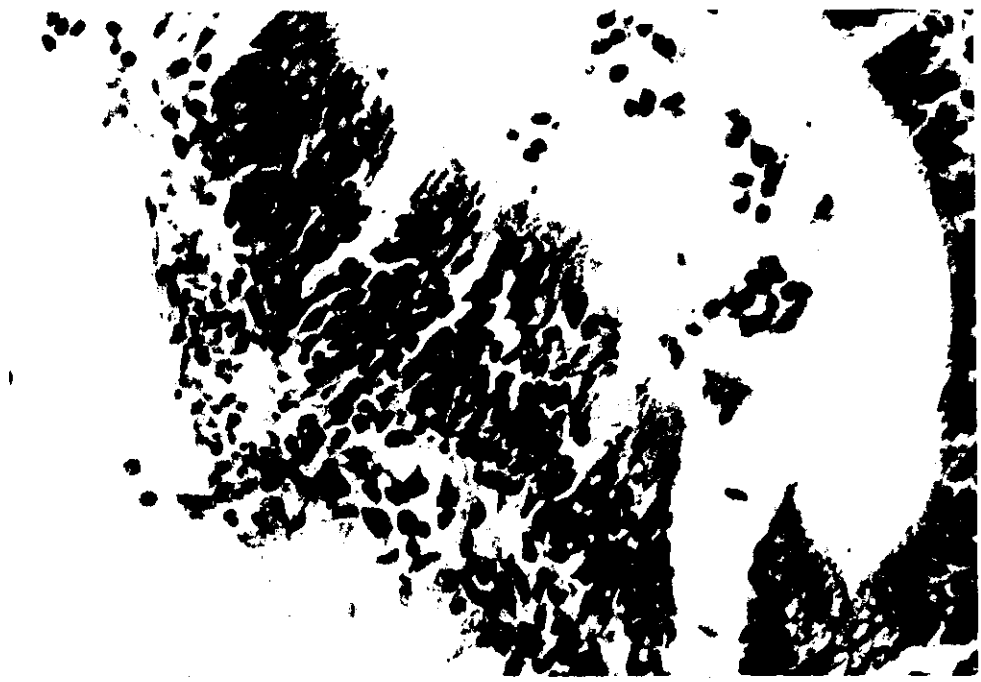

Figure (29) Respiratory epithelium showing ulceration of ciliated

Figure (30) Respiratory epithelium showing desquamation ,oedema, metaplasia and lymphocytic infiltration.(H and E x400)

Figure (31) Olfactory mucosa showing metaplasia ,oedema and degeneration of basement membrane. (H and E x400)

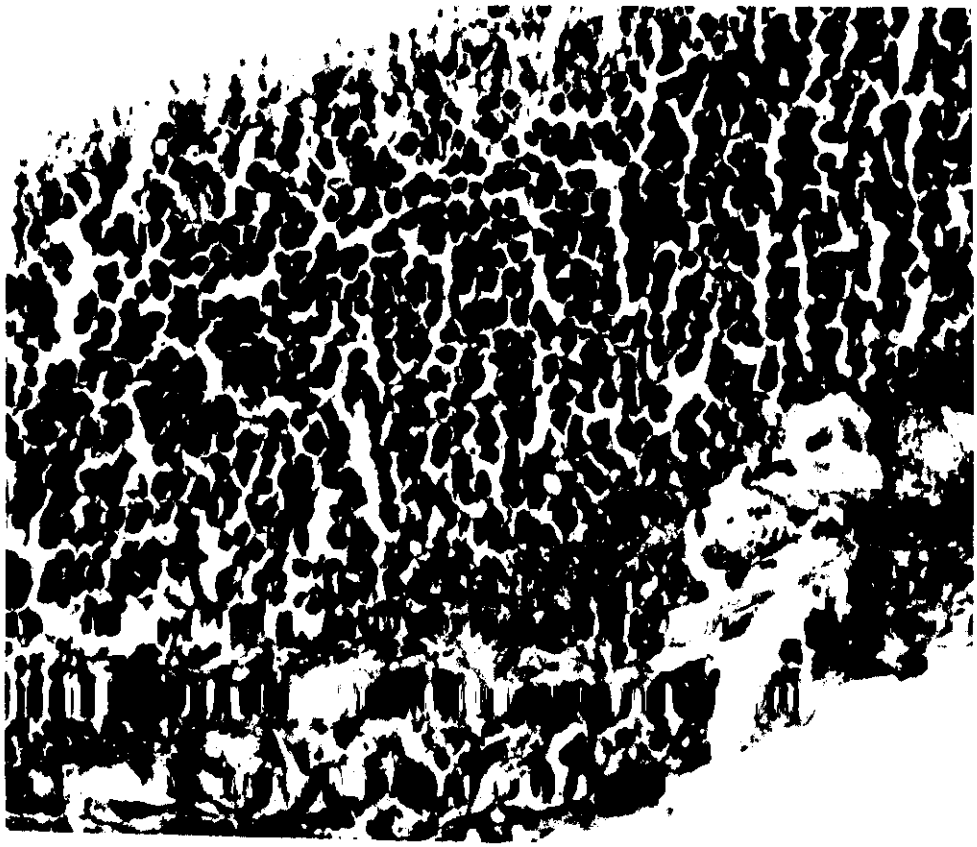

Figure (32) Olfactory mucosa showing hyperplasia,oedema and inflammatory cell infiltration.(H and E x400)

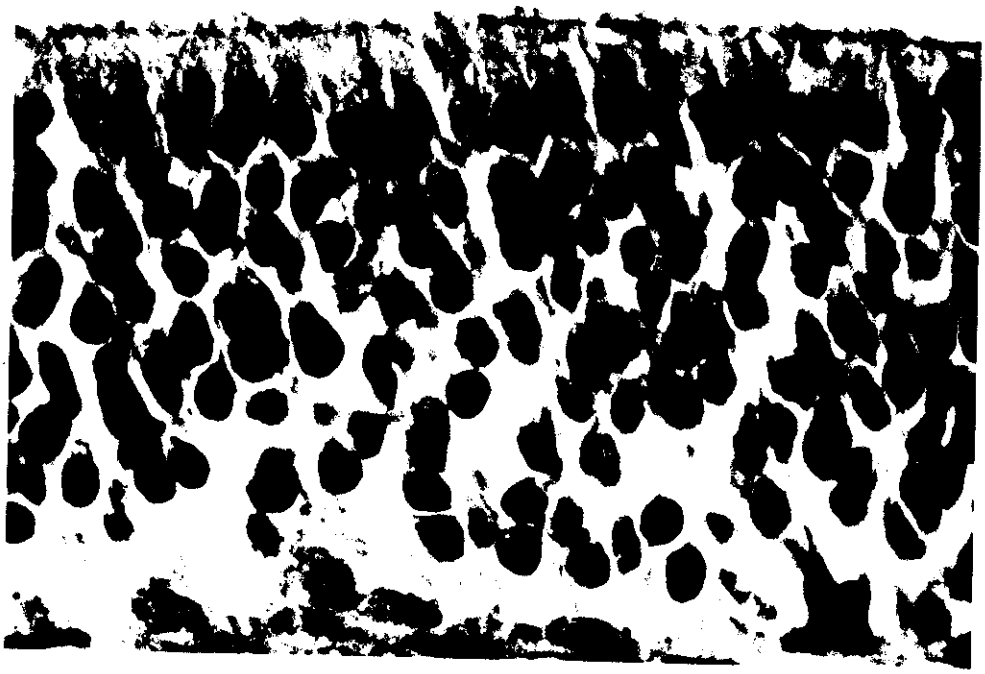

Figure (33) Olfactory mucosa showing hyperplasia , acantholysis and increased mitotic activity. (H and E x1000)

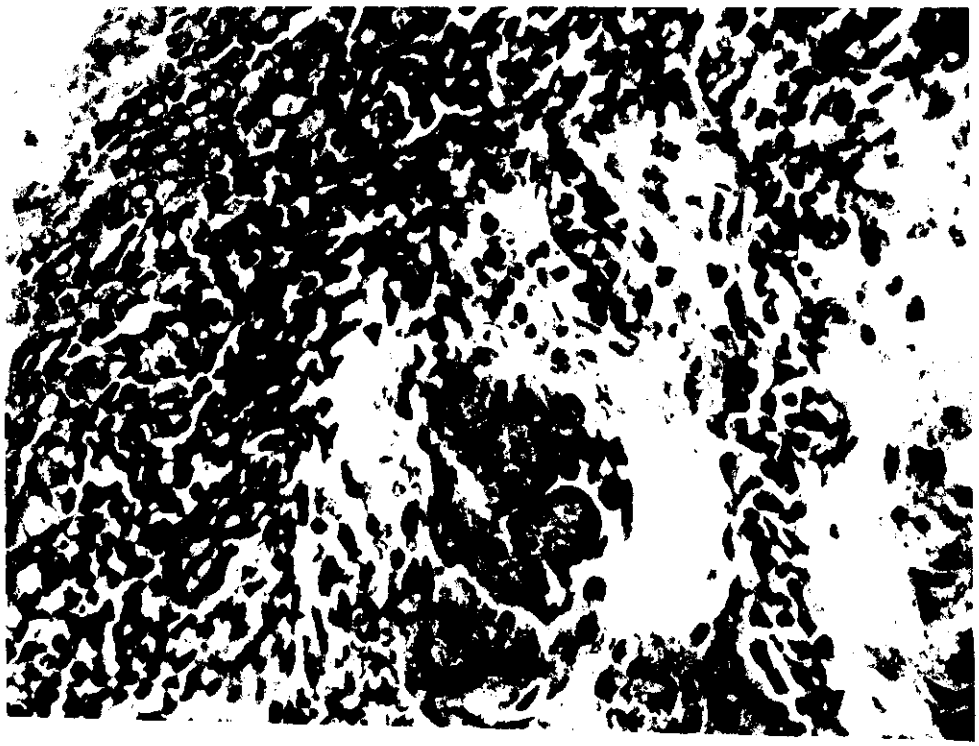

Figure (34) Olfactory mucosa showing hyperplasia of the lining epithelium mucous glands and subepithelial glands.(H and E x400)

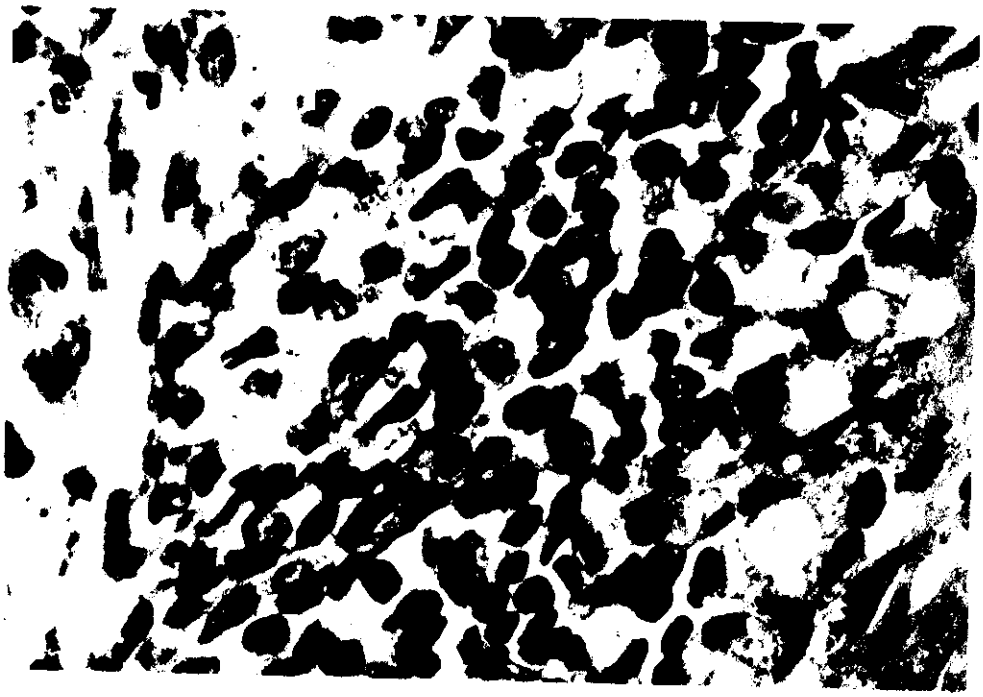

Figure (35) Olfactory mucosa showing dysplasia grade III.(H and E x1000)