CHAPTER 11

GLYCOGEN

The distribution of glycogen in the epithelium of palatal mucosa was studied. It was also hoped to establish the relation between the presence of glycogen and keratinization.

A few conclusions drawn by Trott (1957) concerning the presence and distribution of glycogen in the gingiva are worthy of note.

"In women it would appear that there is no correlation between the deposition of glycogen in the gingival epithelium and its deposition in the vaginal epithelium. In the vaginal epithelium it is deposited in close correlation with the phases of the menstrual cycle and in the broad spectra of the sexual phases in a woman's life the glycogen deposition varies from childhood until after the menopause. This would appear not to be the case in the gingiva and one may presume that glycogen deposition in this site is not therefore influenced by oestrogen activity .....
there does not appear to be any correlation between either the presence or concentration of glycogen found in the

gingiva and the degree of the underlying inflammation.

The hypothesis that glycogen is necessary for the production of keratin is also hard to substantiate. In those areas in which normal keratin is formed, glycogen is not present in any increased amount; and also in the crevicular or the crest epithelium, where keratin is absent, glycogen was often present."

Meyer and Medak (1962) found that full keratinization is rare in gingival epithelium in the presence of glycogen and does not occur at all when glycogen is present in larger quantity. They also found that the epithelium of the region adjacent to the the gingiva, the alveolar mucosa, contained glycogen in all their specimens and was always unkeratinized.

Specimens taken fresh and from the post-mortem room were immediately fixed in Bouin's solution. The stain used was Best's carmine which is fairly specific for glycogen. It stains the glycogen a bright pink. Control slides of liver specimens were employed. The amount of deposition of glycogen was noted as nil, negligible, slight, moderate or heavy.

Here are the findings.

<u>FATTY ZONE</u> - <u>GLYCOGEN</u>

2C Epithelium - slight-stratum corneum only.

Fig. 7.

Soft palate specimen demonstrating moderate glycogen deposits in the stratum spinosum of the epithelium. (Best's Carmine x400.)

Lamina propria - nil

Submucosa - nil.

2F Epithelium - moderate - stratum spinosum

Lamina propria - slight

Submucosa - slight.

2G Epithelium - nil

Lamina propria - nil

Submucosa - nil.

GLANDULAR ZONE - GLYCOGEN

20F Epithelium - slight - stratum spinosum

Lamina propria - slight

Submucosa - slight.

20G Epithelium - slight - stratum spinosum

Lamina propria - negligible

Submucosa - nil.

20H Epithelium - nil

Lamina propria - nil

Submucosa - slight.

SOFT PALATE - GLYCOGEN

38F Epithelium - moderate - stratum spinosum (Fig. 7)

Lamina propria - slight

Submucosa - negligible.

38G Epithelium - slight - stratum spinosum

Lamina propria - nil

Submucosa - nil.

38H Epithelium - slight

Lamina propria - slight

Submucosa - slight.

GINGIVA ADJACENT FATTY ZONE - GLYCOGEN

56C Epithelium - moderate - chiefly in stratum corneum but a little in stratum spinosum

Lamina propria and Submucosa - slight.

56F Epithelium - nil

Lamina propria and Submucosa - nil.

56G Epithelium - nil

Lamina propria and Submucosa - nil.

GINGIVA ADJACENT GLANDULAR ZONE - GLYCOGEN

74F Epithelium - moderate - stratum spinosum

Lamina propria and Submucosa - slight.

74G Epithelium - negligible

Lamina propria and Submucosa - negligible.

74H Epithelium - nil

Lamina propria and Submucosa - slight.

INCISIVE PAPILLA - GLYCOGEN

92F Epithelium - negligible

Lamina propria and Submucosa - negligible.

92G Epithelium - nil

Lamina propria and Submucosa - nil.

92H Epithelium - negligible

Lamina propria and Submucosa - negligible.

MEDIAN RAPHÉ - GLYCOGEN

110F Epithelium - negligible

Lamina propria and Submucosa - nil.

110G Epithelium - nil

Lamina propria and Submucosa - nil.

110H Epithelium - moderate.

Lamina propria and Submucosa - slight - mostly in salivary or fatty tissue.

CONCLUSIONS

The zones of the palate are now presented in decreasing order of amount of glycogen deposition. An attempt is also made to compare the density of the deposits in the epithelium, lamina propria and submucosa.

1. SOFT PALATE

   Epithelium - heavy

   Lamina propria - slight

   Submucosa - slight

   GINGIVA ADJACENT GLANDULAR ZONE

   Epithelium - slight

   Lamina propria - moderate

   Submucosa - moderate

2. GLANDULAR ZONE

   Epithelium - slight

   Lamina propria - slight

   Submucosa - slight

3. FATTY ZONE

Epithelium - moderate

Lamina propria - negligible

Submucosa - negligible

4. MEDIAN RAPHÉ

Epithelium - slight

Lamina propria - negligible

Submucosa - negligible

5. GINGIVA ADJACENT FATTY ZONE

Epithelium - slight

Lamina propria - negligible

Submucosa - negligible

6. INCISIVE PAPILLA

Epithelium - negligible

Lamina propria - negligible

Submucosa - negligible

There are two interesting observations which can be made from the foregoing:

1. According to Montagna et al (1962) glycogen, when present in the epidermis, is found in the cells of the upper stratum spinosum; with rare exceptions, the cells of the lower layers are free of it. This absence of glycogen from the cells in the lower layers of the stratum spinosum was not evident in palatal mucosa. Glycogen was observed in all layers of the stratum spinosum.

2. One zone only showed heavy glycogen deposits in the epithelium, namely the soft palate. This is the least keratinized of all the palatal zones (see chapter on keratinization). Thus Trott's suggestion (1957) that glycogen may not be necessary for the production of keratin has been advanced by Meyer and Medak (1962), who considered that the presence of glycogen inhibits keratinization. The present investigation confirms the hypothesis of these workers.

CHAPTER 12

KERATOHYALIN GRANULES

"Waldeyer (1882) called the granules in the stratum granulosum "keratohyalin" granules. In the stratum granulosum, keratohyalin granules are usually aggregated at the poles of the nucleus. The granules may be stained with most basic dyes as well as with acid dyes such as Congo red, acid fuchsin, and others.

It is not known which cell component or compenents are responsible for the elaboration of keratin. The keratohyalin granules in mucuous membranes have much greater dye affinity at low pH then those in the cutaneous membranes.

The electron microscope clearly indicates that keratohyalin granules are specific products of epidermal cells, which become a part of the final horny component of cornified cells. The granules develop in the cytoplasm of epidermal cells as submicroscopic corpuscles at the time the cells enter their course of differentiation. The granules grow to various sizes independent of one another and cease to grow when the cells are nature. The mechanism involved in the formation or in the growth of keratohyalin granules is not known. Since Brady noted that their fine granular component also occurs freely dispersed in the cytoplasm,

perhaps the fine granules are synthesized at scattered points in the cytoplasm, and the first keratohyalin granules are formed by an accumulation of the fine granular material which later grows by accretion." (Montagna, 1962).

In brief, then, keratohyalin granules are basophil staining granules in the cytoplasm of epithelial cells. They can be demonstrated clearly with congo red which stains them blue to purple. Sections from the various palatal zones were examined after treatment with congo red to determine the presence or absence of keratohyalin granules.

FATTY ZONE - KERATOHYALIN GRANULES

3A Virtually every cell in the granular layer, which was usually four to seven cells thick, contained numerous cytoplasmic keratohyalin granules.

3D Keratohyalin granules were clearly seen in the cytoplasm of the cells of the stratum granulosum.

3E The congo red stain failed to reveal keratohyalin granules in these sections.

GLANDULAR ZONE - KERATOHYALIN GRANULES

21B No evidence of keratohyalin granules could be seen.

21D Keratohyalin granules were clearly seen in the cytoplasm of the cells of the stratum granulosum.

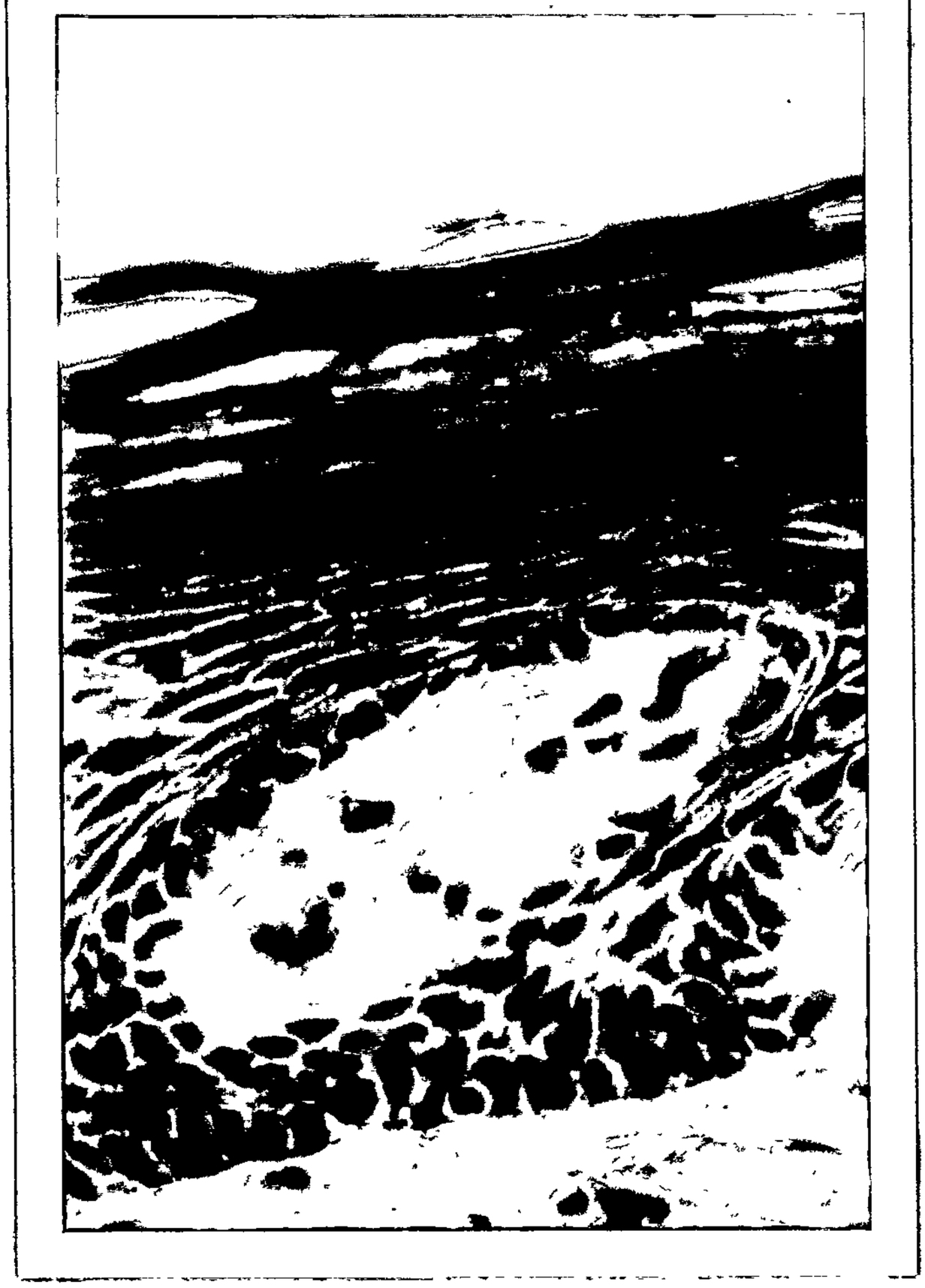

Fig. 8.

Glandular zone specimen demonstrating parakeratinization. (H. and E. x400.)

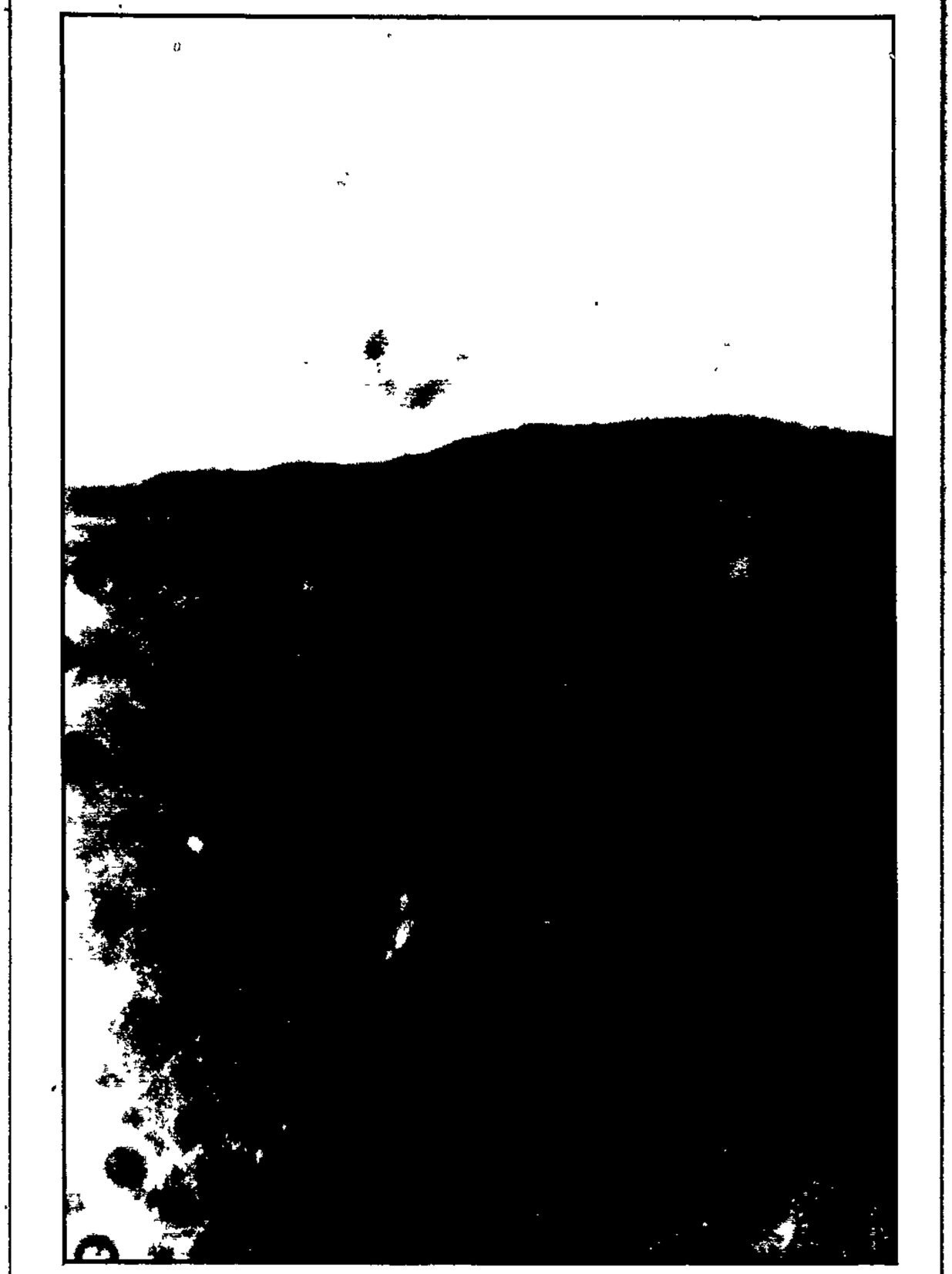

Fig. 9.

Gingiva adjacent fatty zone specimen demonstrating keratohyalin granules in the cytoplasm of the cells of the stratum granulosum. (Congo Red X400.)

21E No keratohyalin granules were found. The stratum corneum featured parakeratosis (Fig. 8).

SOFT PALATE - KERATOHYALIN GRANULES

39B
39D Keratohyalin granules were absent.
39E

GINGIVA ADJACENT FATTY ZONE - KERATOHYALIN GRANULES

57B There was no evidence of keratohyalin granules.

57D Keratohyalin granules were clearly demonstrated in the cytoplasm of the cells of the stratum granulosum of the epithelium of the gingiva adjacent fatty zone by the congo red stain (Fig. 9).

57E Careful examination failed to reveal keratohyalin granules in this epithelium.

GINGIVA ADJACENT GLANDULAR ZONE - KERATOHYALIN GRANULES

75B Keratohyalin granules were absent.

75D The stratum granulosum was dense with keratohyalin granules.

75E No keratohyalin granules were found.

INCISIVE PAPILLA - KERATOHYALIN GRANULES

93B Keratohyalin granules were not in evidence.

93D Keratohyalin granules were in evidence in abundance in the stratum granulosum.

93E No keratohyalin granules were seen.

MEDIAN RAPHÉ - KERATOHYALIN GRANULES

111B There was no evidence of keratohyalin granules.

111D Keratohyalin granules were abundant in the stratum granulosum.

111E No keratohyalin granules were seen.

CONCLUSIONS

1. Keratohyalin granules are absent from the epithelium of the soft palate.
2. A striking conclusion with 100 per cent agreement in the findings was established. Without exception fully keratinized palatal epithelium contains keratohyalin granules while palatal epithelium featuring parakeratosis does not contain keratohyalin granules.

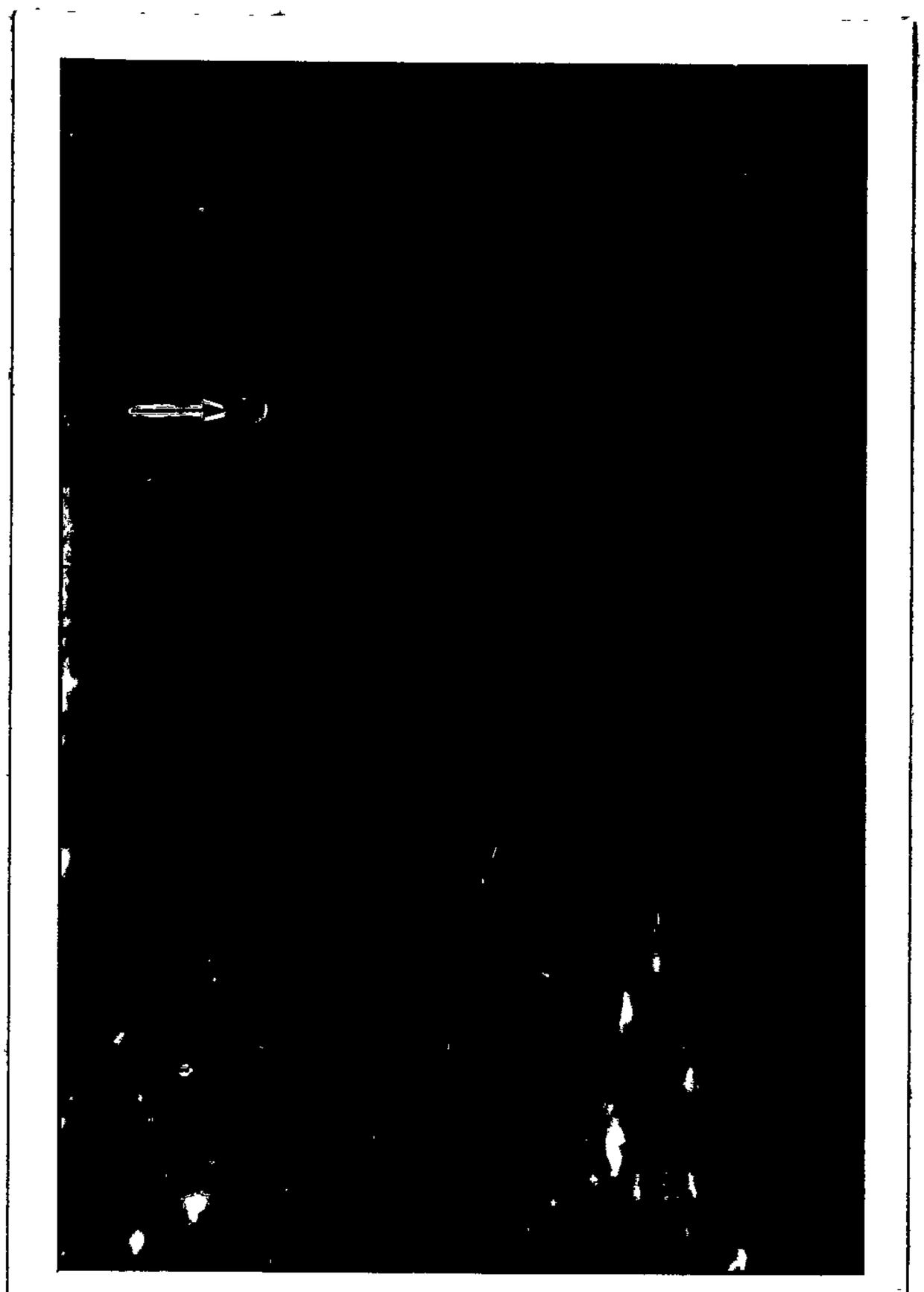

Fig. 10.

Fatty zone specimen demonstrating gradation of basophil intensity of nuclei from basal to superficial layers of epithelium. A clear cell can be seen. (H. and E. x400.)

CHAPTER 13.

BASOPHIL INTENSITY OF THE NUCLEI OF THE EPITHELIAL CELLS

The aim of this section of the project was to determine whether there was any variation in the intensity of the basophil staining of the nuclei in the various layers of the epithelium in palatal mucosa.

FATTY ZONE - BASOPHIL INTENSITY OF NUCLEI

4A
4D
4E

The intensity of basophil staining of the nuclei was greatest in the cells of the basal layer. This intensity diminished progressively through the stratum spinosum to the surface cells. The keratohyalin granules stained quite intensely with haematoxylin and gave the cytoplasm of the cells of the stratum granulosum a densely stained appearance. Thus the nuclei of the cells of the surface layers were weakly stained in comparison with those of the deeper layers, with a reversion to intense staining of the occasional superficial flattened nucleus (Fig.10).

GLANDULAR ZONE - BASOPHIL INTENSITY OF NUCLEI

22B
22D
22E

The basophil staining intensity of the nuclei diminished noticeably from the basal layer of epithelium to the upper layers.

SOFT PALATE - BASOPHIL INTENSITY OF NUCLEI

40B
40D
40E

The cells of the basal layer stained more basophilic than those of the stratum spinosum.

GINGIVA ADJACENT FATTY ZONE - BASOPHIL INTENSITY OF NUCLEI

58B
58D
58E

The haematoxylin and eosin stain demonstrated strikingly the more basophil nature of the basal cells compared with the cells of the more superficial layers. The intensity of the staining decreased progressively from the basal layer through the stratum spinosum and stratum granulosum. However, the flattened nuclei in the superficial two or three layers reverted to the dark staining characteristic.

GINGIVA ADJACENT GLANDULAR ZONE - BASOPHIL INTENSITY OF NUCLEI

76B
76D
76E

The intensity of basophil staining of the nuclei of the epithelial cells decreased progressively from the basal layer to the surface. Some flattened nuclei in the extreme surface layers were densely stained.

INCISIVE PAPILLA - BASOPHIL INTENSITY OF NUCLEI

94B
94D
94E

The basal cells were the most intensely stained cells. There was a progressive lessening of the intensity of staining through the prickle cell layer to to the surface layers. There were some pyknotic nuclei in the extreme surface layers which were densely stained.

112B MEDIAN RAPHÉ - BASOPHIL INTENSITY OF NUCLEI
112D
112E A decrease in intensity of basophil staining of the nuclei of the epthelial cells was observed from basal to superficial layers.

CONCLUSIONS

The findings indicate that, in the palates examined, the nuclei of the epithelial cells conform to a pattern as regards intensity of basophil staining. The nuclei in the basal layer of cells stain most intensely. Those in the more superficially placed layers stain progressively less intensely, the closer they are to the free epithelial surface. This overall pattern is always present.

Occasional dark staining pyknotic nuclei are seen in the most superficial cell layers. Dark-staining keratohyalin granules should not be confused with the paler staining nuclei.

CHAPTER 14.

BINUCLEATE EPITHELIAL CELLS

Describing the soft palate of the white rat Jolly (1964) states: "The outstanding feature of the stratum spinosum is the abundance of binucleate cells. This may be an indication of amitotic division. Whether any of the binucleate cells progress to actual cell division is not certain. It is obvious that many do not divide because cells with twin nuclei are to be seen in the superficial part of the granular layer. Superficially however there appear to be fewer binucleate cells than in the deeper layers."

It is not known whether these binucleate cells undergo amitotic division.

In this investigation a searchwas made for binucleate cells in the epithelium of the human palate. The results follow.

5A 5D 5E

FATTY ZONE - BINUCLEATE EPITHELIAL CELLS

A careful examination of these three slides revealed only two binucleate cells (in one slide, 5E).

23B 23D 23E

GLANDULAR ZONE - BINUCLEATE EPITHELIAL CELLS

Binucleate cells were not in evidence. An occasional mitotic figure was seen in the basal layer.

SOFT PALATE - BINUCLEATE EPITHELIAL CELLS

41B 41D 41E No binucleate cells were found in any of the sections. However, a few "clear" cells with seemingly twin nuclei were found in one section.

GINGIVA ADJACENT FATTY ZONE - BINUCLEATE EPITHELIAL CELLS.

59B No evidence of binucleate epithelial cells could be found. There were present a few cells which appeared to have nuclei; however, these cells invariably had a clear cytoplasm and could not be considered to be epithelial cells.

59D No binucleate epithelial cells were visible.

59E Binucleate epithelial cells were relatively prominent in the sections of this part of the palate. Of the three sections examined the first contained five, the second nine and the third ten binucleate cells. These were all in the stratum spinosum, one being quite superficial.

GINGIVA ADJACENT GLANDULAR ZONE - BINUCLEATE EPITHELIAL CELLS

77B 77D Occasional binucleate epithelial cells were visible.

77E Even a cursory appraisal of the sections suggested that there were a large number of binucleate cells present. The three sections available were counted for binucleate cells and gave the following results.

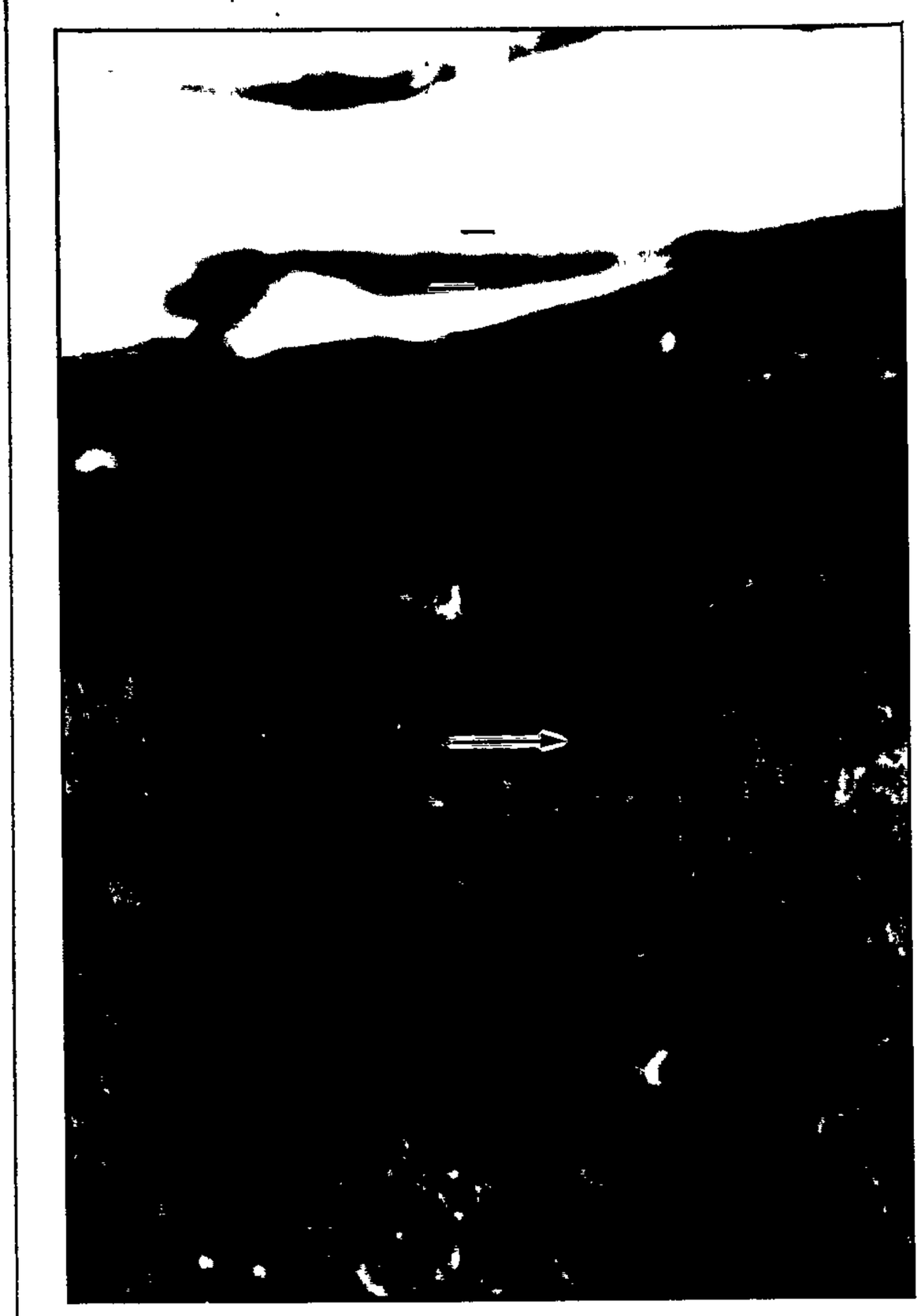

Fig. 11.

Medium power specimen demonstrating binucleate epithelial cell in stratum spinosum. (H. and E. x400.)

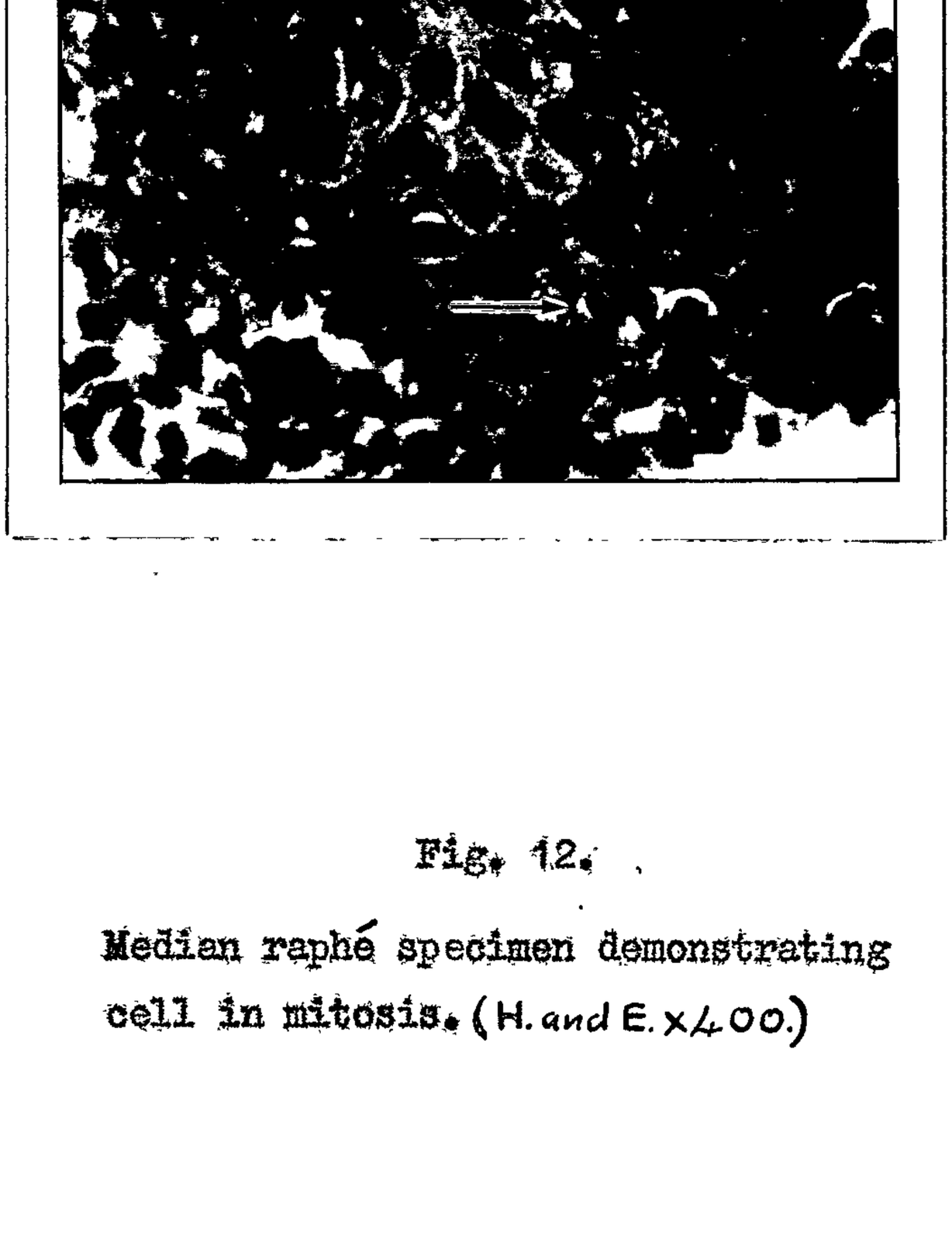

Fig. 12.

Median raphé specimen demonstrating cell in mitosis. (H. and E. x400.)

1. 17
2. 27
3. 37

81 Total

Additional sections subsequently prepared and examined confirmed the results in this zone.

INCISIVE PAPILLA - BINUCLEATE EPITHELIAL CELLS

95B
95D No evidence of binucleate epithelial cells could be found.

95E The three stained sections from the incisive papilla region were examined for binucleate cells. The following numbers of such cells were counted in the three sections:

1. 4
2. 7
3. 1

12 Total

MEDIAN RAPHÉ - BINUCLEATE EPITHELIAL CELLS

113B
113D Evidence was found of binucleate epithelial cells in the median raphé (Fig.11). A total of five such cells was counted in the stratum spinosum. In one field a binucleate cell and a cell in mitosis could be seen (Fig.12).

113E Eight binucleate cells were seen in three sections of palatine raphé.

CONCLUSIONS

Binucleate cells were found in all zones of the palate except two, namely the glandular zone and soft palate. It is noticeable that most of the sections showing binucleate cells came from the same palate (E).

With the limited number of specimens available no firm conclusions can be drawn regarding the occurrence of these cells; however, age may be the significant factor since by far the greatest number of binucleate cells were found in various zones of the palate of an eighty-one year old male. One hundred and twenty-seven binucleate cells were counted in the sections from this specimen compared with five binucleate cells in the other specimens. This finding is particularly interesting considering the dearth of information available on binucleate cells.

Binucleate cells, then, were observed in the fatty zone, gingiva adjacent fatty zone, gingiva adjacent glandular zone, incisive papilla and median raphé.

CHAPTER 15

CAPILLARY LOOPS OF THE LAMINA PROPRIA

It is known that the long, narrow dermal papillary ridges on the palms and soles contain long and relatively straight capillary loops. By contrast, the shallower and broader papillary ridges on the trunk have more meandering, less geometric capillary loops. The aim of this section of the investigation was to determine whether those portions of the palatal mucosa with long, narrow papillary ridges have long and relatively straight capillary loops and whether the portions with shallower, broader papillary ridges have more meandering, less geometric capillary loops. The observations were as follows:-

FATTY ZONE - CAPILLARY LOOPS

6A 6D 6E The capillaries observed in these sections were long, straight and narrow, running in the connective tissue papillae parallel with the long rete pegs.

GLANDULAR ZONE - CAPILLARY LOOPS

24B 24D 24E The hard palate is a region which, like the gingiva, has long connective tissue papillae. The capillary loops visible, because of the longitudinal sectioning, appeared to be long and straight.

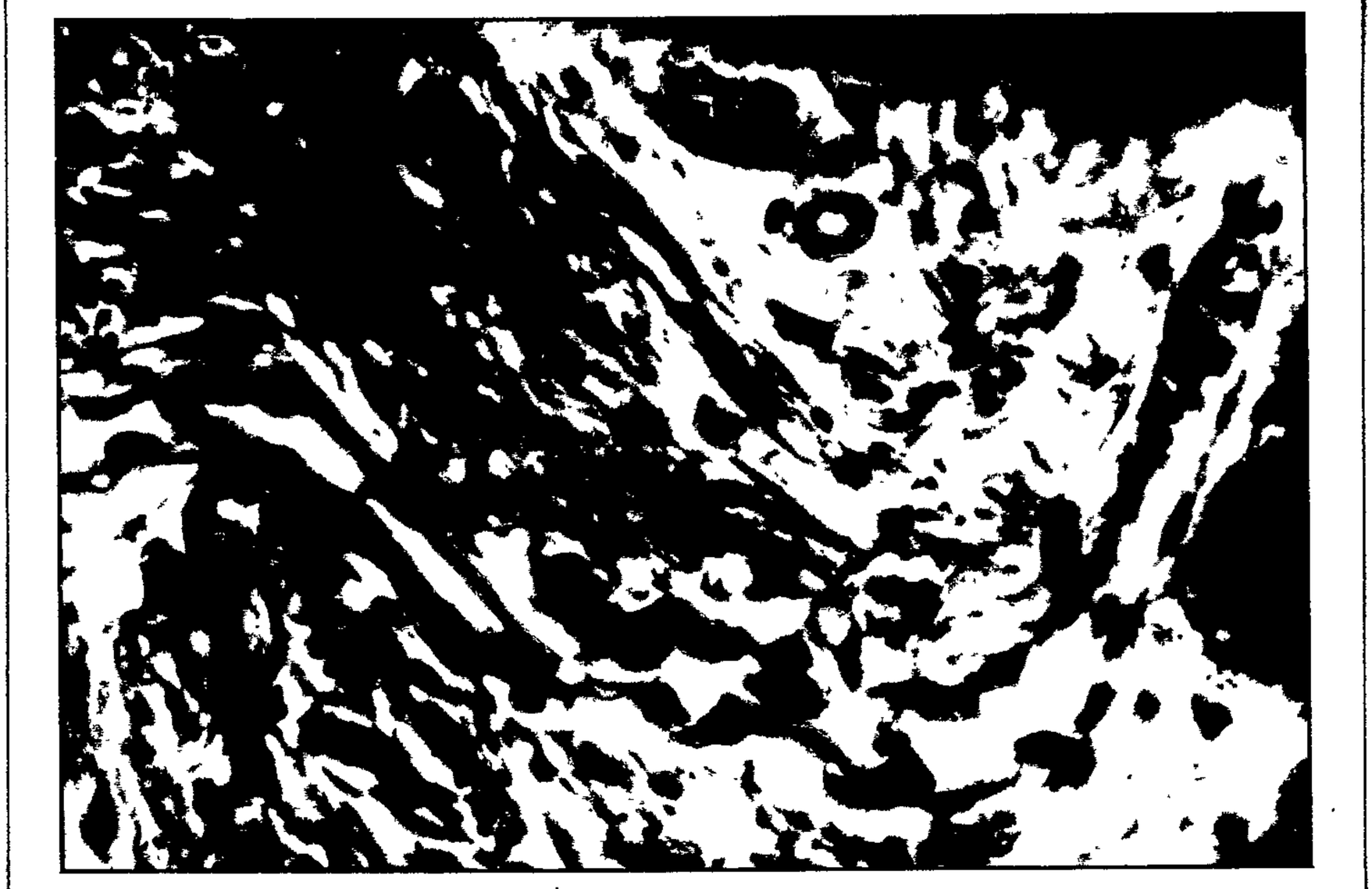

Fig. 13.

Gingiva adjacent fatty zone specimen demonstrating a long, straight capillary running at right-angles to the surface between the rete pegs. (H. and E. X400)

SOFT PALATE - CAPILLARY LOOPS

42B 42D 42E In the soft palate the papillae of the connective tissue are few and short. The picture was one of capillaries of a less geometric and more meandering nature than seen in the longer dermal ridges of other parts of the palate. Nevertheless a few capillaries were seen coursing straight along the respective ridges. However, the overall pattern was less orderly than in some other palatal zones.

GINGIVA. ADJACENT FATTY ZONE - CAPILLARY LOOPS

60B 60D 60E There was good evidence here of long, straight capillaries running at right-angles to the surface between the rete pegs; this corresponded to the pattern of long rete pegs (Fig. 13).

GINGIVA ADJACENT GLANDULAR ZONE - CAPILLARY LOOPS

78B 78D 78E The available evidence indicated the capillaries in the connective tissue papillae to be long and straight.

INCISIVE PAPILLA - CAPILLARY LOOPS

96B 96D 96E Capillaries were plentiful in these sections. Numerous examples could be seen of capillaries extending up into the connective tissue papillae between the rete pegs. Like the rete pegs the capillaries were long and for the most part straight.

MEDIAN RAPHÉ - CAPILLARY LOOPS

114B
114D
114E

Good evidence was found of long, straight capillaries coursing along the connective tissue papillae between the rete pegs.

CONCLUSIONS

It can be concluded that, in the specimens examined, those portions of the palatal mucosa with long, narrow papillary ridges, have long and relatively straight capillary loops while the portions with shallower, broader papillary ridges have more meandering less geometric capillary loops.

The sections indicated that the incisive papilla had a more abundant blood supply than the other regions. Each of the latter, approximately equally supplied, had less than the papilla.

CHAPTER 16

INTERCELLULAR SPACES AND INTERCELLULAR BRIDGES

The spaces and bridges between the epithelial cells were considered in this section with a view to determining whether they are characteristic of all zones of the palatal mucosa. Their presence in keratinizing zones and in non-keratinizing zones was compared.

The findings are now presented.

FATTY ZONE - INTERCELLULAR SPACES AND INTERCELLULAR BRIDGES

7A
7D
7E

The fatty zone of the palatal mucosa is a keratinizing zone. The intercellular spaces and intercellular bridges of the spinous layer were strikingly conspicious, the spaces being approximately 2.5μ wide.

GLANDULAR ZONE - INTERCELLULAR SPACES AND INTERCELLULAR BRIDGES

25B
25D
25E

The intercellular spaces and bridges were readily seen. Many of the spaces appeared somewhat stained with the acid stain; nevertheless the cell outlines were clearly defined with space separating them and containing the intercellular bridges. The spaces were approximately 2.5μ wide.

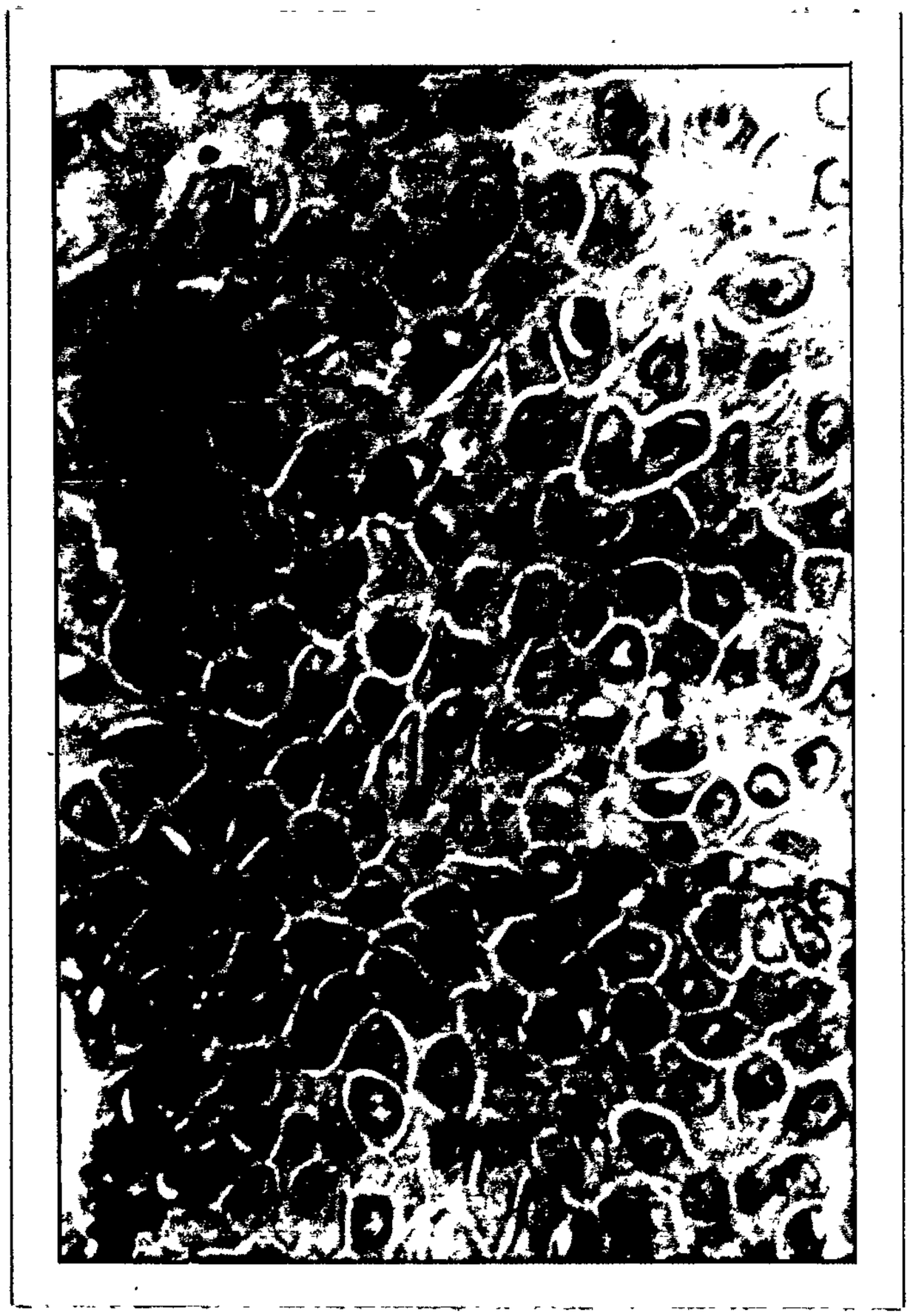

Fig. 14.

Gingiva adjacent glandular zone specimen demonstrating intercellular spaces and intercellular bridges. (H. and E. ×400.)

SOFT PALATE - INTERCELLULAR SPACES AND INTERCELLULAR BRIDGES

43B
43D
43E Neither intercellular spaces nor intercellular bridges could be seen at 400X magnification. Their absence was confirmed by viewing at 1000X magnification under oil immersion.

GINGIVA ADJACENT FATTY ZONE - INTERCELLULAR SPACES AND BRIDGES

61B
61D
61E The intercellular spaces and bridges were in good evidence although they became quite difficult to see in the more superficial layers of the stratum spinosum. The spaces were approximately 2.5μ in width.

GINGIVA ADJACENT GLANDULAR ZONE - INTERCELLULAR SPACES AND BRIDGES

79B
79D
79E Both the spaces and the bridges were highly conspicuous. The spaces were approximately 2.5μ wide, (Fig. 14).

INCISIVE PAPILLA - INTERCELLULAR SPACES AND BRIDGES

97B
97D
97E The intercellular spaces and bridges of the stratum spinosum were clearly visible except in the superficial layers where they became almost unidentifiable. The spaces were approximately 2.5μ in width.

115B MEDIAN RAPHÉ - INTERCELLULAR SPACES AND BRIDGES
115D
115E The intercellular spaces and bridges of the stratum spinosum were quite distinct though disappearing in the most superficial three or four layers. Their width was approximately 2.5μ.

CONCLUSIONS

The intercellular spaces and bridges of the epithelium are characteristic of all zones of the palatal mucosa except the soft palate. They are less conspicuous in the more superficial layers. It has been found, therefore, that kerantinized zones of the palatal mucosa have well-defined intercellular spaces and bridges in the epithelium. By contrast, intercellular spaces and bridges are absent from non-keratinized mucosa.

The explanation of these findings may be that, because the epithelium in the keratinized zones is subjected to more frictional force than that in the non-keratinized zone, intercellular bridges are required in the former to assist cohesion of the cells. However, some doubt has been cast on this theory by recent electron-microscopic findings which show lack of continuity of the tonofibrils across the intercellular bridges.

CHAPTER 17

RETE PEGS

Measurements were made of the lengths and widths of the rete pegs in the various palatal zones. The measurements were made usually from the middle third of the sections. Ten consecutive rete pegs were measured and averaged in each specimen. Measurements for length were made from the apex of the rete peg to the imaginary line joining the apices of the two adjacent connective tissue papillae. Measurements for width were made across the rete peg half-way along its length. The eyepiece used was an Carnst Leitz GmbH Wetzlar eyepiece with a scale showing ten larger divisions each divided into 10 smaller divisions. The eyepiece had a magnification of 10X. The accompanying objective had a power of 40X. Under these conditions one fine division on the eyepiece scale equal 2.5μ.

Here are the results.

FATTY ZONE - RETE PEGS

	Length μ	Width μ
1.	375	37.5
2.	250	50
3.	280	25
4.	500	25
5.	275	25
6.	262	25
7.	312	50
8.	250	25
9.	200	12.5
10.	175	12.5
Total	2879	287.5
Average	287.9 = 288/μ	28.75

8A

It was noted that the rete pegs in this zone were arranged in "twin form"; i.e. many large rete pegs were divided into two smaller rete pegs by a connective tissue papilla which tended to be shorter than two adjacent papillae

8D

	Length μ	Width μ
1.	300	100
2.	312.5	87.5
3.	275	87.5
4.	375	50
5.	300	100
6.	250	100
7.	212.5	62.5
8.	225	57.5
9.	300	125
10.	300	50
Total	2850	125
Average	285	Total 945
		Average 94.5

8E The rete pegs were numerous and long.

	Length μ	Width μ
1.	312.5	62.5
2.	187.5	117.5
3.	175	87.5
4.	175	50
5.	175	52.5
6.	175	75
7.	262.5	325
8.	225	137.5
9.	175	25
10.	550	112.5
Total	2412.5	1045
Average	241.25	104.5

GLANDULAR ZONE - RETE PEGS

26B	Length μ	Width μ
1.	207	37
2.	175	60
3.	175	112
4.	212	25
5.	150	62
6.	162	25
7.	150	37
8.	175	50
9.	150	62
10.	137	25
Total	1693	495
Average	169.3	49.5

26D	Length μ	Width μ
1.	87.5	100
2.	87.5	250
3.	50	100
4.	67.5	50
5.	75	87.5
6.	75	87.5
7.	62.5	137.5
8.	37.5	75
9.	100	150
10.	175	100
Total	817.5	1137.5
Average	81.75	113.75

These measurements are extremely interesting. There was no doubt that the entire length of the rete pegs was visible, since keratin could be seen superficially and the basal cells at the other end. These measurements do not support the commonly accepted idea that the hard palate always has numerous long rete pegs as these rete pegs were short and wide.

26E It was felt that accurate measurements of the rete pegs could not be guaranteed in this specimen; consequently measurements were omitted in this case.

44B SOFT PALATE - RETE PEGS

	Length /u	Width /u
1.	75	50
2.	61.5	57.5
3.	50	50
4.	87.5	82.5
5.	62.5	50
6.	37.5	137.5
7.	50	62.5
8.	25	137.5
9.	37.5	125
10.	75	100
Total	561.5	852.5
Average	56.15	85.25

44D There were no rete pegs in the mucosa of this soft palate. The basal membrane ran a more or less straight course parallel to the surface, separating the epithelium from the connective tissue.

44E The rete pegs were very short indeed in this specimen. Measurements were:

	Length /μ	Width /μ
1.	100	200
2.	137.5	62.5
3.	150	112.5
4.	150	32.5
5.	75	37.5
6.	87.5	25
7.	125	50
8.	50	62.5
9.	37.5	50
10.	50	175
Total	962.5	807.5
Average	96.25	80.75

GINGIVA ADJACENT FATTY ZONE - RETE PEGS

62B	Length /μ	Width /μ
1.	460	22.5
2.	250	15
3.	97.5	22.5
4.	337	62.5
5.	350	75
6.	125	50
7.	100	10
8.	175	22.5
9.	150	50
10.	250	12.5
Total	2294.5	342.5
Average	229.45	34.25

62D

	Length /u
1.	450
2.	362.5
3.	250
4.	400
5.	450
6.	412.5
7.	350
8.	262.5
9.	337.5
10.	412.5
Total	3687.5
Average	368.75

Width measurements were omitted in this specimen.

62E

	Length /u	Width /u
1.	112.5	50
2.	112.5	75
3.	100	50
4.	437.5	30
5.	187.5	37.5
6.	250	37.5
7.	200	75
8.	187.5	50
9.	200	37.5
10.	325	37.5
Total	2112.5	480
Average	211.25	48

GINGIVA ADJACENT GLANDULAR ZONE - RETE PEGS

80B	Length /u	Width /u
1.	250	42.5
2.	350	50
3.	395	50
4.	300	62.5
5.	250	42.5
6.	250	37.5
7.	262.5	37.5
8.	200	42.5
9.	275	25
10.	377.5	50
Total	2910.0	440
Average	291	44

80D
80E The configuration of the rete pegs was such that their limits could not be determined accurately; consequently measurements were omitted.

INCISIVE PAPILLA - RETE PEGS

98B The measurements of the rete pegs were as follows:

	Length /u	Width /u
1.	387.5	60
2.	375	75
3.	575	50
4.	350	62.5
5.	400	60
6.	375	75
7.	500	100
8.	457.5	75
9.	250	25
10.	225	50
Total	3875.0	632.5
Average	387.5	63.25

98D The rete pegs in the sections from this incisive papilla were long and numerous.

	Length /u	Width /u
1.	350	62.5
2.	250	37.5
3.	150	37.5
4.	200	62.5
5.	162.5	125
6.	175	250
7.	375	75
8.	300	125
9.	188.5	37.5
10.	275	125
Total	2426	937.5
Average	242.6	93.75

98E The papillae in this region were numerous and long. The following were the measurements obtained:

	Length /u	Width /u
1.	250	25
2.	225	25
3.	250	75
4.	200	50
5.	350	50
6.	275	75
7.	387.5	25
8.	400	62.5
9.	550	37.5
10.	125	87.5
Total	3012.50	512.5
Average	301.25	51.25

MEDIAN RAPHÉ - RETE PEGS

116B	Length /μ	Width /μ
1.	400	75
2.	350	137.5
3.	237.5	137.5
4.	222.5	62.5
5.	162.5	32.5
6.	188.5	75
7.	250	100
8.	275	47.5
9.	162.5	55
10.	225	65
Total	2476	787.5
Average	247.6	78.75

116D	Length /μ	Width /μ	
1.	150	60	
2.	237.5	75	
3.	275	55	Toward the posterior
4.	387.5	87.5	end of the raphé the
5.	425	100	rete pegs became broader
6.	337.5	95	as the raphé neared the
7.	225	22.5	soft palate.
8.	300	62.5	
9.	275	60	
10.	312.5	92.5	
Total	2925	710	
Average	292.5	71	

116E	Length /u	Width /u
1.	362.5	87.5
2.	425	25
3.	225	32.5
4.	250	37.5
5.	250	132.5
6.	150	50
7.	125	325
8.	200	75
9.	112.5	75
10.	200	100
Total	2300	940
Average	230	94

CONCLUSIONS

The various palatal zones are listed in decreasing order of the average length of their rete pegs.

1. INCISIVE PAPILLA

   Length 310.5 /u

   Breadth 69.0 /u

2. GINGIVA ADJACENT GLANDULAR ZONE

   Length 291.0 /u

   Breadth 44.0 /u

3. FATTY ZONE

   Length 271.4 /u

   Breadth 75.9 /u

4. GINGIVA ADJACENT FATTY ZONE

   Length 269.8 /u

   Breadth 41.1 /u

5. MEDIAN RAPHÉ

Length 256.7 /u

Breadth 81.3 /u

6. GLANDULAR ZONE

Length 125.5 /u

Breadth 81.6 /u

7. SOFT PALATE

Length 50.8 /u

Breadth 55.3 /u

N.B. It can be seen that there is not a great difference in the lengths of the rete pegs from one to five. However at the glandular zone there is a marked decrease and at the soft palate a further marked decrease. Since the palatal mucosa increases in mobility from anterior to posterior it would appear that the mobility of the palatal tissues is inversely proportional to the length of the rete pegs.

CHAPTER 18.

CLEAR CELLS

Blakiston's New Gould Medical Dictionary (1956) defines a clear cell as follows: "A cell considered to be of neural origin which has a small, darkly stained nucleus and clear, slightly basophilic cytoplasm in sections stained with haematoxylin and eosin. Syn., celle claire, cellule claire."

Lever (1961) names these cells melanocytes. "Melanocytes are of neural origin. They stain with Block's dopa reaction (because they have the ability to form melanin). They are found wedged in between the basal cells of the epidermis. In sections stained with haematoxylin and eosin, melanocytes appear as clear cells having a small, dark-staining nucleus and a clear, slightly basophilic cytoplasm. On the other hand, in sections impregnated with silver, they appear as dendritic cells with numerous, long, branching processes, provided that a sufficient amount of melanin granules are present within the processes to show their outline. Whereas normally melanocytes wear out and become dopa negative and aureophilic, under conditions of stimulation they remain physiologically active, even during their

passive movement into the higher layers of the epidermis."

The object in this section was to determine whether clear cells are present in the epithelium of the palatal mucosa and, if so, to determine whether they are equally prevalent in all zones of the palate. Clear cells were found and it was decided to count the number of such cells in ten random 400X fields of diameter 250/^{u}. The average number per field for the zone under investigation would then be calculated. Findings were as follows:

FATTY ZONE - CLEAR CELLS

The number of clear cells per 250/^{u} diameter 400X field were:

9A 1, 9, 14, 18, 11, 13, 13, 21, 8, 9.

Total = 117

Average = 11.7

9D 8, 6, 3, 7, 3, 1, 1, 5, 6, 15.

Total = 55

Average = 5.5

9E 1, 2, 3, 4, 5, 2, 2, 2, 2, 4.

Total = 27

Average = 2.7

The majority of these cells were in the stratum spinosum.

GLANDULAR ZONE - CLEAR CELLS

The number of distinct clear cells in consecutive 400X fields of 250/^{u} diameter of epithelium was measured. The numbers were:

27B 8, 7, 2, 3, 1, 3, 4, 1, 2, 3.
Total = 34
Average = 3.4

27D 1, 6, 4, 1, 3, 1, 2, 1, 2, 4.
Total = 25
Average 2.5

27E 1, 0, 2, 4, 6, 3, 1, 2, 1, 2.
Total = 22
Average = 2.2

SOFT PALATE - CLEAR CELLS

The number of clear cells in ten consecutive 400X fields of diameter 250/^{u} were measured.

45B 3, 1, 2, 6, 2, 0, 2, 2, 1, 0.
Total = 19
Average = 1.9

As can be seen very few clear cells were visible. The epithelium of this dissection-room specimen had taken stain very heavily. This could partly account for the scarcity of clear cells though this is doubtful. One would expect that a clear cell would tend, if anything, to stand out more clearly in a densely-stained section.

45D 0, 0, 0, 0, 0, 0, 0, 0, 0, 0.

Total = 0

Average = 0

Clear cells were singularly scarce in this epithelium.

45E 3, 1, 1, 5, 2, 2, 2, 4, 1, 0.

Total = 21

Average = 2.1

GINGIVA ADJACENT FATTY ZONE - CLEAR CELLS

Counts of the clear cells in ten adjacent fields of 250/^{u} were as follows:

63B 6, 6, 6, 7, 8, 12, 4, 9, 8, 7.

Total = 73

Average = 7.3

63D 1, 4, 3, 1, 2, 4, 3, 1, 3, 2.

Total = 24

Average = 2.4

63E 6, 3, 4, 8, 5, 6, 7, 20, 6, 6.

Total = 71

Average = 7.1

GINGIVA ADJACENT GLANDULAR ZONE - CLEAR CELLS

The number of clear cells per field was as follows:

81B 10, 3, 4, 6, 10, 4, 3, 6, 6, 3.

Total = 55

Average = 5.5

81D 2, 1, 5, 2, 2, 11, 5, 4, 4, 8.

Total = 44

Average = 4.4

81E 7, 6, 3, 6, 9, 4, 5, 4, 3, 4.

Total = 51

Average = 5.1

INCISIVE PAPILLA - CLEAR CELLS

Following are the counts made of ten consecutive high-power fields for clear cells:

99B 3, 5, 4, 9, 3, 6, 11, 11, 4, 25.

Total = 81

Average = 8.1

The tenth field counted, which yielded an abnormally high count, contained an infolding of the epithelium to form a sulcus lined on both sides by epithelium.

99D 30, 2, 2, 3, 6, 2, 3, 2, 0, 10.

Total = 60

Average = 6.0

99E 2, 9, 6, 5, 2, 6, 17, 4, 3, 11.

Total = 65

Average = 6.5

MEDIAN RAPHE - CLEAR CELLS

The counts of clear cells were as follows:

117B 10, 19, 13, 11, 9, 14, 10, 15, 8, 11.

Total = 120

Average = 12.0

117D 3, 3, 1, 3, 1, 1, 3, 2, 1, 0.

Total = 18

Average = 1.8

117E 3, 6, 5, 2, 3, 0, 2, 3, 2, 2.

Total = 28

Average = 2.8

CONCLUSIONS

This investigation leaves no doubt that clear cells are a feature of the epithelium of palatal mucosa in every zone, (Fig. 10). They do not appear to be equally prevalent for all zones. The average number of clear cells per field in each zone investigated, was calculated as the average of the averages obtained for three different specimens of each zone. Under certain circumstances the average of averages is untrustworthy but in this case it is valid. The zones, in descending order of clear cell population for the specimens investigated are:

Incisive papilla	6.9	
Fatty zone	6.6	
Gingiva adjacent fatty zone	5.6	It is noted that
Median raphé	5.2	the clear cell
Gingiva adjacent glandular zone	5.0	population decreases
Glandular zone	2.7	from anterior to
Soft palate	1.3	posterior.

The present investigator agrees with Lever (1961) that clear cells are found "wedged in between the basal cells of the epidermis". However the specimens reported above indicate that, in palatal mucosa, clear cells are more prevalent in the prickle cell layer than in the basal layer.

CHAPTER 19

TASTE BUDS

Many unsuccessful attempts have been made to discover taste buds in the palatal mucosa. The author determined to make a careful search of his sections for such organs.

"Taste buds are small ovoid or barrel-shaped intraepithelial organs about 80 microns in height and 40 microns thick. They touch with their broader base the basement membrane, while their narrower tip almost reaches the surface of the epithelium. The tip is covered by a few flat epithelial cells, which surround a small opening, the taste pore. It leads into a narrow space between the peripheral ends of the sustentacular supporting cells of the taste bud. The outer supporting cells are arranged like the staves of a barrel; the inner and shorter ones are spindle-shaped. Between the latter are arranged 10 to 12 neuroepithelial cells, the receptors of taste stimuli. They are slender, dark-staining cells that carry a stiff hairlike process at their superficial end. The hairs reach into the space beneath the taste pore." (Sicher, 1962).

FATTY ZONE - TASTE BUDS

10A
10D No taste buds could be found.
10E

GLANDULAR ZONE - TASTE BUDS

28B
28D No taste buds could be seen.
28E

SOFT PALATE - TASTE BUDS

46B
46D No taste buds were found.
46E

GINGIVA ADJACENT FATTY ZONE - TASTE BUDS

64B
64D No taste buds were found.
64E

GINGIVA ADJACENT GLANDULAR ZONE - TASTE BUDS

82B
82D A careful search failed to reveal any taste buds.
82E

INCISIVE PAPILLA - TASTE BUDS

100B
100D No taste buds were seen.
100E

MEDIAN RAPHÉ - TASTE BUDS

118B
118D No evidence of taste buds was found.
118E

CONCLUSIONS

The specimens of palatal mucosa examined in this survey contain no taste buds.

CHAPTER 20

TONOFIBRILS

Tonofibrils are "thin fibrils or striae observed in epithelial cells and thought to be supporting in function." (MacMalty, 1961). They are scattered through the cytoplasm of epidermal cells as delicate striations. In paraffin sections they are stainable with Heidenhain's haematoxylin, which was the stain employed in this investigation. The aim was to compare, in palatal mucosa, the tonofibrils in the cells of the malpighian layer, stratum granulosum and stratum corneum. A magnification of 1,000X was used with oil immersion.

FATTY ZONE - TONOFIBRILS

11C
11F
11G

Tonofibrils could be seen in the cytoplasm of cells of the stratum spinosum. They were more difficult to see in the stratum granulosum and impossible to see in the stratum corneum.

GLANDULAR ZONE - TONOFIBRILS

29F
29G
29H

Tonofibrils were apparent in the cytoplasm of the cells of the stratum spinosum. In the stratum granulosum the definition was diminished and in the stratum corneum absent.

Fig. 15.

Soft palate specimen demonstrating toro-fibrils in the cytoplasm of cells of the stratum spinosum.
(Heidenhain's Haematoxylin x1,000)

SOFT PALATE - TONOFIBRILS

47F
47G
47H

There were tonofibrils visible in the stratum spinosum. (Fig. 15) They were still visible in the cells close to the surface but not in the most superficial cells.

GINGIVA ADJACENT FATTY ZONE - TONOFIBRILS

65C
65F
65G

Tonofibrils were visible in the cytoplasm of the cells of the stratum spinosum. They were very difficult to see in the stratum granulosum and could not be seen in the stratum corneum.

GINGIVA ADJACENT GLANDULAR ZONE - TONOFIBRILS

83F
83G
83H

Some tonofibrils were seen in the stratum spinosum. They could not be seen in the stratum granulosum or stratum corneum.

INCISIVE PAPILLA - TONOFIBRILS

101F
101G
101H

Striae representing tonofibrils were seen fairly clearly in the cells of the stratum spinosum. These were much vaguer in the stratum granulosum and could not be seen in the most superficial cells.

MEDIAN RAPHÉ - TONOFIBRILS

119F
119G
119H

Tonofibrils were seen in this specimen in the stratum spinosum. However, they could not be seen in the stratum granulosum or stratum corneum.

CONCLUSIONS

This part of this research into palatal mucosa proved the most difficult from the microscopist's point of view. Even with the fine equipment available the tonofibrils could only just be seen. Nevertheless it is established that, in palatal mucosa, there is a gradual disappearance of tonofibrils from the cytoplasm of the epithelial cells when comparing successively the stratum spinosum, stratum granulosum and stratum corneum. This can be explained if it is accepted that the tonofibrils give the soft cell body a supporting framework. As the cells flatten in the more superficial layers of the epithelium this support is no longer required; the tonofibrils therefore disappear.

CHAPTER 21

KERATINIZATION

"The reactions of squamous epithelium are very limited; a prickle cell can form keratin or it can divide." (Rushton and Cooke 1959). The aim of this piece of research was to observe which zones of the palatal mucosa are keratinized and more specifically what type of keratinization is present. Thickness measurements were also made.

Rushton and Cooke (1959) say that "keratosis is the formation of a keratin layer". "In fully keratinized epithelium the surface layers consist of flat, tightly-packed, horny scales, the transformed surface cells. Nuclei are absent." (Sicher, 1962).

"Hyperkeratosis is an increase in the thickness of the keratin layer" (Rushton and Cooke, 1959).

"Whereas in hyperkeratosis the stratum corneum is perfectly cornified in parakeratosis it is imperfectly cornified, and the nuclei of the cells remain." (Rushton and Cooke, 1959). "In parakeratosis the surface cells seem to consist of keratin but have retained pyknotic nuclei" (Sicher, 1962).

"In incomplete parakeratosis specific stains,

e.g. Mallory's stain, show the surface layer divided into two layers. The deeper layer stains like keratin, but this stain is lost in the superficial layer, probably by the influence of oral fluids on the incompletely differentiated keratin of the nuclei-containing cells.

Where keratinization is lacking, the flat surface cells retain their nuclei." (Sicher, 1962).

The modified Mallory technique stains keratin red. Nevertheless the difference between non-keratinization and parakeratinization can be difficult to detect. However,if it is remembered that in parakeratosis the cell bodies lose or tend to lose their identity(i.e. the outlines of the cells are lost although the nuclei are still visible)and that the surface layers have a homogeneity of the cytoplasm, a differentiation can be made.

Ten random measurements of the thickness of the keratin layer (where present) were made and averaged for each slide.

FATTY ZONE - KERATINIZATION

12A The modified Mallory stain demonstrated brilliantly a band of keratin, 10 random measurements of the thickness of which were as follows:

32.5, 25, 50, 17.5, 15, 15, 12.5, 15, 10, 25.

Total 217.5

Average = 21.75/μ

Examination of both the haematoxylin and eosin and the modified Mallory sections revealed full keratinization; findings indicative of this were:

1) Absence of cells in the keratinized layer in the H & E sections.

2) The prominence of keratohyalin granules in the granular layer in the modified Mallory sections.

12D The modified Mallory stain revealed an unmistakable band of keratin at the surface of the epithelium. Ten random measurements of its width were as follows:

37.5, 25, 32.5, 30, 25, 20, 25, 27.5, 35, 32.5.

Total = 290.0

Average = 29/u

The impression was that this was full keratinization. Nuclei were not visible in the keratin layer with the modified Mallory stain and were very scarce in the haematoxylin-eosin section.

12E The modified Mallory section demonstrated a cornified layer which had taken the stain at varying intensities along the length of the section. Thickness measurements were as follows:

22.5, 20, 25, 22.5, 22.5, 52.5, 32.5, 25, 12.5, 37.5.

Total = 272.5

Average = 27.25

The haematoxylin-eosin section was indicative

of parakeratinization although the keratin in a few places appeared free of nuclei.

GLANDULAR ZONE - KERATINIZATION

30B The modified Mallory stain did not produce the classical clear-cut picture of keratinization with orange-stained keratin contrasting sharply with blue-green-stained prickle-cell layer. The basal layer and prickle-cell layer stained orange. The more superficial layers stained purple. Stained nuclei were present throughout this purple zone. The type of keratinization was parakeratosis. On the very surface of the section and strictly confined there was a very thin layer of luminous-red material, which was true keratin.

The orange prickle-cell layer (excluding rete pegs) and the purple parakeratotic layer were approximately of equal thickness, about 25 x 2.5/^{u} = 62.5/^{u} The red keratin layer was about 5/^{u} in thickness.

30D An unmistakable band of keratin was seen in the section stained with the modified Mallory stain. Ten random measurements of its thickness were as follows:

10, 12.5, 7.5, 15, 5, 5, 12.5, 20, 10, 12.5.

Total = 110.0

Average = 11.0/^{u}

The stratum corneum appeared free from nuclei.

Fig. 16.

Soft palate specimen demonstrating keratin.
(Modified Mallory x400.)

30E An easily defined band of keratin was revealed by the modified Mallory stain. Measurements were made for keratin thickness and were as follows:

12.5, 17.5, 30, 12.5, 30, 12.5, 12.5, 17.5, 12.5 20.

Total = 177.5

Average = 17.75/μ

In the majority of the fields nuclei were visible in the keratin and the description of parakeratosis seemed appropriate.

SOFT PALATE - KERATINIZATION

48B The modified Mallory technique stained the entire epithelium orange-red. No keratin could be seen. The haematoxylin-eosin preparation confirmed the absence of keratinization.

48D The modified Mallory stain technique stained the entire epithelium an orange-red. A most interesting observation, however, was the presence of a keratin layer, an unexpected finding on the soft palate. (Fig. 16)

Thickness measurements were made:

7.5, 10, 7.5, 10, 7.5, 10, 7.5, 7.5, 10, 10.

Total = 87.5

Average = 8.75/μ

Of further interest was the fact that keratinization was present on an epithelium in which inter-

cellular spaces and bridges could not be found.

The haematoxylin and eosin section showed an occasional very flat nucleus in the cornified layer. This was considered to be parakeratosis.

48E An undeniable stratum corneum was present.

Thickness measurements were:

7.5, 7.5, 10, 10, 10, 7.5, 7.5, 12.5, 7.5, 7.5.

Total = 87.5

Average = 8.75/^{u}

The haematoxylin-eosin sections demonstrated clearly that this cornified layer was parakeratinization.

GINGIVA ADJACENT FATTY ZONE - KERATINIZATION

66B The modified Mallory stain revealed a surface layer of keratin stained a brilliant red. Ten random measurements of the thickness of this layer were as follows:

7.5, 12.5, 7.5, 12.5, 10, 5, 7.5, 5, 5, 7.5.

Total = 80.0

Average = 8/^{u}

Examination of the haematoxylin and eosin specimen revealed that this was parakeratosis, there being flattened nuclei present right to the surface.

66D Pronounced keratinization was observed in the sections stained with the modified Mallory stain.

Thickness measurements were as follows:

27.5, 32.5, 17.5, 12.5, 15, 12.5, 10, 7.5,

27.5, 12.5.

Total = 175.0

Average = 17.5/μ

Findings on the haematoxylin and eosin section were suggestive of full keratinization; there were certainly darkly stained nuclei in the stratum granulosum but the stratum corneum was free of nuclei.

66E There was no keratinization of the epithelium of the gingiva adjacent fatty zone of this palate, as stained with the modified Mallory technique.

GINGIVA ADJACENT GLANDULAR ZONE - KERATINIZATION

84B The modified Mallory stain revealed a distinct band of keratin on the surface of the epithelium; its staining was brilliant red. In places the keratin seemed to be either stripped from the epithelium or itself split into strands. Therefore the accompanying random measurements of keratin thickness were confined to the areas where the keratin layer was properly positioned at the surface of the epithelium.

12.5, 20, 25, 17.5, 25, 17.5, 5, 7.5, 5, 7.5.

Total = 142.5

Average = 14.25/μ

It was difficult with the modified Mallory

stain to tell whether one was looking at full keratinization or parakeratinization; however, the haematoxylin and eosin section revealed pyknotic nuclei right to the surface which indicated parakeratinization.

84D This epithelium was undoubtedly cornified. The accompanying measurements were made. The appearance of the keratin stained with haematoxylin and eosin was one of complete keratinization, the keratin being virtually free of nuclei.

25, 35, 25, 10, 7.5, 27.5, 17.5, 17.5, 30, 17.5.

Total = 212.5

Average = 21.25/μ

84E The epithelium was considered keratinized but the type of keratinization could not be stated with certainty.

INCISIVE PAPILLA - KERATINIZATION

102B The modified Mallory stain showed a layer of keratin. Measurements of the thickness of the brilliant red zone were confined to places where the keratin had not been disorganized in the processing.

15,20, 20, 20, 15, 17.5, 5, 12.5, 10, 12.5.

Total = 147.5

Average = 14.75/μ

The haematoxylin and eosin section demonstrated this to be parakeratinization, having flattened, pyknotic

nuclei right to the surface.

102D A fairly thick band of keratin was revealed on the surface of the epithelium by the modified Mallory stain. Measurements of its thickness were as follows:

25, 20, 15, 15, 17.5, 15, 15, 17.5, 20, 15.

Total = 175

Average = 17.5/μ

Although the dominant impression with the haematoxylin and eosin stain was that of full keratinization, every now and again a pyknotic nucleus would be seen in the keratin. All things considered however, the epithelium in these sections was best described as being fully keratinized with a slight tendency to parakeratinization.

102E There was no evidence of keratinization in the sections of this incisive papilla.

MEDIAN RAPHÉ - KERATINIZATION

120B The keratin in this section was rather sparse. Measurements of the thickness of the layer, where present, were as follows:

5, 5, 12.5, 5, 7.5, 5, 5, 7.5, 6.25, 5.

Total = 63.75

Average = 6.38/μ

The type of keratinization present was shown by the haematoxylin-eosin specimen to be parakeratiniz-

ation featuring pyknotic nuclei in the surface layers.

120D The epithelium was keratinized. Measurements were as follows:

15, 15, 10, 12.5, 12.5, 15, 15, 27.5, 30, 12.5.

Total = 165

Average = 16.5/μ

The haematoxylin-eosin sections demonstrated cell-free keratin indicating complete keratinization.

120E The raphé was clearly cornified by a substantial band of keratin which was stripped off a little in places due to the processing. These were the thickness measurements of the keratin band:

25, 17.5, 20, 17.5, 15, 22.5, 22.5, 15, 20, 25.

Total = 200

Average = 20/μ

The haematoxylin-eosin section revealed that the keratin layer contained nuclei and the type of cornification was considered to be parakeratosis.

CONCLUSIONS

The various palatal zones are now arranged in descending order of keratin thickness. The average thickness for the zone is recorded and the predominant type of keratinization in that zone (as ascertained from this investigation) stated.

1. FATTY ZONE

Thickness 26/^{u}

Type - full keratinization

2. GINGIVA ADJACENT GLANDULAR ZONE

Thickness 17.8/^{u}

Type - parakeratosis

3. GLANDULAR ZONE

Thickness 14.4/^{u}

Type - parakeratosis

4. MEDIAN RAPHE

Thickness 14.3/^{u}

Type - parakeratosis

5. INCISIVE PAPILLA

Thickness - 10.8/^{u}

Type - parakeratosis

6. GINGIVA ADJACENT FATTY ZONE

Thickness 8.5/^{u}

Type - no predominant type

7. SOFT PALATE

Thickness 5.8/^{u}

Type - parakeratosis

N.B. It is the finding of this investigation that parakeratinization of soft palate epithelium sometimes occurs, despite the commonly held belief that the epithelium of the soft palate is not keratinized.

CHAPTER 22.

MELANIN

The stain used to demonstrate melanin in the epithelium of the palatal mucosa was methenamine silver. "The silver stain", according to Lever (1961) "unlike the dopa reaction, does not demonstrate the site of formation of melanin but, instead, demonstrates the presence of melanin. In a lightly pigmented epidermis, melanin is seen only in the region of the basal layer. However, in a deeply pigmented skin, as in the Negro, melanin is found also in the upper layers of the epidermis and in phagocytic cells of the dermis. In basal cells, melanin often appears concentrated above their nuclei as supranuclear caps. Any doubt that has been expressed in the past concerning the presence of melanin in basal cells has been resolved by electron-microscope studies. These studies have shown, especially after stimulation with ultra-violet light, abundant melanin granules in basal cells. The transfer of melanin from the melanocyte to the basal cell is accomplished by the penetration of dendritic processes into the basal cell."

Montagna (1962) stresses an important concept.

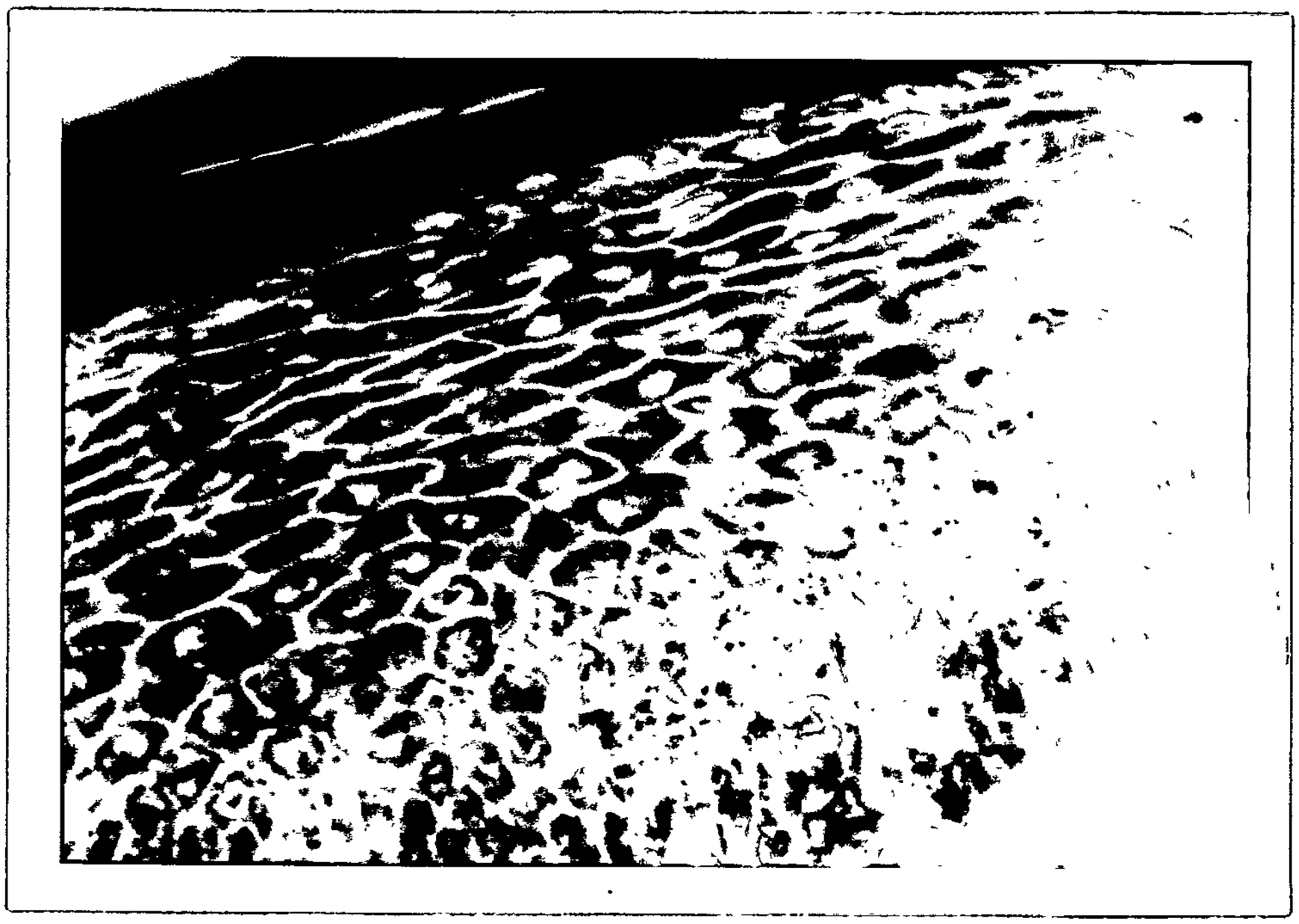

Fig. 17.

Bandicoot snout epithelium specimen demonstrating melanin.
(Methenamine Silver x400.)

"The colour of the skin depends less upon the density of the melanocytes than on the amount of colour that they produce. The differences in skin colouration between the races of men are not due to differences in the density of melanocytes, but to their functional variations in the production of melanin."

The palatal mucosa was duly investigated for the presence of melanin in the epithelium, using control slides which demonstrated that the stain was effective (Fig. 17 - bandicoot snout).

FATTY ZONE - MELANIN

13A
13D
13E — No melanin was seen.

GLANDULAR ZONE - MELANIN

31B
31D
31E — No melanin was seen.

SOFT PALATE - MELANIN

49B
49D
49E — No melanin granules were evident in the epithelium.

GINGIVA ADJACENT FATTY ZONE - MELANIN

67B
67D
67E — No melanin was seen.

GINGIVA ADJACENT GLANDULAR ZONE - MELANIN

85B — No melanin was seen.

Fig. 16.

Gingiva adjacent glandular zone specimen demonstrating melanin in the basal layer cells. (Methenamine Silver x 400)

85D The cells of the basal layer of epithelium were found to contain numerous melanin granules (Fig. 18). The granules were very fine even at 400X magnification.

85E Melanin granules could not be seen in the epithelium.

INCISIVE PAPILLA - MELANIN

103B
103D No melanin was seen.
103E

MEDIAN RAPHE - MELANIN

121B
121D No melanin was seen.
121E

CONCLUSIONS

Despite the fact that another phase of this investigation (Chapter 18) demonstrated that clear cells (melanocytes) are a feature in every zone of the epithelium of palatal mucosa, this phase shows that melanin is not found (except in one specimen) in the palatal epithelium. It must be remembered that the specimens included tissue from white-skinned donors only. It must also be remembered that the palatal tissues are not exposed to the stimulating effect of direct ultra-violet light. The reason for melanin appearing in one specimen (gingiva adjacent glandular zone) is unknown.

It must be concluded that the melanocytes which are present in the palatal epithelium are melanotic.

CHAPTER 23

ELASTIC FIBRES

The distribution of elastic fibres in palatal mucosa was investigated. The stain orcein which stains elastic fibres reddish-brown was used. Under the microscope the fibres appear extremely fine, even at 400 times magnification. They usually have a wavy configuration.

FATTY ZONE - ELASTIC FIBRES

14A
14D
14E

Most of the connective tissue papillae contained elastic fibres. It was noted that most of the fibres in the papillae were running approximately parallel to the rete pegs i.e. at right angles to the surface. Elastic fibres were likewise sparingly scattered through the remainder of the lamina propria. The submucosa too contained quite a lot of elastic tissue, in parts more dense than in the lamina propria. Elastic tissue was noticeable in the blood-vessel walls as in other parts of the body.

GLANDULAR ZONE - ELASTIC FIBRES.

32B
32D
32E

In the connective tissue papillae elastic

Fig. 19.

Glandular zone specimen demonstrating elastic fibres in the submucosa.
(Orcein x400)

fibres were evident running for the most part vertically.

The submucosa featured elastic fibres in greater numbers (Fig. 19).

SOFT PALATE - ELASTIC FIBRES

50B
50D
50E

Elastic fibres were a prominent feature of the lamina propria of these soft palate sections. They were present mainly in a dense band situated close beneath the epithelium and running parallel to the surface. Elastic fibres were not a prominent feature of the submucosa, other than in vessel walls.

GINGIVA ADJACENT FATTY ZONE - ELASTIC FIBRES

68B
68D
68E

Elastic fibres were not a prominent feature of the sections, notwithstanding the fact that some were to be found scattered here and there in the submucosa.

GINGIVA ADJACENT GLANDULAR ZONE - ELASTIC FIBRES

86B
86D
86E

Elastic fibres were not a prominent feature of this region. The lamina propria was free of elastic tissue while only in the deepest part of the submucosa were a few elastic fibres seen.

INCISIVE PAPILLA - ELASTIC FIBRES

104B
104D
104E

Elastic fibres were not a prominent feature of

the lamina propria of the incisive papilla. Elastic fibres, however, were a prominent feature of the submucosa. They were arranged as an intertwining mass with no set direction.

MEDIAN RAPHÉ - ELASTIC FIBRES

122B
122D
122E

The lamina propria and submucosa contained a substantial amount of elastic tissue extending right up into the connective tissue ridges and as deep as the sections extended. This finding is surprising in view of the firm nature of the raphé.

CONCLUSIONS

From the results obtained, the zones of the palatal mucosa are arranged below in descending order of density of elastic tissue. The relative density of fibres in the different layers of each zone is also indicated.

1.
GLANDULAR ZONE

Papillae - moderate

Lamina propria - moderate

Submucosa - heavy

SOFT PALATE

Papillae - heavy

Lamina propria - heavy

Submucosa - slight

2. MEDIAN RAPHE

Papillae - moderate

Lamina propria - moderate

Submucosa - heavy

3. FATTY ZONE

Papillae - moderate

Lamina propria - moderate

Submucosa - moderate

4. INCISIVE PAPILLA

Papillae - negligible

Lamina propria - negligible

Submucosa - heavy

5. GINGIVA ADJACENT FATTY ZONE

Papillae - negligible

Lamina propria - slight

Submucosa - moderate

GINGIVA ADJACENT GLANDULAR ZONE

Papillae - slight

Lamina propria - negligible

Submucosa - moderate

The most important characteristic of elastic fibres is their ability to stretch, then return to their original form. It follows that tissue containing abund-

ant elastic fibres can be temporarily deformed without damage. Muco-compressive impression techniques are based on this principle. Oral surgery techniques involving rotation or repositioning of flaps should take into account the fact that the glandular zone and the soft palate are the palatal zones most abundant in elastic fibres.

CHAPTER 24.

FEULGEN REACTIVITY OF THE EPITHELIAL NUCLEI

When human skin is stained with P.A.S. stain by the Feulgen technique, it is found that the nuclei are more strongly Feulgen reactive in the basal layers of the stratum Malpighii than they are in the upper layers. The aim of this section of the investigation was to ascertain whether this is also true of the epithelium of palatal mucosa.

The findings were as follows:

FATTY ZONE - FEULGEN REACTIVITY OF NUCLEI

15C
15F
15G

The cells of the basal layer and the layer or two of cells adjacent had nuclei stained strongly green. The nuclei of the cells of the stratum spinosum were less strongly stained.

GLANDULAR ZONE - FEULGEN REACTIVITY OF NUCLEI

33F
33G
33H

The basal nuclei were a dense purplish-green. The nuclei of the spinous cells changed from this hue through lilac to clear, as they approached the surface.

Fig. 20.

Gingivo adjacent glandular zone specimen demonstrating strong Feulgen reactivity of the nuclei of the cells of the basal layer. (P.A.S. x400.)

SOFT PALATE - FEULGEN REACTIVITY OF NUCLEI

51F
51G The nuclei of the cells of the basal layer
51H
and those of the deepest cells of the stratum spinosum were unquestionably more strongly Feulgen reactive (purplish-green) than those of the more superficial spinous cells.

GINGIVA ADJACENT FATTY ZONE - FEULGEN REACTIVITY OF NUCLEI

69C
69F Feulgen reactivity was strongest in the
69G
basal layer of cells. Their nuclei were purplish-green. More superficially in the cells of the spinous layer the nuclei were either clear or lilac.

GINGIVA ADJACENT GLANDULAR ZONE - FEULGEN REACTIVITY OF NUCLEI

87F
87G These specimens demonstrated clearly that the
87H
nuclei of the cells of the basal layer and adjacent layers of the stratum spinosum were strongly Feulgen reactive while the more superficial spinous cells had either clear or bottle-green stained nuclei (Fig. 20).

INCISIVE PAPILLA - FEULGEN REACTIVITY OF NUCLEI

105F
105G The basal limit of the epithelium was clearly
105H
demarcated by the strongly Feulgen reactive nuclei

of the cells in the basal layer. The deepest cells of the stratum spinosum were strongly Feulgen reactive also. In contrast to their decisive purplish-green colour the other nuclei of the stratum spinosum were progressively lilac, then clear, as their distance from the surface lessened.

MEDIAN RAPHÉ - FEULGEN REACTIVITY OF NUCLEI

123F
123G
123H

The contrast between the deeper and more superficial epitholial nuclei was not as striking here as in other regions. However, there was a gradual decrease in strength of staining from the basal layer to the superficial cells of the stratum spinosum.

CONCLUSIONS

In human palatal mucosa, the nuclei are more strongly Feulgen reactive in the basal layers of the stratum malpighii than they are in the upper layers. The gradation is not pronounced but it is there. The only region where this does not seem to be the case is the median raphé. Here there appears to be very little difference in reactivity to Feulgen stain between the basal cells and those of the stratum spinosum.

The significance of these findings is uncertain. However a possible explanation is the presence of D.N.A. in the cell nuclei. The Feulgen reaction is specific for this enzyme. D.N.A. is necessary for cell multiplication. The fact that the more superficial cells stain less intensely is probably indicative of decreased amounts of D.N.A. and therefore of reduced cell multiplication.

CHAPTER 25.

GROUND SUBSTANCE

The intention in this section was to describe the variations in the abundance of the ground substance in the various regions of the palatal mucosa and to compare, if possible, its density in the lamina propria with that in the submucosa.

Orban (1962) has this to say about ground substance: "Connective tissue which is derived from the mesenchyme, consists of specialized cells, fibres and an amorphous ground substance...Specific cell types appear to be implicated in the production of intercellular fibres and ground substance components. Fibroblasts and osteoblasts for example, are associated with the formation of collagenous fibres and MUCOPOLYSACCHARIDES of the ground substance. The latter are hexosamine-containing polysaccharides. Ground substance also has proteins which contain carbohydrates, and these are referred to as GLYCOPROTEINS (mucoproteins). Mucopolysaccharides, the acid type of which is widely distributed in nature, are of primary significance in connective tissue and presumably act as binding and protective agents. The

acid mucopolysaccharides of the ground substance are polymers containing acetylated amino sugars and hexuronic acids. Among the best-known muco-polysaccharides are hyaluronic acid and chondroitin sulfuric acid. Hyaluronic acid forms viscous gels that are hydrolyzed by the enzyme hyaluronidase. Relatively little is known about the state of mucopolysaccharides in tissue from a biochemical standpoint."

Orban also explains the rationale of the P.A.S. stain for ground substance.

"The ground substance of the oral tissues, including bone, stains with a number of histo-chemical procedures. Among these are techniques for the demonstration of carbohydrate groupings, the best known of which is the periodic acid - Schiff (P.A.S.) technique. The chemical basis of this method lies in the fact that periodic acid oxidises glycols with vicinal hydroxyl groups to aldehydes, which in turn are revealed as a coloured dye by leuko-fuchsin. This colourless reagent thus results in formation of a red dye when reacted with aldehydes formed in the tissues.

The periodic acid - Schiff method is believed to demonstrate under specific conditions the carbohydrate moiety of a glycoprotein complex. ..... Salivary gland mucins (which contain glycoproteins) can also be stained by the use of the P.A.S. reaction."

P.A.S. positive material, i.e. ground substance, stains cherry red i.e. a bright purplish red. Ground substance which stains weakly with the P.A.S. technique probably contains glycoproteins that contain less than 4% hexosamine in contrast with mucoids which contain more than 4%.

The findings were as follows:

FATTY ZONE - GROUND SUBSTANCE

16C
16D The stratum corneum featured a lot of
16E weakly P.A.S. positive material; in some places the entire stratum looked to be stained light pink. The remainder of the epithelium was P.A.S. negative with the exception of the basal membrane whic was lightly positive. The lamina propria and submucosa bot : contained some weakly P.A.S. positive substance scattered sparsely amongst the collagen.

Fig. 21.

Glandular zone specimen demonstrating P.A.S. positive material in the stratum spinosum of the epithelium. (P.A.S. x400.)

GLANDULAR ZONE - GROUND SUBSTANCE

34D
34E
34H

The stratum corneum showed considerable evidence of P.A.S. positive material in the form of a pale pink staining material in more or less continuous layers parallel with and amongst the keratin layers. The stratum spinosum also contained P.A.S. positive material (Fig. 21). A noticeable though not dominating amount of weakly P.A.S. positive material was intermingled with the collagen bundles of both the lamina propria and submucosa. However, the striking feature was the strongly P.A.S. positive mucous of the salivary glands which was stained a brilliant crimson.

SOFT PALATE - GROUND SUBSTANCE

52D
52E
52H

P.A.S. positive material was not a feature of the epithelium either in the stratum corneum, a term which the author's results indicate is sometimes applicable to the soft palate, or in the lower layers. The basal membrane however was weakly P.A.S. positive. The lamina propria did not contain strongly P.A.S. positive material although everywhere amongst the collagen considerable weakly positive material was present. This feature continued

Fig. 22.

Soft palate specimen demonstrating mucus of the salivary glands brilliantly stained P.A.S. positive. (P.A.S. ×400.)

into the submucosa where, in addition, the mucus of the salivary glands could be seen brilliantly stained (Fig. 22).

GINGIVA ADJACENT FATTY ZONE - GROUND SUBSTANCE

70C
70D
70E

P.A.S. positive material was a dominating feature of these sections of gingiva adjacent fatty zone. The most superficial layer, the stratum corneum, indicated the presence of quite a lot of pink staining material amongst the keratin. The stratum spinosum featured a large amount of fairly strongly P.A.S. positive material in the cytoplasm of many of the cells in the superficial half or more of the stratum. At 400X magnification this material had a granular appearance. The basal membrane was P.A.S. positive. The collagen of the lamina propria and submucosa was almost completely masked by weakly P.A.S. positive material.

GINGIVA ADJACENT GLANDULAR ZONE - GROUND SUBSTANCE

38D
38F
38H

The epithelium was free of P.A.S. positive material except for some weakly positive substance in the stratum corneum and the basal membrane. The lamina propria - submucosa contained a considerable amount of P.A.S. positive material amongst the collagen. Some of it was stained fairly strongly, but not

Fig. 23.

Incisive papilla specimen demonstrating P.A.S. positive material in the epithelium, lamina propria and submucosa. (P.A.S. x 400.)

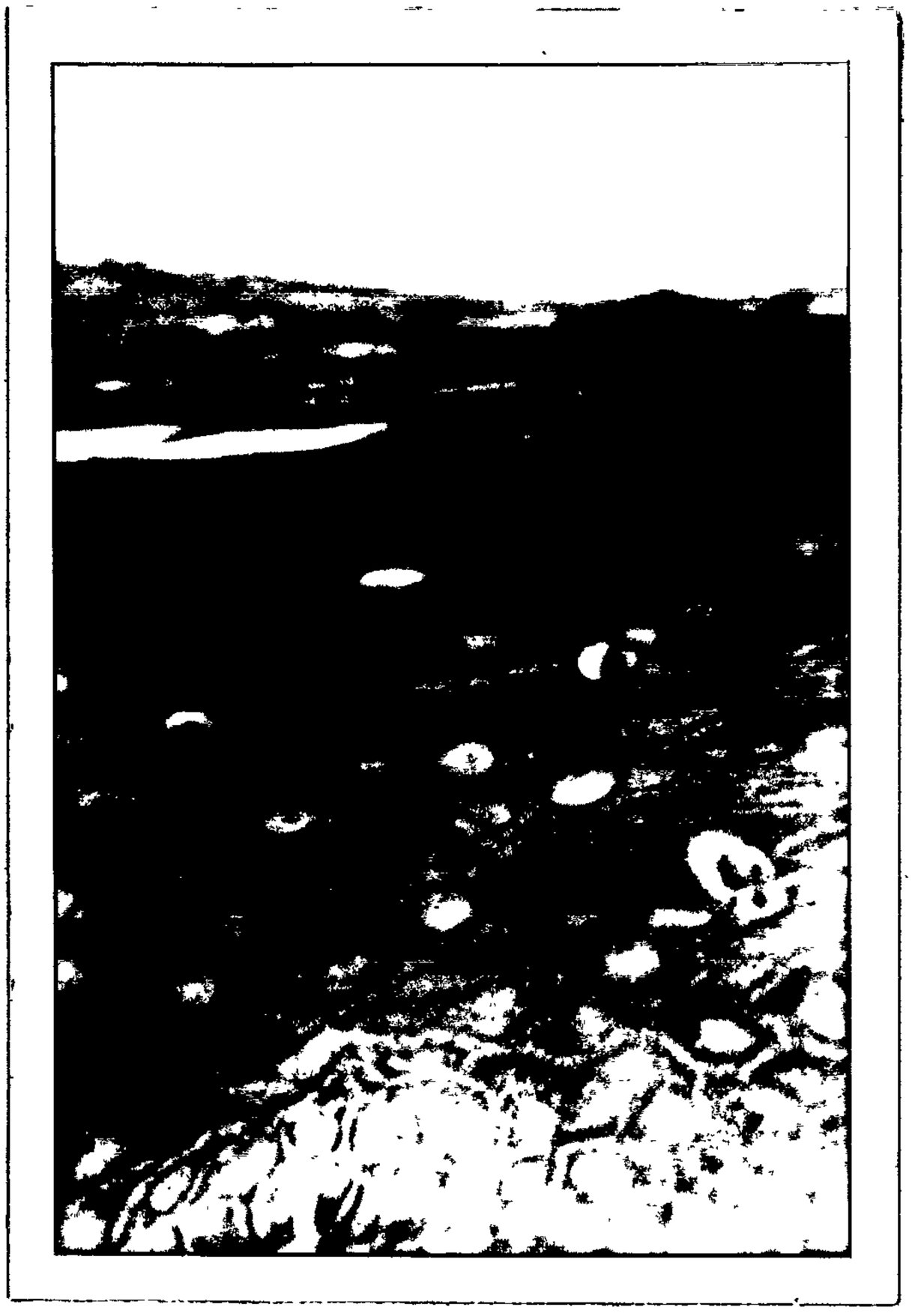

Fig. 24.

Median raphé specimen demonstrating P.A.S. positive material in the stratum corneum and stratum spinosum. (P.A.S. x 400.)

brilliantly. The P.A.S. positive material was equally as prominent as the collagen.

INCISIVE PAPILLA - GROUND SUBSTANCE

106D
106E
106H

The incisive papilla sections featured a considerable amount of moderately P.A.S. positive material (Fig. 23). The superficial half or more of the epithelial cell layers featured cells, the cytoplasm of which appeared faintly P.A.S. positive. The cells in the deeper layers had bottle green staining cytoplasm as usual. The basal membrane was lightly P.A.S positive. The lamina propria contained a great deal of mildly positive material while the submucosa was positively dominated by it. The pink stained material seemed abundantly interspersed amongst the collagen.

MEDIAN RAPHÉ - GROUND SUBSTANCE

124D
124E
124H

The first striking feature of these median raphé sections was the presence of P.A.S. positive substance in the stratum corneum (Fig. 24). This presented as bright pink stained material, in some places granular, in layers between the keratin layers. Striking also was the presence of P.A.S. positive material, some strongly so, in the cytoplasm of quite

a few of the epithelial cells in the superficial half or more of the stratum spinosum. This feature seemed more prominent at the anterior end of the raphé than at the posterior end. However throughout the raphé the majority of the cells in the zone described had a cytoplasm which was weakly P.A.S. positive. The basal membrane of the epithelium was weakly positive.

While the lamina propria was relatively free of P.A.S. positive material the submucosa was abundant in light pink stained material interspersed amongst the collagen.

CONCLUSIONS

The palatal zones are now presented in decreasing order of density of ground substance. The densities in the epithelium, lamina propria and submucosa of each zone are compared.

1. SOFT PALATE

   Epithelium - negligible

   Lamina propria - moderate

   Submucosa - heavy

1. GINGIVA ADJACENT FATTY ZONE

   Epithelium - moderate

   Lamina propria - moderate

   Submucosa - moderate

2. GINGIVA ADJACENT GLANDULAR ZONE

   Epithelium - negligible

   Lamina propria - moderate

   Submucosa - moderate

3. GLANDULAR ZONE

Epithelium - slight

Lamina propria - negligible

Submucosa - heavy

4. MEDIAN RAPHE

Epithelium - slight

Lamina propria - slight

Submucosa - moderate

5. INCISIVE PAPILLA

Epithelium - negligible

Lamina propria - moderate

Submucosa - moderate

6. FATTY ZONE

Epithelium - negligible

Lamina propria - slight

Submucosa - slight

CHAPTER 26.

MAST CELLS

"Any connective tissue cell containing cytoplasmic granules that stain metachromatically with toluidine blue is a mast cell." (Metachromasia is a staining reaction exhibited by various tissue components towards certain basic dyes, whereby they are stained a different colour from that of the dye employed). "Thus, many cells indistinguishable from a fibroblast in size and shape but containing from few to many metachromatic granules could be considered mast cells. 'Typical' mast cells, however, are large and rounded, with one, rarely two, small nuclei, and a cytoplasm filled with coarse basophil granules that stain metachromatically with toluidine blue, azure B, thyronine, etc.

Mitochondria, usually difficult to demonstrate because the highly refractile granules tend to obscure them, can nonetheless be shown; the granules stain green, and the mitochondria red. Thse are more numerous in the fibroblast-like mast cells which contain only a few granules, and they resemble those of ordinary fibroblasts. This suggests that (a) mast cells are

transformed from fibroblasts, and that (b) mast granules may bear an inverse relation to mitochondria.

An impressive amount of information indicates that mast cells are the source of heparin, or at least an anticoagulant substance similar to heparin. In the skin of haemophiliacs, mast cells seem to be more numerous than in the skin of normal subjects, and the dermis shows greater amounts of metachromatic staining. Mast cells seem to contain different types of heparin. The cells with strongly metachromatic and P.A.S. reactive granules are believed to contain the highly esterified form of anticoagulant, and those with weakly staining granules, the less developed variety, heparin monosulfate.. It is assumed that the first type mentioned is the more mature of the two.

Since mast cells increase in number in several itching skin diseases it was suggested that they contain and release histamine. Experimental evidence supports the belief that mast cells are as rich in histamine as they are in anticoagulant substances" (Montagna, 1962).

The question comes to mind: "What is the distribution of mast cells in palatal mucosa?" Sections were stained with toluidine blue and examined. All mast cells, mature and immature were expected to stain with

Fig. 25.

Bandicoot snout epithelium specimen demonstrating mast cells.
(Toluidine Blue x400.)

the technique employed. They are seen to have a blue or purple nucleus and red cytoplasm (Fig. 25 - bandicoot c ntrol). Mature mast cells show blue to reddish purple granules in the cytoplasm. Variations, which were counted as mast cells, may show the nucleus obscured by granules or or no granules but a nucleus present. Variation in the staining materials can cause the cytoplasm to stain pale purple while the nucleus stains bottle green. The shape of the mast cells varies considerably from compact cells, to elongated "comet-shaped" cells.

The mast cells in ten 400X fields in the lamina propria were counted and averaged and likewise in the submucosa.

The results were as follows.

FATTY ZONE - MAST CELLS

	Larina Propria	Submucosa
17A	Total = 4	Total = 9
	Average = 0.4	Average = 0.9
17D	Total = 6	Total = 10
	Average = 0.6	Average = 1
17E	Total = 1	Total = 7
	Average = 0.1	Average = 0.7

GLANDULAR ZONE - MAST CELLS

Mast cell counts for the glandular zone were as follows:

	Lamina Propria	Submucosa
35B	Total = 11	Total = 31
	Average = 1.1	Average = 3.1
35D	Total = 13	Total = 25
	Average = 1.3	Average = 2.5
35E	Total = 7	Total = 30
	Average = 0.7	Average = 3

SOFT PALATE - MAST CELLS

The counts of mast cells for the soft palate were as follows:

	Lamina Propria	Submucosa
53B	Total = 22	Total = 68
	Average = 2.2	Average = 6.8
53D	Total = 10	Total = 11
	Average = 1	Average = 1.1
53E	Total = 6	Total = 19
	Average = 0.6	Average = 1.9

GINGIVA ADJACENT FATTY ZONE - MAST CELLS

The submucosa in this region was, of course, not very distinctive; the count nevertheless was made in the connective tissue deep to the lamina propria for comparative purposes.

	Lamina Propria		Submucosa	
71B	Total	= 12	Total	= 21
	Average	= 1.2	Average	= 2.1
71D	Total	= 9	Total	= 9
	Average	= 0.9	Average	= 0.9
71E	Total	= 1	Total	= 10
	Average	= 0.1	Average	= 1

GINGIVA ADJACENT GLANDULAR ZONE - MAST CELLS

Counts of mast cells were as follows:

	Lamina Propria		Submucosa	
89B	Total	= 8	Total	= 27
	Average	= 0.8	Average	= 2.7
89D	Total	= 2	Total	= 18
	Average	= 0.2	Average	= 1.8
89E	Total	= 8	Total	= 12
	Average	= 0.8	Average	= 1.2

INCISIVE PAPILLA - MAST CELLS

Counts of the mast cells in the sections through

Fig. 26.

Median raphé specimen demonstrating mast cells.
(Tolvidine Blue x400.)

the incisive papilla were as follows:

		Lamina Propria		Submucosa
107B	Total	= 13	Total	= 19
	Average	= 1.3	Average	= 1.9
107D	Total	= 4	Total	= 10
	Average	= 0.4	Average	= 1

MEDIAN RAPHE - MAST CELLS

The following were the counts of mast cells obtained from the median raphe area. It is recognised that here, as in certain other areas, the submucosa is scarcely a distinct layer; however the count was made in the connective tissue deep to the lamina propria for comparative purposes.

		Lamina Propria		Submucosa
125B	Total	= 10	Total	= 10
	Average	= 1	Average	= 1
125D	Total	= 4	Total	= 12
	Average	= 0.4	Average	= 1.2

125E Counts for the lamina propria and submucosa were: (Fig. 26)

Total	= 18	Total	= 15
Average	= 1.8	Average	= 1.5

CONCLUSIONS

The zones of the palatal mucosa are now listed in decreasing order of mast cell population. In every zone there were more mast cells in the submucosa than in the lamina propria.

1. SOFT PALATE
2. GLANDULAR ZONE
3. GINGIVA ADJACENT GLANDULAR ZONE
4. MEDIAN RAPHE
5. INCISIVE PAPILLA
6. GINGIVA ADJACENT FATTY ZONE
7. FATTY ZONE

The explanation of the highest population of mast cells occurring in the soft palate may be concerned with one of the following:

a) The venous network of the soft palate described by Maher and Swindle (1962), (see Chapter 7). This network drains the blood from the entire palate. Perhaps the histamine and heparin-like products of the mast cells are required to prevent blood stasis and coagulation.

b) The prevalence of mucous glands in this region.

Fig. 27.

Glandular zone specimen demonstrating collagen fibres encircling a structure in the submucosa. (Van Gieson's x400.)

CHAPTER 27.

COLLAGEN FIBRES

The direction of orientation of the collagen fibres was studied. Use was made of van Gieson's stain which stains collagen fibres red and muscle fibres orange. To simplify description the following terms were used as follows:

Horizontal - parallel to the surface

Vertical - normal to the surface

Beneath - deep to

Oblique - neither horizontal nor vertical.

FATTY ZONE - COLLAGEN FIBRES

18C
18F
18G
The collagen fibres ran vertically between the rete pegs. No constant orientation could be seen in the remainder apart from those encircling the blood vessels.

GLANDULAR ZONE - COLLAGEN FIBRES

36F
36G
36H
In the lamina propria the direction of fibres was horizontal except between the rete pegs where it was vertical. In the submucosa the collagen fibres conformed with the other structures present (Fig. 27). Although the direction was still basically horizontal fibres encircled the glands, blood vessels and nerves.

SOFT PALATE - COLLAGEN FIBRES

54F
54G The collagen fibres ran towards the surface
54H of the epithelium in the interpapillary spaces. Otherwise they were predominantly horizontal in both lamina propria and submucosa. This gave way to a circular arrangement around glands, nerves and blood vessels. A number of vertically arranged groups were seen which divided the submucosa.

GINGIVA ADJACENT FATTY ZONE - COLLAGEN FIBRES

72C
72F Between the rete pegs the fibres ran vertically.
72G Otherwise the collagen fibres lacked an organised orientation in both lamina propria and submucosa. These layers could not be differentiated although the collagen fibres looked thicker in the deeper regions. Neurovascular structures were encircled by collagen fibres.

GINGIVA ADJACENT GLANDULAR ZONE - COLLAGEN FIBRES

90F
90G The collagen fibres between the rete pegs were
90H predominantly vertical. Otherwise the arrangement of the fibres in both lamina propria and submucosa was haphazard. These layers could not be distinguished. The deepest fibres displayed a horizontal orientation.

INCISIVE PAPILLA - COLLAGEN FIBRES

108F
108G
108H

Between the rete pegs the fibres had a vertical orientation. The deeper fibres had no dominant orientation and no definite distinction could be made between lamina propria and submucosa.

MEDIAN RAPHE - COLLAGEN FIBRES

126F
126G
126H

The collagen fibres of the papillae were vertically arranged. Those of the lamina propria were predominantly horizontal. In the deeper tissues the arrangement was less definite except for those collagen fibres encircling neurovascular structures.

CONCLUSIONS

In the specimens examined the predominant orientations of the collagen fibres are:

1. FATTY ZONE

   Papillae - vertical

   Lamina propria - disorderly

   Submucosa - no constant finding

2. GLANDULAR ZONE

   Papillae - vertical

   Lamina propria --horizontal

   Submucosa - horizontal

3. SOFT PALATE

Papillae - vertical

Lamina propria - horizontal

Submucosa - horizontal

4. GINGIVA ADJACENT FATTY ZONE

Papillae - vertical

Lamina propria - disorderly

Submucosa - disorderly

5. GINGIVA ADJACENT GLANDULAR ZONE

Papillae - vertical

Lamina propria - disorderly

Submucosa - horizontal

6. INCISIVE PAPILLA

Papillae - vertical

Lamina propria - disorderly

Submucosa - disorderly

7. MEDIAN RAPHE

Papillae - vertical

Lamina propria - horizontal

Submucosa - horizontal

The only constant arrangement then, is in the connective tissue papillae between the rete pegs. This

indicates that the tensile strength of the connective tissue is high in this region, since tensile strength is greatest when the fibres are orientated parallel to one another.

From the point of view of local anaesthetic injections it is logical to select the areas of the palate which have sufficient submucosal space to accommodate the required volume of solution. Thus the glandular zone is most suitable while the fatty zone can be injected if necessary. By contrast the gingival and median raphé zones are unsuitable injection sites because of the density of the collagen.

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