CONGENITAL AND ACQUIRED DISEASES OF THE TONGUE:

A GROSS, HISTOLOGICAL AND CLINICAL STUDY

by

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The tongue is an extremely complex organ supported, moved and molded by very active skeletal muscles. This muscular body, or corpus linguae, plays a major role in mastication, swallowing and phonation. It also serves as a support for special structures such as mucous and serous salivary glands, taste buds, tactile organs and lymphoid tissue.

In dentistry, the tongue has been a sadly neglected structure often serving as a sourse of exasperation, but in recent years has become of increasing clinical and scientific interest to the profession. Physicians once utilized the tongue as an important indicator of systemic health and metabolic activity but now with the advent of "definitive" laboratory diagnostic methods, only the more bizarre or discrete changes in the tongue tissue are considered of clinical importance. Henning (1879) expressed the feeling of the earlier time by dogmatically stating that the appearance of the tongue serves as a fairly positive diagnostic method for conditions of the digestive organs, nervous system, the blood, and the function of nutrition and assimilation. Specific changes such as a yellow coated tongue, once thought to be an indication of liver disease, is, in most cases, of little practical value when compared to the liver function tests of today. It is of utmost importance that the valid and significant anatomical and pathological features be compiled, analyzed, and utilized clinically by the medical and dental professions. Equally important, is the elimination of many

misconceptions based upon inadequate and incomplete clinical observation and lack of histological material. In this study, an attempt has been made to re-evaluate anatomical and pathological features of the tongue and suggest new approaches in differential diagnosis and treatment.

In this study, two sources of material have been utilized. The major source consisted of a series of 306 tongues, which were removed at autopsy, ranging in age from 7 months in-utero to 89 years. No attempt was made to alter the sampling as to age, sex, or cause of death.

Table I

Age, Age Range and Sex Distribution of Tongues Examined

Type of Examination	Age Average	Range	Sex Male	No. of Tongues
Detailed Study	50.5	Premature-86	62%	87
Partial Study	59.2	Premature-91	70%	68
For Lesions Only	52.0	Premature-95	NA*	151
Total	53.8	Premature-95	66%*	306

* Sex not ascertained

Because of the paucity of significant studies since 1930 when the greatest strides were made in elucidating the tongue's anatomy and histology, a compilation of certain anatomical features and structures was made. These included features such as length of the body and the root compared with the width, the number of circumvallate and foliate papillae, the form of the circumvallate distribution, the

depth of the foramen cecum, the number of primary papilli in the median rhomboid area, the number and form of the lymphoid follicles, distribution and form of the unspecialized papilli, type and distribution of the salivary glands, and the general shape and color. This phase of the study serves as a basis for understanding the observations and clinical evaluations of such pathological conditions as fissuring, lingual tonsillitis, median rhomboid glossitis, coating and hair formation, hyperplasias, ulcerations, neoplasms and infectious processes. The second source of material consisted of routine clinical and pathological material observed in the Oral Pathology Department over a four year period. This material was readily integrated with and supplemented that of the gross tongues.

For anatomical and pathological considerations, the tongue must be divided into two portions, the body and the root. The body is derived from the oral or ectodermal portions of the primitive stomadeum and the root from the entodermal or pharyngeal portions of the branchial arches. These two portions of the tongue are distinctly different in pathological conditions as well as in function, despite the fact that both portions are supported by relatively the same type of muscle. As will be seen in the illustrations and tables, the two parts react to pathological stimuli in diverse ways and only rarely do they react in a similar manner.

Embryology

The tongue develops from the floor of the primitive oral cavity from tissues anterior to the buccal-pharyngeal membrane, and from portions of the second and third branchial arches which lie posterior

to the membrane. That part of the tongue derived from the mandibular arch lying in front of the buccal-pharyngeal membrane will be referred to as the body and that part derived posterior to the membrane and derived from the second and third arch are referred to as the root. The sulcus terminalis in the fully formed tongue is the boundary between the embryologically and histologically different parts. The muscle of the tongue corresponding to its innervation by the hypoglossal nerve is thought to be derived from the occipital myotomes and presumably grows into the foundation provided by the proliferations and fusions of the first, second and third arches.

The processes which fuse to form the tongue first begin to proliferate at about the 5 mm. stage. This usually is just at the period of rupture of the buccal-pharyngeal membrane. (Figure 1.) The mandibular arch produces ventro-medial elevations which arise on each side of the tubercle which lies in the midline between the mandibular and hyoid arches. This tubercle, or tuberculum impar, merges with the ventro-medial or lingual swellings and these merge with each other. His (Schumacher, 1927) and others felt that the tuberculum impar was the primary and only proliferation and it contributed the bulk of the body of the tongue. This theory is no longer held by most embryologists. Since the tuberculum impar lies behind the buccal-pharyngeal membrane, it is probably of endodermal origin.

At the 7 to 10 mm. stage, the tuberculum impar and ventro-medial swellings have fused together and begin to fuse with the root portion of the tongue which is derived from ventro-medial swellings of the second arch. The hypobranchial eminence or copula,

lying between the hyoid and aortic arches, forms the major portion of the epiglottis. The tuberculum impar is a transient elevation and probably does not contribute to any significant portion of the adult organ, except in anomalous conditions as will be seen later in discussing median rhomboid glossitis. (Figures 1, 40, 57, 59). This position can be identified, however, in later stages of development owing to the endodermal downgrowth by the thyroid anlage which is later marked by the foramen cecum, immediately behind the tubercle. Since the mandibular arch forms the anterior or body of the tongue, the epithelial nerve supply is mainly from the first arch nerve. The root of the tongue is involved in a more complicated series of events which takes place at approximately the 10 mm. stage up to approximately 20 mm. A subepithelial overgrowth of the third, or aortic arch together with its nerve supply moves over the second arch mesoderm which is consequently separated from the surface of the adult tongue. Hamilton, et al,(1952). The third arch mesoderm fuses with the first arch mesoderm thus obliterating the ventral portions of the first and second pharyngeal endodermal grooves. The epithelial nerve supply on this part of the tongue is the glossopharyngeal or third arch nerve. The extreme posterior part of the tongue which lies immediately in front of the copula or hypobranchial eminence receives its epithelial supply from the fourth (carotid) or superior laryngeal branch of the vagus. The sulcus terminalis, as the junction between the two portions of the tongue, is not an absolute boundary since glosso-pharyngeal fibers cross it to supply taste buds which develop in the region medially anterior to the sulcus. Schumacher (1927) felt that the tuberculum impar, being of

endodermal origin, contributed the area of the vallate papilli and the medial part of the dorsum of the tongue, which lies in front of them, and the taste buds in these papilli. Hamilton, et al, (1952), however, feel that the tuberculum impar essentially disappears in the normal tongue and that the circumvallate papilli simply receives fibers of the glosso-pharyngeal nerve which cross over this boundary between the root and the body. In view of the marked differences between the root and the body of the tongue as delineated by the sulcus terminalis, the inference of the present study is that the entire body arises from ectodermally derived and supported tissue growth.

It is possible that the musculature of the tongue arises in situ, but this view is not held by most embryologists who feel that the morphology of the hypoglossal nerve along with studies of comparative embryology point to the derivation of lingual musculature as being derived from a ventral migration of three or more occipital myotomes. At about 22 to 25 mm., musculature migration progresses and the primordia from the branchial arches have fused.

The foramen cecum at this point is extremely deep due to the downward and posterior migration of the thyro-glossal duct which leads down to and through the primordial hyoid bone to its position where it will develop over the thyroid cartilage. The foramen cecum is extremely variable as will be seen in the discussion of abnormalities of this structure.

At about 25 mm., the lingual epithelium of the dorsum of the body is a single layer of cuboidal cells which rapidly proliferates into a three cell thickness. Papilli begin to make their appearance

with the vallate and foliate preceding the fungiform, filiforms and conicals. The former two, found in close relationship with the terminal branches of the glosso-pharyngeal nerve, may possibly be stimulated by these nerve fibers into development. Hamilton, et al, (1952). The fungiform papilli appear later and are under the influence of the facial nerve. Taste buds begin to develop at about the 27 mm. stage and increase rapidly in number up to birth. Jordan and Kindred (1937). The filiform papilli arise in embryos of about 45 mm. and apparently are unassociated with nerves. The development, histology and innervation of the papilli will be discussed seperately.

The glands of the tongue appear relatively late, at about the 90 mm. stage. The first glands are mainly mucous glands of the base of the tongue. In the 120 mm. fetus, the serous glands (Von Ebner), in the region of the vallum of the circumvallates, begin to proliferate. Generally speaking, those glands which develop in the anterior part of the tongue develop much faster than those in the posterior part. Schumacher (1927). According to Cutore (1925), only in the last fetal month, may the various serous, mucous and mixed ducts be identified with accuracy.

The Corpus Lingua

Most investigators feel that the submucosa of the tongue is missing and, therefore, the mucosa is relatively immovable on the muscle or corpus lingua. Schumacher (1927). The tough and firm lamina propria (Figures 3 and 76) of the mucosa is directly connected with the perimycium. The lamina propria is particularly well

developed at the tip and on the dorsum. The thickness appears to be greatest in the area just beneath and anterior to the median rhomboid depression. (Figure 74). The lamina propria has been called fascia linguae but Schumacher (1927) points out that this is a poor term as it cannot be shown separately as a membrane.

In addition to the muscle fibers which radiate into the fascia linguae, there are occasionally some smooth muscle fibers according to Schaffer (1897). The bulk of the musculature, however, is composed of skeletal muscle and is divided into two types. The intrinsic muscles have their origin and insertion within the tongue entirely. The extrinsic muscles have their origin on bone and insertion into the intrinsic muscles and connective tissue. The intrinsic muscles cannot be distinguished with any accuracy as specific groups. They apparently are composed of bundles which intermingle in three different directions. Three types of bundles are thus identified,longitudinal, vertical and transverse. Vertical muscles reach deeply into the mucosa and occasionally reach into the base of the papilli and primary ridges. (Figure 25). Schumacher (1927). The vertical and transverse bundles dominate the bulk of the tongue with only a limited number running longitudinally.

The extrinsic muscles of the tongue are the genioglossus, the hyoglossus and the styloglossus. The glossopalatinus is sometimes described as a muscle of the tongue but usually as one of the soft palate. The genioglossus arises from the genial spine on the posterior surface of the mandible and forms a fan-like sheet reaching to the tip of the tongue and as far back as the hyoid bone. This

muscle is primarily responsible for propelling the tongue forward and preventing it from being displaced into the pharynx. The hyoglossus muscle arises from the lateral part of the body of the hyoid bone and from its greater cornu. Its fibers pass upward and slightly forward and lateral to the genioglossus to interlace with the styloglossus and the intrinsic muscles of the tongue. The hyoglossus flattens the dorsum of the tongue and is generally a retracter. The styloglossus muscle arises from the lower end of the styloid process, running deep to the internal pterygoid muscle and to the lingual nerve where many of the fibers continue superficially as a longitudinal bundle or others interdigitate with the hyoglossus and pass more deeply into the tongue. The glossopalatinus runs upward from the posterior lateral side of the dorsum of the tongue to reach the soft palate and functions more as a pharyngeal muscle than as a lingual muscle. The intrinsic muscles primarily produce changes in the shape of the tongue such as cupping and flattening. Whillis (1946). The extrinsic muscles function primarily to assist in pulling the tongue forward, backward, upward or downward and also modify the action of the suprahyoid group of muscles, particularly in swallowing.

Both intrinsic and extrinsic muscles are supplied by branches of the hypoglossal nerve. Along with the hypoglossal nerve are sensory fibers which are derived from the first and second cervical nerves and are probably proprioceptive. Hollinshead (1954). Numerous authors have reported different conclusions as to the proprioceptive fibers. Olmstead (1922) and Barron (1936) felt that these fibers were contained in the lingual nerve rather than the

hypoglossal while Langworthy (1924) found that bilateral section of both the lingual and ninth nerves cause no apparent ataxia of the tongue. Weddell, et al, (1940) found that in man anesthetization of the lingual nerves gives no ataxia or tendency to bite the tongue.

The afferent nerve supply to the mucous membrane of the tongue is mainly by the lingual and glossopharyngeal nerves although the vagus sends twigs through the superior laryngeal nerve, to the epiglottis, and, to a small area on the posterior basal aspect of the tongue. The lingual nerve supplies approximately the anterior two-thirds of the tongue,while the glossopharyngeal is distributed to the posterior one-third, including the circumvallate papilli. Taste fibers in the glossopharyngeal and lingual nerves pursue courses which are still a subject of considerable dispute. Contradictory results of many experiments in man make taste innervation an extremely controversial matter.

The individual muscles of the tongue according to Von Ebner (1902) are 20 to 51 microns in thickness which is rather thin for such a highly motile organ. Generally, the fibers of the muscles have a good deal of sarcoplasm. The ends of the muscle fibers which extend into the fascia do not have uniform appearance. They are sometimes divided and at other times dendritic. Occasionally, they will look pointed or even be thickened like a bulb. The end of the muscle continues into the bundle of connective tissue which is soon lost in the mass of soft tissue of the fascia lingua. Sobotta (1924) was able to demonstrate a direct transition from the myofibrils into the connective tissue fibrils. There apparently is a direct connection between the connective tissue layers of the sarcolemma

and the connective tissue of the tendon.

Between the muscle fiber bundles there are frequently groups of fat cells. This is particularly true between the fibers of the genioglossus near the septum and in the root of the tongue. In this study, fat was most prominent in areas under the cerebriform type of fissuring.

The septum lingua is derived from or directly connected to the lyssa, which has considerable variation in its development in the different mammals. Nussbaum and Markoski (1897) have clarified the function and the derivation of the lyssa in mammals in the following manner: 1 - They are supportive organs which are only locally differentiated parts of the mucosa of the dorsum of the tongue as in the dorsal cartilage of the tongue of the horse; 2 - They are supporting organs which are differentiated portions of the septum lingua; for instance, the upper second cord of the mole; 3 - They are supporting organs of remnants of the cartilaginous rod of the tongue and the muscles which belong to the reptiles were derived from this structure. Nussbaum and Markoski also reported that the septum lingua was derived from connective tissue enveloping the lyssa and phylogenetically it differentiated from the transversus muscle. In mammals which do not have a transverse muscle of the tongue, the septum lingua is missing. In human fetuses and in some newborns, there is a capsule near the septum which consists of tough connective tissue and occasionally cartilaginous nodules are found in the septum itself, particularly in the posterior. Occasionally, cartilaginous enclosures are reported from the midline of adult tongues. None were found in this study.

The Regions of the Tongue

The entire surface of the tongue is covered with a stratified squamous epithelium. The undersurface of the tongue which directly extends into the floor of the mouth and the posterior or root of the tongue is covered by an epithelium which is normally devoid of any surface projections. The epithelium of the dorsum of the tongue, however, is pushed into distinct ridges and projections by macroscopic connective tissue papilli. Within each macroscopic papilla, there are numerous microscopic papilli within the epithelium itself.

The dorsal surface of the tongue can be divided into four general regions based upon the characteristics of the macroscopic and microscopic connective tissue papilli, the resultant proliferations of the epithelium from them, and the underlying structures. 1 - Is the dorsum proper including the tip, the sides, and extending back to the foliate papilli and circumvallate line. 2 - The median rhomboid area which usually measures 2 cm. in front of the foramen cecum and is approximately 1.5 cm. in width. 3 - The region of taste which includes the foliate papilli and the fungiform papilli and the sulcus terminalis. 4 - The root or posterior part of the tongue is characterized by lymphoid tissue in close association with a profuse distribution of mucous glands. The characteristics of these four areas will be discussed under the individual papilli.

Each of these four areas contains glands which are distinctly characteristic. On the dorsum of the tongue, on the undersurface near the tip, is the anterior lingual gland first described by Blandin (1823) and later by Nuhn (1845). It consists of a group of individual glands which empty into the region of the median sulcus from

about 9 to 14 orifices. The glandular tissue belongs to the mixed type of salivary gland containing both serous and mucous elements. At the base or root of the tongue, macroscopic papilli are missing. Beneath this fairly smooth epithelium are numerous glands which are purely mucous. They lie in the deeper layers of the mucosa and go very deep into the intermuscular connective tissue of the body of the tongue. (Figure 79). Lymphoid follicles appear in a definite structural arrangement around invaginations or pores which also serve as the orifices of the mucous glands. Some mucous glands, however, have ducts which empty directly onto the surface. The lymphoid tissue, which proliferates with age, often becoming extremely hyperplastic as seen in Figures 65, 66, 67 and 68, the nodules give the root a bumpy appearance. There is a definite linear converging of the lymphoid tissue and its crypts from a lateral position near the circumvallate papilli through a median position near the epiglottis. Aagaard (1913) noted 6 to 8 of these longitudinal folds on each side of the tongue in newborns, whereas in this study, there appeared to be a greater number of these folds, in most cases between 12 and 14. In older individuals as the lymphoid tissue increases in size it very often becomes extremely hyperplastic, as will be seen later. These folds are lost and the tissue becomes extremely irregular. The region of taste divides the dorsum and median rhomboid area from the root of the tongue. The median part of the region is characterized by the circumvallate papilli which are formed in a "V". Extending out from these vallate papilli at the margin of the tongue are a group of almost vertical folds, the foliate papilli. Beneath the foliate and circumvallate papilli are

the serous salivary glands of Von Ebner. These glands reach extremely deep into the body of the tongue in the connective tissue between the muscle bundles. (Figures 73 and 79).

Immediately behind the most distal projection of the circumvallate line is the foramen cecum. (Figures 5, 9, 13 and 16). Occasionally, a vallate papilla reaches into this foramen or will be on a mound above the foramen. Schumacher (1927) found that the foramen cecum varied in length between 5 and 10 mm. That portion which was within the body of the tongue has been called a ductus lingualis and is generally considered to be remains of the thyroglossal duct. Gegzow (1893) could find this ductal remnant in only half of his cases. Kanthack (1891) found it only infrequently and in most animals it was missing. In the present study, considerable emphasis was placed upon the thyroglossal duct and an attempt was made to find ectopic thyroid gland. This will be discussed in a later section.

In the literature, there is very little mention of the variations in the shape and size of the tongue of man. In Table II variations in the shape of 67 tongues are given. Arbitrary descriptions of pointed, tapering, round and ovoid were made. The pointed and tapering tongues are generally long and are characterized by the amount of convergence in the anterior one-third. The round and ovoid tongues are shorter with the round tongue appearing characteristically squat and generally flaccid. The ovoid tongue, which is the most common type, is generally square in the root and posterior portion with a rounding of the anterior one-third.

Table II

Variations in Shape of 67* Tongues Studied in Detail

	Pointed	Tapering	Round	Ovoid
Adult Males	2	6	3	17
Adult Females		5	4	12
Male Children Under 10		3	2	7
Female Children Under 10			1	2
Total	2	13	10	38

* Some cases were eliminated because of post-mortem distortion.

The dimensions of tongues have not appeared in literature with any great frequency. Most figures are based upon clinical measurements and were admittedly inaccurate. Table III and Graph I give the measurements of the width, body length and the root length and the relative increase in size with age.

Table III

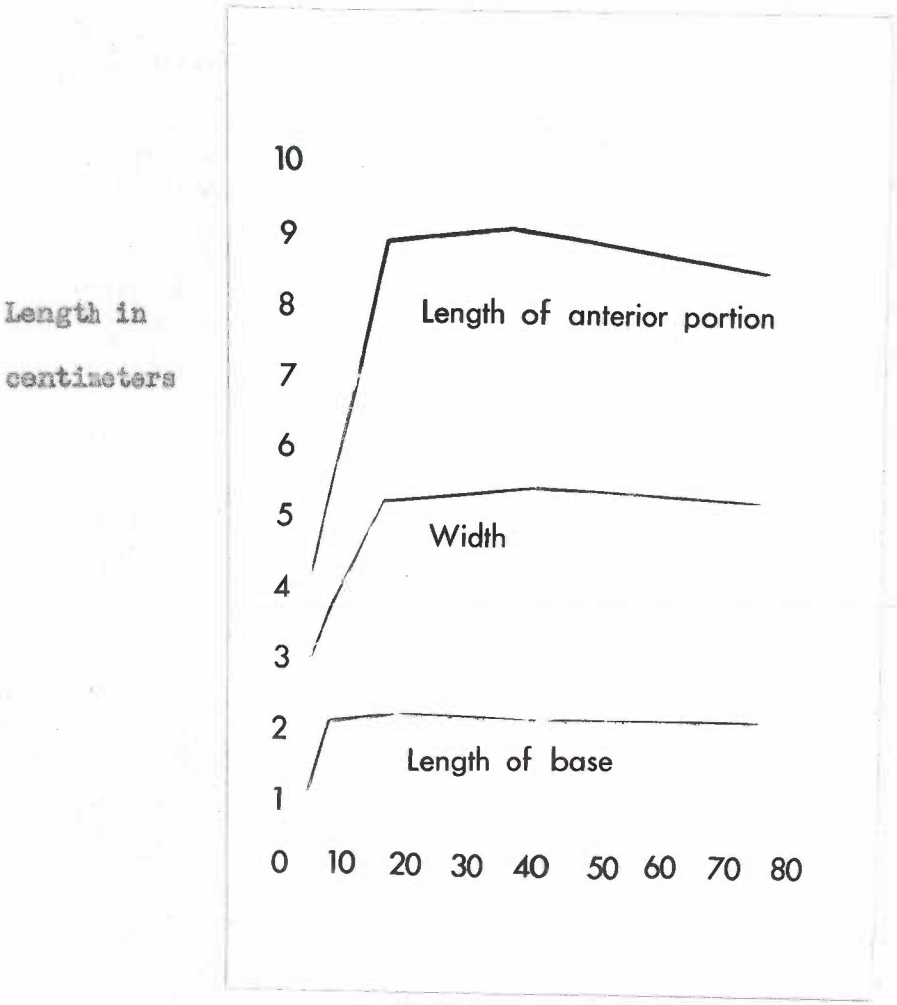
Dimensions of 87 Tongues

	Width	Body Length	Root Length
Average Dimensions	446	7.24	1.91
Range	1.90-6.7 cm.	2.8-12.0 cm.	.7-3.0 cm.

Average age is 50.5. Range: Premature - 86.

Graph I

The Dimensions of the Tongue as Compared with Age



The relative growth as seen in Graph I of the three dimensions is remarkably parallel. The oft repeated observation of a thickening and widening of the tongue with age is not born out in this study. However, the slightly greater decrease in length of the body with age may account for this relative or clinical "spreading out" so often observed particularly in edentulous patients. It is, of course, appreciated that the specimens have been removed in varying stages of fixation after autopsy and then were firmly and completely fixed in 10% formalin. This could possibly have led to some discrepancy and distortion. In Table IV, the average dimensions and ranges within five age groups are given. Because of the lack of specimens in the 2 - 10 year age group, no definite conclusions can be reached as to a correlation of the growth and development of the tongue and the mandibular and maxillary dental arches. The growth of the tongue apparently is probably slightly in advance of the maximum growth of the two jaws. Clinically, this has been studied by orthodontists for some time and presents a considerable problem, particularly in the mixed dentition age (6 - 12 years) with spreading of the teeth and resultant malocclusion.

Table IV

Dimensions of 87 Tongues Broken Down as to Various Age Groups

A - Width

Age Range	0-2	3-10	11-30	31-50	51 -
Average Age	1/3	4 1/2	16 1/2	38.7	72.8
Average Dimensions	2.84	3.68	5.15	5.36	5.27
Range	1.9-3.8	3.65-4.1	4.2-5.5	4.6-6.0	4.5-6.7

B - Body Length

Age Range	0-2	3-10	11-30	31-50	51 -
Average Age	1/3	4 1/2	16 1/2	38.7	72.8
Average Dimensions	4.24	5.4	8.83	9.05	8.68
Range	2.8-5.2	NA-5.4	7.4-9.8	6.9-12.0	6.6-11.0

C - Root Length

Age Range	0-2	3-10	11-30	31-50	51 -
Average	1/3	4 1/2	16 1/2	38.7	72.8
Average Dimensions	1.15	2.1	2.15	2.09	2.07
Range	0.7-1.9	2.1-NA	1.7-2.8	1.6-2.5	1.3-3.0

The Papilli of the Tongue

The macroscopic papilli of the tongue constitute the elevated projections of various shapes which are formed by upward projections of the lamina propria and not the epithelium alone. Each papilla, therefore, has a distinguishing connective tissue portion and epithelial portion. The connective tissue in all cases consists of the basic or primary projection and, in addition, sends microscopic papilli or secondary papilli into the epithelium. These secondary papilli nourish and support the epithelium and the downward rete peg projections. According to Krause (1908), the papilli of the tongue may be divided into papilli of taste and papilli of touch. Oppel (1900) divided the papilli of animals into those of taste and mechanical function. The latter or primary filiform papilli have in some animals, such as the cat, reached a high degree of specialization in aiding the mastication of food.

Filiform Papilli

The filiform papilli - "shaped like a thread" are characterized by a base which is broader than their tip. They are the most numerous of all papilli. (Figures 7, 8 and 51). In man, they are densely distributed over the dorsal surface of the tongue, particularly near the midline where they are particularly thick. They give the tongue a velvet-like appearance. According to Von Ebner (1902) they are densest in the median rhomboid area. Figure 43 shows the tongue of a child in which the normal growth of the filiform papilli give a velvet appearance and this velvet appearance is distorted or disturbed by the protruding fungiform papilli. Towards the margins and the tip of the tongue, the filiforms become shorter

and less numerous. Neuffer (1925) found filiform papilli on the undersurface of the tongue. In the present study, no such papilli were observed. On the dorsum of the tongue, the filiform papilli may be demonstrated in a linear pattern called the papillary rows or primary rows. On the back of the tongue they go laterally and forward. Towards the tip of the tongue, they usually angle until they are nearly parallel with the median fissure. The papillary ridges are divided by a sulcus which is usually less than .5 mm. in depth. (Figures7 and 9). Each filiform papilla has an epithelial part and connective tissue part. In gross outline, the epithelial papilla corresponds to the connective tissue papilla. This connective tissue papilla is the primary papilla and from this go out the secondary or microscopic papilli as previously noted. (Figures 51 and 87). Primary papilla protrude from place to place from the primary or papillary rows. The secondary or microscopic papilli are arranged in a circle around the primary papilla. As observed by Schumacher (1927), this papillary circle is usually open towards the front. Figure 19 shows an infant's tongue with the primary papilla and the beginning of secondary projections. These projections, at this stage, can be seen only with a dissecting microscope. These secondary papilli range between 5 and 30 on each primary papilla. Neuffer (1925). The secondary papilli actually give the tongue its fur-like appearance. The primary papilla without the secondary projections is a relatively smooth tapering projection. As seen in Figures 51 and 87, the secondary projections of epithelium are supported by the secondary projections of the connective tissue. This epithelium exhibits a slight spongiosis

and a parakeratosis. These cells, which have been altered by the fluids and condensation, desquamate very easily. They are generally worn away at a rapid rate. In digestive and other disturbances, this rate of spongiosis and parakeratosis may be increased and this material may not be worn away rapidly enough and a furred or coated tongue results. (Figures 43, 44 and 49). Clinically, a tongue which has been inactive in a patient with febrile disease or digestive disturbance characteristically shows this piling up of the secondary projections along with the trapping of mucous, food, and bacterial products.

Von Ebner (1902) classifies the papilli into three groups, those which are 3 to 4.5 mm. in length and have numerous protrusions or extensions (lingua villosa). Second, those where very small or no secondary protrusions may be seen on the primary papilla. Third, the entire papilla does not constitute a particular protrusion, but is buried into the common epithelial covering as seen in old people with atrophy.

Table V is a compilation of 44 adult tongues and 16 infant tongues. Measurements were made 1 cm. anterior to the foramen cecum and the number of filiforms per centimeter and the height of the filiform papilli was determined. This area is in the center of the median rhomboid area where the filiforms are most profuse and even in the most atrophid tongues some papilli could be found in this area. It is interesting to note that in infants, the primary papilli are more than twice as frequent as in the adult tongues. Although it was difficult to measure the diameter of the primary papilli, it was felt that those of infants were at least one-third the size of

the adult papilli. The height of the filiform papilli vary considerably in the adults and was impossible to determine in the infants.

Table V

Number and Height of Filiform and Conical Papilli

Per Centimeter in Midline of 44 Adult Tongues and 16 Infant Tongues

	Number of Filiform	Height of Filiform	Number of Conicals
Adults			
Average	17.5/cm.	.73 mm.	1.43/cm.
Range	5 - 7	.1 - 1.5 mm.	0 - 11
Infants			
Average	39.51 cm.	not valid	15/ cm.
Range	24 - 90	not valid	0 - 5

The measurement was begun 1 cm. anterior to the foramen cecum in the midline and was along 1 cm. in front of this point and included all papilli within 1 mm. of the plane of section.

Conical Papilli

This papilla is extremely controversial and the term has been used to describe two different types of papilli. Some feel that the conical is a specialized form of the fungiform. Most authors are of the opinion, however, that the conical is actually a hyperplastic and elongated primary filiform papilla. The preponderance

of conical papilli in the median rhomboid area and in other areas where filiforms are most commonly found make the latter designation of the conicals more valid. In this study, conical papilli were arbitrarily determined on the basis of their longer length than the filiform and their considerably larger diameter. In Table V, the conicals have been counted and are considerably larger and less profuse than the filiforms. In Figure 58 are many conical papilli showing extreme variation in size and length.

Fungiform Papilli

The fungiform papilli are characterized by having a base which is smaller than their free end. They are considerably more sparse than the filiform papilli and are located particularly upon the anterior half of the dorsum of the tongue. (Figures 9 and 10). They are usually scattered over the entire surface in children but are definitely concentrated at the tip. The papilli also protrude from papillary ridges. Muench (1896), Rudberg (1922) and Squires (1955), feel that the distribution of the fungiform papilli are so individually characteristic that their arrangement may serve to identify a person much like fingerprints. Because of their great variance with age and in topographical distribution, these papilli could not be studied with any degree of accuracy in this project. Of considerable interest, was the appearance in the newborn tongues of definitely elongated and pointed fungiform papilli on the tip. The possibility of these papilli having a function of nipple perception might be considered. Certainly, the taste buds which do appear in the fungiform papilli are most common in the newborn and regress as life progresses. Hoffman (1875), Stahr (1901). In

suckling, the infant propels the milk in such a way that little contact is made with the circumvallate and foliate papillae. It is interesting to speculate that the sense of taste in these elongated and profuse fungiform papilli on the tip of the infant tongue are specifically designed for the suckling period and regress after that time.

The fungiform papilli in a living human has a characteristic red appearance and is markedly different than the surrounding filiform papilli. This reddened appearance is due to a rather profuse capillary network which can be seen through the non-keratinizing epithelium. Occasionally fungiform papilli will have rather primitive small secondary projections which will partially obliterate these capillaries.

Lenticular Papilli

The lenticular papilli - Krause (1908) - are flattened papilli at the sides of the tongue and are probably flattened fungiform papilli. The term, lenticular papilli, has also been applied to atrophic projections behind the sulcus terminalis and the lymphoid tissue areas usually on the lateral margins. The term is a very obscure one and is used rather loosely by most authors.

Circumvallate Papilli

The walled papilli are the largest, most specialized, and most constant of the lingual papilli. They are distributed roughly in a "V" which is anterior to and parallel with the sulcus terminalis. (Figures 2, 5, 9 and 13). Considerable variation is present in their number and particularly in the vertex of the "V" where one or more papilli may be present.

Many arrangements of the vallates have been described ranging from a "Y" to a "T". The "T" arrangement is quite rare. Schumacher (1927). The "V" (Figure 13) and "Y" (Figure 16) are about equal in number.

The contention that the angle of the vertex has racial significance is discussed by Schumacher (1927). Angulations in Japanese were 115 degrees, in Hottentots 140 degrees and in Melanesians up to 150 degrees. No racial study was possible in this series.

The number of the papilli varies. Schumacher reported a range of 6 to 16, with 9 the average. In Table VI, the papilli ranged from 1 to 8 on one side. There was little difference between the two sides. The midline papilli had previously never been counted and in this series show a range of 0 - 4.

The diameters of the papilli vary from 1 - 3 mm. in diameter according to Schumacher (1927). In this study, a greater range was found. This is probably due to the inclusion of the infant tongues. The average was 2.2 mm. with a range of .2 - 3.3 mm.

Table VI

Location of Circum Vallate Papilli and Average Diameter in MM. of Each Papilla in 83 Tongues

	Right	Left	Midline	Average Diameter
Average	3.5	3.9	1.3	2.2 mm.
Range	1-7	1-8	0-4	.2-3.3 mm.

Average age is 50.5 years. Range is Premature to 89 years .

Table VII

Form of Individual Circum Vallate Papilli in 87 Tongues

	Keeled	Round	Ovoid
Number of Papilli	72	483	228
Percent of Total	9.2%	61.6%	29.2%
Tongues with all One Type	3	34	13

The shape of the papilli are less regular than in animals. The trench or vallum may be interrupted in places (Figures 11 and 15) and are given the term keeled. In Table VII, the three forms are compiled. The simple round type predominating. The ovoid type are seen in a crowded vallum and often appear twinned. Most of them are separate, however. (Figures 9 and 12).

The ducts of the serous glands of Von Ebner open normally into the depth of the vallum. (Figures 73 and 79). Adjacent mucous glands have never been reported emptying into the vallum. The chief function of the glands is felt to be entirely as a flushing agent and to provide a relatively wet environment for the taste buds. The number of ducts have never been accurately counted. An attempt to do so was done on 18 tongues. The duct openings averaged 6.9 per papilla. It was felt that because of considerable shape variation, accurate counting would have to be done with serial microscopic sections.

Smooth muscle fibers have been reported in the papilli and may contract the papilla to provide a pumping action.

Ganglion cells are usually found beneath the glands deep in the muscle. It is felt that they control secretion but may have some influence on muscular activity.

The papilli are amazingly free of pathology. Few abscesses have been reported. No well-documented cases of mixed tumor or carcinoma have been reported.

The Foliate Papilli

These are a rudimentary group of taste bud bearing papilli located on the lateral border of the attachment of the posterior tonsillar pillar. (Figures 22 and 24). The number on each side reportedly varies from 3 to 20. In Table VIII, the two sides were nearly equal.

Lymphoid tissue is occasionally found in this area. (Figure 23). When irritated, it may become hyperplastic producing a clinical nodule. This is frequently seen in clinical practice, particularly in a cancerphobia patient.

Table VIII

Foliate Papilli in 63 Tongues

	Right	Left
Average Number	5.17	5.30
Range	1-12	2-15

Blood Vessels

The branches of the lingual artery penetrate obliquely toward the front and upward into the body of the tongue. Numerous branches extend into the muscle and after several divisions enter the mucosa. Arterioles then form and curve into the papilli. The smallest papilli (filiform) receive only a singular vessel, while the fungiform and vallate papillae receive several branches which further divide and anastomose within the papilla. These anastomoses send capillary branches into the secondary papilli. The number of capillary loops will vary in all papilli according to the number of secondary projections. The veins attain considerable size in the vallate papilli. There is apparently a sizeable net between the arterioles and the venules in the fascia lingua. There appears to be some crossing over the midline of the venous drainage while the arterioles apparently never cross the midline.

Lymphatic Vessels

The lymphatic vessels form a dense network of rather coarse vessels in the deeper layers of the mucosa and in the superficial layers, they form a rather fine net which is in contact with the papilli of the tongue. The secondary projections receive only a single loop while the primary and other papilli may receive several anastomosing loops, which send branches into each microscopic papilla. There is a particularly well developed network in the vicinity of the lingual follicle. The vessels are also very numerous in the median portion of the tongue adjacent to the circumvallate papilli and around the ducts of the Von Ebner gland. In Figure 79 and 88 these lymphatic vessels are very evident.

Fissuring

Fissures of the tongue have not been studied to any degree during the past twenty-five years except for a statistical analysis by Halperin, et al, (1953). Fitzwilliams (1927) compiled an extensive number of papers, all of which based their conclusions upon clinical observations.

Tongue fissuring refers to the furrows and shallow clefts which are not due to injury, infection or neoplasia, but are relatively constant and tend to show uniform patterns. Fitzwilliams (1927) quotes the classification of Dubreuil-Chambardel in which three types are described; cerebriform, filiaceous and transverse. Halperin, et al, (1953) felt that this classification was unsatisfactory due to the complexity of fissuring. In the present study, Dubreuil-Chambardel's classification has been used with the addition of the longitudinal type. 1. Cerebriform, (Figures 29, 30 and 37), scrotal, or beef-steak type, is characterized by numerous fissures which course over the tongue in an irregular manner giving a pattern similar to the convolutions of the brain; 2. Foliaceous, (Figures 28, 31, 32, 34 and 36), or leaf-like type, has a central fissure from which many fissures course outward toward the lateral margins in a somewhat anterior direction giving a leaf-like appearance. The fissures generally follow the course of the primary ridges; 3. Transverse, (Figure 33) fissuring is characterized by one to several fissures which run perpendicularly to the midline generally in the center of the dorsum; 4. Longitudinal (Figures 35, 38, 39 and 40), fissures are often in the midline but are seen occasionally on both sides. The fissuring found in this study was classified on

the above pattern. Occasionally, when two types were present in the same tongue, it was classified according to the predominant pattern.

The presence or absence of papilli in the fissures has been assigned considerable importance by several authors. Schaffer (1951) felt that fissuring which contained papilli in the furrow was only an abnormality while the furrows which were devoid of papilli were due to a pathological condition. This contention does not appear valid in light of the complete lack of correlation between presence of papilli in the furrow and the type, severity and age of the patient. Nearly half of the fissured tongues contained some papilli in the furrows. (Figures 25, 26 and 27).

In this study, 154 tongues were studied in detail for fissuring. No attempt was made to alter the sampling. There were 113 tongues which had definite gross fissuring to give a surprisingly high 73.3 percent age. (Table IX). This is by far the greatest percentage ever reported. Fitzwilliams (1927) quoted Chaumie who reported an incidence of 60 percent in patients over 40 years. Fitzwilliams felt this was an exaggeration, although Bernier (1955) felt this was a realistic figure. Halperin, et al, (1953) found only 127 cases in 2,478 patients observed clinically with no sex difference, but nearly 67% of the patients were under 30 and over 88% were under 50. And of considerable significance, only 11% of the patients were over 50 years of age, but they had 32% of the total fissuring. Prinz and Greenbaum (1939) felt that the condition was present in only 0.5 % of all humans regardless of age.

The high incidence reported in this study of gross tongues is

probably a truer picture of the incidence than the clinical observations. It has been observed clinically that many apparently fissureless tongues on digital or instrument manipulation of the anterior and middle portion of the body will show well developed fissuring. (Figures 41 and 42). This is particularly true of the cerebriform type. Post-mortem differential contractability between the muscle and the fibrous tissue may account in part for this more easily apparent feature.

The etiology of fissuring has been a subject of considerable speculation: much of it empirical. Fitzwilliams (1927) felt that the condition might be simply a normal variation or of atavistic significance. He quoted many theories which included: large size which resulted in folding, direct relationship to hereditary arthritis, congenital syphilis, septic stomatitis, epileptic bites, and even a result of or a sign of criminality and degeneracy. He felt along with Thomson that fissuring was prevelant in children who sucked continually on the tongue, fingers, or foreign objects. Myers (1914) felt that tongue chewing was itself hereditary and led to fissuring but this view is felt to be invalid on the basis of clinical observation.

Many writers have stressed the hereditary nature of the condition. Because of the high incidence of fissuring it is felt that familial tendency is merely coincidental. The fairly infrequent three and four generation examples are more publicized than cases like the patient cited by Fitzwilliams, who had severe fissuring but none of her ten children and only a very few of the grandchildren had it.

Table IX

Fissuring in 154 Tongues

	Cerebriform	Foliaceous	Longitudinal	Transverse	All Fissures
Number	63	28	20	2	113
Percent of Tongues	40.0%	18.2%	13.0%	1.3%	73.3%
Percent of Fissures	55.7%	24.7%	17.7%	1.1%	~~44.6%~~
Male Percentage	67.0%	84.0%	58.9%	50.0%	65.5%
Female Percentage	33%	16.0%	41.1%	50.0%	34.5%
Average Age (Both Sexes)	68.8 yrs.	66.2 yrs.	55.1 yrs.	74 yrs.	62.2 yrs.
Range in Age	15-91 yrs.	25-89 yrs.	7-86 yrs.	59-89 yrs.	

Of 97 patients over 50 years of age, only 10.3% had no fissuring.

The area of the tongue affected has never been studied to any degree because of the difficulty of complete access to the entire body and root. One case cited by Dubreuil-Chambardel extended the entire length of the tongue, ending in the epiglottic fold. This probably represented a cleft rather than a fissure. In this study, no fissures passed or through the sulcus terminalis. Only two fissures (both of the longitudinal type) entered the median rhomboid area. Most fissures were restricted to the anterior one half of the dorsal surface of the body. (Figures, 30, 31, 32, 33, 34, 35, 38 and 40).

On the basis of the high incidence of fissuring and definite increase with age (89.7 % over 50 years) as also noted by Halperin, it becomes evident that fissuring may well be relatively a non-pathological aging process. Histological sections reveal significant findings. (Figures 25 and 27). The depth of the fissure or furrow has a considerably thicker junction between the lamina propria and the muscle bundles than in the surface or ridge portion. Also of possible importance is the general thinning of the lamina propria in the anterior part of the tongue with increase of fat in the connective tissues, particularly in the surface portion. On the basis of this study, trauma, heavy muscular activity, particularly of the transversus muscle, and atrophy of age are felt to be the most important etiological factors in fissuring.

An apparent sex difference is seen in the foliaceous type of fissure. (Table IX). The male incidence of 84 percent may possibly be explained on the basis of more powerful muscular activity which pulls the inter-papillary ridge tissue still deeper than the ridge itself.

The absence of fissures in any of the newborn and prematures, and children up to 7 years, is an interesting finding which points even more to the importance of trauma, muscular activity, and atrophy as logical etiological factors. Noyes (1956) examined 619 newborn infants and found no cases of fissuring.

Fissuring is of some clinical importance. Severe glossitis may result from food impaction and/or bacterial invasion of the epithelium in the fissure. These patients must be given special instruction in the hygienic care of the tissues. In geographic tongue and lichen planus, there is a decided tendency for fissuring to be present.

Hairy Tongue, Coated Tongue and Crusted Tongue

These three harmless but annoying conditions, (Figures 43, 44, 45, 46, 47, 48, 54 and 58), although separate clinical entities, areproduced by similar etiological factors which act upon the filiform papilli. The variation and degree of the effect is determined by the bacterial flora, state of hydration, type of diet, and metabolic activity; and changes in the relative activity of the above factors upon the papilla felt to result in the three different clinical entities. The basis changes in the papilla are actually localized in the secondary projections rather than the primary papilla or the ridge. These microscopic changes consist of parakeratosis and spongiosis in varying states of degeneration and bacterial activity. (Figures 49, 51 and 52). These changes can take place in any location where filiforms are present in significant amounts, but the median rhomboid area and the mid portion anterior to it are the characteristic sites. This area (Figures 9, 43, 45

and 47), is often depressed and receives little masticatory friction which normally keeps filiforms trim and vital. In altered, local or metabolic conditions, stagnation of food, cell debris and micro-organisms can foment filiform proliferation.

Many explanations exist regarding the etiology of the condition. Chemical irritants, such as strong mouth-washes, hyperacidity from gastritis, and particularly oxidizing agents have been implicated. Many investigators have felt that parasitic stimulation was a factor, particularly as an aftermath of persistent antibiotic administration which permits yeast and fungus forms to proliferate. (Crohn and Drosd, 1943). Most investigators (Crohn and Drosd) feel that the coated tongue is not due to autointoxication. Today, it is felt that the condition is not due to a specific factor but to a general unhygienic condition coupled with reduced salivary flow and lack of proper masticatory wear. Bernier (1955) noted the great number of cases seen in troops living on dry packaged foods and a limited water supply. Most hospital patients with the condition are debilitated by a febrile disease which decreases salivary flow, or suffer from a depressed metabolism which leads to stagnation and resultant proliferation. In this study, 3.8% of a group of 154 patients (average age - 69.5 years) had well developed hairy tongues. In all cases the patients succumbed to long illnesses such as tuberculosis, diabetes mellitus, or severe cerebro-vascular disease: all diseases in which food debris often becomes concentrated on the dorsum of the tongue.

Coated tongue usually is a pre-existing condition to hairy tongue and generally is caused to a lesser degree by many of the same

The crusted tongue is actually a dehydration and slight necrosis of the coated tongue. It is seen in severe mouth breathing habits and is a frequent occurrence after general anesthetics or the use of oxygen. There is little mention of the condition in the literature because it is transitory and reversible clinically. In this detailed study of 154 tongues, 12 extensive cases (7.9%) were found and numerous small areas particularly just posterior to the tip were noted on approximately 30 other tongues. Grossly, the conditions pattern and characteristics may be seen in Figures 54 and 55. In Figure 56, the histological picture is one of necrosis and dehydration of the spongiotic epithelium on the more exposed portions of the filiform papilli.

Hairy tongue, coated tongue, and crusted tongue are similar conditions involving the filiform papilli. In any consideration of halitosis (fetor ex oris) these types of tissue and debris accumulation must be considered first. Increase of the roughage of the diet, tongue brushing and exercises, and elimination of systemic conditions are of greatest benefit. Decrease in the ability to taste has been noted in these conditions because of debris which piles up in the vallates and foliates. When good oral hygiene is instituted, the sense of taste usually returns rapidly.

Atrophy of the Lingual Papilli

Clinically, atrophy of the papilli can be temporary or permanent. It is apparent that the filiform papilli are extemely labile. The secondary projections especially may show extreme variation to metabolic changes. Because of the difficulty of correlating a myriad of conical and gross features, only the complete absence of filiform

factors. Coating or furring, is simply spongiosis and slight parakeratosis which forms as a result of drying, as in mouth breathing. (Figure 51). Disuse caused by altered metabolism, as in fever, (Figure 43), intoxication, and gastro-intestinal disturbances is also a factor. (Figure 44). The specificity ascribed to the causes of coating have been voluminously reported in the literature. Most of these papers, of which that by Henning (1879) is typical, describe a color change or pattern to the coating and then link it to the disease from which the patient is suffering. Clinical experience coupled with the specimens in this survey indicate that there is little or no specificity to the coated tongue. 154 tongues, studied in detail, 90 or 58.4%, had coatings which were classified arbitrarily as slight, moderate, and severe. (Table X). There was a definite trend to severe coating in patients who had been hospitalized for long periods, while in cases of sudden death coating was much less frequent. The age of the patient did not appear to be significant.

Table X

Coating in 154 Tongues

	Slight	Moderate	Severe	Total
Number	48	25	17	90
Percent	31.2	16.1	11.1	58.4

papilli was recorded. In 9.7% of the 154 cases observed, there was complete absence of both the primary and secondary projections. (Figures 39 and 40). Only one of these patients was under 50 years of age. Two of the patients died of chronic leukemia and the others of cerebro-vascular and cardio-vascular disease. It would seem that debilitation and lack of stimulation are factors in the pathogenesis of this condition. Sections of the dorsal surface usually show some fungiforms which are extremely atrophic, and, in which the epithelium shows considerable elongation of the rete pegs but no corresponding surface projections.

Few conclusions can be reached concerning lingual atrophy on the basis of this study. However, it is the author's feeling that the primary papilli, if not completely atrophied, can recover and produce new secondary projections.

The Median Rhomboid Area and Median Rhomboid Glossitis

That part of the tongue lying anterior to the vertex of the circum vallates in the midline is in a peculiar environmental position. It is usually depressed below the anterior part of the dorsum and may be isolated even farther by lateral swellings or protrusions. Table XI shows that 24% of 83 adult tongues have definite lateral masses on each side of the depression.

This isolated atmosphere is responsible for the bulk of hairy tongue distribution. (Figure 47). The results of continual stimulation and irritation of the papilli results in large conical papilli and considerable fibrosis. (Figures 13, 24, 57 and 58). The depression and irregularity of this area has often been explained on the basis of disturbance in the tuberculum impar and

lateral lingual swelling fusion. (Figure 1).

Table XI

Prominent Lateral Masses in 83 Adult Tongues

	Slight	Medium	Prominent	Total
Number	10	3	7	20
Percent	12.0	3.6	8.4	24.0

A condition in which this defect or irregularity includes loss of papilli, clinical reddness, and pseudo-induration has been termed median rhomboid glossitis, Brocq's glossitis, rhombica medians, and etc. First described by Brocq and Pautrier in 1915, it has been described under several names. Lane (1924), Fordyce and Cannon (1923), and Zimmerman (1928). The latter paper is a complete review and analysis of 34 cases: 80% were observed in men. Halperin, et al, (1953) found 8 cases in 2,478 patients in which half of the patients were men.

In this survey, there were only two cases which were sufficiently involved to warrant the diagnosis. Both were males. (Figures 59 and 60). These figures show two cases grossly and clinically. Figure 61 is almost identical to the case presented by Bernier in 1955.

This clinical entity has been of considerable importance because of the confusion with carcinoma. Many specimens have been biopsied because of the hardness from underlying fibrosis and the marked

differentiation from the surrounding papilla-containing tissue. However, in reviewing the literature, Martin, Munster, and Sugarbaker (1940) found no cases of carcinoma arising in this area and since that time, no cases have been reported. The condition should be considered a congenital defect and no treatment is necessary except good hygiene.

Lingual Tonsil Hyperplasia

The root of the tongue is difficult to visualize and palpate clinically and consequently, little material is available in the literature concerning the conditions which can occur in the most inferior portion of Waldeyer's ring. The study of this portion of the tongue is extremely interesting.

In Table XII, the surface characteristics of 128 tongues were divided into nodular, severe nodular, and smooth. The varying degrees of nodularity are seen in Figures 63, 64, 65, 66, 67 and 68. The smooth tonsil area (Figures 12 and 62). The smooth tonsil area is not normal since the linear folds which converge posteriorly toward the epiglottis are a direct result of development. (Figures 6 and 9). The smoothness was accompanied by a decrease in the number of lymphoid openings and decrease in the lymph follicles and mucous gland tissue. Nodularity has been described as a lymphoid hyperplasia. In this study, this was not true. Many of the severest nodules are composed entirely of mucous gland tissue which contains little or no lymphoid tissue. (Figure 69). Actual tonsillitis in which the lymphoid tissue predominates was impossible to accurately differentiate from the gland hyperplasia on gross examination.

Because most lymphoid openings are flushed with a mucous gland

severe tonsillitis is seldom encountered on the tongue as in the palatine and pharyngeal tonsils. The lingual tonsil is supported only on its base and is not held firmly by a strong fibrous capsule. There appeared to be a gradual enlargement with age of the lingual tonsil. The smooth atrophic tonsil is certainly less frequent in older age groups. There was a slightly higher incidence of severe nodularity in males. The greater use of forceful breathing by men in smoking and athletics may account for this slight difference.

Table XII

Surface Characteristics of Lingual Tonsil in 128 Tongues

	Smooth	Nodular	Severe Nodular
Number	39	64	11
Average Age	43.5	56.7	57.8
Age range	0-86	0-89	25-86

In the microscopic sections varying degrees of hyperplasia of the mucous glands and lymphoid tonsils may be seen in Figures 70, 71 and 76.

Despite this great growth of the surface of the root, there appears to be little limitation of function. Some limitations in phonetics might be expected in the tongues in Figures 67 and 68. This may be an explanation of gradual hoarseness with the normal true vocal cords.

Thyroglossal Ducts and Cysts

One of the most interesting phases of this series of tongues was the finding of 7 persistent thyroglossal ducts in the adult tongues. In one of these, at the base of the epiglottis, was a small nodule of thyroid tissue. (Figure 80). In 2 premature infant tongues, definite cysts with primitive epithelium were found in the area of the thyroglossal duct. Figures 84 and 84 show the largest of these cysts.

Most of the studies of thyroglossal ducts and ectopic thyroid have been on surgical specimens. Bailey (1925) felt that cysts of the thyroglossal duct above the hyoid in the tongue is rarer than lingual thyroid. A number of workers have emphasized the complete removal of thyroglossal sinuses and fistuli is essential, to prevent recurrence of cysts. Kinsella, (1939), Pemberton, and Stalker, (1940). Complete removal would be extremely difficult in those lying in the tongue above the hyoid. Most cysts lie below the hyoid. Marshall and Becker (1949) reported that only 61 of 310 occurred above the hyoid.

Schumacher (1927) stated that in 5 mm. embryos, the duct has become a solid epithelial mass which breaks up at 16 mm. He felt that remnants of this duct may remain well developed into old age. Many branches and compartments in the ducts have been described, and examples are seen in Figures 79, 81 and 82.

A foramen cecum which extended beyond 7 mm. was arbitrarily considered to be a thyroglossal duct. In 58 foramina which were accurately measured, an average depth of 3.4 mm. was obtained with a range from a slight depression to 7 mm. (Figure 73).

Seven ducts were found in 306 tongues (over 7 mm. Six were in elderly patients and one in a fifteen year old boy. There were no other abnormalities of these tongues. Figures 74, 76, 77, 78, 80 and 81 are typical of the ducts found. Figure 82 shows a small cystic area from the tongue of Figure 81.

In such a limited type of material, it is difficult to interpret the significance of these asymptomatic structures. The two thyroglossal cysts in the infants were undetected at autopsy.

Of possible surgical importance is the observation of the relationship of the foramen cecum and the sulcus terminalis on the surface. In all cases but Figure 81, the apex of the "V" is at the level of and slightly below the apex of the sulcus terminalis as seen in Figures 73, 74, 75, 76, 77, 78, 79 and 80. In viewing such a foramen cecum from the front of the mouth, a small probe could be directed straight back into the foramen. In cases of severe thyroid disease or where difficulty in deglutition is experienced, this technique might aid in determining whether an exploratory dissection is necessary. Further investigation of a larger sampling in indicated in order to establish the usefulness of this suggestion.

Miscellaneous Pathological Conditions

In the routine study of conditions evident in autopsy specimens, there were many lesions found incidentally. Tabulation was made of these conditions but because of the relatively small sampling very few conclusions can be reached as to incidence and clinical significance.

The occurrence of trichinella organisms in human muscle is

believed to be quite high. Wright and Walton (1944) found an incidence of 16.1% of the organisms, most of them calcified. Four cases of calcified trichinellae were found incidentally in 104 separate slides taken of routine areas or specific lesions of the mucosa, an incidence of 3.8%. It is felt that this figure could be higher if routine muscle sections were taken. The tongue is not the most frequent reported site of the organisms but might prove to be one of the more important muscular deposit organs. Of the other oral tissues seen by this observer, only the lip in routine pathological sections has contained the organisms incidentally. No particular area of the tongue appeared to be predisposed toward this condition in these four cases. One in a 46 year old male was near the epiglottis, on the right lateral margin in a 79 year old male, near the tip beneath the lamina propria in a 74 year old female, (Figure 89), and in an 82 year old male, beneath the lingual tonsil in the midline. (Figure 90).

Tooth bite marks were a common finding - 17 of 87 cases or approximately 20% (Figures 10, and 40). One one showed definite antemortem evidence of pathology. (Figure 93). Most of the tooth marks were felt to be post-mortem or a pressure just at death. Most of the tongues showing this distortion were from patients who had died in surgery or who had been in pain just prior to death.

Inflammatory infiltration in the mucosa of the tongue is an extremely uncommon occurrence. In one apparently healthy young male, who committed suicide by carbon monoxide, a diffuse subepithelial chronic inflammatory infiltration was noted. (Figure 94). This may be a coincidence but it warrants further study as a

possible change in carbon monoxide poisoning. Moritz (1953) noted chronic inflammatory infiltration around central nervous system lesions which resulted from anoxic destruction in patients who succumbed some time after exposure. No references are available which describe infiltration due to a lethal dose.

Vasodilation, particularly of the mucosal vessels in the root, was a frequent finding and probably resulted from strained respiratory movements prior to death. (Figure 63). In one case, (Figure 91), thrombosis of the vessel had occurred.

Only one true canker sore (apthous ulcer) was found. (Figure 95). It is fairly typical of this ulcerative condition and had probably been present for several days prior to death. It is highly probable that apthous ulceration is more frequent than found in this study. Hospital patients show a high incidence of the condition.

The presence of stagnated and clotted blood in vessels adjacent to the lamina propria was seen in six cases. In Figures 6 and 85, this darkening may be seen grossly and in Figures86 and 87, the blood can be seen microscopically. It was felt that this is a result of pressure upon the tongue prior to death.

This appears to be due to a dilation of the lymphatics (Figure 88) in the area and an escape of blood into them from small capillaries. This condition could not be seen until the tongue was cut in half.

Discrete nodules of lymphoid tissue were seen occasionally. Most of them like Figure 96 contained one or more lymphoid follicles. They are felt to be a result of injury to the throat mucosa and are not specific for any disease process.

Scar tissue similar to that in Figure 92 was seen in ten cases. Most of the scars were found on the anterior one half of the body. Most of them were probably due to bites. Foreign bodies such as bones, buck-shot, and tooth-brush bristles are reported to be common but none were encountered in the specimens examined.

Although neoplasms, both benign and malignant, did occur in some of the tongues, they were removed by the pathologist at autopsy, and were, therefore, not available for this study.

DISCUSSION AND CONCLUSIONS

In this study particular emphasis was placed upon finding histological and gross verification for conditions of the tongue that have been described, classified and treated upon the rather empirical basis of clinical observation and examination of distorted surgical material.

Initially, a large number of entities were considered for evaluation but many were eliminated because of post-mortem distortion and lack of definitive detail in the fixed state. The study as completed consists of seven basic parts.

First, a compilation of anatomical measurements and features was made. This included variations in symmetry and shape, lymphoid openings, the circumvallate area characteristics based on the over-all dimensions at different ages. The latter study of the width, body length, and root length produced a rather significant curve of nearly parallel growth up to the age of puberty. The length of the anterior portion shortens somewhat after 40 years while the width and the base or root remain fairly constant. This feature may explain what clinically appears to be a broadening of the tongue with age, but which might be actually a shortening of the length accompanied by lack of flexibility and vitality. The rapid growth attainment as shown in the tables included may be of some value in Orthodontia where muscular growth of the tongue may be a factor in producing or intensifying a malocclusion.

Second, the pertinent features in fissuring were studied with particular reference to age incidence, area of the tongue involved, the pattern of the fissures, and the tissue changes in the lamina

propria and musculature. Fissuring did not occur before the age of seven, but increased in incidence with age. 73.3 percent of the tongues had fissures; the highest incidence reported in the literature. The fissures were restricted to the anterior two-thirds of the body and were classified as cerebriform, foliaceous, transverse, and longitudinal. Only in the foliaceous type was there a significant sex difference with 84.0 percent in males. 89.7 percent of the patients over 50 years of age had fissuring, indicating that the process may be a phase of aging. Histological evidence of changes in the lamina propria and fat content in the anterior portion of the tongue along with the primary ridge distribution may be factors.

Third, involvement of the filiform papilli and its role in hairy tongue, coated tongue, crusted tongue, and atrophy was studied. In the four conditions, the basic change is mainly within the epithelium of the secondary projections and inflammatory changes in the connective tissue is not a feature except in secondary involvement. In hairy tongue, the process is mainly a parakeratosis of the secondary projection, in coated tongue it is primarily a spongiosis of the projections, and in crusted tongue it is a necrosis of the spongiotic and parakeratotic epithelium. Atrophy of the papilli is possibly a reversible process if the primary projection does not completely atrophy.

Fourth, the median rhomboid area, its irregularities, its predisposition to hyperplasia, and its involvement in the clinical entity of median rhomboid glossitis were evaluated. This area is susceptible to filth accumulation and resultant stimulation of the papilli and fibrous tissue. The lateral masses are of some importance.

Histological features of the median rhomboid glossitis were studied with little upon which to base conclusions. The absence of any reported carcinoma in this area is an important characteristic.

Fifth, the irregularities of the lingual tonsil area and their increase with age were evaluated. Many of the bulbous and nodular proliferations are not a true tonsillitis but are due to extensive hyperplasias of the mucous glands. Clinical tonsillitis is felt to be a minor problem as the tissue may expand upward without resistance from a fibrous capsule. The slightly higher incidence of severe nodularity in men may possible be explained on the basis of heavier smoking and more forced breathing due to physical exertion.

Sixth, the thyroglossal duct and its relationship to the foramen cecum and sulcus terminalis were studied. Seven cases of persistent thyroglossal ducts and two cases of thyroglossal cysts (both in infants) were found. One of the ducts ended in a nodule of throid tissue at the base of the epiglottis. In the persistent ducts there was a significant inferior-posterior direction of the foramen cecum and the vertex was usually depressed below the posterior wall of the sulcus terminalis. This anatomical feature may be of some significance surgically when ectopic thyroid or thyroglossal duct cyst formation is suspected.

Finally, a tabulation was made of lesions or features which were not noted or removed by the pathologist at autopsy. Four separate cases of single trichinella organisms were found microscopically as incidental findings. This 3.8% incidence indicates that the tongue is a rather frequent site of the organisms. Further studies along these lines are suggested.

Tooth bite-marks were found in approximately 20 percent of the

tongues. Most of the marks were seen in individuals who died in surgery or who were in severe pain prior to death.

The relative absence of inflammatory infiltration was noted. In one case of carbon monoxide poisoning, a chronic inflammatory infiltrate was present in apparently normal tissue. This warrants further study as a possible medical-legal tool.

The presence of blood in apparently dilated lymphatics in the lamina propria was found in several cases, and were presumed to be due to pressure or manipulation of the tongue prior to death.

Scar tissue was present on the anterior one half of ten tongues. No foreign bodies were found.

Suggestions of clinical significance based upon the results of this study may be of value in medicine and dentistry. In several instances further studies are indicated and suggested.

SUMMARY

A series of 306 tongues which were removed at autopsy were studied for anatomical and pathological features. Measurement and descriptions were made of the major anatomical structures in one third of the tongues. The pathological features of fissuring, filiform papilli disease, the median rhomboid area, the nodular lingual tonsil, the persistent thyroglossal duct, and incidental lesions were compiled. Correlation with clinical features was made wherever possible. Suggestions, of clinical importance are based upon the conclusions which were made.

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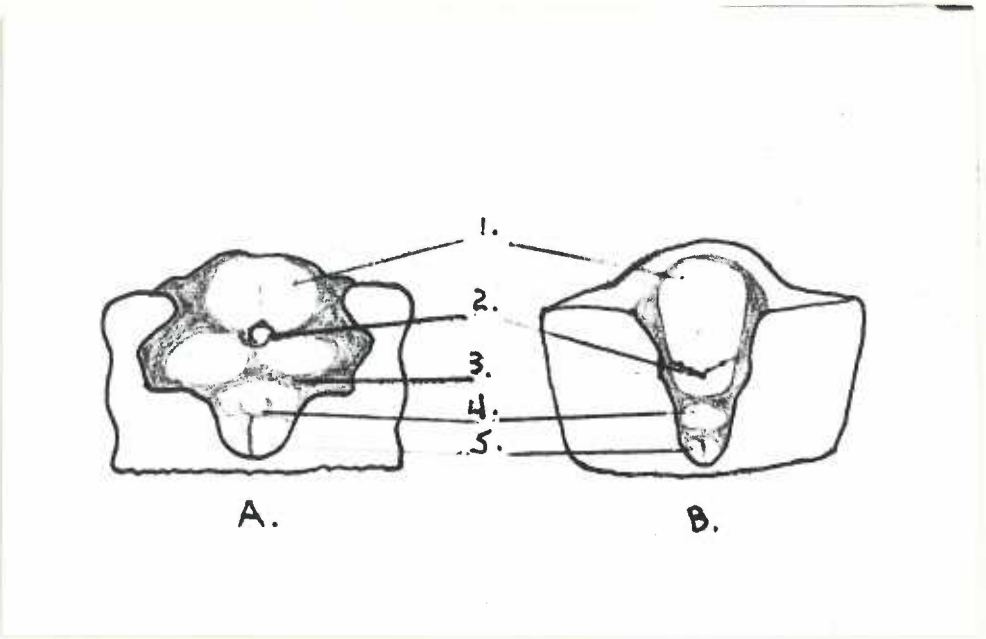

Figure 1

Figure 2

Figure 1. Schematic drawing of the development of the tongue. A is approximately 5 mm. B is approximately 18 mm. 1 is body of tongue formed by lateral lingual swellings. 2 is foramen cecum area and site of tuberculum impar. 3 is second branchial arch which is not present in the fully formed tongue. 4 is copula which has formed the major portion of the epiglottis. 5 is arytenoid formation.

Figure 2. The root and posterior portion of the body. A well developed and deep sulcus terminalis is present. The foramen cecum is at the vertex. The converging folds of lymphoid tissue and the openings of each nodule are well demonstrated. Several lenticular papilli are seen just posterior to the sulcus terminalis on the lateral borders. The circumvallate papilli are not well demonstrated and are irregular in distribution. Some conical papilli may be seen in the median rhomboid area.

Figure 3

Figure 4

Figure 3. Midline section of the tongue with demonstration of the longitudinal, transverse and genio-glossal muscles. The lamina propria, near the tip on the left, is extremely thick. Note the foliaceous fissuring with associated irregularity of the connective tissue.

Figure 4. The genio-glossal muscle fibers can be seen entering the intrinsic musculature. The tip of the tongue is on the left. Anterior to the foramen cecum are large conicals. Some slight lymphoid nodularity is present in the root. There is slight fissuring of the foliaceous type with slight distortion of the lamina propria.

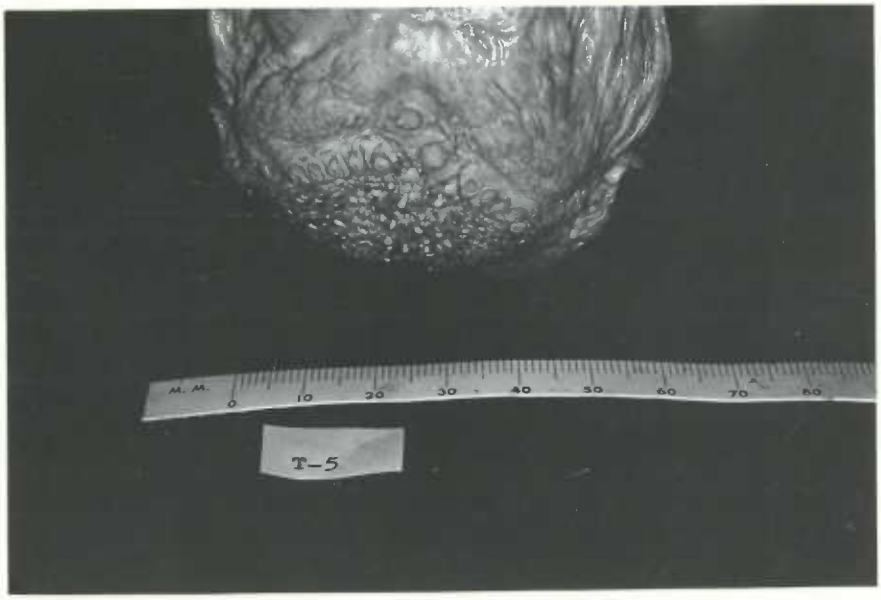

Figure 5

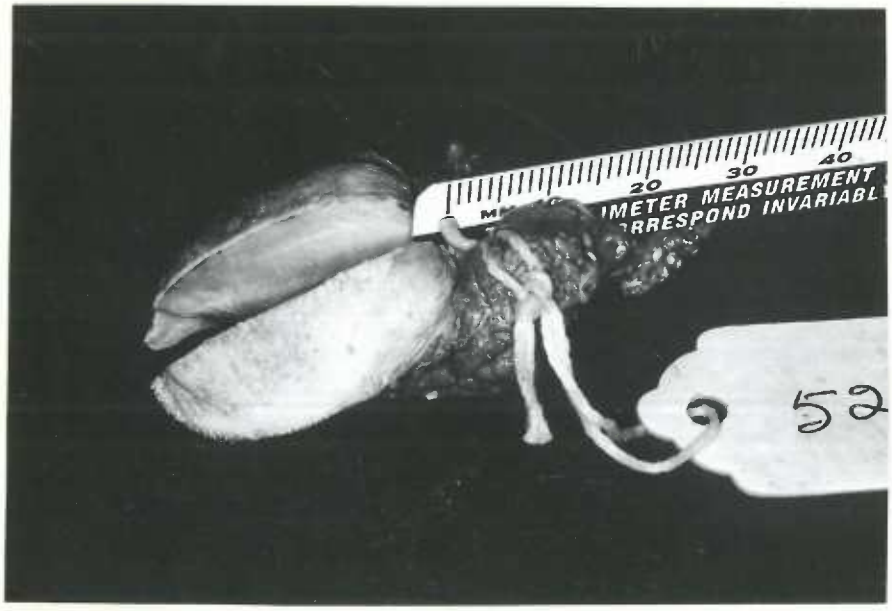

Figure 6

Figure 5. Normal circumvallate distribution with many of the papilli raised above the vallum. Several are stippled and two are doubled. The median rhomboid area contains numerous conical papilli and considerable debris. The lingual tonsil area is relatively smooth but has a slight converging pattern. The mucous glands are slightly hyperplastic.

Figure 6. The lamina propria in a 10 day infant showing blood stagnation in adjacent lymphatic channels. The elongated fungiform papilli on the tip can be well seen. The linear converging lymphoid tissue is well demonstrated.

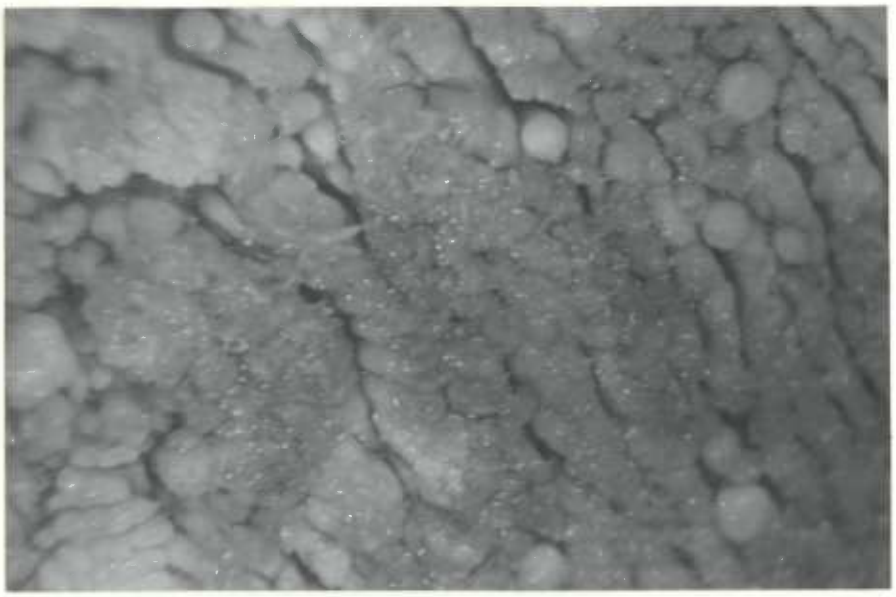

Figure 7

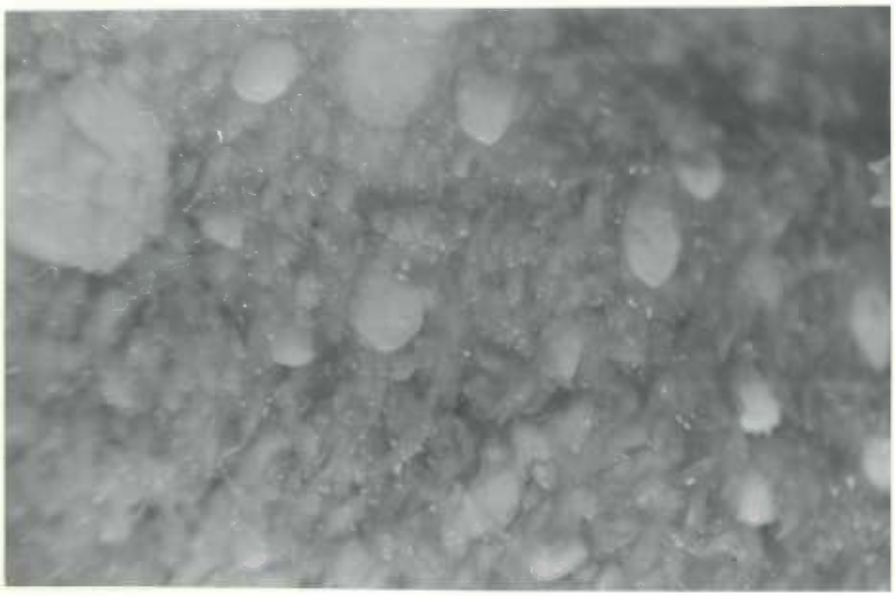

Figure 8

Figure 7. Primary ridges and projections with some secondary projections. Some fungiforms can be seen . This area is 1 cm. anterior to the foramen cecum and 1 cm. to the left of the midline in a 74 year old male. .66x.

Figure 8. Primary filiform papilli containing many secondary projections. Numerous conicals in varying stages of hyperplasia are seen. Section is from the median rhomboid area in a 34 year old male. .66X.

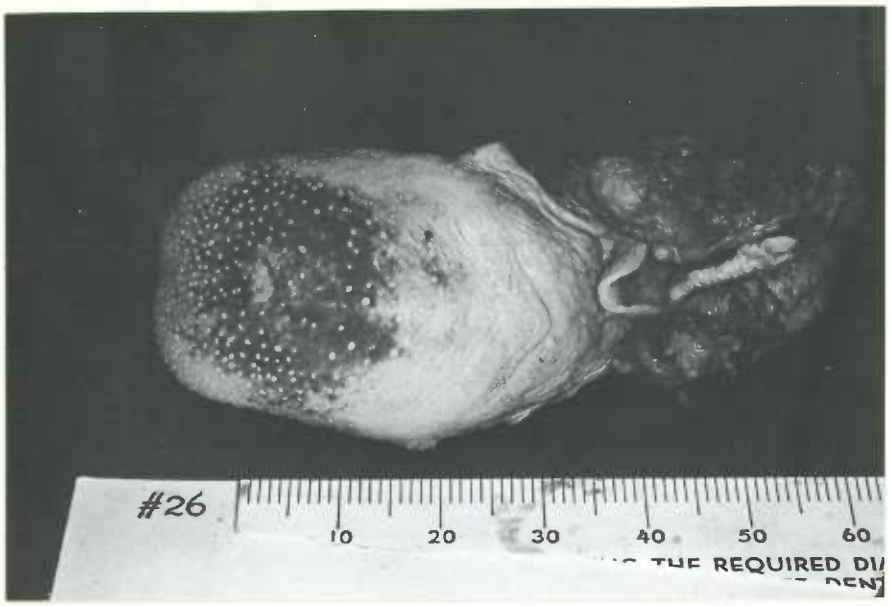

Figure 9

Figure 10

Figure 9. The tongue of a 4 month infant with the fungiform distribution accentuated by blood pigment on the dorsum. The sulcus terminalis is very prominent. The lymphoid tissue of the root is relatively undeveloped. The circumvallate papilla at the apex is double. The filiform distribution is roughly outlined by the pigmentation, although it does extend into the median rhomboid area.

Figure 10. Fungiform distribution on the dorsum of a 5 year old boy. The secondary projections of the filiform papilli accentuate the fungiforms near the midline. Pronounced tooth marks are present. The patient died several hours after an automobile accident.

Figure 11

Figure 12

Figure 11. Circumvallate papilla on the right is single with a separate vallum. On the left is a triple papilla which has incomplete vallum. The keeled papilla on the left is typical of this type. Several mucous gland openings may be observed. The patient was a 14 year old male. .66X.

Figure 12. A large circumvallate papilla is at the vertex. It has a slight bifurcation but has a single base. The fungiform distribution is irregular. Three of the papilli are raised above the surface. The lymphoid area is quite smooth. The median rhomboid area shows slight irregularity and slight depression. No sulcus terminalis is present. The patient was an 86 year old male.

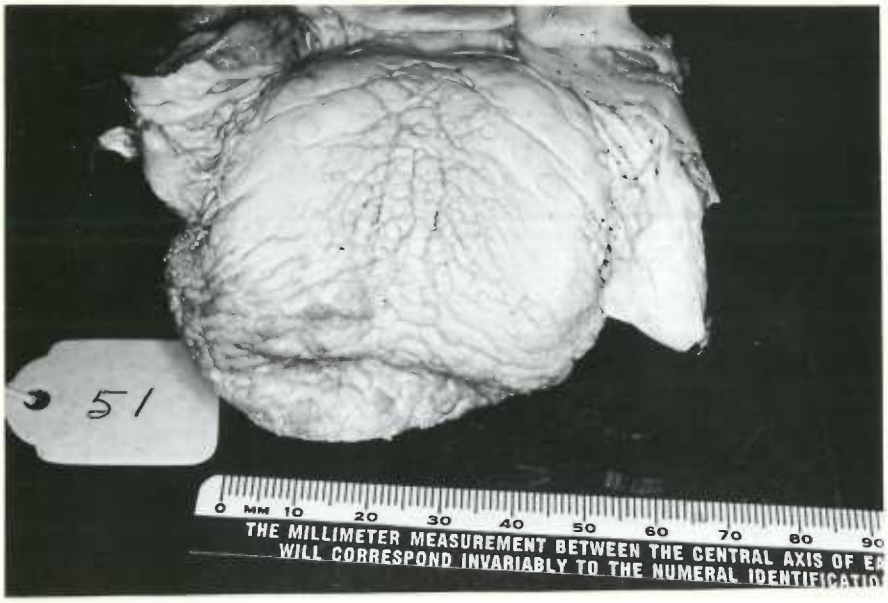

Figure 13

Figure 14

Figure 13. The sulcus terminalis is very prominent and the circumvallate papilli show good distribution. They are flat and flush with the vellum. The median rhomboid area shows a typical depression with a slight ridge in the center. There is considerable nodularity which resembles fissuring, however, this is not a true fissuring. The lymphoid tissue of the root is relatively smooth. The patient was a 70 year old male.

Figure 14. A deep foramen cecum without a central circumvallate papilla. The foramen measured 5 mm. in depth and ended rather abruptly. The orifices of the mucous glands are prominent. The patient was a 14 year old male.

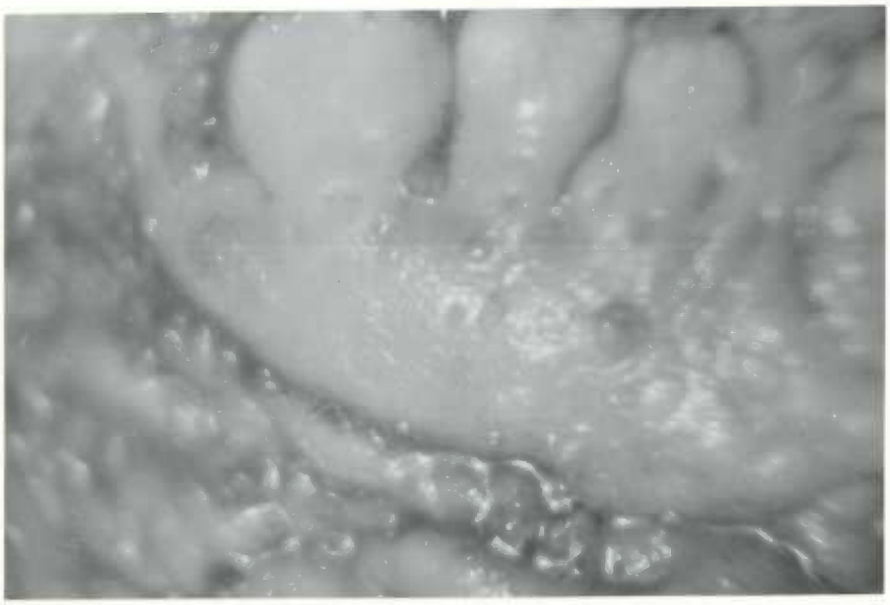

Figure 15

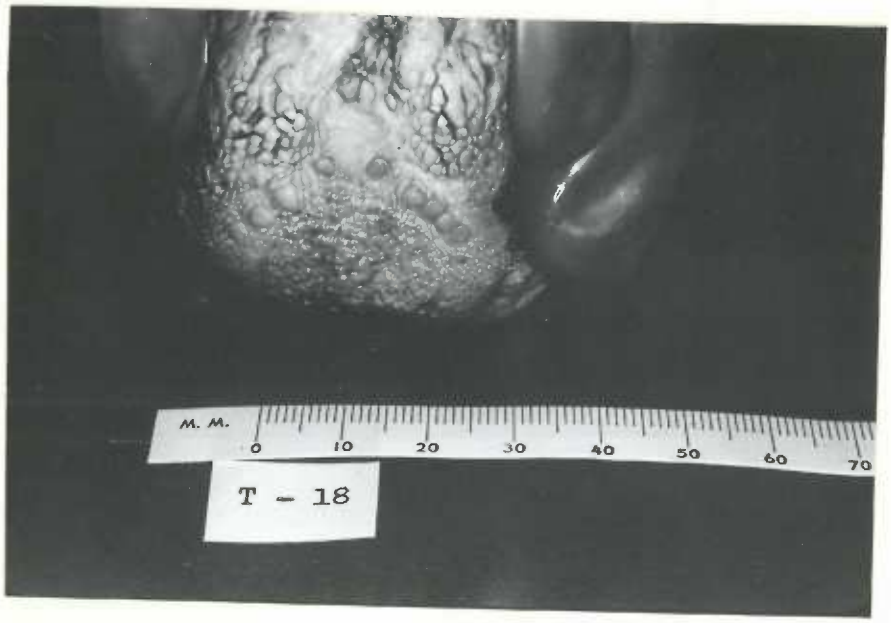

Figure 16

Figure 15. A good example of a triple circumvallate papilla showing a wide vallum and a keeled attachment of the vallum to the papilli. Several duct openings are seen and are probably from the serous glands of Von Ebner. 1.0X. The specimen is from a 68 year old male.

Figure 16. A "Y" shaped circumvallate distribution. The papilli on the left are raised while those on the right are almost flush. The smooth area just anterior to the foramen cecum may be a median rhomboid defect. There are numerous conicals and hyperplastic filiforms in the more typical median rhomboid area. Very hyperplastic lenticular papilli are present posterior to the sulcus terminalis. The lymphoid tissue is hyperplastic and nodular. The specimen is from a 78 year old male.

Figure 17. The circumvallate papilli showing a relatively smooth but not a polished surface. The sulcus terminalis is in the upper left and filiform papilli of the dorsum of the body are in the lower right. The specimen is from a 4 month male. 1.3X.

Figure 18. A circumvallate papilla with the oral surface on the left. A Von Ebner gland and duct may be seen along the lower margin emptying into the trough. A small central area shows squamous metaplasia in a duct of Von Ebner near the surface. The muscular distribution into the papilla can be seen in the center. Glandular tissue on the right is all of the Von Ebner type. The specimen is from an 82 year old female. 16X.

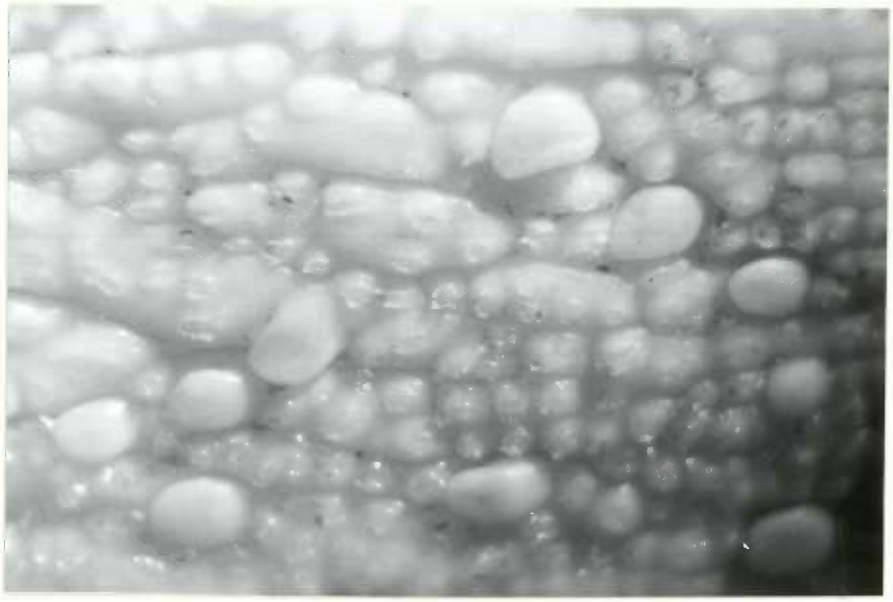

Figure 19

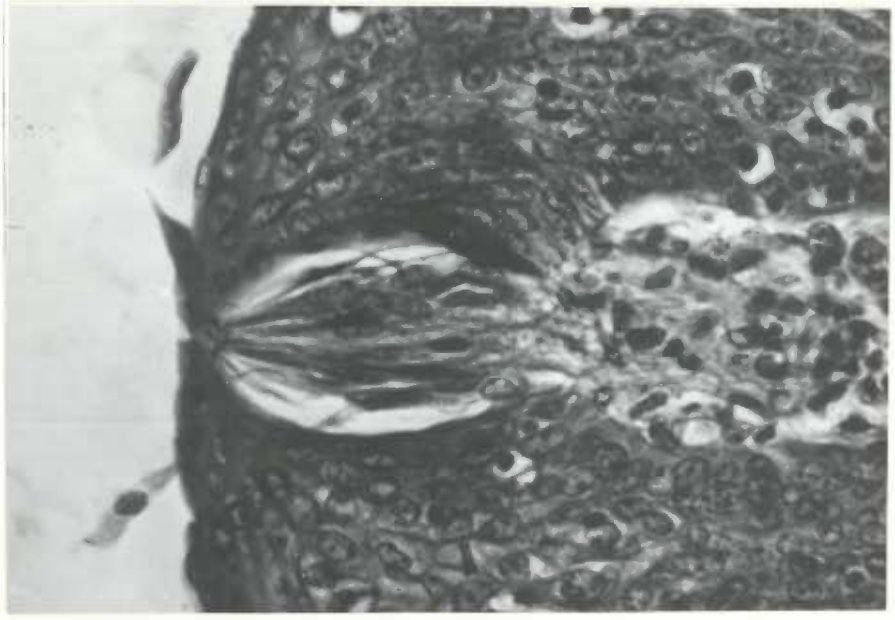

Figure 20

Figure 19. Primary ridges and primary projections with beginning secondary projections. The very fine "hairs" can be seen best in the middle and slightly to the left. The specimen is from a 5 month male. 1.3X.

Figure 20. Taste bud from the exposed surface of a circumvallate papilla. The central depression on the surface can be seen. The area of the inner taste pore is just beneath the central pit. The sustentacular cells are the more peripheral thinned out structures. The neuro-epithelial cells are in the center. Since this is an H & E section, nerve fibers leading from the bud cannot be seen. The specimen is from an 82 year old female. 220X.

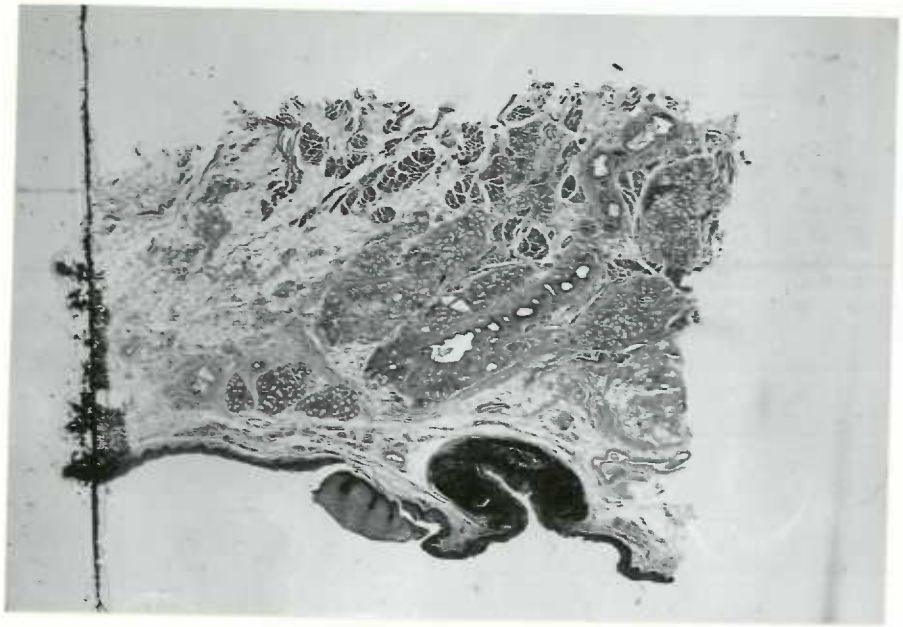

Figure 21

Figure 22

Figure 21. A very small lingual tonsil and pore. Mucous glands showing some ductal distention are separated from the lymphoid tissue by some fat containing fibrous tissue. The specimen is from a 79 year old male. 5X.

Figure 22. Foliate papilli on the lateral surface of the tongue. The primary filiform papilli on the right are somewhat elongated. On the left, the foliate papilli blend into the smooth undersurface of the tongue. The specimen is from a 35 year old male. 1.3X.

Figure 23

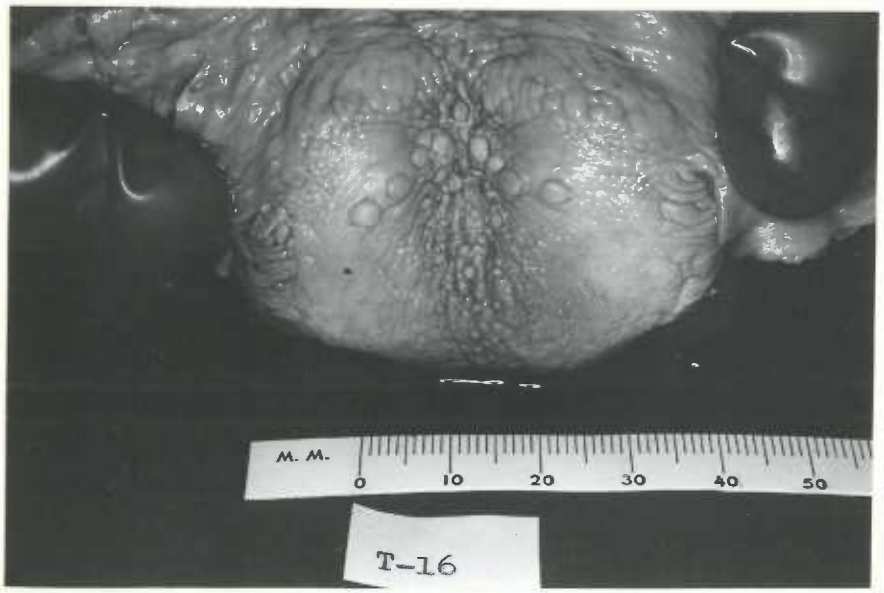

Figure 24

Figure 23. Foliate papilli on the lateral surface showing some lymphoid tissue in the center. Clinically, this lymphoid tissue becomes nodular and can produce a clinically disturbing lesion. The specimen is from a 47 year old male. .66X.

Figure 24. The circumvallate papilli are very prominent. Those close to the midline show a granular surface, while those that are lateral are quite smooth. The median rhomboid area is depressed with a slight furrowed ridge. The conicals are hyperplastic. The foliate papilli on the lateral surfaces are very prominent and quite characteristic. The nodularity in the lymphoid tissue is fairly typical. Primary ridges, which are devoid of primary filiformes, can be seen anterior to the circumvallate papilli running in an anterior-lateral direction. The specimen is from a 76 year old female.

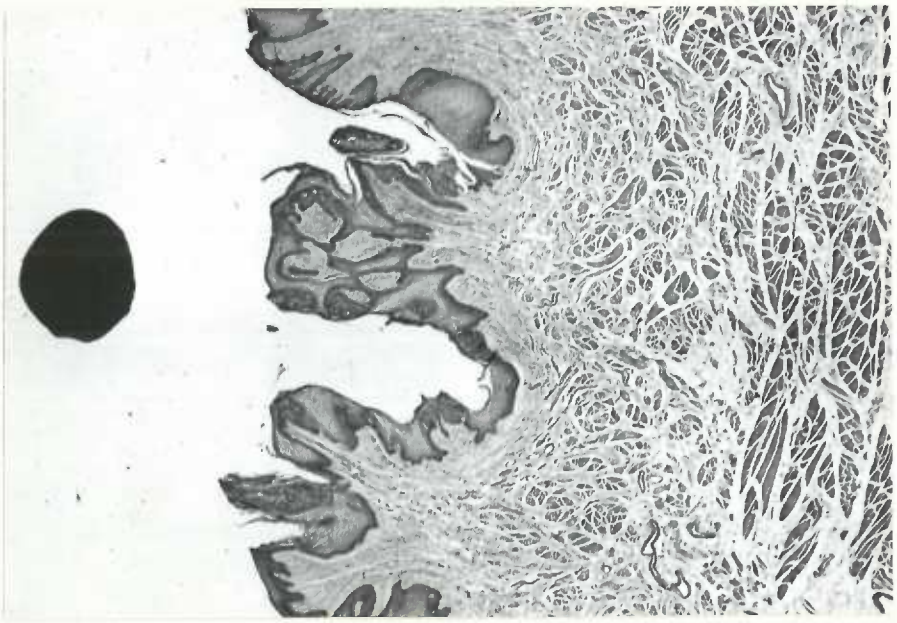

Figure 25

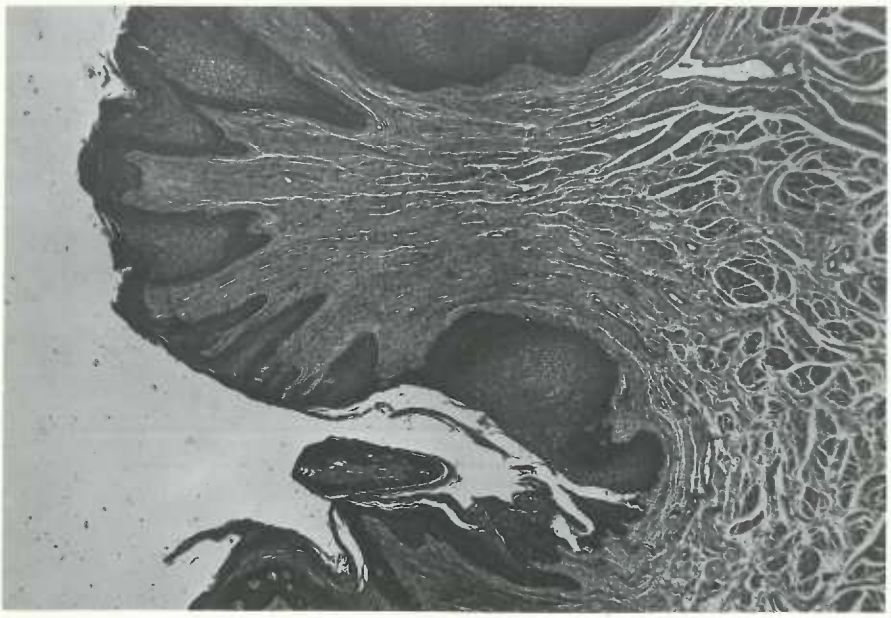

Figure 26

Figure 25. Cerebriform fissuring showing the organization of the muscle and connective tissue adjacent to the furrow and leading up into the ridge. In the lower ridge a primary filiform papilla with slight secondary projections may be seen. The furrow at the top contains portions of a papilla which originated from the wall of the ridge. There is some suggestion of a pattern to the muscular distribution at the base of the ridge. The lack of inflammatory infiltration is typical. The specimen is from an 82 year old male. 5X.

Figure 26. A higher power of Figure 25 from the area of the furrow with the papilla arising from the wall of the ridge. The irregular surface of the ridge shows a slight desquamation of parakeratotic epithelium. The linear distribution and the muscular attachment are at the base of the projection. 12X.

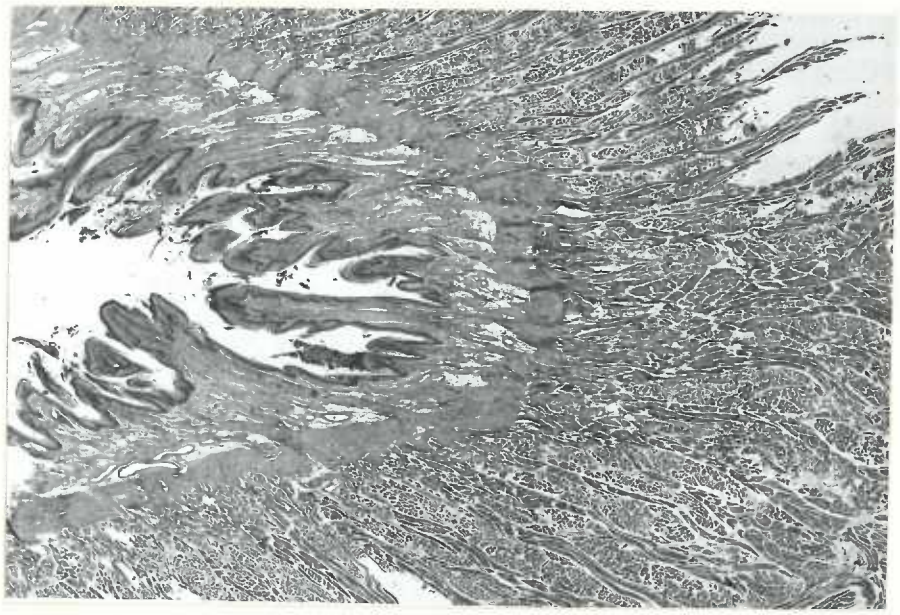

Figure 27

Figure 28

Figure 27. A deep longitudinal fissure from the midline. The muscular attachment to the lamina propria is very characteristic. The papillary projections within this large fissure are of a compound conical type having numerous secondary projections. The connective tissue within these papilli, particularly at the bottom of the furrow appear to have direct connection with some of the muscle bundles. There is considerable fat present adjacent to the lamina propria. Some dialated lymphatic vessels may be seen in the left hand part of the picture. The specimen is from a 59 year old male. 5X.

Figure 28. The tongue of a middle aged male showing the lateral furrows which are usually the terminals of foliaceous fissuring. Whether trauma from mastication has produced this change is unknown. This is a common finding.

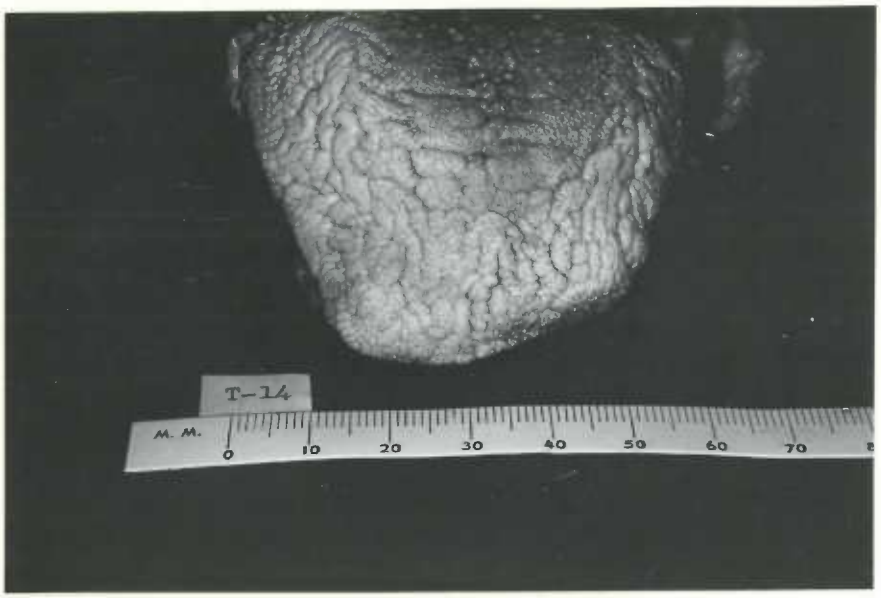

Figure 29

Figure 30

Figure 29. This is a generalized distribution of the cerebriform type of fissuring which shows a slight transverse pattern in the middle and foliaceous pattern on the lateral margins. Note the absence of secondary projections except in the median rhomboid area where there are also some hyperplastic conicals. The specimen is from a 60 year old male.

Figure 30. A typical cerebriform type of fissuring with numerous secondary projections of the filiform papilli in the middle portion of the body. Some hyperplastic conicals and fungiforms may be seen in the median rhomboid area and on the lateral margin. There is a slight distortion in symmetry. The specimen is from an 85 year old male.

Figure 31

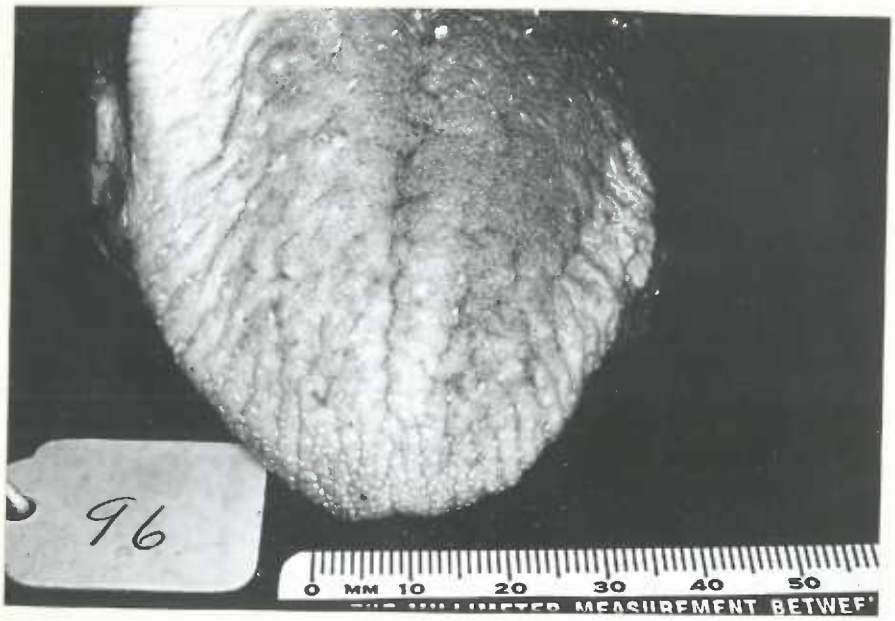

Figure 32

Figure 31. Cerebriform fissuring which is difficult to differentiate from the foliaceous type. The diagnosis is made primarily on the basis of the incomplete path of the fissures towards the lateral border. The median rhomboid area shows a characteristic irregularity. On the right is an area of postmortem destruction. The fungiform papilli are quite prominent and no secondary projections and only a few primary filiform papilli are present. The specimen is from a 72 year old male.

Figure 32. Foliaceous type of fissuring showing the lateral pattern of the fissures radiating from the central fissure. This linear pattern is almost parallel to the midline at the tip. The filiform distribution is quite typical and there are many elongated secondary projections. This imparts a furred appearance. Several hyperplastic conicals may be seen in this area of furring as well as along the lateral border on the left. The specimen is from a 45 year old male.

Figure 33

Figure 34

Figure 33. Transverse fissuring of the middle one third. This is a typical distribution of this type of fissuring. The papilli are extremely atrophic except in the median rhomboid area where some conicals and filiforms are present. Some of the papillary ridges are still prominent just anterior to the circumvallate papilli. This patient was a 68 year old male who died of leukemia.

Figure 34. Deep longitudinal fissure with a very minor foliaceous type involvement of the lateral margin. This type of fissuring presents a problem in diagnosis. Because of the severity of the longitudinal fissures this diagnosis was made. The median rhomboid area shows a slight depression of the central ridge. Many conical papilla are present in this area. Very few secondary projections are present in this area. This specimen is from a 59 year old male.

Figure 35

Figure 36

Figure 35. Longitudinal type of fissuring with a slight cerebriform pattern laterally. Numerous elongated secondary projections can be seen in the base of the fissure. The remaining portion of the dorsum is composed of rather atrophic primary papilli and fungiform. This specimen is from a 45 year old male.

Figure 36. Foliaceous fissuring showing deep non papillary furrows. The ridges can be traced to the lateral border. Note the absence of fissuring in the median rhomboid area. The specimen is from a 60 year old male.

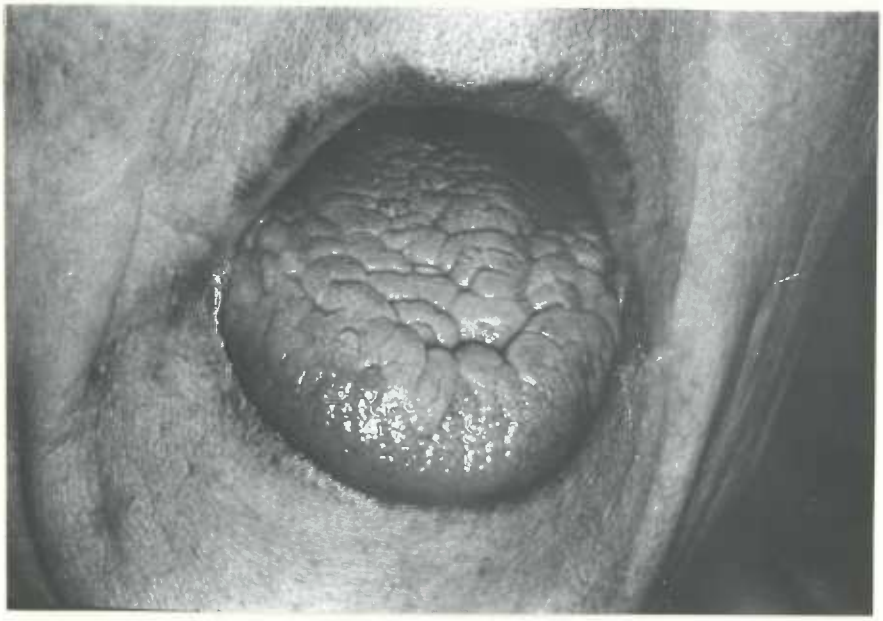

Figure 37

Figure 38

Figure 37. Severe cerebriform fissuring in a 62 year old female. The fissures are extremely deep and no papilli are present in the furrow. Although the posterior part of the tongue appears to be involved, it was merely nodular with no fissuring. No secondary projections are present and the papilli are somewhat atrophied.

Figure 38. Deep longitudinal fissure which has its greatest depth in the middle one third. Notice that the median rhomboid area is not involved. Numerous secondary projections are present and some can actually be termed "hairs". The specimen is from a 38 year old male.

Figure 39

Figure 40

Figure 39. Longitudinal fissuring with some cerebriform pattern on the tip. The median rhomboid area is quite nodular but is not fissured. There is almost complete absence of papilli. The foliate papilli are prominent because of the lack of superimposed papilli. This is a good example of severe atrophy. The stains in the center of the tongue were from food. This 80 year old female died from a pelvic neoplasm.

Figure 40. Longitudinal fissure and severe atrophy. Postmortem tooth marks are present. The median rhomboid area is very nodular and has numerous hyperplastic papilli. No secondary projections are evident. This 82 year old female died of severe arteriosclerosis and bronchopneumonia.

Figure 41

Figure 42

Figure 41. Apparently normal tongue with a prominent central sulcus. The patient complained of severe burning and continual foul taste. The patient was a 50 year old male.

Figure 42. This is the same patient as in Figure 41. The tissue has been retracted with an instrument and a deep longitudinal fissure was apparent. Considerable debris and inflammation was present. There were several fissures which radiated out to the lateral border. This picture illustrates the necessity of manipulation of the tongue tissues in order to detect fissuring.

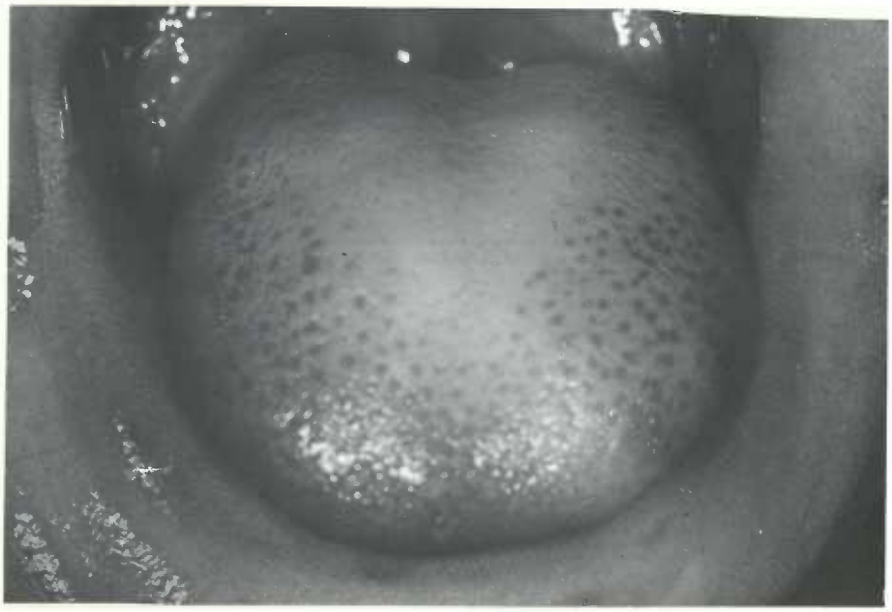

Figure 43

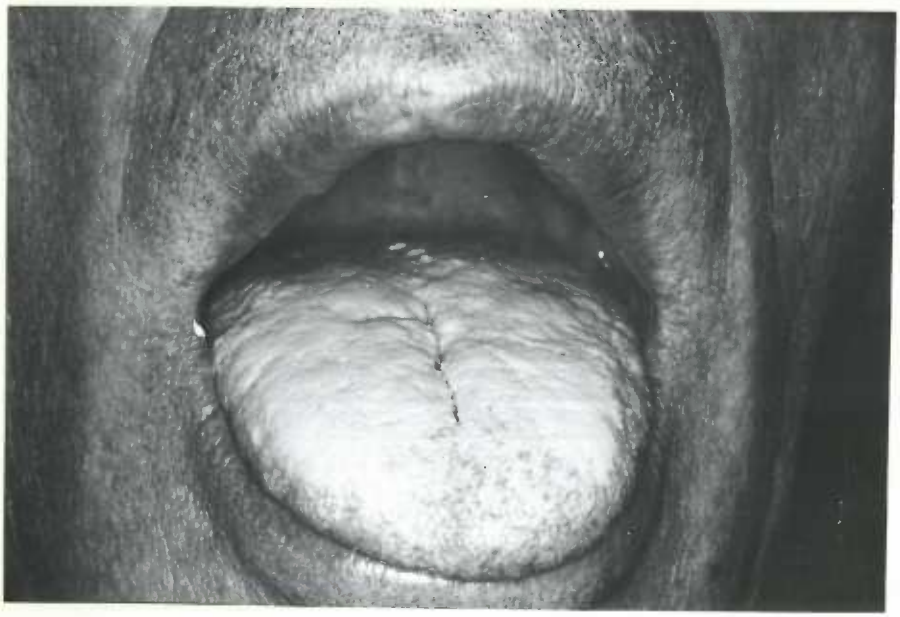

Figure 44

Figure 43. The distribution of the bulk of the filiform papilli can be seen by this coating or furring. The white material is composed of the spongiotic secondary projection. The fungiform distribution may be seen by the darker non-coated areas. This patient was a 6 year old female.

Figure 44. Severe coating in a 55 year old male alcoholic. Note the lateral borders are not as heavily involved due to the continual frictional movement against the teeth. This coating consists of severe spongiosis of the secondary projections. Brisk tongue brushing and return to a normal diet will remove much of this material.

Figure 45

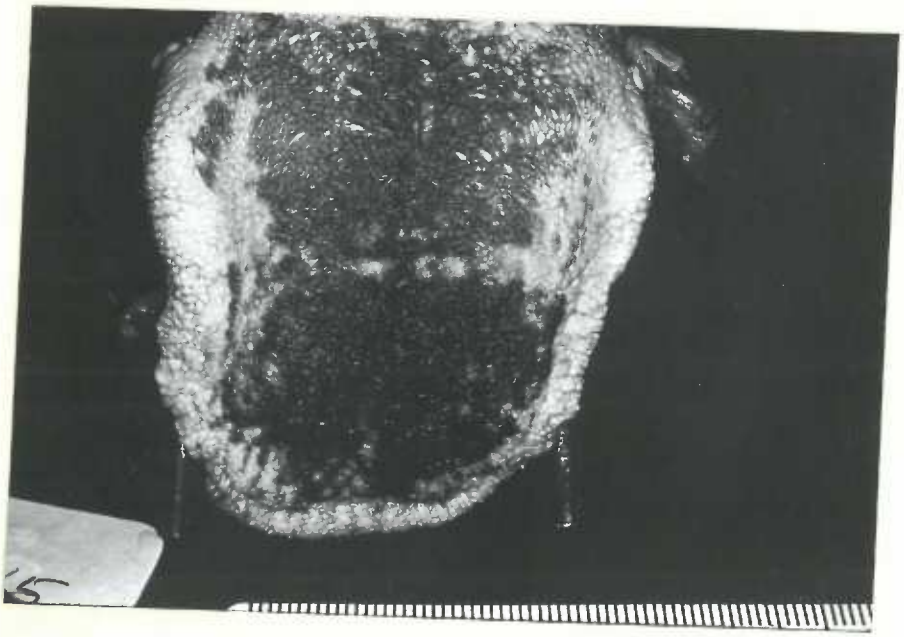

Figure 46

Figure 45. Hairy tongue with deep pigmentation. This is a typical pattern although the median rhomboid area is not as severely involved as in some cases. Lateral to the median rhomboid area the ridges and primary projections have lost their secondary projections and hair formation thus does not form. The specimen is from a 64 year old male, who died of bronchopneumonia.

Figure 46. Hair formation in the typical area. The conicals project above the hairs and are very conspicuous because of the contrasting provided by the pigmentation of the hairs. The anterior one half shows evidence of crusting due to mouth breathing just prior to death. The patient was a 50 year old male, who died of severe lobar pneumonia.

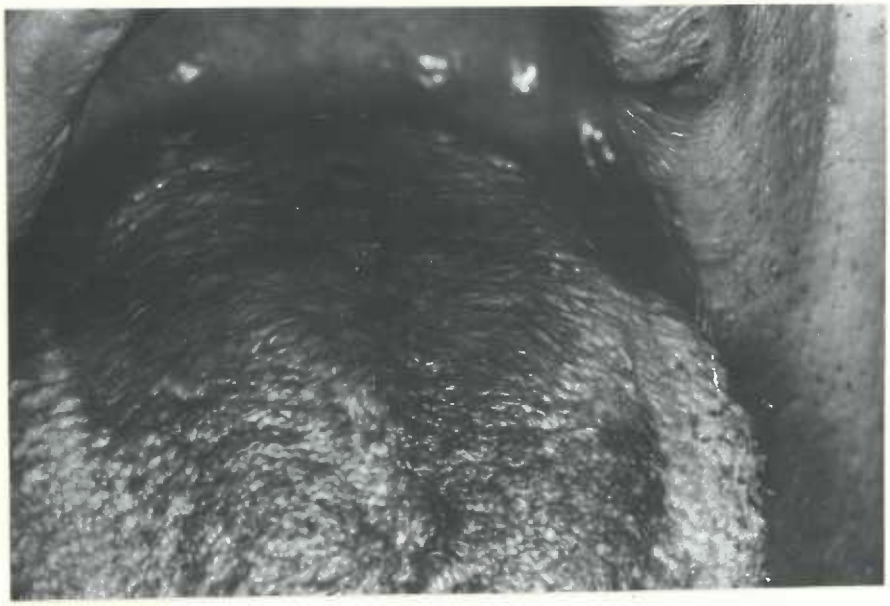

Figure 47

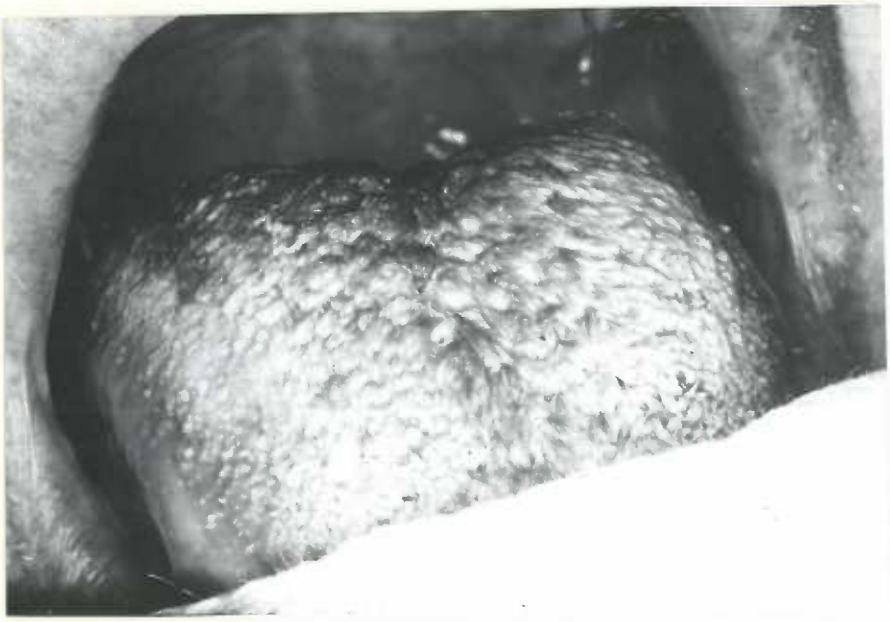

Figure 48

Figure 47. Severe "hair" formation in the typical area. Some of the hairs reach a length of 1.3 cm. Slight coating was present on the anterior portion of the tongue. This patient was a 62 year old male, who had recently been released from a tuberculosis hospital.

Figure 48. Severe coating with early hair formation in the median rhomboid area. The lateral borders are relatively free and clean due to stimulation by the teeth. This 67 year old male had just recovered from a viral pneumonia.

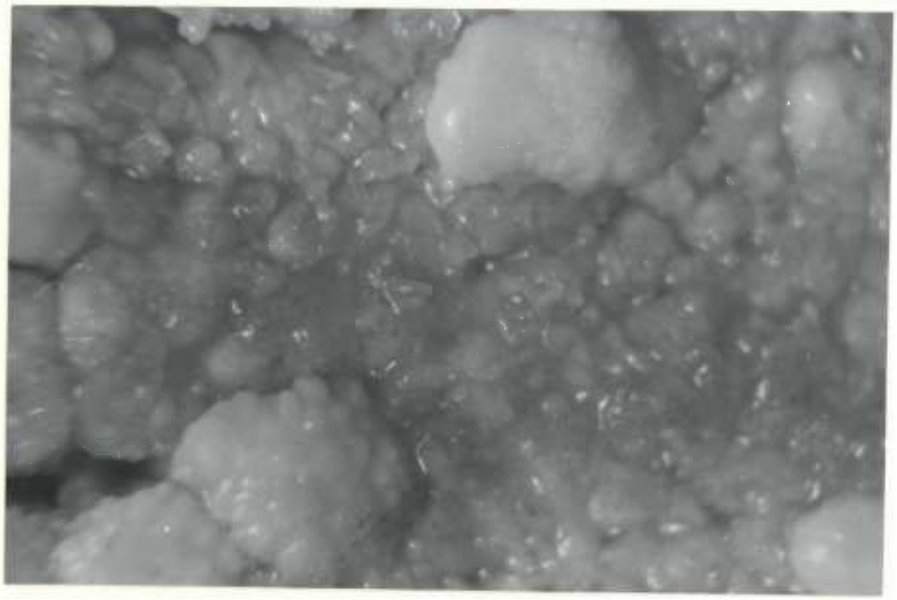

Figure 49

Figure 50

Figure 49. Coating in the median rhomboid area. Several hyperplastic primary ridges are present. Note the lack of discreteness in the material covering the filiform papilli. This is the spongiotic epithelium. This should be compared with Figure 50. This specimen is from a 73 year old female. 1.3X.

Figure 50. Hairy tongue showing the discrete secondary projection. There is no teniency to mat. A conical papilla is seen in the middle of the upper border. The specimen is from a 56 year old male. 1.3X.

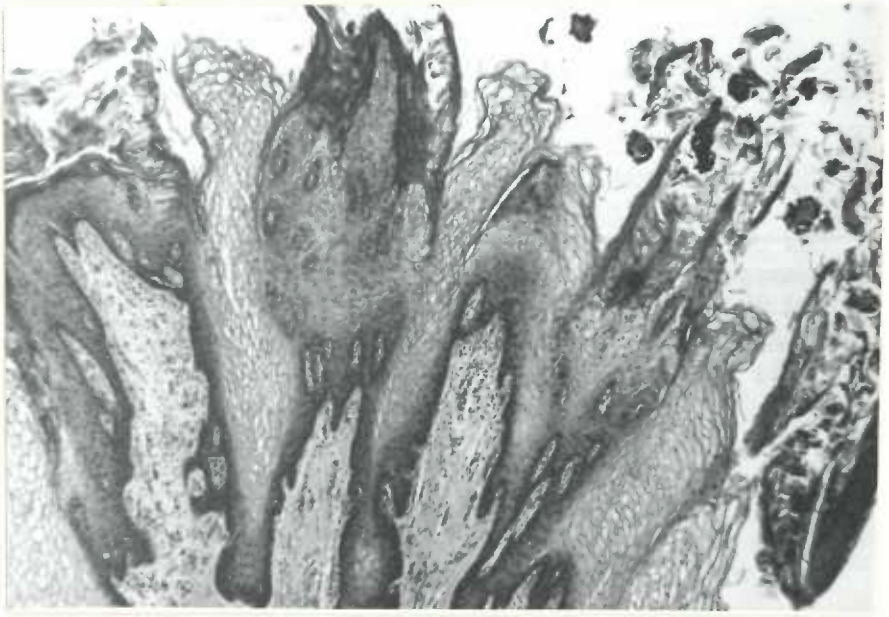

Figure 51

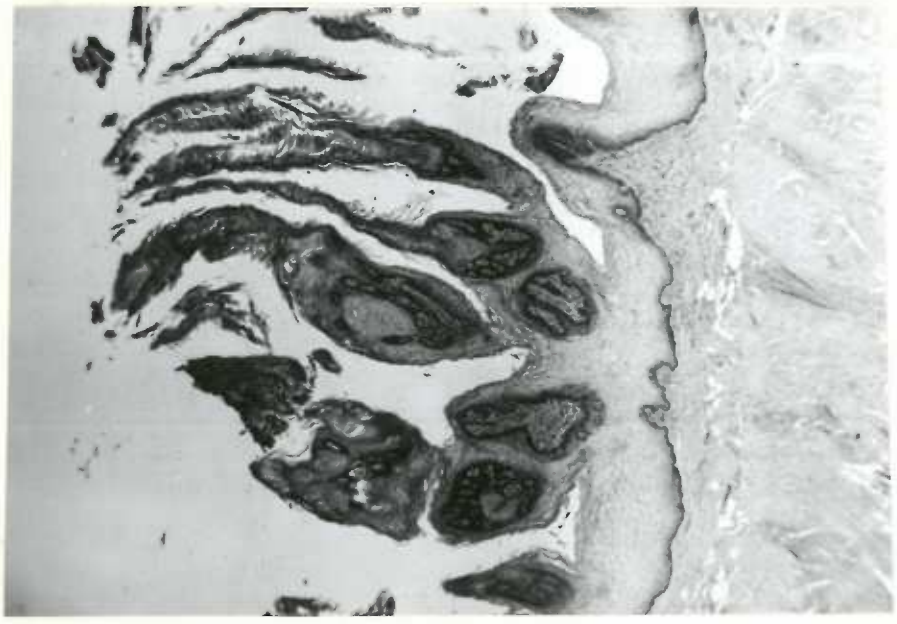

Figure 52

Figure 51. A coated tongue with very early hair formation. The loose, edematous (spongiotic) epithelium between the more discrete epithelial projections gives the clinical picture of coating or furring. The secondary projections near the right margin show typical parakeratosis distorted by spongiosis. Considerable debris is present on the right. On the left hand margin on the surface some of the spongiotic epithelium is in the process of being shed. The specimen is from a 15 year old male. 30X.

Figure 52. Hair formation showing the papillary ridge with three primary projections. The superior primary projection is divided and numerous secondary projections can be seen. No spongiosis is present. The secondary projections are involved by a regular and fairly discrete parakeratosis. Note the lack of inflammatory infiltration. The debris which is present here is mainly parakeratotic epithelium which has been shed. The patient was a 74 year old female, who had a generalized and severe arteriosclerosis. 14X.

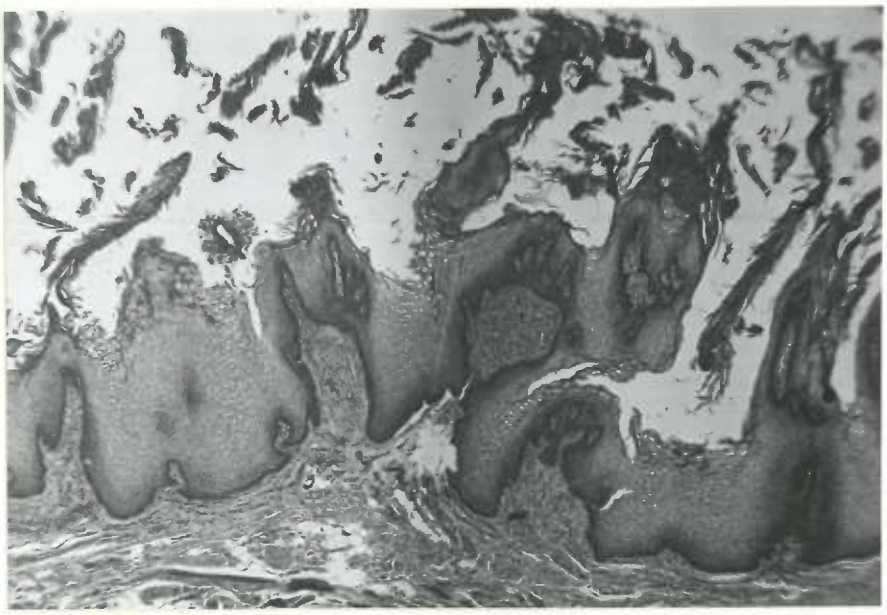

Figure 53

Figure 54

Figure 53. This is an example of a coated tongue with early hair formation. The developing hairs are on the right. On the left several fragments of developing hairs can be seen. The epithelium between the hairs is very spongiotic and is desquamative. The hairs themselves are of a loose parakeratosis. The specimen is from a 74 year old female, who died of pulmonary disease. 18X.

Figure 54. An example of a crusted tongue. The dark color is primarily due to necrosis of the coating. Hairs are not present. The patient was a 70 year old male who died of lobar pneumonia.

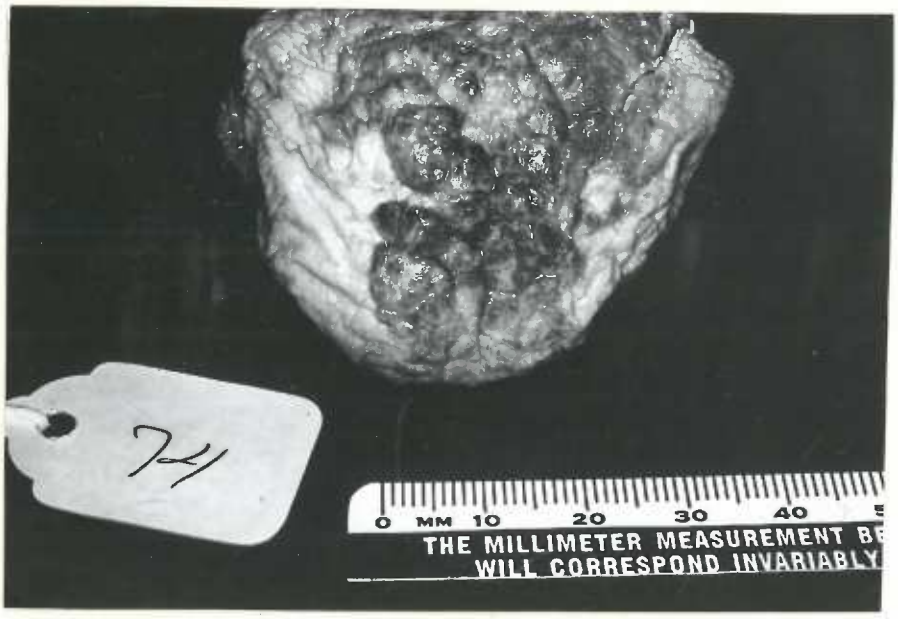

Figure 55

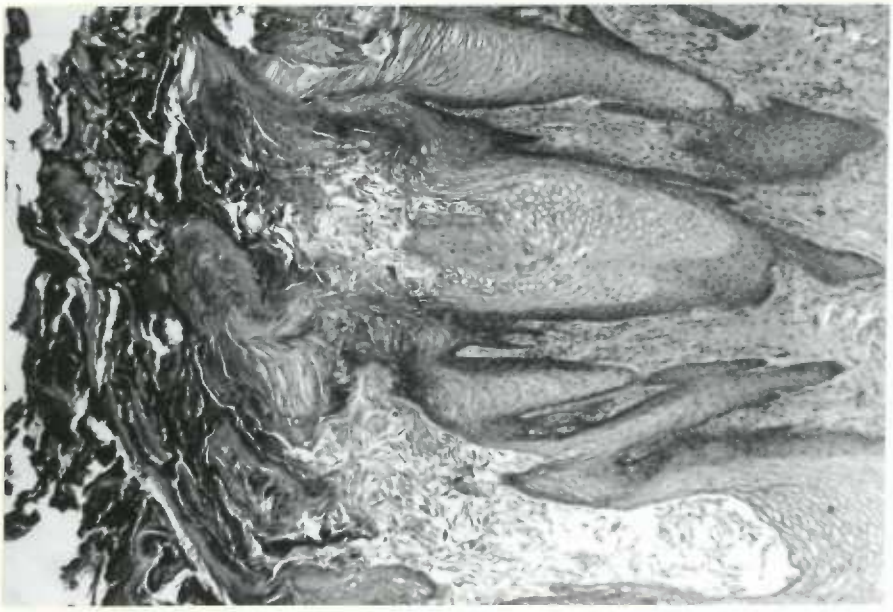

Figure 56

Figure 55. Severe crusting due to prolonged mouth breathing prior to death. Severe coating which built up during a prolonged illness due to severe cerebral-vascular disease became massively necrotic due to drying and lack of oral hygiene. This specimen is from an 83 year old female.

Figure 56. Section from the tongue in Figure 55 shows severe necrosis of the spongiotic and parakeratotic epithelium. A very slight inflammatory infiltration is present in the underlying connective tissue. 24X.

Figure 57

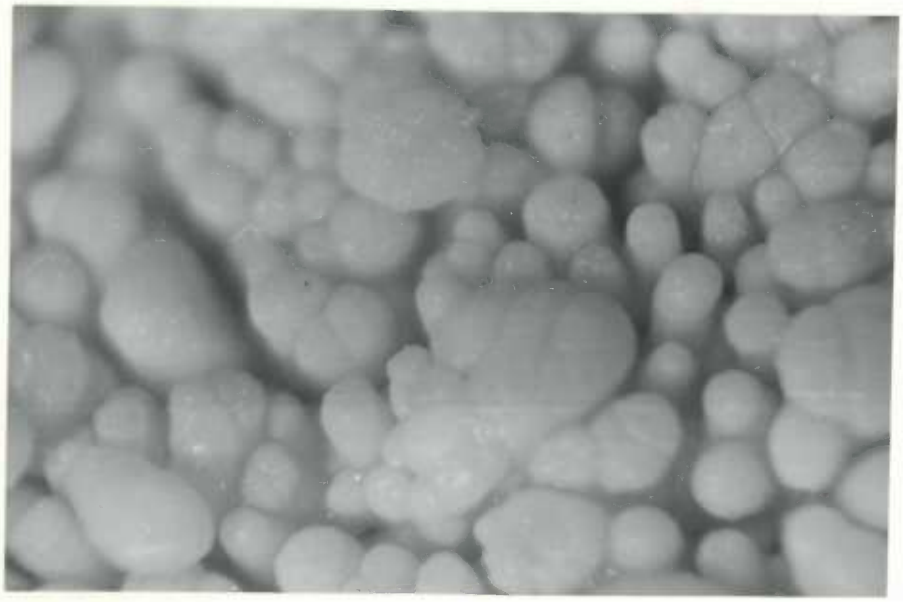

Figure 58

Figure 57. This tongue shows the typical depressed median rhomboid area anterior to the circumvallate papilli. There is considerable nodularity and hyperplasia of conical type papilli. The circumvallate papilli are flush with their vallum. The sulcus terminalis is quite prominent. There is moderate to severe nodularity of the lingual tonsil area. The absence of any secondary projections is not an unusual finding in an 82 year old specimen. The patient was a female, who died of severe arteriosclerotic heart disease.

Figure 58. Nodular hyperplasia of conical type and primary filiform papilli in the median rhomboid area. This is a typical picture of hyperplastic nodular proliferation in this area. This specimen was from a 73 year old female , who died of carcinomatosis. Her oral hygiene was extremely good, but the secondary projections on the tongue had completely atrophied. 1.0X.

Figure 59

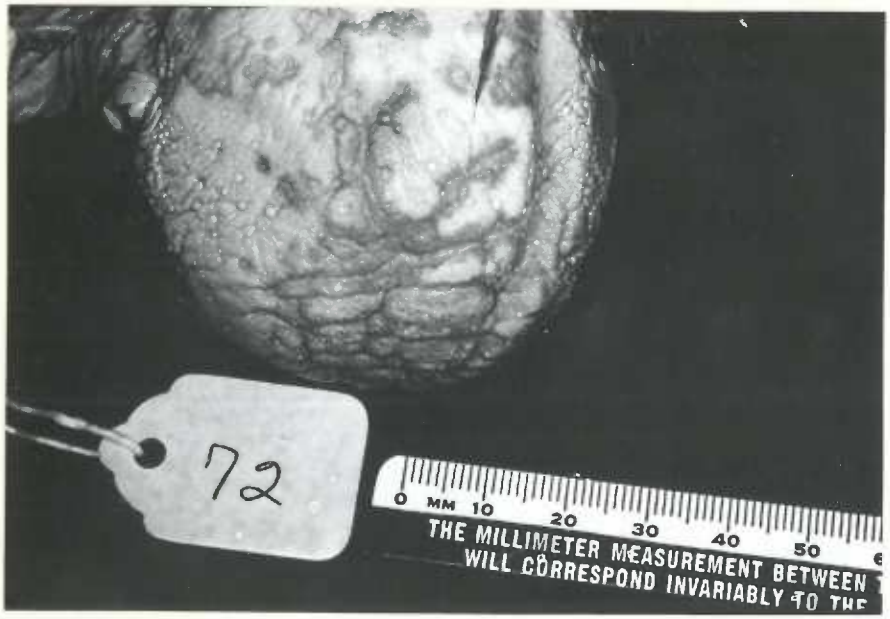

Figure 60

Figure 59. Median rhomboid glossitis in a 34 year old male. The non-coated area is devoid of any papilli and is much redder than the surrounding tissue because of the transparency of the epithelium, which allows the blood vessels beneath to be seen more readily.

Figure 60. Median rhomboid area which grossly fit the pattern of a median rhomboid glossitis. There has been considerable inflammation and desquamation in the fissures and in the lateral lymphoid area. The median rhomboid area is slightly depressed and the epithelium is devoid of papilli and is relatively thin. The specimen is from a 77 year old male, who died of severe trachial bronchitis.

Figure 61

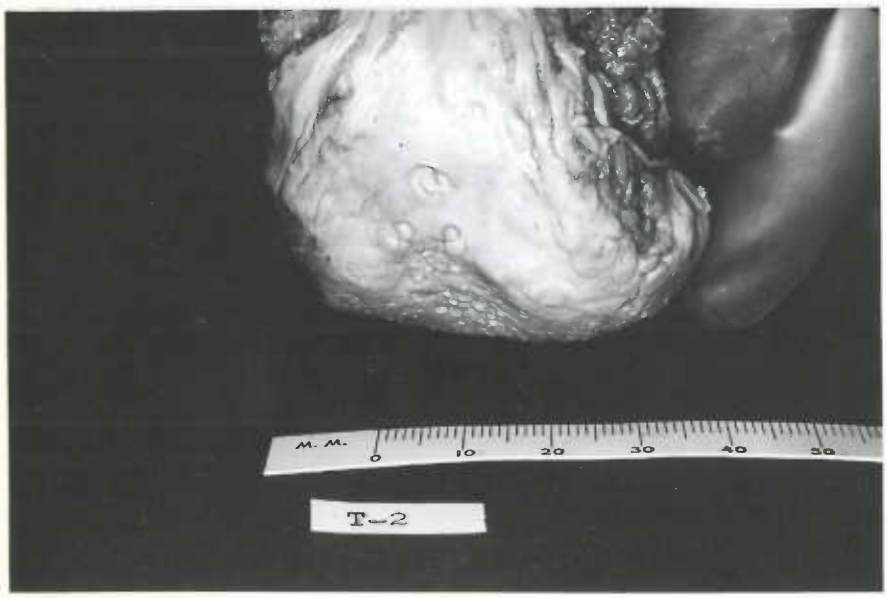

Figure 62

Figure 61. A section from a median rhomboid glossitis. The reactions of the tissue are similar to the case described by Bernier (1955). There was a moderate amount of fibrosis which has taken place above the fat deposit which lies on the lamina propria. There is a complete lack of papilli on the surface of the nodule. The histological picture must be correlated with the clinical characteristics. The specimen is from a middle aged male, who died from severe trauma. 8X.

Figure 62. Smooth, atrophic lingual tonsil area in a 79 year old female, who died of congestive heart failure. Most of the lymphoid nodules have atrophied and very few pores are present. Note the nodularity and irregularity of the circumvallate papilli. The median rhomboid area is depressed between the fairly prominent lateral masses.

Figure 63

Figure 64

Figure 63. The lingual tonsillar tissue is nodular and shows evidence of considerable sub-epithelial hemorrhage. The irregular folds still maintain a somewhat converging linear pattern. The circumvallate area is difficult to delineate. In the median rhomboid area, there are many secondary projections and very prominent conical papilli. The specimen is from a 71 year old female, who died from disseminated carcinomatosis. There was no evidence of metastasis to the tongue.

Figure 64. Discrete nodularity just posterior to the sulcus terminalis. A large nodule in the fossa to the right of the epiglottic fold was mainly hyperplastic mucous gland. In the median rhomboid area, there is definite depression between the prominent lateral masses and a small midline ridge is present. Several typical lenticular papilli may be seen on the left lateral to the circumvallate papilli. This specimen is from a 69 year old male, whose cause of death is undetermined.

Figure 65

Figure 66

Figure 65. Moderately severe nodularity of the lingual tonsil. The sulcus terminalis has not been obliterated but actually has become more pronounced. The circumvallate distribution is relatively typical. The nodule to the left is salivary gland hyperplasia. The rest of the hyperplasia was mainly lymphoid. Note the conicals and furring in the median rhomboid area. The specimen is from an 85 year old male, who had moderate pulmonary congestion.

Figure 66. Severe nodularity with massive mucous gland and concomitant. The pores have slit-like openings. There is some increased vascularity on the right and apparently in the circumvallate papilla. Large bulbous proliferations are usually indicative of mucous gland proliferation. The specimen is from a 62 year old male, with severe coronary arteriosclerosis.

Figure 67

Figure 68

Figure 67. Severe nodular hyperplasia of the lymphoid tissue. This type of proliferation, which is symetrical and in which the linear converging pattern is maintained, is usually indicative of lymphoid hyperplasia and the mucous element is less pronounced. This specimen is from a 46 year old female, who died from a cerebral-vascular accident. Good distribution of the circumvallate papilli should be noted. Moderate coating of the dorsum is present. The median rhomboid area shows a slight furrow.

Figure 68. Extreme irregular nodular hyperplasia with obliteration of the foramen cecum area. This type of hyperplasia is more typical of mucous gland growth rather than lymphoid. The slit-like pores may well indicate distention due to the underlying distorting hyperplasia.

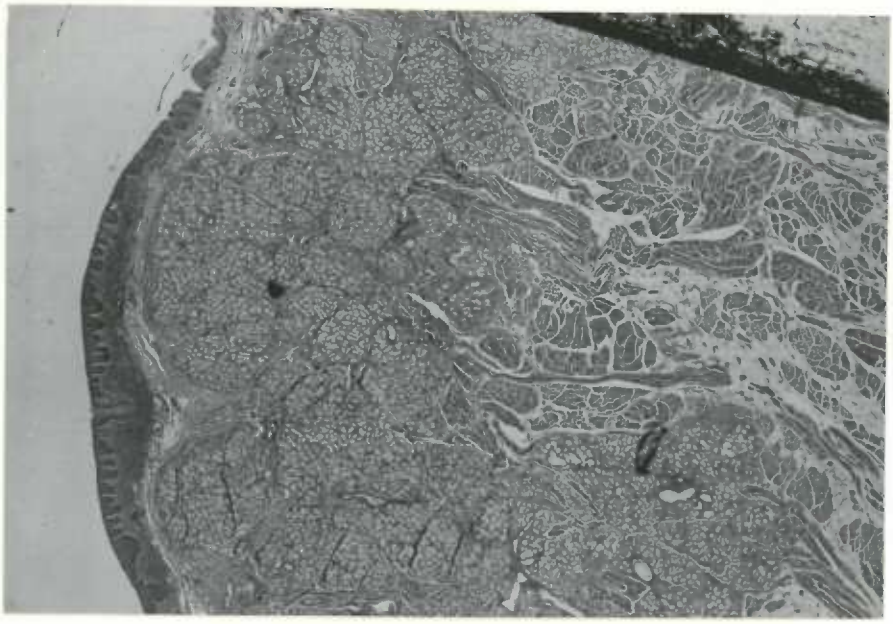

Figure 69

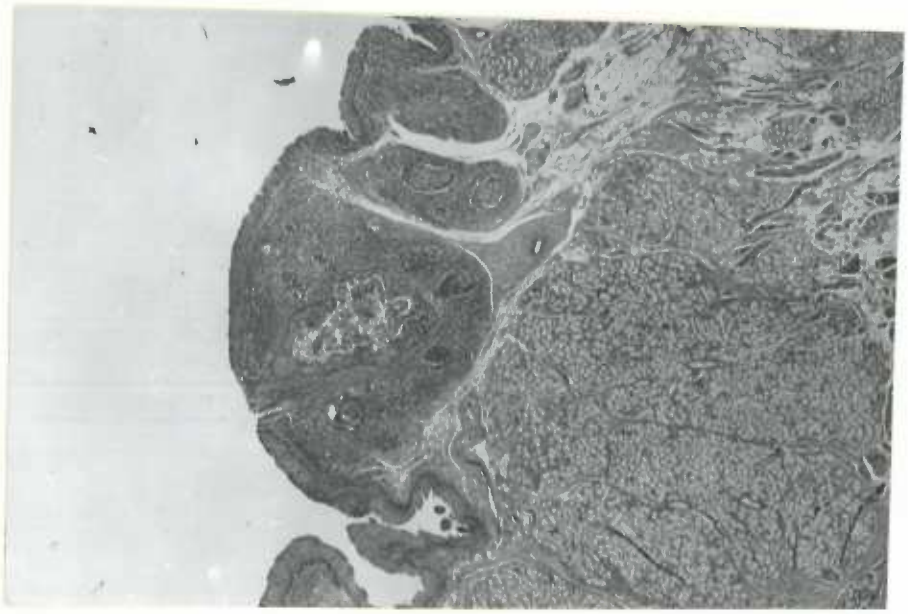

Figure 70

Figure 69. This nodule of mucous salivary gland tissue appeared grossly as a discrete enlargement of the lingual tonsil. The mucous gland elements are deep in the muscle and have distorted the Lamina propria. The chronic inflammatory cells beneath the epithelium appear to be the remnants of a lymphoid nodule. This specimen is from an 82 year old female, who died of severe pulmonary disease. Type unknown. 11X.

Figure 70. A lymphoid nodule on the surface has a pore which is filled with cellular debris. There are numerous lymphoid follicles present. Next to this nodule, at the bottom of the section, is the foramen cecum which has a small papilla present in the center. Beneath the lymphoid tissue on the right is a dense mucous gland hyperplasia. It was felt that the mucous gland hyperplasia was primarily responsible for the appearance of nodularity grossly. The specimen was from a 69 year old male, who died from an undetermined cause. 11X.

Figure 71

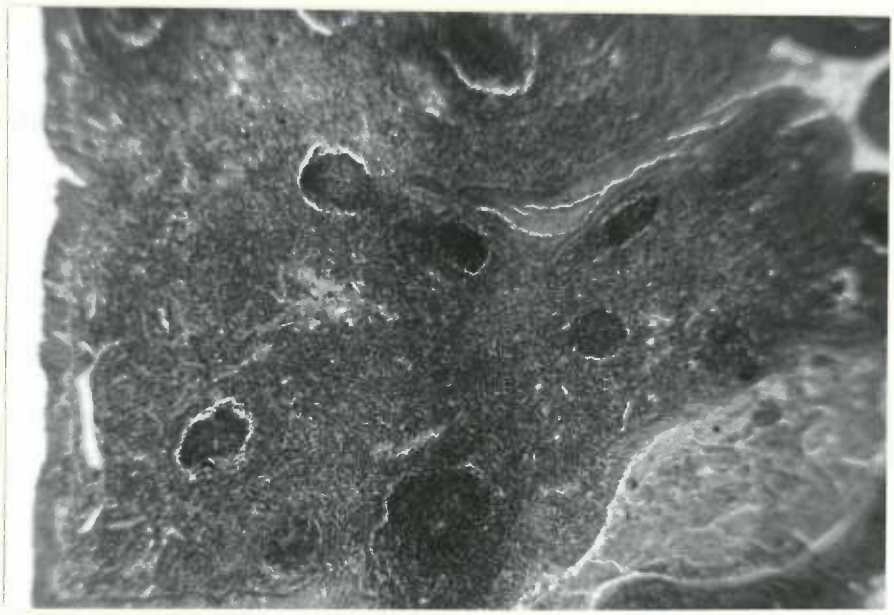

Figure 72

Figure 71. This is a higher power of Figure 70. A lymphoid nodule has active follicles around the central pore. Some ulceration is present at the orifice. Mucous gland showing ductal distention to the right. 92X.

Figure 72. From an area of severe lingual hyperplasia. There is severe distortion of the architecture. The lymphoid follicles are quite active. The specimen is from a 46 year old female, who died of severe pulmonary infection. 27X.

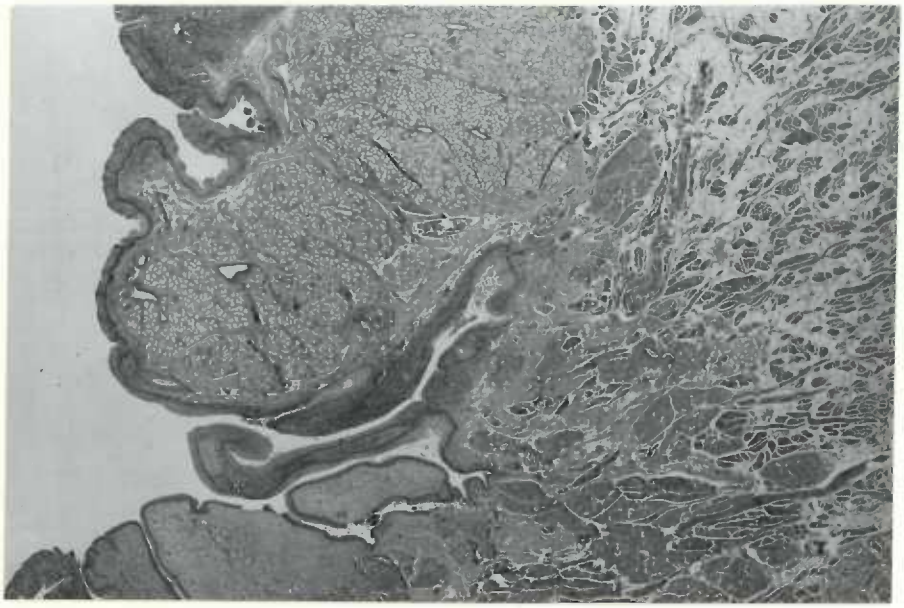

Figure 73

Figure 74

Figure 73. Foramen cecum area showing mucous gland hyperplasia in the tonsillar area. The presence of three papilli in the foramen is a relatively common occurrence. The gland tissue which lies directly beneath the foramen is of the Von Ebner type. There are numerous fat lobules between the glands. Grossly, this foramen appeared to be an irregular pit. This specimen is from a 69 year old male, who died of undetermined causes. 20X.

Figure 74. This is a section through the midline of the tongue. A thyroglossal duct 1.2 cm. in length can be seen arising from a depressed area behind the foramen cecum. Note should be made of the angulation of the tissue anterior to the foramen cecum and the tendency for the sulcus terminalis to be an angular furrow. A probe introduced into the foramen and directed toward the base of the epiglottis penetrated 1.2 cm. before meeting any resistance. Note the thick hyalin-like lamina propria which becomes irregular beneath the circumvallate papilli. The specimen is from a 68 year old male, who died of generalized arteriosclerosis.

Figure 75

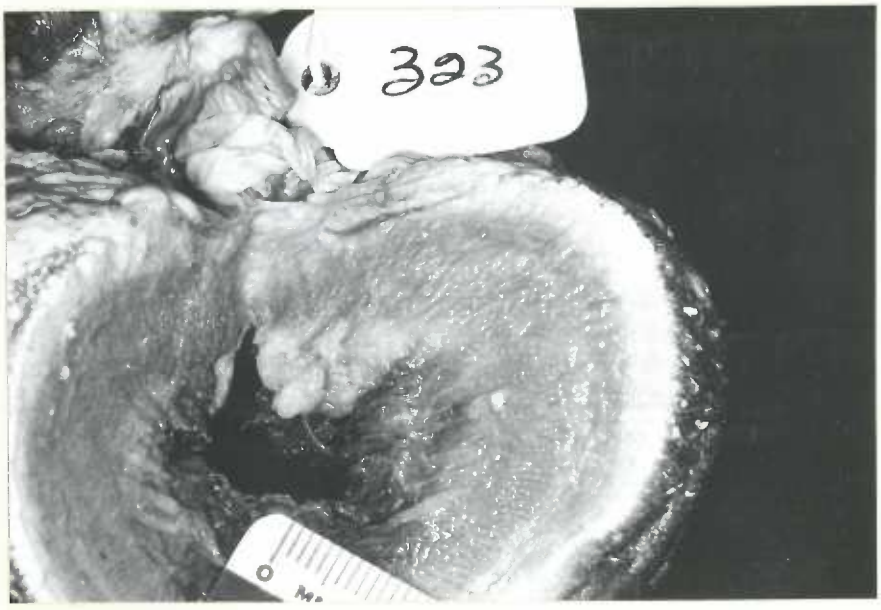

Figure 76

Figure 75. The tongue has been sectioned and the two sides placed together. Note the vertex of the circumvallate line. It is depressed below the sulcus terminalis. In Figure 76 the two sides have been separated and the resultant thyroglossal duct is readily apparent. The circumvallate papilli on the right show a slight stippling. There is considerable coating with rather extreme conical growth on the dorsal surface in the median rhomboid area and extending to the lateral border. The foliate papilli are well demonstrated. The specimen is from a 63 year old male, who died of severe coronary arteriosclerosis.

Figure 76. This is the same tongue as Figure 75 and shows the pattern of the thyroglossal duct as it extends from the depressed foramen cecum backwards towards the base of the epiglottis. It ended blindly approximately 1.8 cm. from the foramen.

Figure 77

Figure 78

Figure 77. A thyroglossal duct which reached all the way to the base of the epiglottis approximately 2.4 cm. can be seen arising from the depressed foramen cecum such as in Figures 76 and 74. The lingual tonsil area is smooth and slightly atrophic, with only a minimal number of openings or pores. This specimen is from a 61 year old female, who died of congestive heart failure.

Figure 78. This thyroglossal duct is also arising from a depressed foramen cecum, but the posterior wall of the sulcus terminalis is not as pronounced as in other cases. The lamina propria, on the anterior one-half of the body, shows the downward indentation corresponding to the foliaceous fissuring on the dorsal surface. This specimen is from an 8 year old male, who was killed in an automobile accident.

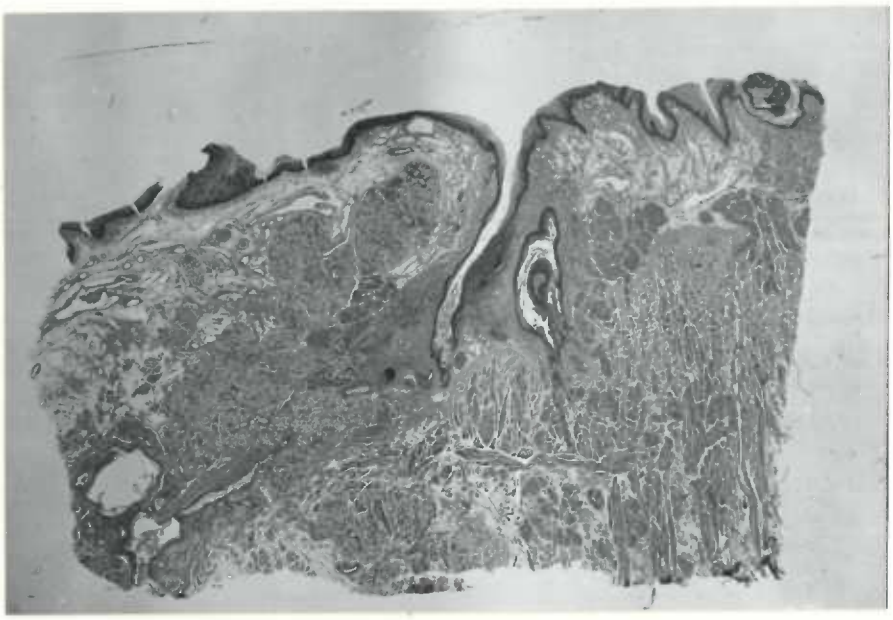

Figure 79

Figure 80

Figure 79. This is a routine section taken from a tongue which grossly had a foramen cecum of 6 mm. In the lower left hand corner are two cystic spaces lined by a simple stratified squamous epithelium. The lower cyst appears to be continuous with a duct which comes from the general direction of the foramen cecum. Anterior to the deep foramen cecum is another cystic space containing a papilla in the lumen. This incidental finding is of considerable importance since the cystic areas were not seen on gross section. This specimen is from an 85 year old male, in which there was no anatomical cause of death. 11X.

Figure 80. This is a deep thyroglossal duct with a small nodule of thyroid gland at the bottom of the epiglottis. The foramen cecum does not show the depression from the anterior aspect because of the extremely largepepilli. However, the slanting in the posterior direction is similar to the previous cases. This specimen is from an adult with the cause of death undetermined.

Figure 81

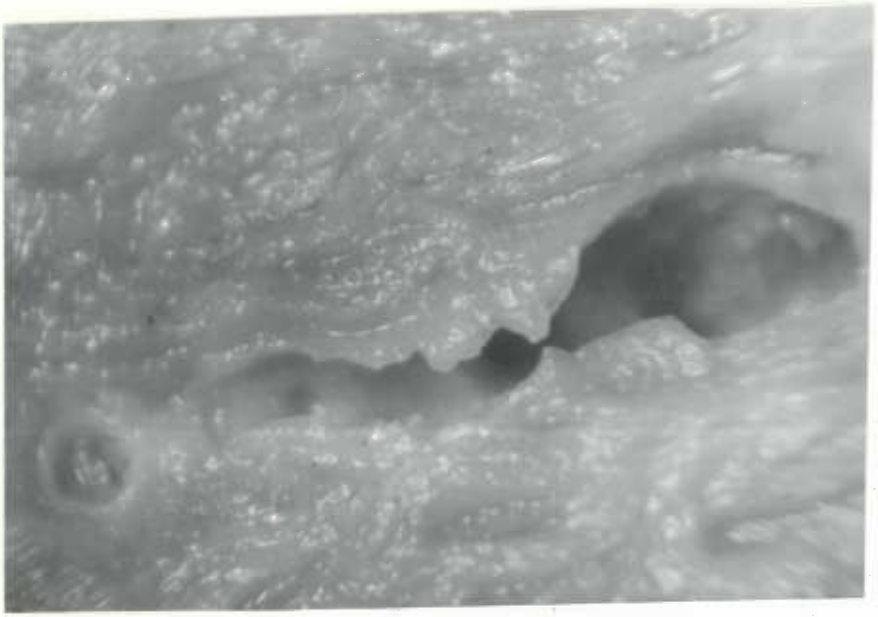

Figure 82

Figure 81. A thyroglossal duct arising in a slightly depressed foramen cecum shows a sharp deviation from the normal path and ends in the musculature lying over and anterior to the hyoid bone. The end of this duct is a series of cyst-like spaces. A magnified picture of this area is seen in Figure 82. This specimen is from a 52 year old male, who died from traumatic compression of the spinal cord.

Figure 82. This is a magnification of the cystic area at determination of the thyroglossal duct in Figure 81. A small cyst-like area in the lower left corner is typical of other outcroppings from the wall of the large cystic space on the right. 1X.

Figure 83

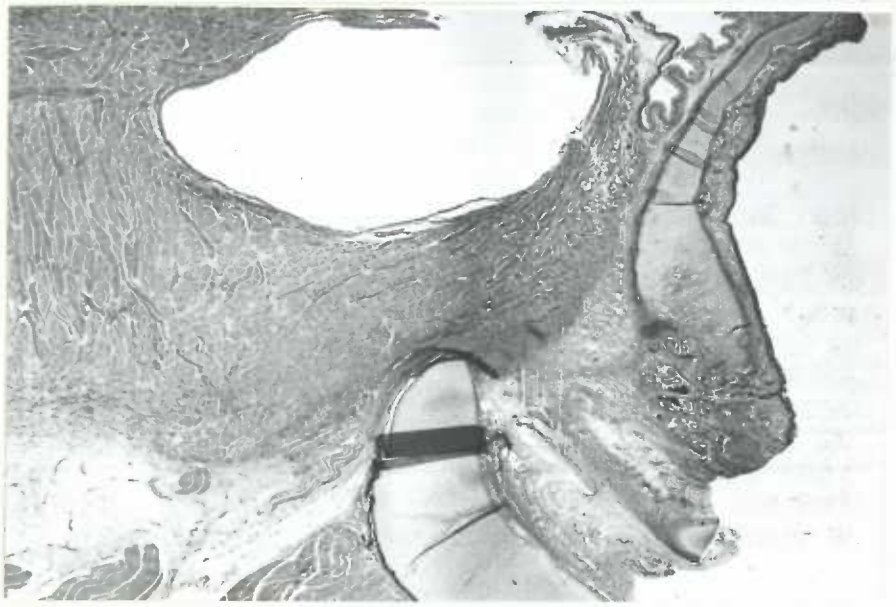

Figure 84

Figure 83. There is a large cyst beneath the foramen cecum and lingual tonsil area. This large area was undetected at autopsy. No direct connection could be found with the surface, although the cyst lining was within a mm. of the epithelium of the surface of the root. The microscopic section is in Figure 84. The specimen is from a premature infant that lived 12 hours.

Figure 84. The cystic space seen in Figure 83 is in the middle of the upper portion of the photomicrograph. There is a very thin primitive epithelial lining. No inflammatory infiltration is present. Due to slight distortion of the block, the section does not show the epitheliated surface of the root. The cartilagenous structure on the right is the epiglottis which shows several folds on the anterior surface. Portions of the hyoid bone are in the center at the bottom of the photograph. The cyst has distended and almost obliterated the mucous gland of the root and apparently has prevented the formation of the Von Ebner glands. 8X.

Figure 85

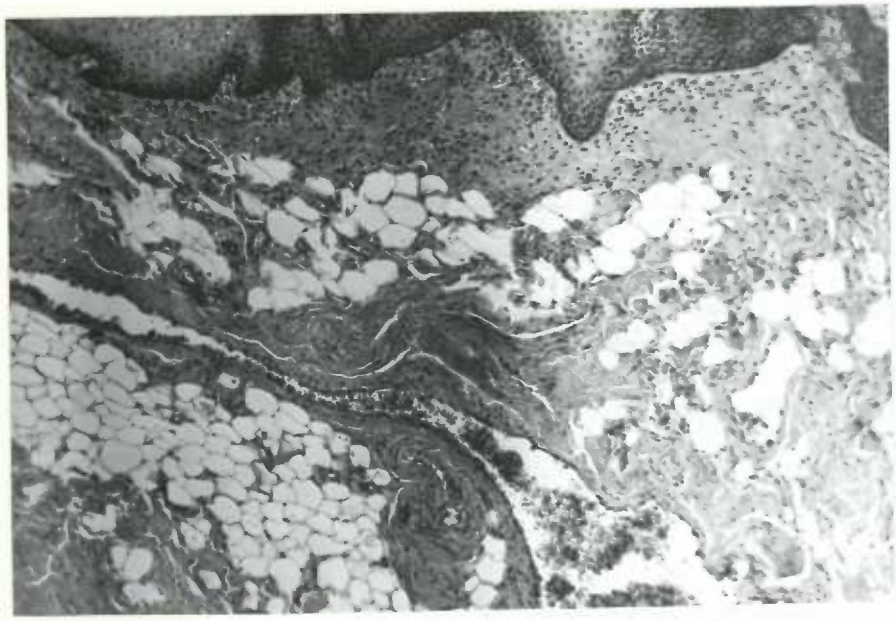

Figure 86

Figure 85. In the lamina propria there is an accumulation of blood which is apparently just beneath the epithelium. In the anterior part of the tongue there is a marked deviation of the lamina propria in the presence of a deep central fissure. The muscle and fibrous tissue beneath this fissure appear to be denser than the adjacent tissues. The photomicrograph of the dark area beneath the epithelium is seen in Figure 86. This specimen is from a 72 year old female, who died from chronic pyelonephritis.

Figure 86. In the left hand side of the photomicrograph is an endothelial lined channel which extends downward to the middle of the fissure. This vascular channel has within its lumen numerous erythrocytes which are undergoing degeneration. Because of the lack of any evidence of thrombosis in the large vessel or any infiltration of inflammatory elements, it is felt that this represents capillary damage with bleeding into the lymphatic channels which lie beneath the epithelium, mainly on the dorsal surface. 38X.

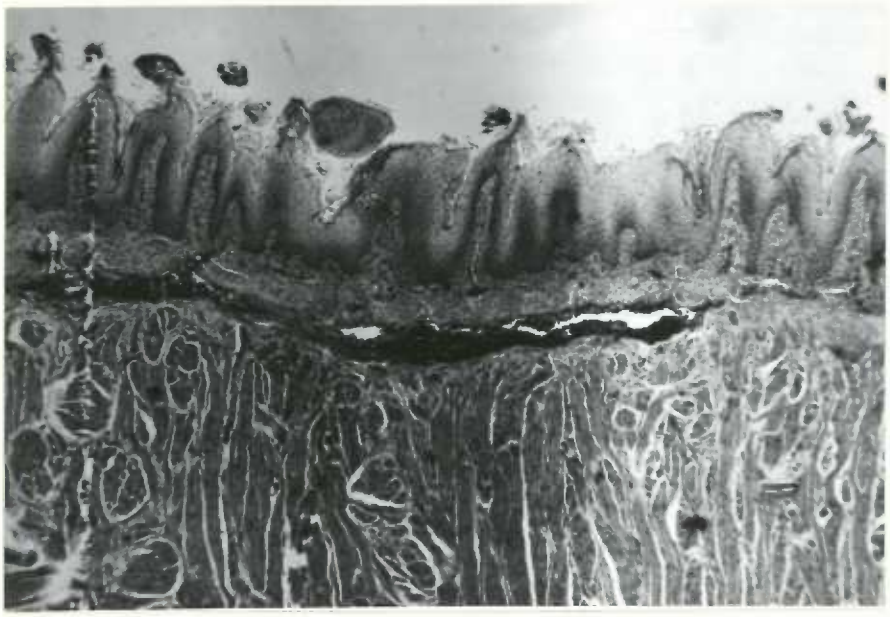

Figure 87

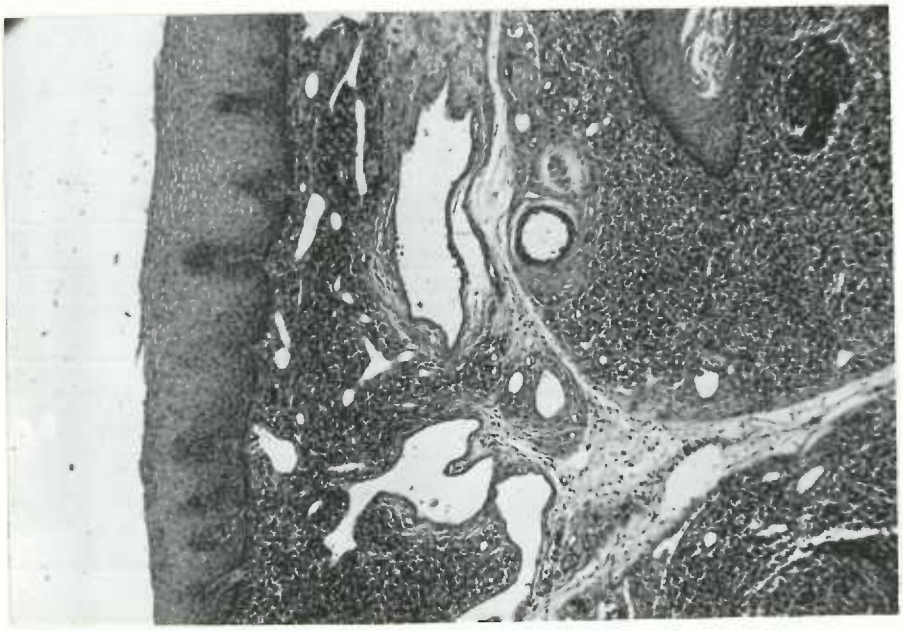

Figure 88

Figure 87. This is a similar accumulation of blood in the lamina propria almost identical to Figure 86. The blood is more tightly packed but no evidence of thrombosis can be seen. The epithelial surface shows numerous primary papillary projections with occasional secondary projections. This specimen is from a premature infant with multiple congenital anomalies, who lived for 10 days. 24X.

Figure 88. This is from the lingual tonsil area just beneath the epithelium. The spaces are dialated lymph channels and may be of some significance in explaining the accumulation of blood beneath the epithelium in Figures 86 and 87. This specimen is from an 85 year old male, with no anatomical cause for death. 29X.

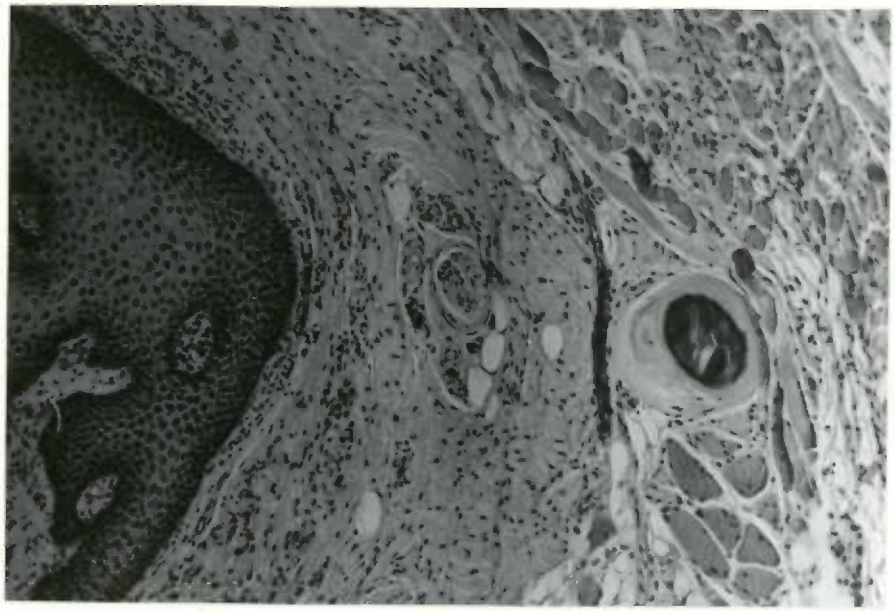

Figure 89

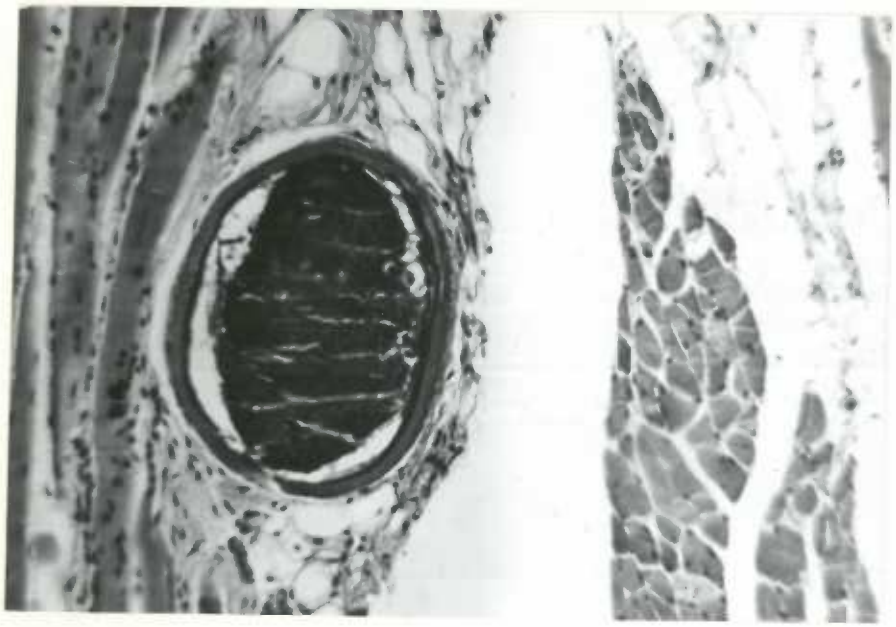

Figure 90

Figure 89. Slightly to the left of the right margin, is a spherical mass of calcified material surrounded by a hyalin structure. This represents a trichinella organism encysted and calcified within the muscle. This is from a routine section taken in the middle one third to the left of the midline. Grossly, there was no evidence of this structure. This specimen is from a 74 year old female, who died of severe pulmonary disease. 46X.

Figure 90. The large calcified mass within the homogenous hyalin structure is a calcified trichinella organism from the tongue of an 82 year old male, who died of bronchopneumonia. This area was not evident on grosssection and, like Figure 89 was an incidental finding on a routine section, from an area 1 cm. posterior to the foramen cecum. 80X.

Figure 91

Figure 92

Figure 91. This thrombus within a dialated blood vessel appeared as a hard dark mass in the lingual tonsil areas approximately 1 cm. to the left of the foramen cecum. The dark rod in the center slightly below the middle of the picture is an artefact. This specimen is from a 15 year old male, who died of carcinoma of the urinary bladder. 30X.

Figure 92. Several scars of the tongue were found but in color they resembled the surrounding tissue. This clinical picture of the scar resulting from an old tooth bite is typical of the size and area of similar lesions. This specimen is from the tongue of a 36 year old male.

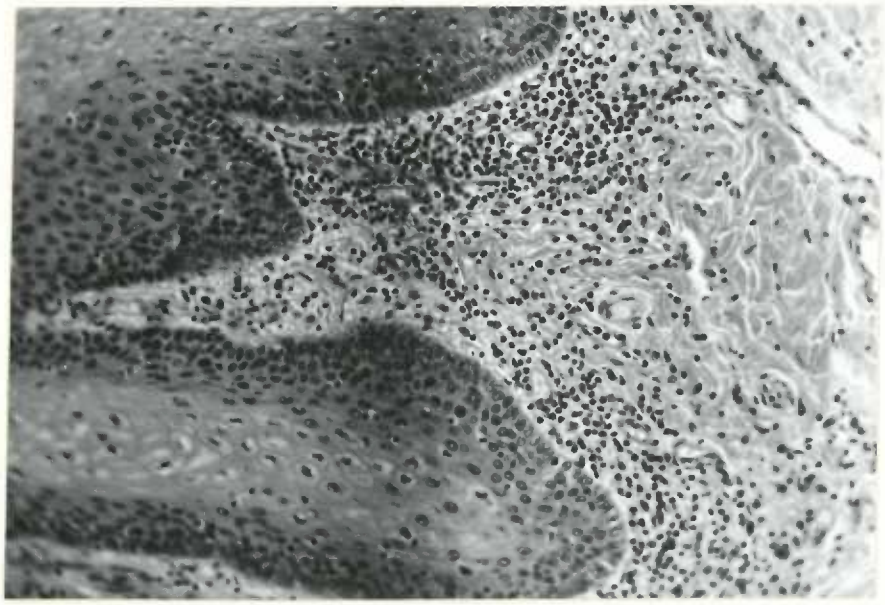

Figure 93

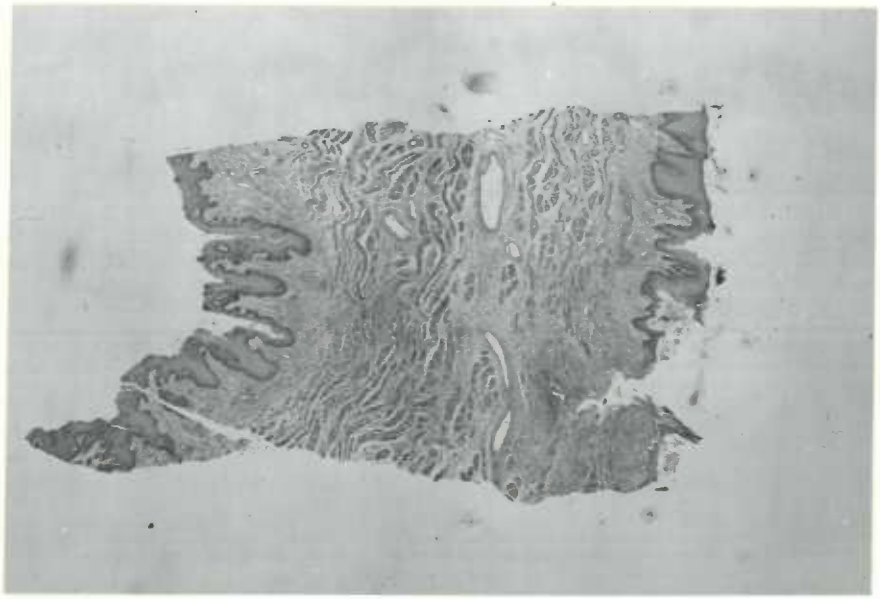

Figure 94

Figure 93. The chronic inflammatory infiltration seen beneath the epithelium was an incidental finding from the body of the tongue of a 25 year old male in good health who committed suicide by carbon monoxide inhalation. Since chronic inflammatory infiltration is a relatively rare finding in the tongue, this may well prove to be of some medical-legal significance. The surface epithelium was perfectly normal in all respects. 70X.

Figure 94. This is from the tongue of a 5 year old male, who died several days after receiving injuries in an automobile accident. The ulceration of the surface on the right is of the decubitus type. It is possible that the tongue remained pressed against a tooth or some surgical instrument was used for retracting. Inflammatory infiltration is mainly of a chronic type with some acute cells present. 5X.

Figure 95

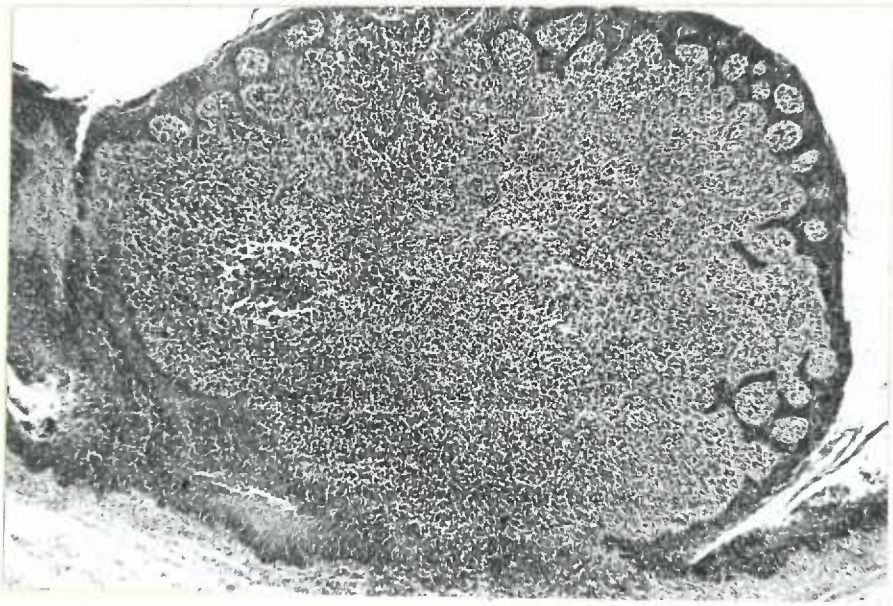

Figure 96

Figure 95. This ulceration was just below the lateral margin of the dorsum of the tongue and appeared to be quite vascular. The upper surface of the photomicrograph shows an ulcerated area with moderately severe chronic inflammatory infiltration. On the right is a segment of oral epithelium which was attempting to proliferate over the ulcer. It is felt that this represents an apthous ulcer or canker sore which was present for a few days before death. This specimen came from a 72 year old male, who died of severe cerebral hemorrhage. 70X.

Figure 96. This is a nodular proliferation on the surface of the root of the tongue approximately 1 cm. to the right of the foramen cecum. It was slightly darker than the surrounding tissue. This represents a dense lymphoid area with one lymphoid follicle to the left. There was considerable atypism of the cells but it was felt that they were within benign limits. This section is from the same patient as in Figure 95. 19X.