SURGICAL PATHOLOGY OF THE MOUTH

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PREFACE

THE form and content of this book are frankly vocational. This is not due to any lack of respect or regard for liberal principles in education, but because the book is written for a very special and closely-defined purpose. It arose from an attempt to escape empiricism in everyday dental practice, and it is an account of what appeared to happen when dental or oral tissues were interfered with experimentally, supplemented by deductions arrived at from examination of them when they became diseased and found their way to the laboratory.

Its purpose is to present in an orderly manner the results of this experimental interference and laboratory investigation so that the gaps in our knowledge may become apparent, and in due course be filled in as a closer relationship grows up between dental practice and the basic sciences. To further this project the usual arrangement of a general textbook of pathology has been followed so far as it would meet the case. The result is perhaps the story of general pathology as a dental man might see it. It cannot in the nature of things provide a very wide review of the general science, but is almost completely limited to those instances of cell degeneration, aberrations of growth and nutrition, inflammation and neoplasia which are of dental and oral interest.

The first chapter is not even very much concerned with pathology, for it seemed necessary to review the biological status of the dental tissues, which are highly specialized and have perhaps received rather scant attention at the hands of physiologists and bio-chemists. This is, of course, very natural, because physiology, like pathology, has been most widely studied and taught in relation to medicine, and both dental and veterinary science have suffered for lack of that close relationship with the basic sciences which alone can provide the proper foundation on which to build the study of pathology or the art of surgical intervention.

Now, however, a change appears to be taking place in dental education, which promises to be quite revolutionary. An attempt is being made to encourage selected dental graduates to take an honours course in science, and possibly a degree in medicine too, for the purpose of specializing in and teaching basic science subjects to dental students. This introductory chapter will at least indicate how wide a scope there is for original research, and, perhaps more specifically, some of the problems; indeed it consists very largely of an account of a number of biological observations and experiments which were necessarily made in order to elucidate our investigations into the pathology of the dental tissues. The same may be said of Chapter III and the reader may find both more useful if he refers back to them after reading some of the later chapters.

Owing to the growth and increasing complexity of human knowledge, no one can give his close attention to every aspect of any one of the basic medical sciences. One must select, even within a speciality, and the dental aspect has naturally not been a very popular one, since very few dentists have, until recent years, embraced the academic life as pure scientists.

The result is that dental students have sometimes been offered an abridged edition of the medical students' curriculum in these subjects, and were perhaps not always either very interested or much enlightened. Cell degeneration might at first sound interesting to them, but when it seemed to be an affair of the convoluted tubules of the kidney it lost dental importance. Study of the degeneration of fibroblasts or odontoblasts, however, provides the student with just as wide a cultural background, and is more likely to hold his interest if he intends to practise dentistry.

Similarly the streptococcal granuloma at the apex of an infected tooth may prove to be quite as stimulating and profitable an object for study as the corresponding tubercular or syphilitic lesion. It is therefore perhaps permissible that the latter should receive as little attention in a textbook for dental students as the former does in a text for medical students.

At all events, the author has learnt to rely on the generosity of his scientific colleagues, and knows they will be indulgent when he displays his own unfamiliarity with lesions that lack a dental interest. They will have no difficulty in supplying the deficiency, and when they recall that they themselves have never been very interested in the morbid anatomy of dental caries or pyorrhœa they will no doubt forgive him if he devotes more attention to ulceration of the gingival sulcus than to that of the intestinal mucosa in typhoid fever. None of us has perhaps given as much attention to the morbid anatomy of foot-rot in sheep as a strictly non-vocational pathologist might, or a veterinary specialist would.

The author cannot, however, hope to excuse himself so easily for presuming to write a textbook on pathology. He is a clinician, and such knowledge of pathology as he may possess, although it has cost him much of his leisure for the past twenty-five years, is not very catholic. Nevertheless, as a clinician one does find out just what sort of knowledge is needed, and the matters discussed in this book should prove to be to the point so far as the practice of dental surgery is concerned. Perhaps at best they may form a scaffolding round which others will build. Where inaccuracies exist, the author must claim special indulgence; but even so these approximations to truth may serve to make operations on the dental and oral tissues more predictable and less empirical, and that was the author's purpose.

It is to be hoped then, that this book will not be judged by the standard of a general textbook of pathology, or by that of one of the invaluable American compilations which illustrate and describe every oral abnormality or disease which has ever been reported; its purpose is quite

different from either. It can be given to the dental student either before he reads a general text book of pathology or after; but it is not meant to replace it. It makes no attempt to deal comprehensively with pathological phenomena unless they have a direct dental application. Even such universal reactions as inflammation are described from an unfamiliar angle. Neither is this a book to consult when some rare clinical manifestation of oral disease turns up; but it does perhaps represent, however inadequately, the irreducible minimum of pathology which the dental student or practitioner will need to assimilate and remember if he is to understand his daily work and predict his results.

Grateful acknowledgment is due to Mr. William Pereira for his invaluable help. The sections and photomicrographs are nearly all his own work, except where acknowledgment is made in the text. The author is also deeply indebted to Professor Lovatt Evans and Professor Sir Alexander Fleming and Professor Wilfred Newcombe for their constant, and often quite deservedly critical, advice and encouragement. Dr. I. H. Maclean is an old associate and has once more nobly come to the author's rescue by writing Chapter VI, and reading proofs. It is not possible to say how much the author owes to his old colleagues at the John Hampton Hale Research Laboratory of the Royal Dental Hospital, but they are all gratefully remembered.

Acknowledgment is due to The Royal Society of Medicine and The British Dental Association for the generous gift of blocks with permission to reproduce the illustrations, and to many friends who have put illustrations at the author's disposal. Professor R. V. Bradlaw has earned the author's special gratitude by going over the text most meticulously and suggesting many amendments which the author has adopted so far as it lay within his power to do so. Sir Isaac Pitman and Sons, Ltd., have with great patience, courtesy and skill, made the publication of the work possible.

INSET COLOUR PLATES

PLATE		*f.p.*
I	*Drawing of the deposit of "eburnoid" at the senile end of the pulp chamber of a guinea pig's molar*	64
II	*Drawing of root apex of monkey's tooth which has been transplanted to the medullary cavity of the same animal's femur*	76
III	*Drawing of odontoblasts of monkey 65 hours after a peripheral cavity in the dentine had been cut*	80
IV	*Drawing of a ground section showing a later stage of the reaction shown in Plate III*	92
V	*Drawing of human molar after dye diffusion from the pulp showing early caries of a fissure*	212
VI	*Drawing of a ground section of a monkey's incisor after dye diffusion from the pulp; an experimental cavity had been cut at the periphery of the dentine three months before*	216
VII	*Drawing of a section of a human canine after dye diffusion from the pulp showing an erosion cavity*	218
VIII	*Drawing of a human incisor after dye diffusion showing the excessive dead tract in this plant when mesial and distal caries plus attrition are present*	226
IX	*Drawing of a human lower incisor after dye diffusion to show the dead tract and barrier of eburnoid under attrition*	228
X	*Hereditary hypoplasia of enamel in two sisters*	366

CONTENTS

CHAP.		PAGE
	Preface	v
I	INTRODUCTION	1
II	CELL GROWTH AND DEGENERATION	59
III	REPAIR OF THE CALCIFIED MATRIX	89
IV	CIRCULATORY DISTURBANCES	111
V	INFLAMMATION	125
VI	CHEMOTHERAPY AND BACTERIAL DEFENCE	161
VII	THE SURGICAL PATHOLOGY OF BONE	175
VIII	THE PATHOLOGY OF THE DENTINE AND THE DENTAL PULP	211
IX	THE PATHOLOGY OF THE CEMENTUM	249
X	THE PATHOLOGY OF THE PULPLESS TOOTH	266
XI	THE PATHOLOGY OF THE MUCOSA	291
XII	THE PATHOLOGY OF THE PARODONTAL TISSUES	304
XIII	FOCI OF INFECTION	352
XIV	PATHOLOGY OF THE ENAMEL ORGAN AND ENAMEL	359
XV	NEOPLASIA	384
XVI	MESENCHYME TISSUE TUMOURS	395
XVII	EPITHELIAL TUMOURS AND TUMOURS ARISING FROM SPECIALIZED TISSUE	424
XVIII	TUMOURS OF DEVELOPMENTAL ORIGIN	441
	Index	457

CHAPTER I

INTRODUCTION

(A preliminary discussion of certain features of epithelia and of tissues derived from the mesenchyme)

1. Epithelium

The term epithelium is applied to a number of tissues in the body on account of their histological similarity rather than because they are derived from any particular embryonic germ layer. In fact epithelia are not only derived from all three primitive layers but even the mesenchyme gives rise to the endothelium of the blood vessels which in some respects resembles epithelium.

The ectoderm gives rise, amongst other structures, to the outer covering of the body and to the lining of the buccal cavity with, in each case, the associated glands. The entoderm gives rise to the lining of the alimentary canal and respiratory passages together with their associated glands, while the mesoderm produces the mesothelium of the pleura and peritoneal cavity.

These structures have many of their characteristics in common and resemble each other histologically so much that they can be described together. For instance, in epithelial tissues the cells always lie close together with only a very small amount of intercellular substance between them; an important point of distinction from the connective tissues.

Epithelial Cells. Epithelium is described as being of two kinds. In one the cells are arranged in sheets spread out over surfaces or line cavities or channels, while in the other the channels become small and tortuous, or even disappear altogether so that the cells are massed together in clumps to form solid glands. The cells rest on the connective tissue and derive their nourishment from it. There are no blood vessels in the epithelium itself, so that it must rely on the blood vessels in the connective tissue to supply the tissue fluid which seeps into it and nourishes it and takes away its waste products. It follows that epithelial cells are entirely dependent on having normal healthy connective tissue beneath them, or around them, for the maintenance of their integrity.

Papillæ. Under stratified squamous epithelium such as the skin and mucous membrane of the buccal cavity, this connective tissue is as a rule heaped up into papillæ which interdigitate with downgrowths of the epithelium itself (fig. 1). This arrangement facilitates the diffusion of tissue fluid from the vessels into the epithelium. In certain places, however, the

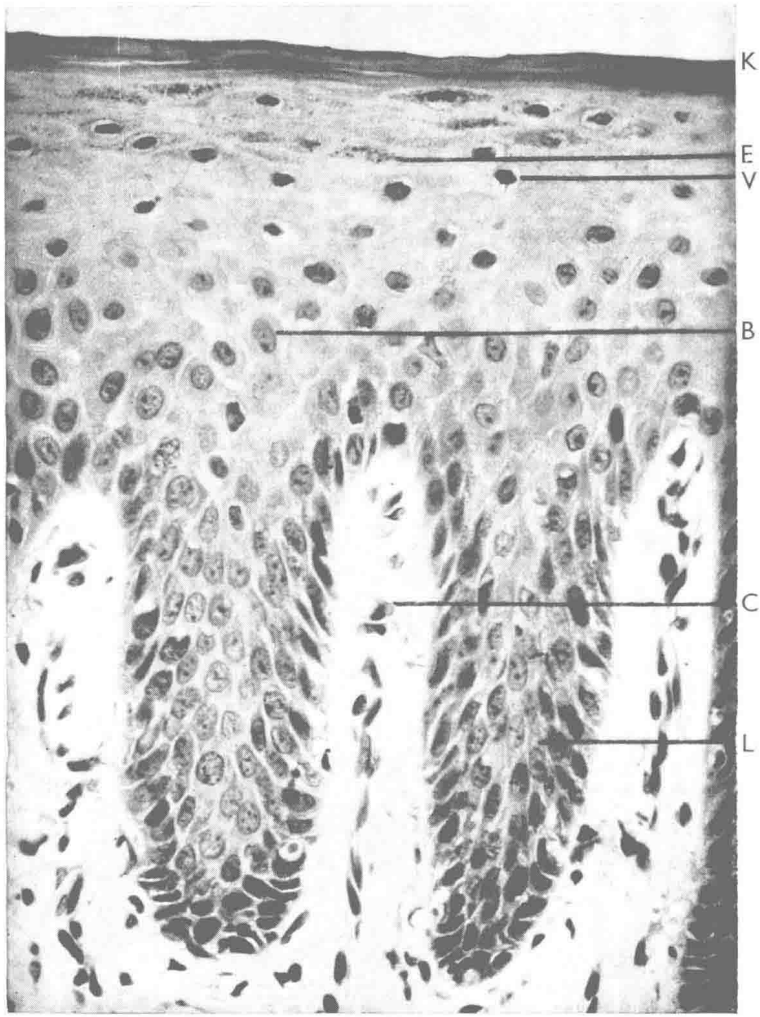

FIG. 1

Photomicrograph × 420 *of typical stratified squamous epithelium with keratinous cuticle* (K) *from the gum margin. The papillæ of the connective tissue corium* (C) *carry blood vessels and supply tissue fluid to the epithelial cells. The columnar cells* (L) *become cuboid* (B) *and then flatten as they reach the surface. The nuclei become contracted, stain more heavily and vacuoles* (V) *form round them; this degeneration is called pyknosis. Eleidin granules* (E) *appear in the cytoplasm; they are the precursor of keratin.*

papillæ are absent, as, for instance, the skin of the forehead, the mid-line of the scrotum and perineum and the epithelium lining the parodontal sulcus.

Between the epithelial cells and the connective tissue on which they rest a *basement membrane* may usually be observed, which appears in stained sections as a thin dark line and is probably formed of intercellular fibres from the connective tissue.

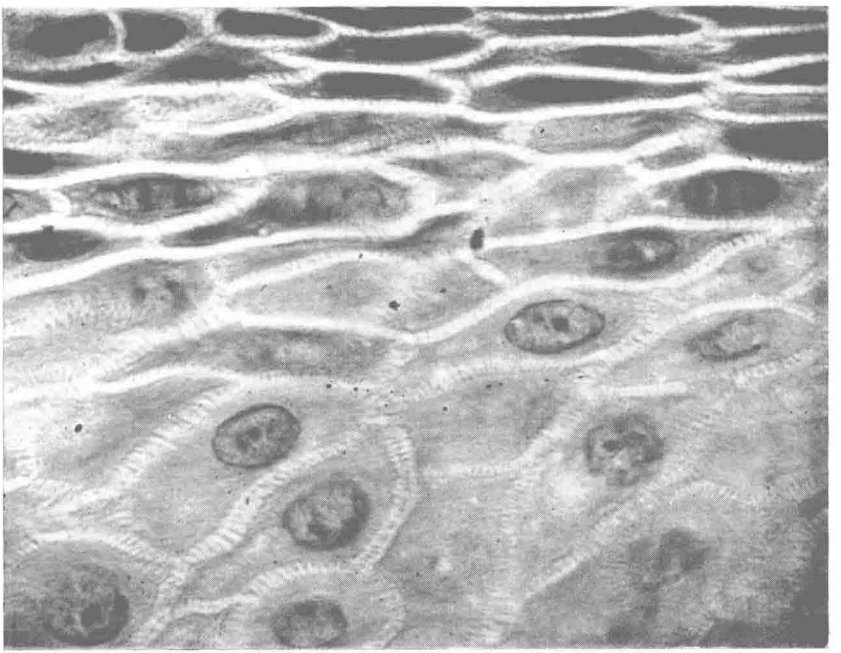

FIG. 2

Photomicrograph × 1150 *of the cuboid cells of stratified squamous epithelium, showing the protoplasmic bridges between the cells.*

It may be quite impossible to distinguish from their structure alone whether a particular group of epithelial cells was derived from the ectoderm, entoderm or mesoderm. They have, however, very different potentialities. For instance, the peritoneum or pleura, because it is derived from the mesoderm, may, under the influence of irritation, be converted into fibrous tissue and produce adhesions, whereas this never happens to epithelium derived from the ectoderm or entoderm. At the same time different types of epithelial cells may arise from the same germ layer.

Polarity. Epithelial cells naturally exhibit polarity. That is, a difference in structure and functions between the end of the cell towards the connective tissue and the other end of the cell. This is due to the fact that the basal end is purely nutritive, in every type, while the free surface

is concerned with the special function of the cell. This may be secretory, as in the cells of the salivary gland, or in part mechanical, as in the case of the cells lining the alimentary canal.

Indeed there is a great variety of purpose for which epithelial cells are adapted, and for which they undergo modifications. In secreting cells

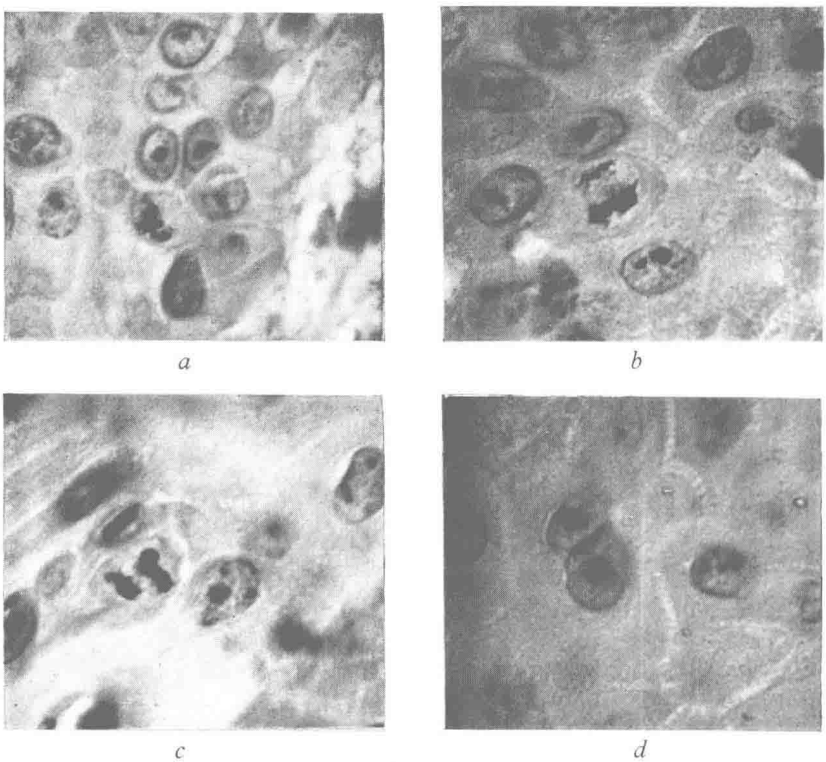

FIG. 3

Photomicrograph × 1000 *of mitosis in the epithelial cells of a papilloma as observed in ordinary histological preparations.*

a the nucleus beginning to divide.
b the chromosomes form a typical "bar" shape.
c the chromosomes have separated into two "bars."
d the nucleus has also divided.

the free ends are filled with granules. In the intestinal epithelium the cells have a *striated* border at the surface. Again we find a brush border in the cells of the uriniferous tubules, while ciliated epithelium is another striking example of cell polarity.

Proliferation and Degeneration. Epithelial cells on the surface of the body are constantly being shed and replaced. In stratified squamous epithelium the surface cells normally undergo a peculiar type of degeneration called *Cornification* or *Keratinization*. This spells death to the

cell but is essential to the life of the individual. The deeper columnar cells proliferate by mitotic division (fig. 3) and gradually move up towards the surface as the top layers are rubbed off. As they move up they recede further from their source of nourishment, the nuclei become pyknotic, vacuoles appear round the nuclei and the cells become more flattened or squamous while *eleidin* granules appear in their cytoplasm (fig. 1). These granules are the precursor of the keratin-like group of proteins into which the whole cell is converted as it gradually shrivels up with old age and lack of nourishment, and flattens even more, until it becomes one of the dead keratinous flakes which form the horny surface layer.

Hyperkeratinization. In those parts of the body where there is great friction this surface layer becomes extremely thick and tough. The increased irritation stimulates reproduction, more cells are produced and a greater number are to be found in each stage of degeneration; so that by applying constant friction to any part of the stratified epithelium the surface layer can be made to keratinize more firmly. A familiar example is the callosity which appears on the hands of a manual labourer or an oarsman, or even a golfer.

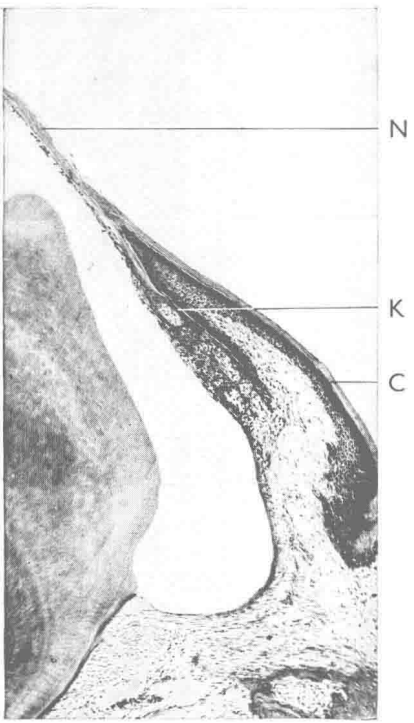

FIG. 4

Photomicrograph × 33 of partly erupted molar tooth of rat showing continuity of Nasmyth's membrane (N) *and the horny cuticle of the gum* (C). *There is a keratinous invagination at* (K) *but no parodontal sulcus.*

This keratinization also appears on the epithelium which forms the gum margin and is kept hard by the constant friction of food; or at least it is kept hard amongst wild animals and men who have to chew hard to live, perhaps masticating the young frond of a tree-fern for hours, to extract the amount of starch which civilized man can derive without any physical effort from eating one single potato.

The Gum Margin. The disposition of the epithelium at the gum margin calls for special description. When a tooth erupts through the stratified epithelium of the gum there is still an epithelial remnant of the enamel organ on the tooth surface, and this fuses with the epithelium of the gum. This epithelial remnant may be seen in any young tooth (figs. 4-7) still adherent to the unerupted part of the enamel.

There is, however, a dipping-in of the keratinized cuticle together with its supporting epithelium at the place where the remnant of the enamel organ joins the mouth epithelium. This arrangement gives a triple horny layer at the actual edge of the gum, and so provides for a rapid proliferation and keratinization of the epithelium at this all-important point where most of the masticatory stress falls (fig. 4).

Unfortunately the device contains within itself the germ of its own undoing, the horny invagination tends to split at the point where tooth and gum epithelia meet, forming the *parodontal sulcus*, and only constant friction by the roughest primitive food or by some artifice can prevent this sulcus from developing, in most people, into a deep infected trough or parodontal pocket. There is a similar dipping-in of keratinized material at the base of the nail-bed, and even in the unmanicured monkey this

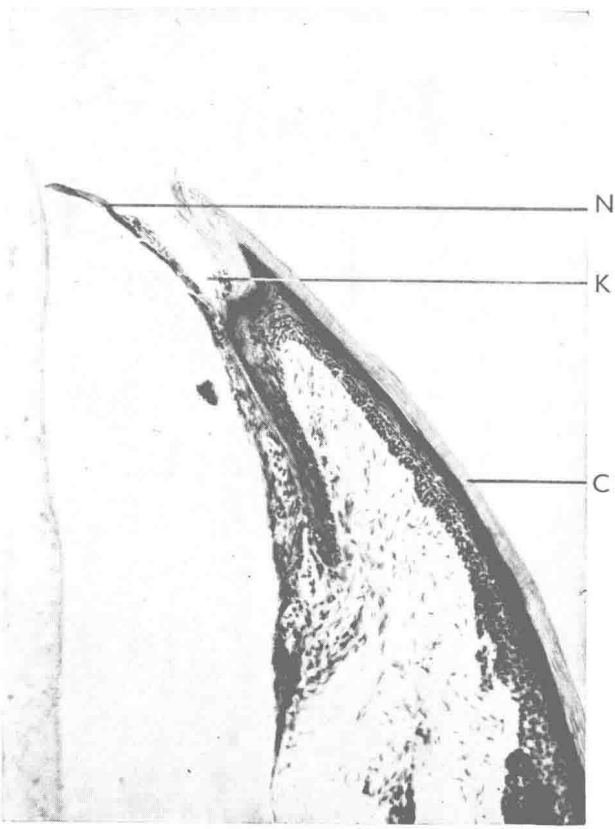

FIG. 5

Photomicrograph × 66 *of a molar tooth of rat showing early split of keratinous invagination* (K), *forming a sulcus.* (N) *Nasmyth's membrane.* (C) *Horny cuticle of gum.*

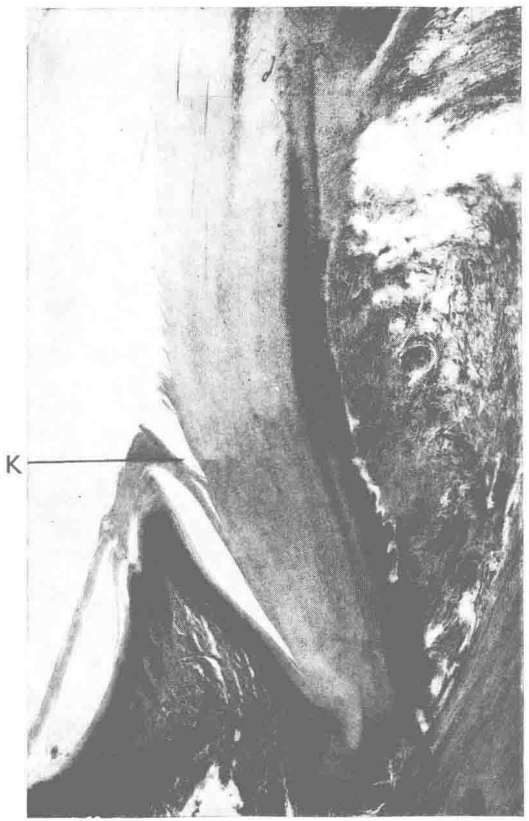

FIG. 6

Photomicrograph × 21 *of base of finger-nail of monkey (Mr. H. B. Harding's specimen), showing a keratinous invagination* (K) *similar to that in Fig.* 5, *which also shows a tendency to split.*

keratinous invagination also shows the same tendency to split (fig. 6). In over-manicured fingers, softened by disuse, chronic infection of the nail-bed, called *onychia*, is not uncommon. The infection enters this crevice, and the nail may be loosened and lost like a tooth, only in such an event a new nail will grow.

Such easy replacement is, unfortunately, only an attribute of simple structures. The relatively undifferentiated teeth of the shark persist in a continuous series, but the human tooth is too specialized to be reproduced so freely, and though well adapted to its native purpose it cannot survive the changed environment imposed upon it by civilization unless the epithelium protecting its attachment be compensated for its lost stimuli.

Under savage conditions, as age advances the gum recedes, just as it

does with civilized races, but the savage wears his teeth down by attrition almost as fast as the gum recedes, so that the gum margin continues to present a stream-lined contact with the tooth, remains attached quite near the biting edge and gets adequate friction which keeps it hard. Only in a very old savage are long clinical crowns observed with stagnation areas and caries and pyorrhœa pockets at the softened gum margin. For a number of years an almost ideal state of structural and physiological perfection persists like that in fig. 5. If the interdental papilla between two molars of a young rat is examined the epithelium is found firmly adherent to the enamel and there is no interdental space. Indeed, in fig. 7 the rat's molars, one of which is perhaps still only partially erupted, are actually stuck together by the cuticle which is common to both at the contact point, precluding for the moment both caries and pyorrhœa.

The Parodontal Sulcus. In material from civilized man there is, however, always some indication of the constant trauma to which the gum margin, softened by relative disuse, is submitted. There is always a definite parodontal sulcus and, apparently, always some chronic inflammatory infiltration round it. This apparently slight deviation from normal is the starting point for the study of pyorrhœa and will be taken up in its appropriate place.

Invaginations of the primitive ectoderm are of extremely common occurrence. Fig. 8 shows some simple types of invagination which are common on the skin and mucous surfaces of the body forming the superficial glands. Their similarity to the invagination which forms the tooth bud from the mouth epithelium is apparent. Actually the neural groove itself starts as an invagination of this kind and all the glands, both exocrine and endocrine, have a similar origin from one or other of the embryonic epithelial surfaces; only the endocrine variety lose their connection with the surface. The permanent tooth bud retains a vestigial contact by means of the gubernaculum.*

The exocrine glands retain a duct so that their secretions pouring along it reach the surface from which the gland was derived. The endocrine glands (such as the thyroid†, adrenal, etc.) have no duct, since they lose their connection with the surface and their secretions pass directly into the tissue fluid and are absorbed into the blood-stream. Mixed glands such as the testis and pancreas have both an endocrine and an exocrine secretion.

Cuticles. An extremely important function of epithelium is the formation of cuticles. These consist of a solid layer of material which, being secreted by a sheet of epithelium, come to lie on its surface. These cuticles are not actually a part of the cells but are secreted by them and

* Warwick James, W., and Wellings, A.W., Proc. Roy. Soc., Sect. Odont. XXXVII, 1.

† A vestigial remnant known as the Thyroglossal duct connects the *Foramen cæcum* of the tongue with the isthmus of the gland, and may become the site of cyst formation (fig. 230).

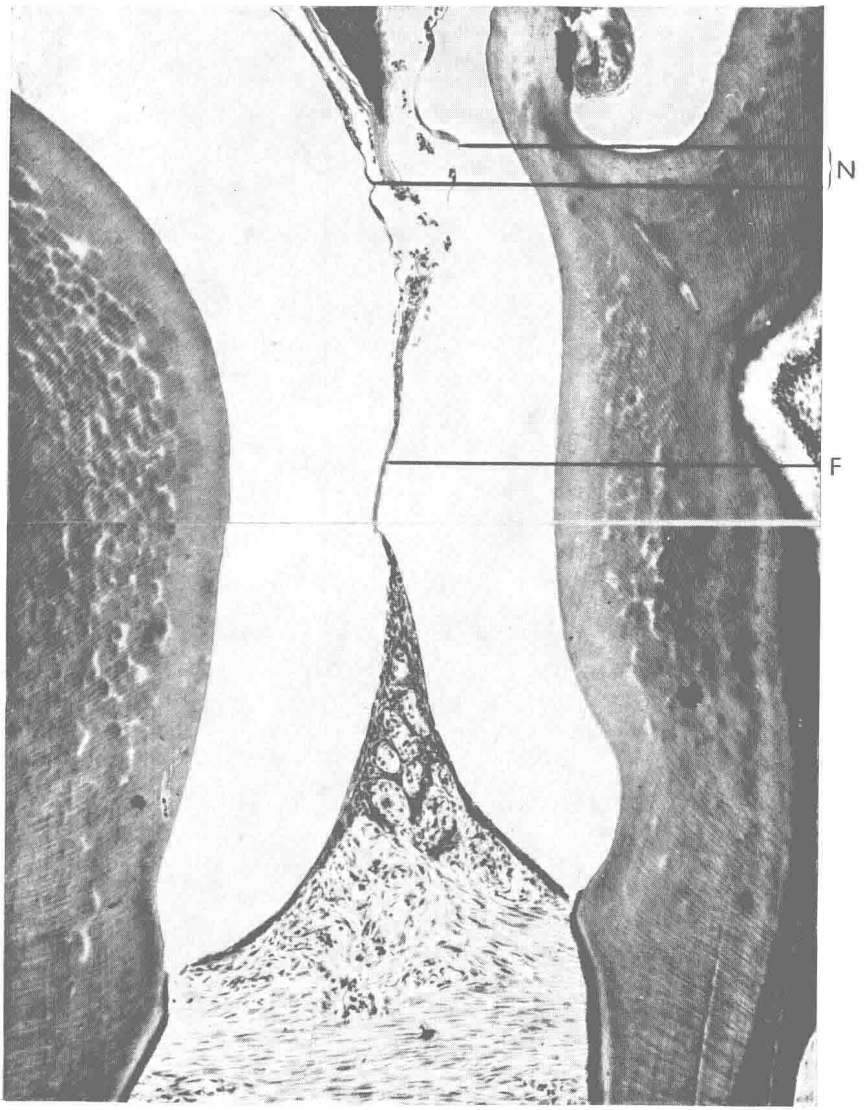

FIG. 7

Photomicrograph × 66 of interdental papilla of rat's molars, showing the Nasmyth's membranes (N) fused at (F) and healthy tissue filling the whole interdental space.