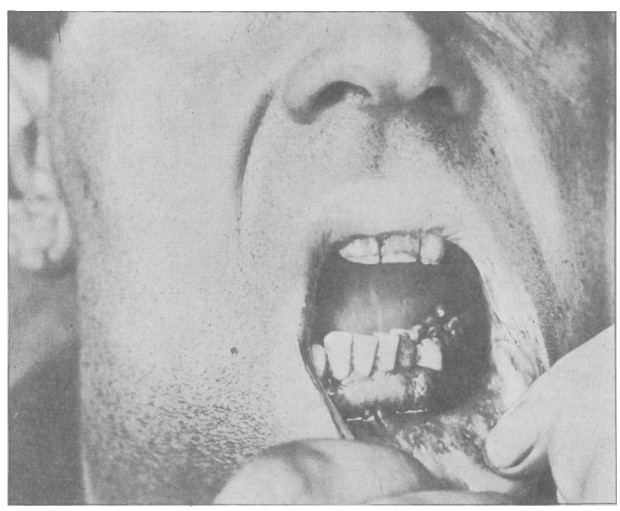
The temperature was 102° F. and the pulse-rate 120. The patient was therefore admitted into hospital, where his spleen was found to be palpable two inches below the costal margin.

A further blood-count showed an increase of myeloblasts to 76%, and a reduction of hæmoglobin to 67%. Blood-count (9.4.37): Erythrocytes 3,300,000; Hb. 67%; C.I. 1·03. Leucocytes 91,500 (poly. neutros. 0·5%; small lymphos. 6%; large lymphos. 7%; large hyals. 4·5%; transitional neutros. 2%; neutrophilic myelocytes 3·5%; myeloblasts 76%). Slight poikilocytosis and anisocytosis. Cultures from the gum margin disclosed nothing relevant.



S. G., 7.4.37. Acute myeloid leukæmia.

The patient died on April 10, of bronchopneumonia. The black area on the buccal aspect of the gums had then extended freely on to the adjacent cheek.

The illustration shows the appearance on the day after admission.

[A specimen taken from the left molar region was shown.]

[*November* 22, 1937]

Infection of the Salivary Glands

By Reginald T. Payne, M.S., M.D. F.R.C.S.

In view of the wide nature of my subject, I propose to confine myself to a consideration of pyogenic infections of the salivary glands and to exclude the chronic infections due to tubercle, syphilis, and actinomycosis, and the virus infections such as mumps. Many of the infections of the salivary glands are secondary to dental disease and many cases closely simulate dental disease. The newer methods of investigation have enabled this branch of stomatology to be approached along more exact lines, with consequent greater accuracy in diagnosis and treatment.

The present paper is based upon a series of 208 cases of infection of the salivary glands (117 parotid; 91 submaxillary) which have come under my personal care or observation.

[The comparative anatomy and development of the salivary glands, and their main anatomical, histological, and physiological, features were then described.]

Special Methods of Investigation

In addition to the clinical examination of the salivary glands, special methods of investigation should be carried out in cases where these are indicated. These should include examination of a canula specimen of saliva from the gland to be investigated, and its subsequent cytological and bacteriological study. Examination of this saliva for the ptyalin content is hardly of more than academic interest. Careful radiological examination should be carried out in all doubtful cases, and may reveal unexpected opacities. The interpretation of these pictures is not always easy. Sialography by means of the injection of lipiodol or other substances may prove of extreme value in determining the anatomical configuration of the duct system of the glands, particularly in cases associated with any degree of retention of salivary secretion.

Infection of the Parotid

The parotitis cases in the present series were distributed as follows :—

Acute parotitis	54 (males 33 ; females 21)
Recurrent parotitis	52
Chronic parotitis	11
Total	117

It is not always easy to decide into which of these categories any given case should go. As far as possible, however, cases have been considered to be (1) Acute, when the patient came under observation in the first attack and in which pain and swelling were characteristic features. (2) Recurrent, when the symptoms were definitely of a recurrent nature and associated with intervening periods of freedom. (3) Chronic, when the infection persisted, did not become acute, and did not exhibit a clinical periodicity. Some degree of overlapping of these various types of case has, however, been unavoidable.

(*A*) *Acute Parotitis*

Acute parotitis is a condition which may at times be initiated by the patient's neglect of oral hygiene ; it is one which in the past was frequently due to the negligence of all hygiene in the post-operative period or during treatment which involved oral starvation, and it is still a condition in which delay in treatment only too often allows the surgeon to wait with folded arms for the signs of abscess formation, or, should these fail to appear, to carry out some minor operation which does little to relieve the underlying parotitis. Nevertheless, as a complication of a variety of diseases, acute parotitis is still met with in a sufficient number of cases to make its ætiology, pathology, and treatment, worthy of study. For, if the pathological processes which lead to gross suppurative changes are understood, treatment based on this knowledge will, if carried out towards the beginning of the disease, frequently prevent its progress and avoid the necessity for operative measures.

Ætiology.—Theoretically, infection may reach the parotid by three routes : by the blood-stream, as an ascending infection via the duct, or by direct extension from adjacent organs. The evidence is conclusive that in practically all cases pyogenic parotitis is ascending in origin and that the other routes of infection are rare.

Hæmatogenous parotitis : Infection of the parotid gland of a septicæmic or pyæmic nature is so uncommon as to render it a pathological curiosity. If hæmatogenous infection does occur, the lesion must be in the nature of an interstitial,

suppurative parotitis starting in the region of the small blood-vessels and extending secondarily to the glandular tissue, a type of lesion which in practice is not found. Although patients with septicæmia or pyæmia do at times develop acute parotitis, it is invariably of an ascending type, and this is supported not only by the histological evidence but by the frequency with which the *Staphylococcus aureus* is the infecting organism in the parotid, irrespective of the organism causing the septicæmia or pyæmia. For example, although parotitis is quite often met with during the septicæmic stage of typhoid fever or during the course of pneumococcal infections, it is seldom due to their specific micro-organisms.

Direct infection : Parotitis occasionally results from the spread of infection from adjacent tissues. This may be of the nature of an acute cellulitis, an acute lymphadenitis or an acute osteomyelitis of the mandible. In all such cases, the infection reaches the parotid through lymphatic channels.

Ascending infection : Acute infection of the parotid is in nearly every case an ascending one, no matter whether it occurs as a post-operative complication, during the course of a specific fever, as a terminal infection, or in patients taking very little food by mouth. It is a matter of some dispute whether micro-organisms are present in the terminal part of the parotid duct. If, for any reason, the virulence or the number of the micro-organisms present in the region of the duct orifice is increased, or, on account of obstruction in the terminal part of the duct, the amount of saliva secreted by the patient is seriously diminished, or the general resistance to disease markedly lowered, ascending infection occurs. Saliva is a poor culture medium for the majority of pyogenic bacteria but, in health, it is probable that the constant flow along the duct possesses a more important mechanical function in preventing ascending infection than any inherent bactericidal action.

From the point of view of clinical ætiology, the following are the most important conditions during the course of which acute parotitis may arise :—

(1) Post-operative—especially after abdominal operations.
(2) Acute specific fevers—especially typhoid, typhus, and lobar pneumonia.
(3) Any cachectic condition—as a terminal infection.
(4) Oral starvation—as after hæmatemesis.
(5) Insanity.
(6) Secondary to duct obstruction.
(7) Secondary to buccal infections.

In a series of 1,000 cases of hæmatemesis recorded by Rolleston and Oliver [1] which had been treated by oral starvation, parotitis occurred in 23.

The recent observations of Christiansen [2], who found that death after massive hæmorrhage from gastric ulcers was due to extrarenal uræmia, would suggest that in many cases at least, parotitis may be considered as possibly a uræmic manifestation.

In the present series of 54 cases, ætiological factors were present in 42. The details are given below :—

Local :—

Dental infections or dental extractions		6
Dental plate	... ...	1
Colds	... ...	2
Pneumonia	... ...	2
Radon to carcinoma of cheek	...	1
Nasal catarrh	... ...	1
Post-recurrent or chronic parotitis	...	2
Parotid calculus	... ...	2
During meal	... ...	1
Tonsillitis	... ...	1
Impetigo	... ...	1
		20

General:—

Hæmatemesis	6	
Post-operative	2	
Acute infections:		
Septicæmia	1	
Pyæmia	4	
Blood diseases (aleukæmic leukæmia)	1	
Chronic duodenal ulcer	1	
Diabetes and hepatitis	1	
Fatigue	1	
Bacillary dysentery	1	
Acute nephritis and uræmia ...	1	
Whooping-cough	1	
Measles	1	
Post-vaccination	1	
	——	22
Total		42

Macroscopic and microscopic pathology.—Pyogenic parotitis is essentially a process starting in the distal third of the duct. In the earliest stage, this consists in the multiplication of micro-organisms followed by catarrhal inflammation of the duct with increased secretion of mucus, desquamation of cells, and invasion of leucocytes. These organisms, pus cells, and desquamated epithelial cells, may form a plug which acts as an obstruction to the free exit of saliva into the mouth, the so-called salivary thrombus. Consequently, at this stage, there is a damming back of saliva, with dilatation of the ducts and acini. The way is then paved for the development of an ascending infection which eventually reaches the finer ducts and acini of the parotid.

The earliest changes are of a catarrhal nature, but if the obstruction to the main duct still persists, or if the organisms are very virulent or the patient's resistance is low, suppurative changes occur. These changes are most marked in the regions of the smaller ducts or the alveoli, and in both these situations the formation of minute abscesses takes place. The next stage of the disease consists in the fusion of many of these small abscesses with the development of single or confluent abscesses. Hitherto the pathological process has been confined within the capsule of the parotid, but if softening takes place, perforation in one of several different directions may follow.

In addition to the above changes, necrosis of more or less of the parotid glandular tissue may occur, depending upon the virulence of the infection and the rapidity with which distension inside the gland capsule takes place. Occasionally, this process is so acute as to convert the whole gland into a slough, a condition which has been described by Cope [3] as acute necrotic parotitis.

The majority of the patients who come to post-mortem show some associated serious disease which might in itself be of sufficient severity to cause death. The parotid glands from these patients are always grossly enlarged and riddled with small abscesses. Microscopically, these abscesses are found to begin in the smaller ducts, whilst the larger ducts are distended with pus and micro-organisms.

A consideration of the gross anatomy and histology of such parotids suggests that the term " carbuncle of the parotid " is not inappropriate, since the lesion is essentially of the same type as two other important staphylococcal lesions, namely, carbuncle of the skin and carbuncle of the kidney.

Bacteriology.—By far the commonest organism found in acute parotitis is the *Staphylococcus aureus*, with the *Streptococcus viridans* as second in order of importance. In addition to these, other organisms which have been found include hæmolytic streptococci, typhoid bacilli, coliform organisms, pneumococci, and

Bacillus fusiformis. Bacteriological examinations were carried out in 38 out of the 54 cases of acute parotitis in the present series, and the following results were obtained :—

Staphylococcus aureus ...	25
Streptococcus viridans ...	5
Streptococcus hæmolyticus	2
Pneumococcus	4
B. coli (atypical) ...	1
B. fusiformis	1
Total	38

Professor Seifert [4] has carried out some interesting and instructive experiments in connexion with the striking predominance of the *Staphylococcus aureus* in acute infections of the parotid. These experiments consisted in the bacteriological examination of saliva from the region of both parotid and submaxillary ducts in patients during the pre- and post-operative periods. As a result of the examination of material from 90 cases, the majority of whom had had abdominal operations, Professor Seifert [4] showed that during the post-operative period there was an exaltation of the *Staphylococcus aureus* content in the mouth, at the expense of other organisms. Although in health staphylococci play a very subsidiary rôle, in the post-operative period they are markedly increased. This increase lasts for three or four days and then falls to normal. The degree of the increase was most marked in cases in which fasting was necessary, or in which the mouth was dirty before operation or in which little care was taken of the mouth after operation. In patients who were extremely ill, the number of staphylococci continued to increase until death. Amongst the cases examined, two developed parotitis. In one of these the parotid had to be drained and staphylococci were found in the pus, and in the other the condition subsided without suppuration. At the same time, Professor Seifert [4] showed that the increase in the number of staphylococci was usually much greater in cultures taken from the mucin-free region of the parotid duct than from the vicinity of the submaxillary ducts, where large quantities of mucin would be normally present. More recently, this investigator has shown that there is an increase in the staphylococcal content of the mouth during all conditions of drying of the mucosa, whether in healthy or in unhealthy subjects. This work appears to be a further link in the chain of evidence that post-operative parotitis, or that associated with any condition of dehydration, is always an ascending infection and, further, that the absence of mucin from the parotid saliva may be an important factor with reference to the frequency with which infection of this gland takes place, compared with infection of the submaxillary gland.

Acute parotitis should therefore be regarded as usually a staphylococcal infection, and the more acute the condition the more likely is this to be the case. This is true where the disease develops as a post-operative complication during the course of an acute specific fever, following a hæmatemesis, or during the septicæmias associated with typhoid fever and pneumonia.

Clinical types.—The various pathological processes occurring in ascending infection have already been described, but from the clinical aspect it is difficult to demarcate these stages accurately. This difficulty is increased by the fact that whilst in some cases the disease develops comparatively slowly, in others it is characterized by the rapidity with which one stage passes into the next. With the foregoing reservations, however, the following classification may be of some value : (1) Catarrhal. (2) Suppurative. (3) Suppurative, with intracapsular abscess formation. (4) Suppurative, with intra- and extra-capsular abscess formation. (5) Necrotic or gangrenous.

Although the foregoing stages of the disease do occur, it must be remembered that in cases terminating fatally the condition is a diffuse suppurative lesion involving the whole gland. The necrotic or gangrenous type cannot be regarded as a normal end-result in acute parotitis, but rather as the type in which the intervening stages have been passed over and necrosis occurs without abscess formation.

Catarrhal parotitis : At this stage, there is local pain, usually in the region of the angle of the jaw or actually in the ear itself, accompanied by slight local swelling, a moderate degree of fever, and a corresponding increase in the pulse-rate. The parotid gland is visibly enlarged within its normal anatomical boundaries, and a little

FIG. 1.—Acute suppurative parotitis, secondary to severe pyorrhœa. The gland was drained externally and the pus contained a pure growth of *Staphylococcus aureus*.

tender on pressure, but the overlying skin is normal. At times, the orifice of the parotid duct shows congestion, and pressure over the gland may produce mucopus.

Suppurative parotitis (figs. 1 and 2) : This stage is characterized by a much greater degree of parotid enlargement, by the exquisite tenderness of the gland, and by the presence of œdema which may extend to the eyelids. Pus may or may not be seen issuing from the duct, but the extremely painful condition of the gland often renders it impossible to carry out prolonged pressure. Constitutional disturbance is generally severe, and delirium may be present, together with a considerable degree of fever. In some patients with this type of parotitis the clinical picture may, however, be an adynamic one, associated with a subnormal temperature.

It is not, as a rule, possible to determine when the stage of suppurative parotitis passes into that of an intracapsular abscess, but an extracapsular abscess, particularly when it develops in its typical situation near the lower and anterior part of the gland, is easily recognized.

Complications.—Parotid suppuration may, in cases of a fulminating type, or where treatment has been delayed, extend beyond the limits of the capsule. Usually this extension is into the subcutaneous tissues, the region near the angle of the jaw being especially liable to be involved. Rupture into the external auditory meatus at the junction of the cartilaginous and bony portions is a fairly frequent route of discharge.

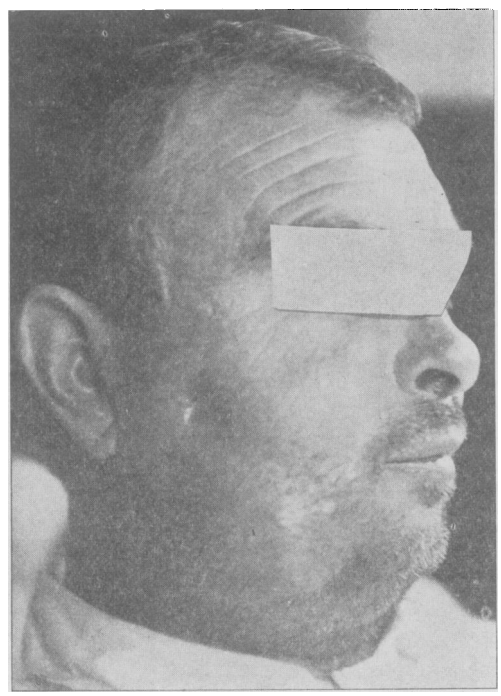


FIG. 2.—Acute parotitis and subcutaneous abscess. The parotitis was secondary to radium treatment of carcinoma of the buccal aspect of the right cheek. The capsule of the gland has ruptured in the lower and anterior part and given rise to a large subcutaneous abscess. This was drained, and the pus contained a pure growth of *Staphylococcus aureus*.

Complications arising from the extension of gross suppuration in the deep part of the gland are more serious in type but fortunately less common. Thus, pus may find its way into the lateral wall of the pharynx or track down the tissue planes of the neck into the mediastinum, it may burst into the temporo-mandibular joint, or even strip up the periosteum of the jaw and lead to necrosis. Rupture may also take place into the internal jugular vein or produce thrombosis in either that or the temporo-maxillary vein, and from such vascular lesions pyæmia or septicæmia may develop, or secondary hæmorrhage occur.

As a rare complication of acute parotitis, facial paralysis must be mentioned. This is likely to occur in the more acute forms of the disease associated with great swelling of the gland, and usually it is of a temporary nature, clearing up with the resolution of the parotitis.

In the present series of 54 cases, complications due to the extension of the infection into sites other than merely subcutaneous ones, and excluding the spontaneous discharge of pus into the mouth, occurred in five instances. In two of these, pus discharged into the external auditory meatus, in one into the pharynx and also into the sheath of the sternomastoid muscle, in one into the masseter muscle, and in one the parotitis was followed by the development of a chronic subcutaneous abscess and fistula in connexion with the buccal portion of the duct (fig. 3). In one other case, the patient developed a pre-operative left facial paralysis which subsequently cleared up. Necrosis of the mandible occurred in the patient with acute parotitis due to the *Bacillus fusiformis*, but the condition was almost certainly associated with the parotitis rather than secondary to it.

Remote complications of acute parotitis are unusual. Occasional cases occur in which the patient has more than one attack of acute suppurative infection, but

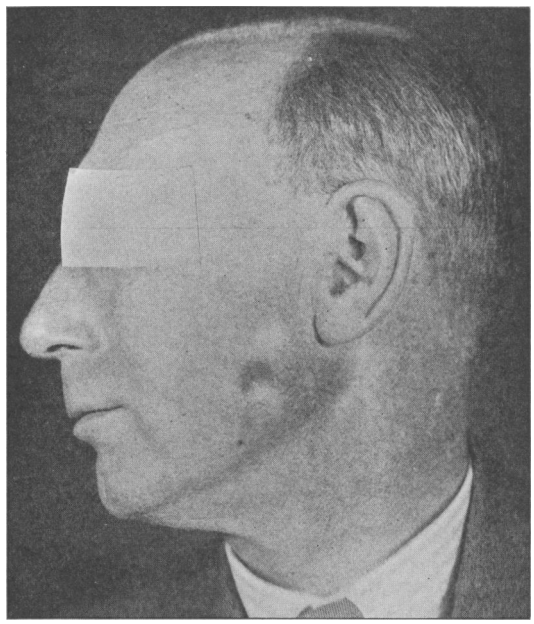


FIG. 3.—Healed parotid fistula. Showing scar at site of subcutaneous rupture of left parotid duct during course of subacute parotitis.

in such cases the possibility of a calculus being the ætiological factor cannot be disregarded. At times acute parotitis is the ætiological factor in the subsequent development of a recurrent type of parotitis. A case of this kind in a boy aged 11 is described later. An unusual complication recorded by Trioumphoff [5] in 1924, in a series of 14 cases, is local sweating and hyperæmia of the parotid region of the face following a recent parotitis. These changes may spread to the whole of the region of the auriculo-temporal nerve, to that of the third division of the 5th nerve and also to that of the great auricular nerve. They appear as soon as the patient begins to eat.

Parotid fistulæ, though they may occasionally follow external drainage of the

gland, never persist, owing to the acute inflammatory nature of the underlying pathological process.

Treatment.—It is not untrue to say that fomentations and procrastination have only too often formed the basis of the treatment of acute parotitis. Even to-day, fomentations frequently form the only bridge between the stage of onset and the stage where subcutaneous fluctuation demands surgical intervention. Such a policy not only endangers the patient's life, but may lead to the carrying out of operative measures which could often be avoided if adequate treatment had been employed from the commencement of the disease.

Treatment can only be considered in relation to the clinical background of the individual patient. Parotitis may be merely a local accompaniment of a duct obstruction, or be secondary to some buccal infection ; it may be a manifestation of dehydration such as occurs in the post-operative period, in acute specific fevers, and during oral starvation in the treatment of gastro-intestinal lesions ; it may be a manifestation of some serious blood disease ; it may result from direct extension of some local infection, and very rarely it may be a pyæmic or septicæmic metastasis. With such a diversity of possible ætiological factors as this, the first step in all cases must be the recognition of the clinical background in the individual patient. It is not proposed to discuss here the treatment of these associated diseases, or even to enter into the question of the general treatment of the patient, which is manifestly important in cases of acute parotitis.

The question of local treatment is complicated not only by the variety of clinical backgrounds to the disease, but also by the extreme variations which occur in the rate of development of the parotitis itself. Treatment in the early stages of the disease is non-operative, and should be instituted immediately the diagnosis has been made.

Non-operative treatment : All forms of acute parotitis start as a sialodochitis in the terminal part of the duct. If treatment is to be efficient and prevent the development of ascending infection, it must be designed to overcome this duct obstruction and to allow the pent-up salivary secretion to take its normal course. To achieve this, a variety of methods is available.

In the early stages of the disease, massage of the parotid is the most certain means of overcoming duct obstruction and of preventing accumulation of pus in the smaller ducts. This should be carried out systematically and always in a forward direction. It is easy to determine its efficiency, by examination of the duct orifice during the massage. It is unusual for any serious local extension of the disease to take place as long as the gland and its ducts can be emptied by this means, even though considerable quantities of pus can be expressed at four-hourly intervals over a period of several days. As a means of treatment in patients who are already seriously ill from some associated disease, massage of the gland is invaluable.

In those cases where massage fails, the probing or syringing of the duct may be necessary to effect the initiation of the flow of infected saliva into the mouth.

In all cases of acute parotitis the patient should be on a diet as solid as he can possibly manage. The act of mastication provides the most powerful stimulus to the secretion of saliva, and if the duct is still working the saliva will tend to dilute the infection and to wash it into the mouth. For similar reasons, the use of chewing-gum between meals is a valuable therapeutic measure in obtaining a steady flow of saliva. At the same time, the free use of acid drinks should be encouraged. The employment of heat in the treatment of parotitis not only relieves the local discomfort, but frequently hastens the appearance of discharge from the duct. Both external and internal forms should be used ; externally antiphlogistine or rubber hot-water bottles are best employed, and internally frequent hot mouth-washes should be given. The use of moist heat externally is to be deprecated as it produces the sodden condition of the skin which favours external rupture of the parotitis.

From the point of view of pharmacological treatment, it would appear that little benefit is to be expected from the use of drugs. In recent years, however, good results have been reported from Germany by the frequent use of " Neu-Cesol ".

Radiotherapy has been regarded as a method of treatment of parotitis by a few workers, but the results have not been very encouraging. I have not yet had any opportunity of carrying out treatment by means of short-wave diathermy in any case of parotitis.

Operative treatment : If treatment in acute parotitis is started early it may in many cases obviate the necessity for operation. Should, however, non-operative measures fail, or should the patient only come under observation at a comparatively late stage, treatment on surgical lines becomes essential. The fact that the parotid gland is enclosed in a dense sheath of fascia makes it difficult to determine the stage of the underlying infective process. A consideration of the question of the indications for operative treatment is best approached by dealing firstly with those cases in which surgery is not indicated, secondly by dealing with those in which surgery is imperative, and thirdly by considering those, falling between the two previous groups, in which surgery may or may not be required. The first of these groups comprises mild cases of parotitis with slight constitutional disturbance, in which discharge may take place either spontaneously or, following massage, through a patent duct. The second group comprises the cases in which an extracapsular abscess is present, usually subcutaneous, at the time when the patient first comes under observation. In this group, there is no doubt about the necessity of immediate operative treatment. With regard to cases falling in the intermediate group, however, the indications for operation are much less definite and must be considered in the light of underlying pathology and of any associated disease from which the patient is suffering. The anatomical configuration of the duct system of the gland favours the rapid spread of the disease, as does the poor general condition of many of the patients. In this group, the question of the patency of the duct is of great importance. If the duct is not patent and a discharge of pus through it cannot be produced by massage of the gland, and if such a state of affairs persists for more than twenty-four hours, operation becomes urgent. On the other hand, the presence of discharging pus through the duct orifice means that a safety-valve exists which may, if the general condition of the patient does not encourage surgical treatment, permit the possibility of delay. It must be remembered, however, that it is not always possible to distinguish between the merely suppurative stage of the disease, which may resolve without external operation, provided the duct is patent, and the stage at which the disease has progressed to a confluent intracapsular abscess, in which case spontaneous resolution in the presence of a patent duct is much less likely to occur.

In those cases of acute parotitis in which operative treatment is indicated and in which the physical signs do not suggest the presence of any merely localized collection of pus, the free exposure of the parotid gland is essential. Any operation designed to secure this must provide a wide exposure of the surface of the gland, it must be followed by the division of the parotid fascia in several places, in the line of the branches of the facial nerve, together with the opening up of the deeper part of the gland, and in view of the situation of the lesion, the question of resulting scarring has to be borne in mind. For this purpose, the incision advocated by Lilienthal [6] appears to be the most satisfactory (figs. 4 and 5). This incision begins just in front of the external ear, at the level of the zygoma, passes downwards in front of the ear in the slight furrow between this and the face, and then, curving just below the angle of the jaw, passes forwards to end at the anterior border of the masseter muscle. The flap of skin, together with the subcutaneous tissues, is dissected forwards, exposing the lateral aspect of the parotid gland, and if necessary, the posterior flap can also be dissected backwards. By this means, the lateral aspect of the enlarged parotid gland is displayed. A series of five or six radiating incisions

in the line of the facial nerve is made, varying in length from ½ in. to 1 in., and through these Spencer-Wells forceps are introduced and the deeper part of the gland opened up. The individual incisions are then packed with gauze soaked in flavine and the superficial part of the wound is similarly treated.

In operating on cases of acute parotitis by this means, it is invariably found that the capsule of the gland is thickened as a result of œdema, and that as soon as this has been incised, the subjacent parotid gland prolapses through the incision. It is further found that in the majority of cases no gross collection of pus is encountered but that minute beads of pus, together with watery fluid, exude diffusely from the gland substance. This finding, although disappointing to the surgeon who would prefer to find a large purulent collection, is in strict accord with what is known of the pathology of acute parotitis. Within twenty-four or forty-eight hours the parotid

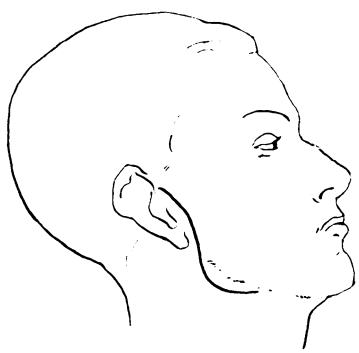


FIG. 4. — Lilienthal's incision for the exposure of the parotid in acute parotitis.

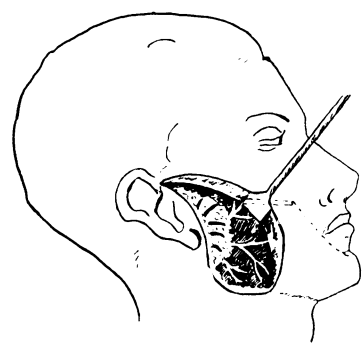


FIG. 5. — Lilienthal's incision showing direction of incisions in parotid gland.

incisions are all freely discharging pus. In an uncomplicated case, healing takes place in from three to four weeks, and what was originally a wide gaping wound on the lateral aspect of the face ultimately becomes an almost imperceptible scar in front of the ear and behind and below the angle of the jaw. At the same time as the external operation is carried out, it may be considered wise to slit the orifice of the parotid duct in those cases where there is an absence of discharge into the mouth. On the other hand, I do not believe that this minor operation alone is ever likely to be of any real value in the treatment of acute parotitis.

In the present series of 54 cases, operative treatment was carried out in 30.

Prognosis.—In the present series of 54 cases of acute parotitis, 11 were fatal, giving a mortality of 20·4%.

In the fatal cases, five were associated with a pyæmia or septicæmia, two followed hæmorrhages from peptic ulceration, one followed an operation for the closure of a fæcal fistula, one followed gastro-enterostomy for carcinoma of the stomach, one was associated with diabetes, hepatitis, and infection of the urinary tract, and one case was associated with aleukæmic leukæmia.

(*B*) *Recurrent Parotitis*

Recurrent pyogenic infections of the parotid form a clinical entity almost as well defined as the acute infections. The disease is much commoner in women than in men. It may affect one or both parotids, and occasionally the submaxillary glands are also involved. The condition is characterized by recurrent swelling of the glands

associated with discomfort or pain, rarely with external inflammatory signs, and not passing on to suppuration. The individual attacks develop gradually or suddenly and are not usually related to eating. Their duration varies from a few hours to weeks or even months, and the frequency of the attacks shows wide variations. Resolution of the attack is in some cases accompanied by the passage into the mouth of tenacious mucopus. The majority of the patients are entirely free from symptoms between attacks; others have persisting mild discomfort, and a few have severe pain in the parotid region.

At times patients date the onset of the disease from a dental infection, from the use of new dentures, or from some infection of the upper respiratory tract. Occasionally, the condition develops as a remote complication of an acute parotitis. The disease is one mainly affecting the female sex, and a striking feature of many of the cases has been the degree of instability.

In the present series there were 52 cases of recurrent parotitis as follows :—

Males 15; females 37. Right 17; left 16; bilateral 19.

The saliva.—The parotid saliva from these cases shows characteristic changes which, although altering in degree during the periods of activity and of quiescence,

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FIG. 6.—The cells found in a catheter specimen of saliva during the quiescent stage.

are always present. The saliva is faintly turbid from the presence of small flakes of mucopus, and microscopic examination shows the presence of epithelial cells and pus cells, the former being either large polyhedral cells or elongated columnar cells. During the more acute phase of the disease pus cells are more likely to be present (fig. 6).

Mucus, although normally almost absent from parotid secretion, is present in considerable excess in the saliva of these patients. The ptyalin content may in some instances be markedly reduced, but this is not of much clinical or practical significance.

Bacteriology.—The *Streptococcus viridans* is the organism most frequently found

in the saliva. In the present series of cases, bacteriological examination was carried out in 30, and the following organisms were found :—

Streptococcus viridans	9
Streptococcus viridans and *Staphylococcus aureus*	2
Streptococcus viridans and pneumococci ...	1
Pneumococci	5
Pfeiffer's bacillus	2
Staphylococcus aureus	1
Gram-negative bacillus	1
Contaminated	1
Sterile	8
Total	30

Sialography.—Investigation of the ducts of the parotid in these cases by means of lipiodol shows varying degrees of abnormality. The most frequent type is that in which the finest ducts show terminal globular dilatations. Lesions are also

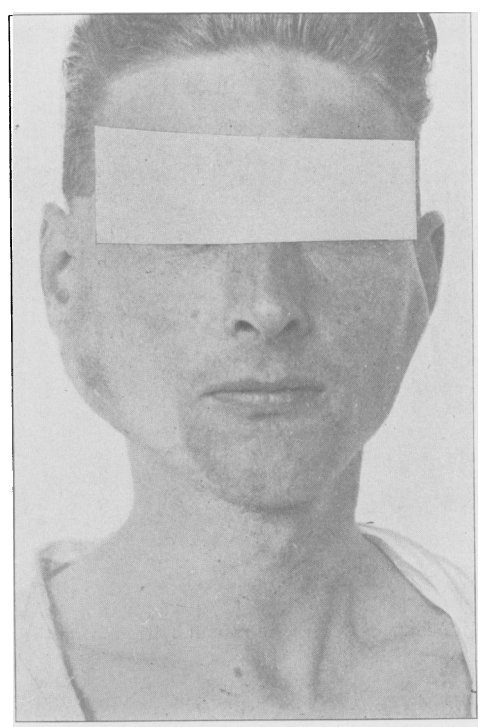

FIG. 8.—Bilateral recurrent parotitis. The patient was a man aged 32, with a seven years' history of parotid swellings. The saliva from both parotid glands was turbid and gave a pure growth of *Streptococcus viridans*.

met with in which the larger ducts, or even the main duct, show a dilatation of definitely segmental or fusiform type. In a few cases, particularly those in which an antecedent acute parotitis has occurred, changes of a destructive type may be met with (figs. 7 to 17).

Ætiology.—Some aspects of the ætiology of the condition have already been discussed. Once, however, the infected condition of the ducts is established, it is not difficult to explain its persistence and the recurrent exacerbations. An explanation

PLATE I.

FIG. 7.—Normal parotid sialogram.

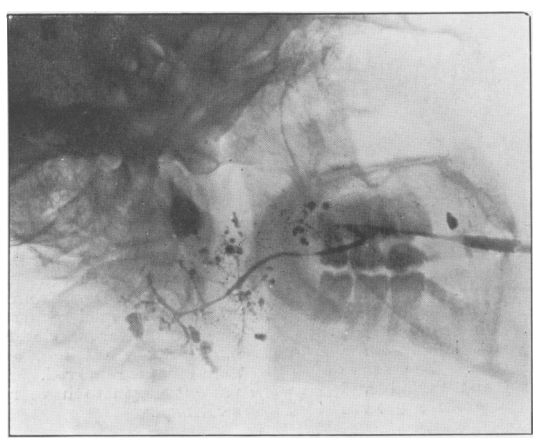

FIG. 9.—Recurrent parotitis. Right sialogram from same case as fig. 8.

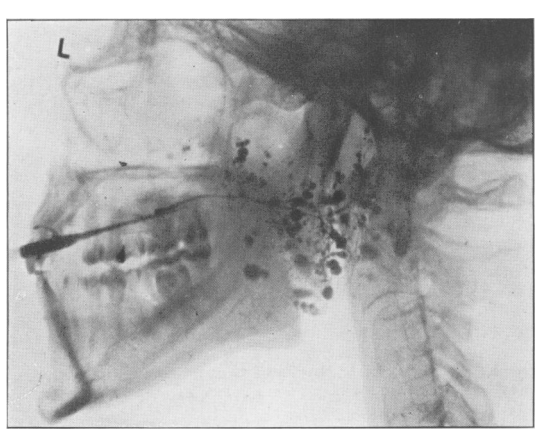

FIG. 10.—Left sialogram from same case.

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PLATE II.

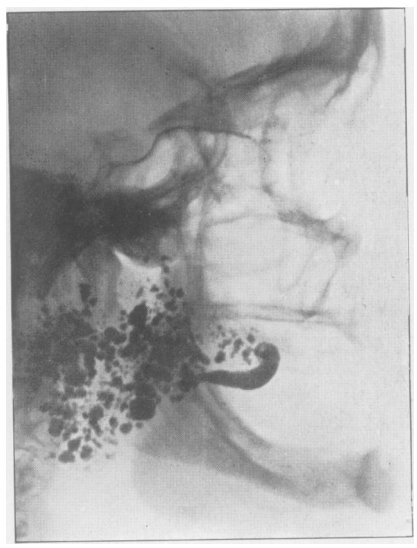

FIG. 11.—Recurrent parotitis. From a woman aged 45 who developed parotitis following influenza twelve years ago. The condition, after persisting for some time, gradually cleared up. She came under observation twelve years later with a further attack of parotitis. The saliva was extremely profuse and turbid and bacteriologically gave a profuse growth of Pfeiffer's bacillus.

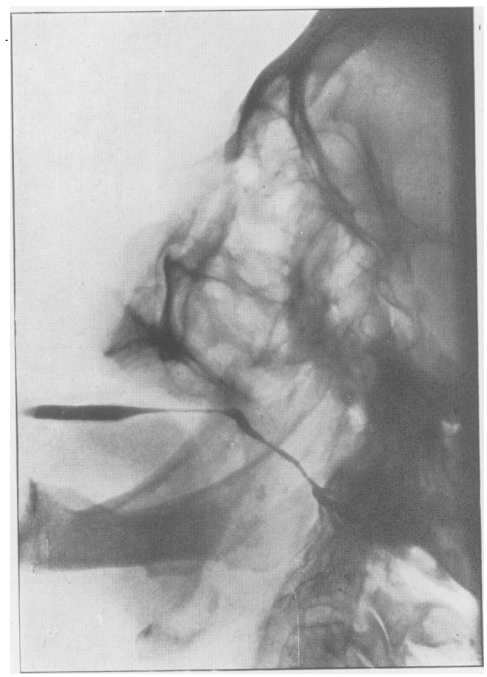

FIG. 12.—Left parotid sialogram in a case of recurrent infection of all salivary glands. From a woman aged 56 who developed recurrent submaxillary swellings after scarlet fever at the age of 7. Six years ago, one submaxillary gland was removed. Two years ago, patient began to have recurrent parotid swellings.

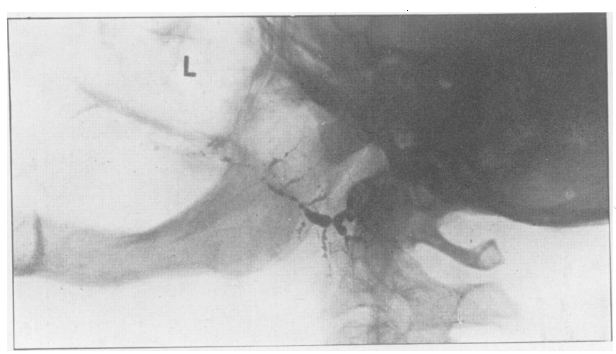

FIG. 13.—Recurrent parotitis. Left parotid sialogram showing segmental type of dilatation. From a woman aged 43 who had suffered from recurrent attacks of parotid swelling for five weeks. The saliva contained a large amount of mucopus, but was sterile on culture.

PLATE III.

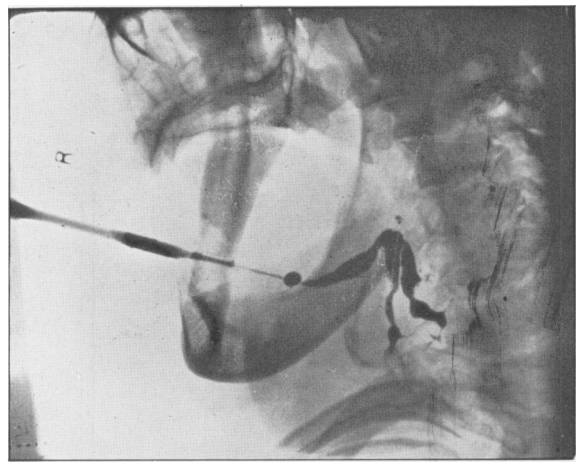

FIG. 14.—Right submaxillary sialogram from same case as fig. 13.

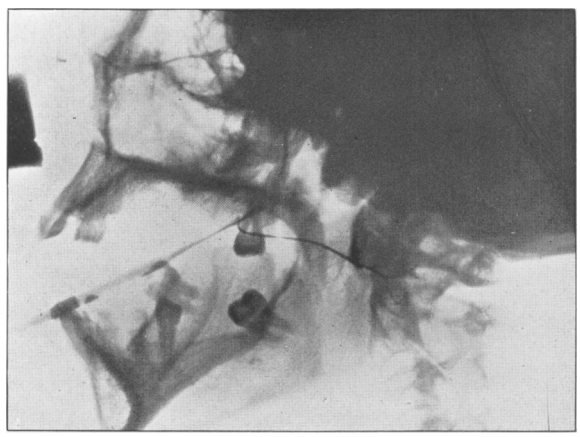

FIG. 15.—Left parotid sialogram in chronic parotitis. Showing destructive type of lesion. From a woman aged 35 who had suffered from bilateral suppurative parotitis and acute suppurative inflammation of both submaxillary glands.

FIG. 16.—Left parotid sialogram in recurrent parotitis. From a woman aged 35 who for eighteen years had suffered from purpura and Plummer-Vinson syndrome. During the past five years there had been five left parotid abscesses, all of which had been drained externally. Between the attacks, there was a constant discharge of pus into the mouth. Cultures of this showed a pure growth of *Streptococcus viridans*.

of the primary development of the infection is much more elusive. Suggestive evidence has been put forward by Pearson [7] and by others that the condition in children is closely related to the group of allergic diseases including asthma, hay fever, and eczema. This view is supported by the rapidity of onset and offset of the parotid swelling in many of the cases occurring in early life, by the association with known

FIG. 17.—Pneumococcal parotitis. The patient, a woman aged 44, had suffered for eighteen months from recurrent swellings of both parotid glands. When she came under observation the left parotid gland was grossly enlarged. The saliva consisted of thick yellow mucopus, which on culture gave a pure growth of pneumococci. As conservative treatment failed to relieve the condition, external drainage was carried out and the gland was found to contain two large cavities. The wound discharged freely, but healed readily. The photograph shows the scar two months after operation.

allergic phenomena, such as eczema, asthma, or hay fever, by the presence of eosinophil cells in the parotid secretion, and by the improvement in some cases in response to dietetic restrictions. Whether or not the origin of the disease be allergic, it is certain that sooner or later infection occurs and the characteristic obstructive changes in the parotid ducts develop. In the present series of 52 cases, possible ætiological factors were present in 14. The details of these are set out in the following table :—

Dentures	1
Dental infection	2
Frequent sore throats	1
Following tonsillectomy	1
Enlarged tonsils	1
Trauma to cheek	1
Post-acute parotitis	1
? post mumps	1
Chill following driving	1
Congestion of lungs	1
Purpura, Plummer-Vinson, and splenomegaly	1
Eczema as child (mother, hay fever) ...	1
Subject to hay fever and skin eruptions ...	1
Total	14

Histology.—In only one case in the present series was any histological examination of the parotid possible. This showed marked proliferative change of the cells in the interior of the smaller ducts, together with dilatation of the duct and surrounding round-celled infiltration (fig. 18).

Differential diagnosis.—Many of the patients suffering from recurrent parotitis are regarded as cases of mumps or recurrent mumps, though it is almost certain that second attacks of that infection do not occur. Cases are also confused with parotid enlargements associated with stone, with Mikulicz's disease, uveoparotitic polyneuritis, innocent and malignant parotid tumours, and pre-auricular lymphadenitis.

Treatment.—Treatment must be considered both during the periods of quiescence and during actual exacerbations of the disease. During the quiescent periods, many of the milder cases can be kept free from attacks by massage of the parotid. Where

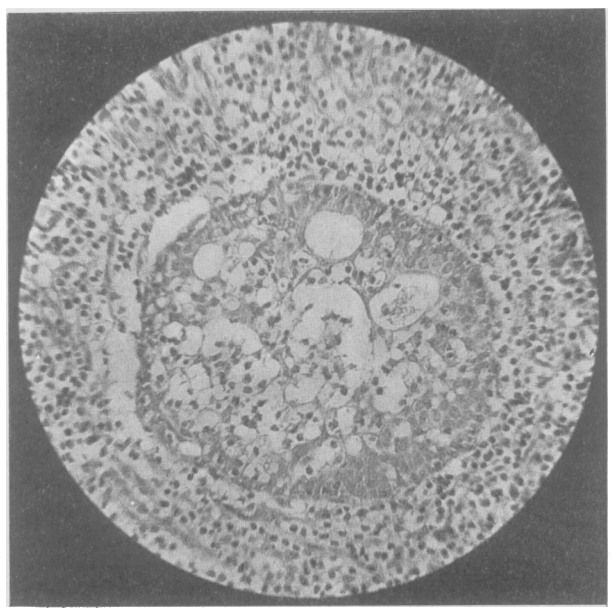

FIG. 18.—Recurrent parotitis. Section of parotid showing recurent parotitis. There is marked proliferation of the duct epithelium and surrounding round-celled infiltration.

there is any evidence of obstruction involving the main duct, operation may be of value. This involves the excision of the distal half-inch of the duct and the incision of the medial wall of the duct behind this, as far back as possible. The resulting cavity is packed, and a week later the orifice is dilated under anæsthesia. This is followed by repeated dilatation until healing is complete. In one severe bilateral case in the series, auriculo-temporal avulsion was carried out with marked temporary benefit, though ultimately the nerve regenerated on both sides. Some cases may be strikingly benefited by the use of X-rays, and not only may symptoms disappear, but a considerable swelling of the parotid may resolve without any evidence of functional disturbance of the gland.

(*C*) *Chronic Parotitis*

Chronic pyogenic infection of the parotid is not nearly so frequent as either acute infection or recurrent infection. In the present series of 117 cases of parotitis, only

11 could be regarded as strictly chronic in type. In eight of these, there was some associated local or general condition. In five cases, parotid calculi were present (one of these was a doubtful case), and one case followed acute parotitis. The seventh case was associated with rheumatoid arthritis and the eighth showed extensive diffuse calcification of both parotids, and was associated with scleroderma and Raynaud's phenomena (figs. 19 to 21).

Infection of the Submaxillary Gland

There are certain fundamental differences between the pyogenic infections occurring in the submaxillary gland and those in the parotid. Primary acute infection of the submaxillary gland is rare, and most acute infections are secondary to calculi within the duct or the gland itself. At the same time, primary chronic infection also occurs in a small group of cases, but recurrent infections comparable with those in the parotid are unusual. I do not propose to enter into the debated subject of the cause of salivary calculi. Whether or not these are primarily infectious in origin is still disputed, but it is certain that sooner or later they are associated with infection of a chronic nature which may under certain conditions become acute and lead to serious complications.

(A) *Calculus cases* :—			
Uncomplicated ...	...	...	56
With acute infection	...	...	18
			74
(B) *Non-calculus cases* :—			
Chronic infection	...	...	7
Recurrent infection	...	...	2
Acute infection with acute glossitis			1
With duct obstruction	...	...	6
With hypertrophy	...	...	1
			17
		Total	91

The long course of the submaxillary duct, its important anatomical relations in the floor of the mouth, the anatomical features of the sublingual and submaxillary regions, and the laxity of the adjacent cellular tissue, together with the frequency of calculi in the duct, make inflammatory changes in its walls and surroundings of much greater importance than inflammatory changes in the parotid duct. In the case of the submaxillary, the brunt of the acute infection falls upon the duct and its surroundings, with but relatively minor changes in the gland itself, whilst in the case of the parotid it is the glandular tissue which is mainly affected, the involvement of the duct being of but secondary importance.

Acute infection and the clinico-pathological types.—Acute infection of the submaxillary gland and duct is, in practically all cases, an ascending infection from the buccal cavity, and the majority of cases are associated with the presence of calculi in the duct or gland. A smaller group of cases is traumatic in origin or due to the entry of foreign bodies into the duct. Others again are secondary to malignant growths in the floor of the mouth, or to strictures of the duct, or they develop as part of a very diffuse inflammation of the floor of the mouth, the tongue, and the cellular tissue of the submaxillary region.

From the pathological point of view, an outstanding characteristic of acute infections of this region is the fact that they so often tend to be of the nature of a cellulitis,

associated with an extreme degree of œdema and congestion, which may involve the floor of the mouth, the tongue, and the submaxillary region, and even spread to the glottis. Submaxillary calculi are in themselves comparatively trivial, yet the acute complications to which they may give rise may be extremely dangerous ones. Some of these cases pass almost insensibly into the group known as Ludwig's angina. This was defined by von Ludwig in 1836 as an inflammation of the cellular tissues starting around the submaxillary gland and subsequently involving the neck and the floor of the mouth.

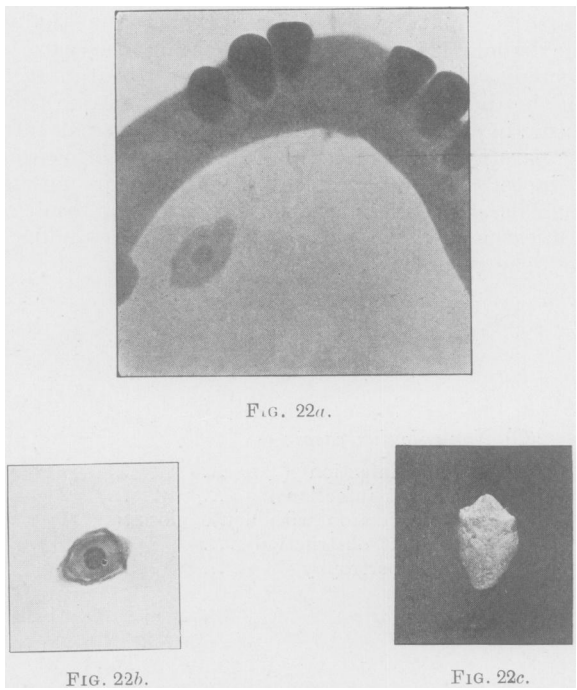

FIG. 22*a*.

FIG. 22*b*.

FIG. 22*c*.

FIG. 22.—Submaxillary duct calculus. (*a*) Skiagram showing calculus in situ. (*b*) Skiagram of calculus after removal, showing nucleus. (*c*) Photograph of calculus after removal.

Amongst the 74 cases of calculi in the submaxillary gland or duct in the present series, there were complications due to acute infection in 18 cases. This acute infection was the result of impaction of a calculus at some part of the duct. In 10 cases, the infection was limited to the duct and its immediate vicinity. In five cases, the inflammatory changes were extensive and were associated with difficulty in swallowing and breathing. In the remaining three cases, the condition was complicated by a suppurative lymphadenitis. Many of the patients in this group were extremely ill when they came under observation (figs. 22 to 24).

The acute inflammatory complications may thus be confined to the duct and gland, or may involve the cellular tissue of the sublingual or submaxillary regions, or spread to the tongue. Suppurative changes may occur in connexion with the submaxillary or other lymph-glands and abscesses may at times track considerable distances down the neck. In cases where the condition is due to duct calculi, resolution may take place either as the result of the passage of the calculus through the duct orifice or its perforation through the duct wall.

Diagnosis.—In acute parotitis, the outstanding feature in diagnosis is the determination of the systemic background to the disease. In acute infection of the

PLATE IV.

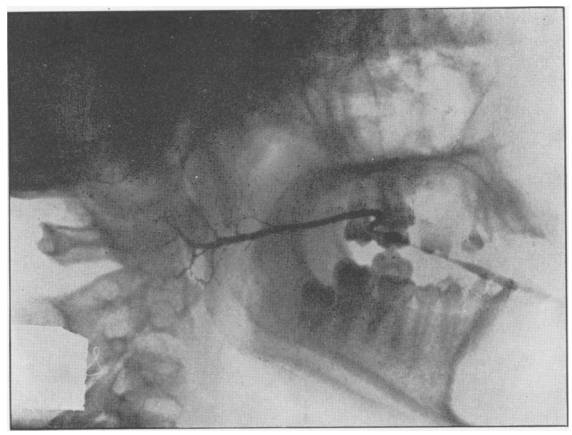

FIG 19.—Chronic parotitis with monilia infection of buccal cavity. Right sialogram showing gross dilatation of main duct.

FIG. 20.—Chronic parotitis showing left parotid calculus.

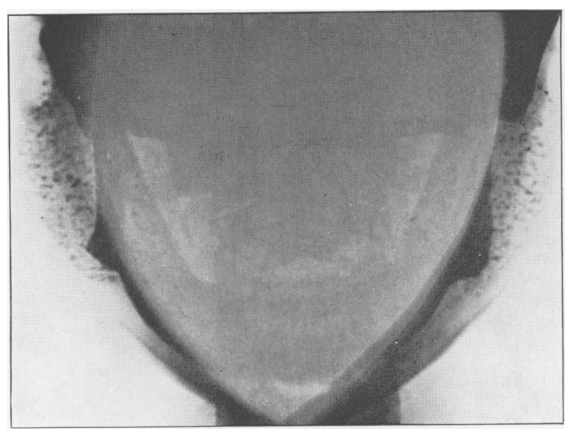

FIG. 21.—Chronic parotitis showing calcification of parotids. From a woman aged 30 with Raynaud's phenomena and scleroderma.

PLATE V.

FIG. 23.—Large calculus in posterior third of submaxillary duct.

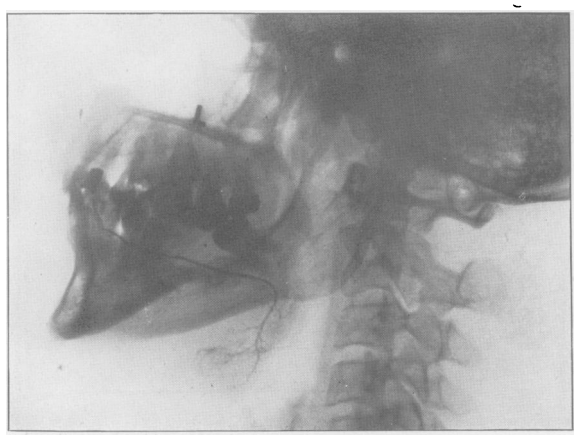

FIG. 25.—Normal left submaxillary sialogram, showing communication with duct of sublingual gland.

FIG. 26.—Lipiodol injection of normal submaxillary gland.

submaxillary gland, it is the local background which is important. In arriving at an exact diagnosis, the history, the physical signs, and the presence of any associated buccal disease will be of outstanding importance. It is impossible to discuss here all the aspects of differential diagnosis, but it is certain that many of these cases are confused with other conditions.

Treatment.—The treatment of the acute infections of the submaxillary gland and duct depends upon the local causative factor bringing about the acute complication, the stage at which the case comes under observation, and its main pathological features. The inherent risks of acute infection in this region cannot be too strongly stressed, for the safety factor is at times a low one.

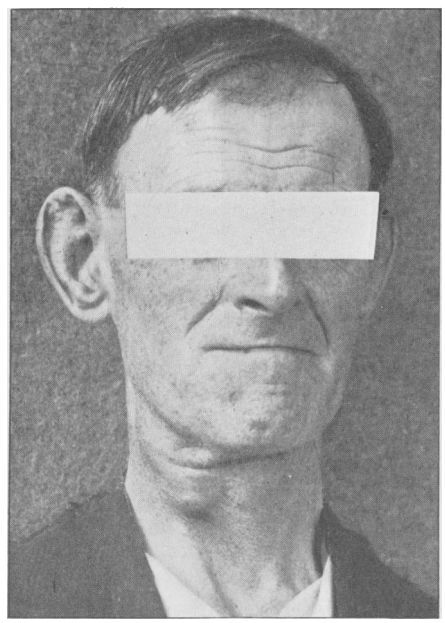

FIG. 24.—Suppurative cervical adenitis, secondary to infection of submaxillary gland.

In cases in which the condition is due to impacted calculus in the duct, the calculus should of course be excised. When this is of such a small size that its removal would be difficult in the presence of the acute inflammatory œdema and congestion in the floor of the mouth, then the duct should be incised behind the calculus. The drainage provided in these ways usually leads to the rapid resolution of the infection.

In cases in which a submaxillary abscess develops secondarily to a calculus within the gland or posterior part of the duct, or in which a suppurative submaxillary lymphadenitis occurs, the region will have to be drained. Subsequently, of course, if calculi are present the gland must be removed. Some of the cases of this type, after an acute course, subside to some extent, and then pass into a subacute phase which may last for many weeks. It is difficult in many of these cases to determine the exact state of affairs. In some of them there is a subacute infection of the submaxillary gland associated with calculi, and the whole gland is enlarged and matted to its surroundings. In other cases again, a small associated abscess is present in the immediate vicinity. It is probably best in these cases to excise the submaxillary gland and to drain the wound, but the operation can be a difficult and tedious one. The acute, diffuse infections of the floor of the mouth and the submaxillary region present a much more

serious problem in connexion with treatment. It is important in these cases to drain not only the sublingual region, but also the submaxillary region. External drainage is necessary in all cases, and this will necessitate a division of the mylohyoid muscle or the removal of the submaxillary gland. Each of these procedures has its advocates. At the same time, it may be necessary to incise the floor of the mouth and the tongue.

Recurrent infection.—Recurrent infection of the submaxillary gland is rare in the absence of calculi or of a stricture of the duct. There is a small group of cases, however, in which the condition is strictly comparable to the recurrent infection occurring in the parotid gland, and in which calculi and duct strictures can be excluded. This condition may at times begin in one submaxillary gland and then spread to the other, and may ultimately involve the parotid glands. In other cases again, the condition starts in the parotid and later involves the submaxillary glands.

Chronic infection.—Chronic infection of the submaxillary gland or duct is much commoner than acute infection and, as has been pointed out, it is usually the clinical background to acute infection. Primary chronic infection occurred in seven cases in the present series of 91. It is impossible to be dogmatic about these cases, for in some of them a minute calculus may have been overlooked. Secondary chronic infection is commonly due to calculi—and, less commonly, to duct obstruction, malignant disease of the floor of the mouth, foreign bodies, or dentures, &c. (figs. 25 and 26).

Pathologically, in these cases, the submaxillary gland shows the characteristic changes of replacement fibrosis. At times, the gland is a little larger than normal, but at other times the chronic inflammatory changes may have produced a gland three or four times the normal size.

On the clinical side there is little to distinguish the primary and the secondary groups of cases. In the primary group the symptoms are more likely to be steadily progressive, whilst the secondary cases, due to calculi, are likely to be more typical of recurrent duct obstruction. As the functional activity of the gland is impaired, its tendency to swell with meals diminishes.

The causal factor in these cases must be determined when possible. In the absence of any gross local cause, the submaxillary gland should be excised. A calculus in the anterior two-thirds of the duct should be excised through the floor of the mouth. When calculi are present in the gland itself, or when they are of a recurrent nature, the gland should, of course, be excised.

Infection of the Sublingual Gland

All types of infection of the sublingual glands are rare. Acute suppurative infection has been described as a primary condition or in association with the very rare calculi which occur in the sublingual gland or ducts. On the other hand, involvement of the sublingual gland secondary to other acute inflammatory processes of the floor of the mouth and tongue is much commoner. In such cases, the infection is really interstitial rather than parenchymatous. The commonest ætiological factor in this connexion is of course acute infection of the submaxillary duct associated with calculus obstruction.

The sublingual gland may be involved in the diffuse phlegmonous inflammation of the floor of the mouth coming under the general heading of Ludwig's angina. The important anatomical connexions of the sublingual and submaxillary regions have already been described.

The sublingual salivary gland may also be involved in a secondary chronic inflammatory process as the result of changes in the immediate vicinity. This chronic sublingualitis may be secondary to submaxillary duct calculi, to operations, or to growths in the floor of the mouth. In such cases, also, the process is interstitial.

The inflammatory conditions affecting the sublingual gland are thus relatively unimportant when considered in terms of this organ as a salivary gland. Such

importance as these infections have arises almost entirely as the result of local anatomical factors.

Conclusion

It has been possible in the course of this paper to consider only certain aspects of pyogenic infections of the salivary glands, and I am fully conscious of many omissions. In concluding, there is one omission to which I would like to refer. I have in this paper confined myself strictly to infectious conditions, but it is certain that just as the secretion of saliva is determined largely by psychological stimuli, in many of the patients with infections of these glands there is an associated or even superimposed functional element. This is, of course, only likely to be the case in recurrent or chronic infections, but I am satisfied that this element exists, that it produces very real symptoms, and that it may confuse the clinical picture.

In connexion with acute infections of the parotid, I would like to stress their pathological features and the necessity for basing rational treatment on these. At the same time, when confronted with a case of acute parotitis we must always ask the question, " Why has this patient acute parotitis, and what is the general clinical background of the process ? " The recurrent infections of the parotid are of much greater clinical frequency than parotid calculi, and although their pathology has been elucidated, they often escape recognition, and as yet therapeutic measures for their control are not entirely certain.

In connexion with infections of the submaxillary glands, I would like to stress the serious nature of the acute complications of the relatively frequent submaxillary calculus, and, in connexion with the acute infections as a whole, the importance in all cases of the anatomical features of the region and the necessity for determining the local pathological factors leading to acute infection.

The successful treatment of many buccal conditions demands co-operation between the dental surgeon and the surgeon interested in the more general aspects of buccal diseases.

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