of saline water is, of course, from the tissues to the blood vessels. Should the protein or colloid content of the blood fall sufficiently, the drift may well turn the other way; and the tissues attract the water and hold it. Accordingly, if we analyse the dropsical fluid, we shall find it to be little more than this saline water, its protein content being practically *nil*; the tissues, indeed, may become stronger in colloid content than the vessels, and the osmotic relations be quite upset. If, for control, we take a dropsical effusion from a case of primary contracted kidney, or of cirrhosis of the liver, we shall find it to contain as much as, or more than, three parts of protein per 100 c.cm. (Epstein). You see then how idle it is under these conditions to rely on expelling the dropsy by diuretics, diaphoretics, and the like; we can expel but the surplus after the tissues have saturated themselves.

In the next place, Dr. Epstein discovers a great excess of lipid in the blood of these cases. This he attributes in great part to starvation; and if derived largely from mobilization of fat, it is also a product of breaking down of the tissues. Now abstraction of lipoids from tissue cells causes imbibition of fluid with consequent swelling of the cells—cell oedema.[†] The diet for this dropsy is therefore largely exclusive of fat.

Once more: I need not remind you that one main product of carbohydrate food is water; we may fear therefore that large amounts of such food may promote the accumulation of water in the system. Moreover we desire to make room rather for the protein constituents, and to secure their full assimilation without rivalry.

These, then, are Dr. Epstein's principles, which, you will admit, seem reasonable, and are based upon careful research. Further experience only can establish or invalidate his conclusions. So far as our one case goes you have seen that the results—we are tempted to say the consequences—were very striking. In conclusion I have to acknowledge the able assistance of our house-physician, Mr. Gittens, in the management of the case.

To bacteriology, Gentlemen, we owe indeed an unspeakable debt; but you have heard me say again and again that, this territory being largely won, we have now to look for the next great conquests to biochemistry and physical chemistry. But these and such advances demand a very different system of clinical investigation from that we now have in England; experience is good, sagacity is good, but now we have penetrated so far that chairs of clinical research, armed with skilled staffs and laboratories, must be established in tardy England as already they are provided in every considerable medical school in Scotland and on the European and American continents.

REFERENCE.

¹ A. A. Epstein: *Amer. Journ. Med. Sci.*, November, 1917; and *Journ. Amer. Med. Assoc.*, August 11th, 1917.

ACUTE ULCERATIVE GINGIVITIS.

BY

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DURING the past year or two a number of observers have written on the subject of acute ulcerative gingivitis. Little attention has, however, been paid to the signs on which an early diagnosis can be made, while no facts have been available regarding the extent to which the disease is prevalent among our armies in France. With regard to treatment, chief emphasis has hitherto been laid on the local use of drugs having a more or less specific action on the organisms found in this condition.

In the present paper, which is a modification of a report drawn up at the request of certain army medical authorities, special attention has been given to the methods of early diagnosis and the incidence rate in troops in France. The treatment has been dealt with on more general surgical lines than in previous communications, less reliance being placed on the action of anti-spirochaetal drugs, and more on thorough surgical cleansing of the infected areas. This method of treatment has been adopted as the result of personal experiences dating from March, 1915, when I saw for the first time cases in France.

[†] On the harm which cholesterol may do to the body see Dr. Epstein (*loc. cit.*), and my *Diseases of Arteries*.

(In passing, it is interesting to note that between November, 1914, and March, 1915, no cases came under my notice.) Since March, 1915, numerous cases of the disease, in all stages, have come under my personal care.

Signs and Symptoms.

Acute ulcerative gingivitis is an acute inflammatory condition of the margins of the gums, which spreads rapidly, and leads to sloughing of the interdental papilla; sloughing of the gums around the necks of the teeth; ulceration of the adjacent mucous membranes (in the more severe cases); rarefying osteitis and destruction of the bone around the teeth, in chronic cases.

The general symptoms are as follows: Malaise; slight elevation of temperature, rarely over 100° F., but occasionally 102° F.; glandular swelling, the submaxillary glands being chiefly affected; general depression.

The local symptoms are: Haemorrhage from the gums, either spontaneous, or as a result of pressure; pain in the gums, especially at night, and often so severe as to make sleep impossible; a foul taste; very offensive breath; mastication difficult and extremely painful, the teeth becoming very tender and loose.

Clinical History.—The onset is gradual. A small area of gum becomes painful, and this pain spreads to the interdental papillae of the adjacent teeth. By the seventh to the tenth day the pain and local symptoms are severe, and the patient may report sick.

Local Signs.—In the earlier stages the only signs are a slight oedema of the interdental papillae; these rapidly become congested and are bluish-red in colour, and are distinctly swollen; if touched they bleed readily. Later the gums appear to be separated from the teeth, this being due to the swelling and not to any destruction of the periodontal membrane. This stage is generally present for two or three days. An acute necrosis of the papillae then follows. The slough formed is non-adherent, of a characteristic brownish colour, and very friable. There is no attempt at formation of a true membrane until the process of healing has commenced. If left untreated, sloughing gradually spreads until a considerable area of gum is destroyed. The gums in the infected region are deeply congested. The teeth are usually loose.

Distribution of the Lesion.—The gums around the upper incisor teeth are commonly affected first, but in a number of cases the disease commences in other situations; an erupting lower third molar, for instance, is a common site, or any spot where food tends to lodge. When one jaw is affected, the other soon shows signs of infection in the corresponding situation. The spread is usually in direct continuity along the gum, the interdental papillae on either side of the primary lesion becoming attacked. It is rare for a large area of gum to slough before several teeth have become implicated. Occasionally, on the other hand, the lesion begins at distinct points.

Pathology and Bacteriology.

In the early stages the tissues attacked by the specific organisms become deeply congested, and after two or three days necrose, making a series of cup-shaped depressions between the teeth. The sloughing does not extend deeper than the bottom of the periodontal sulcus. At first there is little or no bone destruction, although this is to be found in advanced or chronic cases. Tartar is always present on the necks of the teeth exposed by the sloughing of the gum.

[*Note.*—In periodontal disease (pyorrhoea alveolaris), which is the disease most commonly mistaken for acute ulcerative gingivitis, the gums become slightly congested, but *do not slough*. Ulceration proceeds at the bottom of the periodontal sulcus, thus destroying the periodontal membrane. This is accompanied by a rarefying osteitis, which finally leads to the destruction of the bony tooth socket. The gum is not destroyed as quickly as the periodontal membrane, and so a pocket of varying depth is formed between the tooth and the gum. In severe cases this pocket is filled with pus. Periodontal disease is extremely chronic, and in contrast to acute ulcerative gingivitis, may be present for ten or fifteen years.]

The characteristic organisms found in films are a mixture of *Bacillus fusiformis* and spirilla. In well-marked cases, especially when occurring in a clean mouth, these may appear to be present in almost pure culture, giving a very striking picture under the microscope. In other instances where periodontal disease or simple gingivitis is present

in addition, or when the condition has become chronic, a large variety of other organisms may be found as well.

It may be noted that acute ulcerative gingivitis and Vincent's angina of the throat are obviously one and the same disease, the only difference being the part of the buccal cavity affected. When the throat condition is primary, there are frequently multiple lesions on the gums, which eventually coalesce. The ulceration may begin and disappear in the throat before the gums are affected, and vice versa. On the other hand, only the throat or only the gums may be found involved in any one patient.

Incidence and Sources of Infection.

Cases are to be found in all branches of the service, and in all ranks. The condition is also found among the French civilian population, and in certain allied troops who have come under observation (for example, Portuguese). It is noticeable that officers form a large number of the cases treated, but this is most probably due to advice being sought sooner. Men in the trenches, or those living under bad conditions, are only slightly more liable to infection than those under more favourable circumstances. The condition is more prevalent during the winter than in the summer months.

Up to the present I have not been able to trace any definite methods of infection. In France, at least, the disease does not appear to spread by close proximity, for example, in huts and billets. Two cases have come under my notice in which the patients had been attached to "gas schools," and had tested box respirators belonging to other men; in these two instances the gums around the incisor teeth were infected first.

Excessive smoking, in my opinion, predisposes to the condition, and considerably retards the process of healing. The absence of fresh food does not seem to play any part in the causation. Officers and men who are able to obtain fresh vegetables are frequently victims.

Duration.—If untreated the condition becomes chronic, and results within a year or eighteen months in the destruction of the bony sockets of the teeth; when this occurs the teeth must necessarily be extracted before a cure can be effected. If treated by mouth-washes only, although the severity is diminished, the condition is not cured. If treated vigorously all symptoms disappear in three or four days, although a cure is not effected until about the tenth day of treatment; even after this period films may still show the presence of the causative organisms. Men should not be allowed to escape from treatment until three or four days have elapsed after all signs of ulceration have disappeared. Working on this principle I have had very few relapses. Recurrences are reported to be frequent, but the majority of such cases have been discharged before all ulceration of the gums has been completely healed. Careful use of a toothbrush and the employment of an astringent application to the gums for two or three weeks as an after-treatment will tend to decrease these recurrences.

Diagnosis.

In the earlier stages diagnosis may be difficult, except to a person with experience. Suspicion may be aroused by a slight swelling and reddening of an isolated interdental papilla, the surface of which appears to be stretched and glossy and the edges thinned out and transparent. The apex of the papilla may actually have sloughed. At this stage a microscopical examination should be made to establish the diagnosis. In the later stages the characteristic bluish-red gum, covered by slough, the offensive breath, and the glandular enlargement make the diagnosis easy.

The differential diagnosis is as follows:

1. From simple gingivitis. In simple gingivitis the gums are a bright red colour near the margin, the interdental papillae not being especially affected, while the gums gradually become normal as the buccal sulcus is approached. The interdental papillae are swollen, but not painful, and do not show any signs of sloughing. The gums are usually covered with food debris or tartar; this can be removed without causing pain or haemorrhage. The characteristic odour of the ulcerative type is absent, and there is neither pain at night nor glandular swelling.

2. From periodontal disease (pyorrhoea alveolaris). In this condition there is no sloughing, and little obvious inflammation of the gums. Pus can usually be squeezed out from the pockets which surround the teeth. These pockets are caused by the destruction of the periodontal membrane. After some years considerable destruction of gum ensues, but this destruction is slow, and is not brought about by visible ulceration.

3. From ulcerative stomatitis. This condition, although frequently showing similar organisms on microscopical examination, and occasionally associated with ulcerative gingivitis, is not limited to the gum margins. It does not lead to so much destruction of tissue. Small ulcers are usually to be found on the palate, tongue, and buccal mucous membrane.

4. From syphilis. Mucous patches may be mistaken for ulcerative gingivitis, and reliance must be placed on a history of the case for a diagnosis. Secondary ulcers and the punched-out ulcers of tertiary syphilis are most often confused with Vincent's angina of the tonsils and fauces. The ulceration, however, in these cases may spread out along the gums. Slides from such ulcers do not give the characteristic flora, and the ordinary treatment for ulcerative gingivitis will fail. A Wassermann reaction will clinch the diagnosis under such circumstances.

5. From mercurial stomatitis, scurvy, etc. Negative bacteriological findings, coupled with the history of the case, must be relied on.

Treatment.

This may be divided into an account of the general lines of treatment commonly adopted in this disease and an account of the methods advocated by myself.

The commonest local forms of treatment in use are:

1. Swabbing of the gums with Bowman's or other similar solutions. These solutions contain, for the most part, mixtures of vinum ipecacuanhae, liquor arsenicalis, and glycerin, or solutions of silver nitrate or copper sulphate.

2. Mouth-washes, usually associated with the above treatment, generally given every four hours, and composed of hydrogen peroxide, eusol, carbolic acid, etc.

3. Scaling of the teeth and removal of tartar, as soon as all signs of sloughing have disappeared.

The treatment I have adopted, as a result of considerable experience, is briefly as follows:

General Treatment.—Patients are admitted to hospital. Diet is light for the first two days, but ordinary hospital diet is substituted as soon as possible. Smoking is forbidden.

Local Treatment.—When the patient is first seen all slough is scraped away. This is best done with a large, spoon-shaped excavator. The remaining debris is then washed away by means of a water syringe, great care being taken to syringe between the teeth. A concentrated solution of thymol in water is the best lotion for this purpose, but if not available eusol may be used instead. When all the slough has been removed from the ulcers as much tartar as possible is scaled from the necks of the teeth. The haemorrhage caused by the above process is not harmful, although care should be taken that the tissues are damaged as little as possible. The gums are then dried and swabbed with a 5 per cent. solution of silver nitrate; this is allowed to remain for a minute or two and the patient instructed to wash out his mouth with water or thymol solution.

Subsequent Treatment.—A mouth-wash of thymol water is given two-hourly throughout the day. The above treatment is carried out daily until all ulcers have a clean granulating surface (usually four to five days); when this stage is reached mouth-washes are given less frequently, but not less than three times a day; the application of silver nitrate is discontinued, but the syringing of the interdental spaces is carried on. All roots and septic teeth are then extracted and all necessary fillings completed as soon as the ulcers commence to heal.

When obtainable, glycerin and tannic acid is rubbed into the gums daily when the application of silver nitrate has been discontinued.

From the commencement of the treatment patients are instructed to brush their teeth, using the brush with a vertical action, and by using the bristles of the brush in a similar manner to a toothpick—namely, for the purpose of cleaning out the interdental spaces.

Treatment of Chronic Cases.—The treatment of these cases is different from the above in that any attempt to save the teeth in the affected area is useless. Marked bone destruction or a history of several attacks extending over a period of several months necessitates the extraction of the affected teeth. Before this can be done, however, it is essential to render the mouth comparatively clean; two or three days' treatment as indicated above will usually suffice. Local anaesthetics must on no account be used in these cases.

Patients are not cured until the specific organisms can no longer be found by bacteriological examination.

Clinically, patients may be considered fit for duty when all ulcers are completely healed and the gums no longer bleed when pressure is applied to them.

The usual duration of the disease from commencement of treatment is ten to fourteen days, patients usually becoming free from the specific organisms on the eighth or ninth day.

Statistical Evidence.

This has been obtained from two sources: (1) Reports from dental officers of the number of cases of acute ulcerative gingivitis occurring among patients seeking dental treatment. (2) Mouth inspection, by myself, of

soldiers living under various conditions but not reporting sick on account of dental disease.

1. Number of visits made to dental officers in a certain area during a period of one month ... 9,380
 Number of men treated (approximately) ... 7,000
 Number of cases of acute ulcerative gingivitis 46
 Percentage incidence, 0.65.

2. The mouths of 889 men from various units in the army were inspected. These included:

- (a) Men returning after a four days' tour in the trenches. Samples taken from each company of six battalions.

Positive acute ulcerative gingivitis	2 = 0.76 per cent.
Dirty mouths	31 = 11.4 "
Moderately clean mouths	76 = 25.7 "
Clean mouths	157 = 57.1 "
Men wearing dentures	13 = 4.8 "
Total	279

- (b) Troops in back areas—A.S.C. workshops and M.T. companies.

Positive acute ulcerative gingivitis	1 = 0.35 per cent.
Dirty mouths	49 = 15.8 "
Moderately clean mouths	68 = 22 "
Clean mouths	159 = 51.8 "
Men wearing dentures	32 = 10 "
Total	339

- (c) Reinforcements from the base.

Positive acute ulcerative gingivitis	1 = 0.33 per cent.
Dirty mouths	51 = 17 "
Moderately clean mouths	67 = 22.2 "
Clean mouths	154 = 51.1 "
Wearing dentures	28 = 9.3 "
Total	301

The above figures, although not large, appear to show that acute ulcerative gingivitis is present in approximately 0.3 per cent. of men behind the line, and in 0.7 per cent. of those returning from the trenches. None of the cases found at inspection were severe, but all had definite sloughing of the interdental papillae.

Certain other points noted at inspection are of interest. On the whole the condition of the teeth is fair. Of the infantry only a small proportion clean their teeth at all, but in spite of this there is a higher percentage of clean mouths among them than in other branches of the service. This is in all probability due to difference in the diet. Certainly not more than 30 per cent. of the men use their toothbrushes for the proper purpose, although at least 90 per cent. have them for "kit inspection." Of the men (70 per cent.) who do not brush their teeth, 30 per cent. use their brushes for cleaning buttons, while the remainder keep the brushes for inspection purposes only. Caries is present in the majority of the men, and could be largely prevented if more dental officers were available. It would then be possible to inspect troops regularly and fill the cavities while they are still small.

Simple gingivitis is present in a large number of the men who do not keep their teeth clean, and periodontal disease is common amongst the older men and those who have always neglected their teeth.

SUMMARY.

From the foregoing report the information obtained can be briefly summarized as follows:

Severe cases of acute ulcerative gingivitis represent 0.65 per cent. of all men reporting sick on account of their teeth.

Only a small proportion of men suffering from the condition report sick until the pain becomes severe, and there is considerable ulceration.

Significant points affecting the army in connexion with this disease are its contagious nature, the disability produced, and the subsequent loss of teeth unless treated early.

The average duration of treatment in first attacks is ten days, provided treatment is rigorous.

Relapses are common, and probably chiefly due to inefficient treatment or too early discharge.

The treatment is laborious, and personal daily treatment by a dental officer is required for each case.

I am indebted to Major-General H. N. Thompson, C.B., C.M.G., D.S.O., Director of Medical Services, for affording me special facilities in connexion with this and other dental work, and to Major J. W. McNee, D.S.O., Assistant Adviser in Pathology, for many valuable suggestions and help in laboratory work.

ON THE AMINO-ACID CONTENT OF NUTRIENT MEDIA.

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(Report to the Medical Research Committee.)

THE preparation of nutrient media for bacteriological purposes was considerably enhanced by the adoption of Eyre's scale of acidity.¹ A further advance was made when the reaction was adjusted to $P_H = 7.35$ with phenol-sulphonephthalein as the indicator.³ Another stage is gradually being evolved by a more generally recognized necessity for the provision of substances associated specifically with parasitic metabolism.

The ultimate objects of the production of nutrient media are, however, not concerned solely with the compounding of material for exhibiting the growth of bacteria from the visual standpoint. They include also a conception of the biochemical activities of the micro-organism, and envisage the possibility of developing the varying antigenic capacities and agglutinable properties which are manifested during the course of an infection.³ They may even foreshadow the reproduction *in vitro* of the various factors which confront the bacterium when seeking its food in living animal tissues. Media intended for isolation purposes only might be considered, therefore, as a blend of specific amino-acids and other compounds habitually used by the parasite, dissolved, or constituted, under those physical conditions best suited for its enzymic actions; while media devised for the purposes of immunity might be expected to incite bacterial growth under conditions approximating to the lytic and physical changes which accompany vital response to an irritant.

Towards some of these aims our work on the purification of peptones was directed.⁴ Its continuance was prevented by the onset of routine military work; but the introduction of numerous new media designed to meet restricted food supplies has opened up a number of complexities. It seemed worth while, therefore, to make an attempt to consider these from the standpoint of the gross amino content, leaving the previously proposed examination of particular amino-acids to a later investigation.

One of the reasons which led Cole and Onslow to adopt the casein preparation known as "laitproto" as a base for the production of a nutrient medium was the fact that it yielded regularly a rich and fairly equable supply of amino-acids in a tryptic digest.² Dorothy Lloyd, when using the same medium, observed that meningococcal growth increased in relation to the number of hours of digestion, and that as the percentage of amino-acids was raised the necessity for the addition of catalysing or vitaminic influences was decreased.⁵ Rettger, Berman, and Sturges suggested that, unless free amino-acids are present in a sufficient amount, the development of the enzymes necessary for the cleavage of such simple bodies as peptones and proteoses does not take place.⁶ As a practical application of these findings, Glynn, among others, prior to undertaking his extensive work on dysentery bacilli, determined the amino-acid content of several peptones and selected one which yielded a satisfactory formaldehyde figure.¹¹

In the preparation of nutrient media, therefore, it is essential to ensure that there is an adequate content of free amino-acids of low molecular weight. Hence we proceeded to estimate the amino content of ordinary and special media and to determine the minimal percentage necessary for effective growth.

The Formaldehyde Figures for Nutrient Media.

The estimation of the approximate amino-acid content may be carried out in a few minutes by the simple method described in Plimmer's handbook of biochemistry.⁷ It enables the results to be recorded in terms of N/10 alkali per 100 c.cm. of medium. Our findings are incorporated in Table I.