THE TEETH OF THE SOLDIER.

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Prevalence of Decay.—Caries of the teeth causes the loss to the Service of a large number of men, some of them refused by the recruiting agencies, and others invalided after varying periods of service. The recruiting returns do not show the number lost to the Service by the rejections at the recruiting offices: they simply indicate the number of those offering for enlistment who suffer from caries to such an extent that they are considered unfit for the Service; their teeth are examined, and if they are unfit, no further time is wasted in hunting for other disqualifying defects. In order to get some idea of the real proportion of men who were lost for defective teeth alone, I obtained from the five largest recruiting centres returns for the month of March, 1906, of those whose only defect was caries of teeth. A comparison of these returns with those for the previous month furnishes a rough idea of the proportion of men rejected for teeth who were also unfit for other reasons.

	I. February, 1906	II. March, 1906
Manchester	29	13
Leeds	29	10
Liverpool	23	9
Sheffield	17	6
Preston	19	5
Average ..	23·4	8·6

I. Those rejected for teeth; other defects not being looked for.

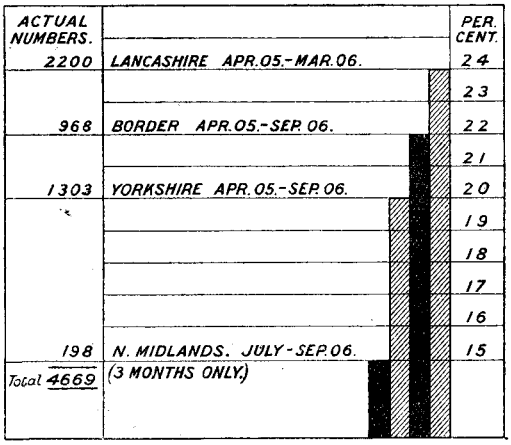
II. Those who, after complete examination, were found to be disqualified by reason of bad teeth only.

It will be seen that a large proportion of those usually shown as rejected for "teeth" possess other disqualifying defects, in this instance about two-thirds. The following Charts, A and B, show the actual numbers of men rejected for "teeth" in the Northern Command during the period April, 1905—September, 1906, and the percentage of those offering for enlistment, arranged for purposes of comparison in "grouped districts" and towns.

Function of the Teeth.—The main value of the teeth is their function of dividing food in order that it may be mixed with the saliva and easily swallowed in a convenient form for gastric digestion; only a very small percentage of the starch of the

food is changed by the time it leaves the stomach, and it would appear that ptyalin, the only ferment in saliva, is of very little importance for the digestion of starchy foods, which occurs chiefly in the duodenum by means of the amylopsin of the pancreatic juice. Saliva is practically water (99·42 per cent.), and its principal function is to dissolve certain constituents of food. These facts explain how the toothless man is able to maintain his health, for, provided he takes his food in a sufficiently divided condition and mixes it well with saliva before swallowing it, digestion will proceed as perfectly as in the man with a good set of teeth. The nutrition of the toothless man therefore depends on the character of the food which he is able to obtain; he cannot

CHART A.

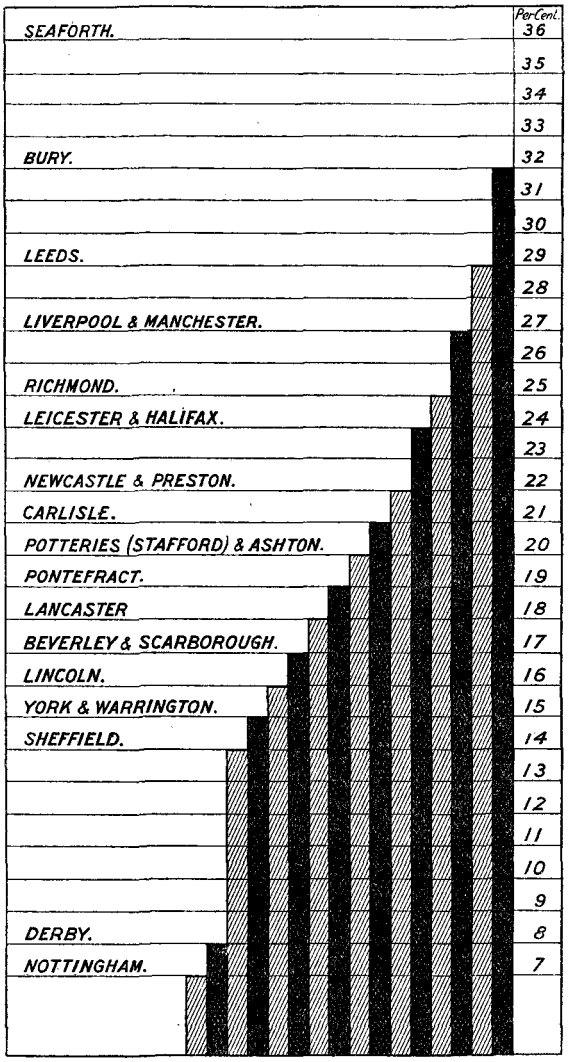


eat tough meat or uncooked vegetables, but he can obtain his carbo-hydrates from such foods as potatoes and bread, his nitrogen from eggs and milk, and his salts from Bovril and soup, and, provided that he does not neglect the churning with saliva in the mouth, in many instances gets on as well without teeth as with them.

Causes of Decay.—Caries is a chemico-parasitical process consisting of two distinctly-marked stages; decalcification of the tooth, and solution, or peptonising, of the soft residue. In the case of enamel there is no soft tissue to be dissolved. The acids, particularly lactic acid, by which the process of decalcification is produced, are mainly derived from the fermentation of carbo-hydrates.

The starch is transformed by the ptyalin of the saliva into grape-sugar, which, by the action of various species of bacteria, is converted into lactic acid. Many bacteria found in the mouth are

CHART B.



capable of effecting the whole change from starch to lactic acid. When the lime salts have been dissolved by these means, organisms invade the dentine tubules, and, by a digestive or peptonising

action, dissolve the soft tissues. Many species of bacilli and cocci found in the mouth are capable of producing this change. There is no specific germ of caries; sometimes one, at other times another species is found. Predisposing causes are—defective formation of the teeth, a deficiency of lime salts, the presence of pits and crevices which encourage the lodgment of carbohydrate food, acid food and drinks, such as cyder and uncooked fruit, civilisation, and neglect of the tooth-brush. Caries is an effect of external causes, and may occur in the well-developed teeth of men of perfect physique and health. The liability decreases with age, and its commencement is less frequent after the age of 25.

It is interesting to note, in connection with the theory so commonly held, that caries is caused by a deficiency of lime salts in water supply, that Sheffield with a low water hardness is nearly at the bottom of the comparative caries table (III.), and Leeds and Halifax, with a high caries index, have also high degrees of hardness in their water supplies. The lime salts required for the formation of bone and dentine are principally derived from foods such as milk, butter, cheese and bread; water supply has little influence either during development or afterwards.

TABLE III.—TABLE SHOWING RELATION OF LIME SALTS TO CARIES.

	Water Hardness			Percentage rejections for teeth
	Total	Fixed	Removable	
Leeds	7·78	3·50	4·28	29
Halifax	8·8	3·96	4·84	24
Sheffield	5·5	4·5	1	14

The Inter-Departmental Committee on Physical Deterioration made this point clear as a result of their enquiry at Glasgow, and concerning which I furnish an extract from a letter from the Medical Officer of Health, Glasgow :—

"As a factor in the production of rickets in Glasgow, water may, I think, be neglected. It was foretold, when its introduction was proposed fifty years ago, that the absence of lime salts would powerfully influence the prevalence of rickets, but experience has, I think, shown the erroneous character of this idea. Within the period of the present water supply there has been an undoubted prevalence of rickets, up till the early eighties, probably, and also a considerable decrease, without any change whatever in the water,

but with a considerable change in the sanitary surroundings of many portions of the population. As this matter is referred to in my evidence before the Inter-Departmental Committee on Physical Deterioration, will you allow me to append some extracts. I agree with you that improper feeding is among the most potent causes of rickets."

The subject of decayed teeth cannot be dissociated from the bacteriology of the mouth. The mouth is crowded with micro-organisms; the more diseased it is, the greater the numbers and varieties, some pathogenic, others not. Of these organisms a large number cause the fermentation of grape-sugar into lactic acid, a large number also have a peptonising action, and render soluble albumen, gelatine, &c. There are several forms of micro-organisms which are found in every mouth, the commonest are: the mouth Diplococcus of Van Lingelsheim, *Bacillus buccalis maximus, B. fusiformis, B. lactis, Indococcus vaginatis, Leptothrix innominata, L. buccalis maxima, Spirillum sputigenum,* and the *Spirochæta dentium.*

Properties of the Various Organisms.—Leptothrix is associated with the formation of tartar, and is the chief constituent of the cheesy nodules common in the lacunæ of the tonsils of young people of impaired constitution. Spirochæta in association with *B. fusiformis* is one of the most frequent causes of caries. The mouth Diplococcus of Van Lingelsheim is present in all mouths, attached to, or in the interior of, epithelial cells. It is non-pathogenic, and is able to ferment urea to ammonium carbonate in the presence of peptone. Sarcinæ and bacilli of the mesentericus group are constantly found in healthy mouths, and also the *Diplococcus pneumoniæ, B. diphtheriæ,* the Diplococcus of rheumatic fever and the tubercle bacillus—the tubercular cervical glands so commonly found among the children of the poor are caused by the absorption of bacilli through the tonsils. The bacilli of the various forms of common colds, *B. catarrhalis, B. coryzæ* and *B. segmentosa,* are also frequent visitors to the mouth. Many of the organisms found in the mouth are very virulent, those connected with *Pyorrhœa alveolaris* are considered to be especially so. Goadby, in 1904, inoculated twenty-four rabbits or guinea-pigs with septic material from the mouth, or cultivations from it. Half the number died with symptoms of septicæmia in periods varying from eighteen hours to six weeks, and in each instance an organism was recovered from the heart blood. Now, what is the significance of the presence of these multitudes of germs? The mouth is a perfect incubator,

kept at the correct temperature, and as a rule well supplied with cultivation pabulum and moisture, so that one would imagine that enough septic material was manufactured to kill anyone in a short space of time. We have seen that guinea-pigs and rabbits die from the effects of inoculation with oral septic matter, but we do not observe these effects in the human being; the mucous membrane of the mouth must therefore be most resistant, even in the diseased condition which exists, as a rule, in a septic mouth, and the germs and their toxins cannot find their way into the general circulation in this way. The tonsils are, however, the frequent site of bacterial invasion, and the portals for systemic infection. But apart from the danger of organised attacks, there does not seem to be a general and constant absorption of toxins into the circulation from the mouth.

Ingestion of Bacteria and their Ferments.—The next point for consideration is the disposal of septic material after it is swallowed; again, there is no probability that it is absorbed under normal conditions of health—the great majority of the organisms are digested in the stomach. When there is a normal amount of acid present no growth occurs, but spores and certain resistant species pass on to the duodenum. If the secretion of the stomach is not normally acid, organisms usually digested multiply and pass on to the intestine. The contents of the duodenum are alkaline, and the germs which normally arrive there with the chyme multiply with great rapidity, and assist the pancreatic ferments in the digestive processes which they are capable alone of carrying to a further degree, both in the starches and proteids. There is no doubt, also, that these useful, healthy germs digest the lower, more poisonous and pathogenic ones; they are capable even of splitting up their ferments, and so of nullifying the effects of oral sepsis or the accidental ingestion of disease germs.

It is an established fact that bacillary toxins may be absorbed from the digestive track, and that, in consequence, tolerance of poisonous doses is established. According to Pliny, King Mithridates was well acquainted with this method of immunisation; he did not inoculate under the skin the poisons against which he immunised himself, but introduced them into the stomach. Behring has used this method successfully in the tuberculosis of sheep and other animals. Koch, also, has habituated human beings to tuberculin, and Ehrlich has experimentally used the poisons of poisonous plants in the same manner.

Persons suffering from diseased teeth continue swallowing an

emulsion of pus and germs with their ferments for practically the whole of their lives, and as a general rule without any consequent ill effect on their health; I also remark that Goadby records a strong reaction to the inoculation of immunising doses of streptococcic emulsion for the treatment of pyorrhœa, showing that no tolerance for the strain used had been established by the swallowing or absorption of the infective material from the alveoli. I therefore surmise that the small doses of ferments constantly swallowed are split up, probably chemically, in the stomach, and rendered harmless before absorption takes place. I do not think that oral sepsis predisposes to specific diseases of bacterial origin. The presence of such an enormous number of different species of organisms, many of them very hardy and prolific, all fighting against each other for existence, results in the survival of the strongest, amongst which the pathogenic germs are not accounted; the acid reaction, also, of a diseased mouth is inimical to the growth of most pathogenic germs.

Physical Degeneration and Decayed Teeth.—Bad teeth do not cause poor physique and impaired constitution; their quality depends on nutrition during the period of their development, and it suffers in like proportion to the other structures of the body. I have frequently sought to select the toothless and orally septic from among the weeds of the recruiting rooms and the Militia at the depôts by their appearance and complexion, and have been surprised at my failure; I more frequently find a good set of teeth than otherwise in the cachectic. The converse holds good, the man of finest physique often possesses a very diseased set of teeth.

Effects of Toothlessness on Military Service.—Opinions, both in the Army and among the public, including those of the medical and dental professions, as to the desirability of enlisting toothless men for the Army vary to an extreme degree; some would accept a man of fine physique and good health without even looking at his teeth, others demand a perfect denture. In order to study the effect of toothlessness on the durability of a soldier I examined 400 men of from seven to twenty years service serving in the Northern Command. They had all served abroad and a large proportion had seen active service; 18 per cent. had not a single opposing pair of molars or bicuspids, 2·25 per cent., in addition, had only single molars opposing, or two pairs of bicuspids; most of the molarless, however, possessed some sound front teeth. Nine men possessed plates; seven of these wore them and liked them, but stated that they could get on very well without them, and, with one

exception, regarded them as a luxury. One man, whose only entry on the medical history sheet was for "Caries of Dentine," came home from a colony and was provided with artificial teeth at the public expense; he accepted the teeth but never wears them, as he finds that he gets on very well without them. Another man on being medically examined for extension of service was discovered to be toothless, and was provided with a denture; he accepted it as a means to an end, but has never worn it, as he did not feel the necessity. I was greatly astonished at the absence of evidence of evil influence of this state of toothlessness on the general health and utility of these men. In a general sense they were of healthy and robust appearance; most of them had either no entries on their medical history sheets or they were for trivial complaints only, in no way connected with malnutrition or with digestive defects. According to their statements their teeth had disappeared without making any impression upon their minds or their habits, and, with one exception, without toothache or neuralgia. They masticated their food somehow, the majority could not explain how, but a certain proportion said they used their front teeth and found them efficient. I gather from this enquiry that front teeth are of value for masticating purposes, and that stumps, even diseased ones, are efficient. They provide a broad surface for mixing, even if they are unable to cut and break food. It is evident, therefore, that when judging of the "possession of sufficient sound teeth for purposes of mastication" in a man of fine physique, that due value should be apportioned to the front ones, and to stumps.

The possession of decayed teeth may be regarded as universal among the rank and file of the Army, some have many, others few, and the little trouble they occasion is remarkable; toothache and neuralgia are rare, and when they occur, are treated by extraction of the offending tooth, and no more is thought of the matter. During my whole service I have never been impressed by the existence of a tooth question (except during the South African war), nor can I find any evidence of its existence, with this exception. In the Army Medical Reports it is not even mentioned, so that dental caries cannot be a cause directly of much sickness or invaliding.

The importance which has been attached to this subject of late years is apparently due to the experiences of the South African war, during which a considerable number were admitted to the hospitals and invalided home for caries of dentine.

The following table (IV.) will convey a general idea of the extent of the losses for this cause after the war.

TABLE IV.—ADMISSIONS AND INVALIDS FOR CARIES OF DENTINE.
South Africa.

	1902	Per 1,000	1903	Per 1,000	1887
Strength	50,125	..	27,680	..	7,205
Admissions ..	627	12	322	11	0
Invalids	225	4·5	79	2·7	0

The South African war caries has no connection with that of the ordinary decay of peace time, nor with the standard of teeth which should be required of recruits; it is rather a question of the preventive hygiene of war, and must be classed with enteric, dysentery and scurvy as a disease of long and trying campaigns. It was due to the attack of organisms of extreme peptonising and acid-forming powers on the alveoli, gums and teeth of those rendered susceptible by exposure to the reducing influences of long-continued active service. It was of the nature of an epidemic, and prevailed to a greater extent than is suggested by the returns. It was simply an outcry from exhausted Nature for a period of recuperative rest, and it will happen in any country under similar circumstances, and can be prevented by obvious means.

The conclusions to be drawn from this enquiry are that much greater consideration should be given to the physique and constitution of a recruit when judging the teeth, and that it is safe to accept men of exceptional physique with a very low standard, in which the possible value of stumps should be considered, many being quite durable or capable of being made so.

Any plan of circulating diagrams as guides to the interpretation of the regulations, which demand a sufficient number of sound teeth for purposes of mastication, is unsatisfactory; it tends to warp the judgment and narrow the outlook of the physical examiners. Although it may be affirmed that standards are not to be construed literally, but merely as guides, any difference of opinion between inspecting and executive officers leads to a hasty retirement to the defence of the rigid observance of diagram standards, and the loss of good men. It is, I think, much better to discuss with all concerned the observance of a common-sense standard on the lines I have indicated, and in the spirit of the excellent Medical Regulations.

The employment of local dentists in this Command since June, 1905, has been a success. The object the General Officer Commanding-in-Chief had in view was the saving for the Service by

dental treatment of men who would otherwise have been rejected. An order was given to all recruiting medical officers to the effect that no recruit was to be rejected for defective teeth who could be rendered efficient by dental treatment at a reasonable cost, the services of the Command Dental Surgeon being used if the railway fare to him cost less than the fee for local treatment. Registered dentists of good standing accept fees in most of the large towns of 2s. 6d. per stopping and 1s. per extraction, gas 2s. and 2s. 6d. extra, or contract for the sum of 10s. per recruit, taking the bad with the better. The system provides for the inspection of all dental work by the medical officer before he signs the final approval on the medical history sheet. Dentists are requested not to attempt any work which they cannot, according to their judgment, guarantee to last. As far as I am able to judge, this condition is being observed, but time only will divulge the quality of the work done. The refusal of treatment by recruits was, in the early days, somewhat frequent, but it is now quite exceptional. During the period June, 1905, to September, 1906, 1,510 recruits were treated at a cost of £588 8s., an average of those offering for enlistment of 7 per cent., at a cost of 7s. 9d. each.

Decay of teeth is practically a universal complaint, and the difference between one person and another is simply one of degree. Owing to this universal prevalence, it is impossible to estimate correctly its influence on health, but we know that people live long and healthy lives in spite of it. It is difficult to appraise the financial value of any particular sanitary preventive measure, but, on principle, it may be regarded as certain that a person possessing good teeth and a healthy mouth is a better "life" than one suffering from oral sepsis; it would not be just, however, to spend public money on the teeth of any particular class, and therefore the expenditure on recruits should be regulated by the state of the recruit market, and incurred only when an excursion into the toothless section is required to complete numbers. I estimate that 10 per cent. of good men can be added to the strength of the Army by the aid of local dentistry. It would be better to select any smaller proportion from all sources, than to press the system in any single Command. The financial return to be expected from this system is largely dependent on the systematic use of the tooth-brush, which should be insisted on in all branches of the Army.