

Results—Lesions very markedly improved.

Condition, October, 1917.—Patient has had leprosy for 20 years and has been in prison for one year.

There are two large pale maculæ covering a large part of both thighs and extending down below the knee-joints. There are pale-coloured maculæ on chest, face and both arms. Retraction of left hand.

Complete anæsthesia of all maculæ. Anæsthesia of both hands, legs and feet.

Diagnosis—Maculo-anæsthetic leprosy.

Condition, April, 1918, i.e., after seven months' treatment.—Maculæ have markedly returned towards normal skin colour though those on thighs are still quite evident.

No anæsthesia of body, face or hands but partial anæsthesia, *i.e.*, can feel pinching but not stroking where formerly he could not feel the prick of a pin, still remains from the thigh to the feet.

Results—Considerable improvement.

Condition, October, 1917.—He has been in prison 2 years and has only had leprosy for 1 year, therefore it appears as if he had been infected while in prison.

He has a small red macula on nose, small maculæ on both forearms and one on back of left thigh. Dermatitis of both arms, both legs and feet, but most marked on right thigh.

Complete anæsthesia in all maculæ, anæsthesia of both hands and feet.

Diagnosis—Maculo-anæsthetic leprosy.

Condition, April, 1918.—All anæsthesia has disappeared with the exception of that of both feet. The maculæ on the face and arms have disappeared. Maculæ on back of thigh still evident.

Dermatitis has disappeared from his arms but is still present on his legs, though much improved.

The patient has many syphilitic scars on his body, which somewhat reduce the value of the photos.

Result—Considerable improvement.

Condition, November, 1917.—The patient has been in prison for 2 years and 9 months. He has only had leprosy for 1 year and 3 months, therefore it appears as if he were infected in the prison.

He has dark-red maculæ on face, arms, left scapular region, thighs and legs. All are completely anæsthetic.

Dermatitis on both arms, left thigh, left leg and both feet.

Anæsthesia of left leg and foot, and also of both hands.

Diagnosis—Maculo-anæsthetic leprosy.

Condition, April, 1918 (6 months' treatment).—Almost complete return of normal sensation. The dermatitis has disappeared.

The maculæ have disappeared in places and now only show on the face and right arm, though much improved.

Result—Considerable improvement.

Condition, November, 1917.—He has been in prison for 1 year and has had leprosy for two years.

He has disseminated tubercles on his face, arms and body.

Anæsthesia of left foot and ring-finger of left hand.

Diagnosis—Mixed leprosy.

Condition, April, 1918.—The tubercles have completely disappeared from the body, a few still remain on the arms and face, the latter being markedly reduced in size.

Anæsthesia has completely disappeared.

Result—Considerable improvement.

Condition, February, 1918.—Patient has been in prison for 5 years and has only had leprosy for 2 years, therefore it appears as if he were infected in prison.

He has small red maculæ on both cheeks, on thorax and abdomen, which are very slightly anæsthetic. There is complete anæsthesia of fourth toe of right foot.

Diagnosis—Maculo-anæsthetic leprosy.

Condition, June, 1918—The maculæ have entirely disappeared and the only remaining symptom is the anæsthesia of fourth toe which now is only partial, *i.e.*, he can feel it when the skin is pinched.

Result—Marked improvement.

CONCLUSIONS.

1. Of these 13 cases, 7 cases have only shown the symptoms of leprosy some time after being imprisoned, therefore it appears as if they were infected in the prison, especially as no method of isolation was employed and as the prison has contained lepers for many years past.

2. Maculo-anæsthetic	... 9 cases.
Mixed leprosy	... 4 "
3. All lesions disappeared	... 2 cases.
Very marked improvement	... 3 "
Considerable improvement	... 6 "
Improvement	... 1 case.
No improvement	... 1 "

Total ... 13 cases.

4. Neither the duration of the disease nor the type of the disease seems to have any marked influence on the rapidity of the improvement. The cases showing most rapid change being—

Case No. 4, with duration of disease 8 years, mixed leprosy.

Case No. 6, duration of disease 6 months, anæsthetic leprosy.

Case No. 8, duration of disease 15 years, mixed leprosy.

5. In my opinion, the relief granted to the patient by the improvement of his general health, together with the almost universal improvement of the symptoms of the disease, indicate that the treatment by sodium gynocardate A is indicated in all cases of leprosy of whatever type or duration. And that although it is still too early to state definitely that the treatment is specific and curative, the results already obtained strongly indicate that happy result.

THE ETIOLOGY OF SPRUE.

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SPRUE is among the "Tropical Diseases" of which the etiologies are unknown; and a variety of causes of this disease have been suggested.

Success is more probable, when seeking for the causal organism of a chronic disease, from a study of it during its onset in each patient before the disease has progressed and lowered the resistance of the body which will favour the appearance of secondary organisms, or when the disease occurs in its aberrant forms.

Kohlbrugge (1) was the first to record that yeasts may appear in large numbers in the alimentary

tract of patients who are suffering with sprue. Many observers have noted this presence of yeasts, but the suggestion that these organisms play a principal part in the etiology of this disease has received enhanced attention since Bahr (2) published his "Report on Researches on Sprue in Ceylon." But probably these organisms grow in the stools after a primary cause has weakened the digestive and absorptive functions of the alimentary system, and this allows the accumulation in the intestines of a large amount of suitable pabulum for the growth of the yeasts.

The normal bacterial *fauna* of the *faeces* is altered in most diseases of the intestines, and this is particularly well marked in such acute diseases as typhoid and dysentery, where the usual preponderance of lactose-fermenting organisms has been replaced by the time the patient commences convalescence by members of the alkaligenes or proteus groups, and this is due to an alteration in the intestinal contents and not to a change in the resistance of the body.

The essential feature of sprue may be defined as a superficial inflammation and erosion of the mucous membrane of the whole alimentary tract, which gradually leads to profound degeneration of the entire digestive system.

It is logical to consider that the changes which occur in the mouth, pharynx and *æ*sophagus are of the same nature, and have the same cause as those which take place in the lower parts of the alimentary tract.

There is an exceedingly common form of superficial glossitis and *æ*sophagitis among the native population of Ceylon, which more frequently afflicts women than men; a number of these cases can always be seen at the out-patients' department of the Women's Hospital in Colombo. The patient complains of a sensation as though cayenne-pepper were held in the mouth, and almost all explain that this pain extends backwards, and the food produces a feeling of scalding as it is passing down the gullet.

The tongue has a smooth, clean, glazed appearance, and there are areas of very superficial ulceration.

The condition is exactly similar to that seen in Europeans who are suffering from typical sprue. These native patients seldom complain of diarrhoea, and the voluminous frothy stool, usual with Europeans, is practically always absent.

I conclude that, due to racial immunity, sprue, though common, is a mild affection among the natives of Ceylon, and seldom produces symptoms referable to any portion of the alimentary tract lower than the *æ*sophagus.

The disease usually is manifested in Europeans by changes throughout the alimentary tract; yet one part may be more affected than another, for

cases are not uncommon in which tongue symptoms are absent, and others in which the sore mouth is the only symptom present.

In the majority of these cases in natives and in six out of eleven European patients, I have failed to grow yeasts in culture media which had been inoculated with scrapings from the tongue and mouth.

The only organisms which I have succeeded in isolating on every occasion have been streptococci.

Sprue occasionally has a sudden onset, and the patient is able to state the day or even hour on which the first symptoms appeared.

I can record two striking examples of this—the first patient was a person who knew that I was studying Ceylon sore mouth; he visited me one day because he had an attack of sprue which started that morning; the previous night he had been in perfect health; but that morning when he went to breakfast, he found that he could not eat with comfort because of a burning sensation as though he had cayenne-pepper in his mouth, and also he could not smoke. His tongue was very red but clean, and when examined with a lens there appeared to be very superficial congestion and shredding of the mucous membrane. I cleaned a small portion of the tongue and mucous membrane of the cheek with alcohol, and from scrapings of these areas I inoculated tubes and plates of glucose-agar, glycerine-agar and blood-agar. There appeared on these media numerous colonies of streptococci of the "viridans" group, a few isolated colonies of other organisms, but no yeasts.

This patient soon developed other symptoms of sprue and within a week the stools were numerous, large and frothy.

A second patient, when he was staying in the hills last September, experienced a similar onset, he states that he was in very good health, when on a definite date he found that he could not eat his meals, or drink a whiskey and soda, on account of the sudden appearance of soreness in his mouth; the next day he had diarrhoea, and in a few days he passed typical sprue stools.

I did not see this patient at that time, so I was unable to obtain cultures as had been done in the previous case.

I have been able to obtain only one *post-mortem* examination on a patient who had died of sprue. The deceased was a woman, and the examination was made within a few hours of death. I obtained a large number of colonies of streptococcus viridans on glycerine-agar and blood-agar from the tongue, *æ*sophagus, duodenum, ileum, colon, spleen and liver.

I can find articles from only one observer who previously has suggested that sprue may be a streptococcal infection. Sir Leonard Rogers has made this suggestion in the *Lancet* (June 6th, 1914) after the successful treatment of two

patients with a vaccine of streptococci which had been isolated from their mouths.

Streptococci can be isolated from the mouths of the majority of persons in normal health, and any claim that they are the cause of a disease requires considerable substantiation.

It is very necessary to attempt to define the characters of the streptococcus associated with sprue; and this raises the vexed question whether or not the organisms of this class, which are found in etiological relationship with so many and various diseases, can be described satisfactorily.

Various morphological, cultural and serological tests have been suggested to distinguish the different types of streptococci. I will discuss them and apply them to the organisms under consideration.

Morphological.—All bacteriologists are now agreed that it is hopeless to differentiate between various streptococci from their microscopical appearances, for the organism can be altered from long to short chain forms by changing the composition of the culture media.

When first isolated on blood-agar, the chains of the streptococci from sprue patients were short or of moderate length, occasionally long forms appeared in the first culture in glycerine broth, but after several subcultures in this media the chains were long or conglomerated in all cases. I could find no capsule around these organisms when stained by Buerger's method, which has been used for distinguishing the pneumococcus and streptococcus mucosus.

Bile test.—When fresh and filtered ox bile is added to broth cultures of most strains of pneumococci and certain streptococci, they swell up and are dissolved. This action did not take place with the organisms under consideration.

Cultural characters.—The best primary grouping of streptococci as they occur in association with man, is that suggested by Schöttmüller, which is based upon the characters of their colonies on blood-agar plates:—

1. Colonies which are surrounded by a clear zone of hæmolysis:—streptococcus hæmolyticus (seu pyogenes, seu erysipelatos).
2. Colonies of a greenish colour and usually no zone of hæmolysis:—streptococcus viridans (seu mitior).
3. Whitish colonies of a slimy consistence, they tend to adhere to the media, and the cocci are capsulated:—streptococcus mucosus.

The organism from sprue patients produces green colonies and no hæmolysis, and is therefore a strain of streptococcus viridans.

Precipitation test.—Some organisms when growing on ascitic agar produce a cloudiness in the media in the neighbourhood of their growth; this is due to the precipitation of the proteids of the ascitic fluid; when others are growing on this

media it remains clear and transparent. This is known as the precipitation test and it is considered a very distinctive test by some workers. In my hands the test has varied and streptococci have produced precipitation with one lot of ascitic fluid and failed to do so with ascitic fluid from another source. Also this test is one of degree, one streptococcus will produce a deep opacity throughout the whole ascitic agar slope, while with another the opacity will occur only in the neighbourhood of the growth.

Most of the "sprue" organisms have produced a greater or less degree of precipitation.

Carbohydrate fermentation.—Numerous efforts have been made to classify streptococci by their actions on carbohydrates; Gordon and Houston (3) were among the first to study these reactions, but in none of their reports is a satisfactory classification suggested, even though the organisms came from such different sources as cow-dung and human stools. Andrewes and Horder (4) studied 288 strains and they divided them into the following types:—streptococcus equinus, streptococcus mitis, streptococcus pyogenes, streptococcus salivarius, streptococcus anginosus, streptococcus faecalis and pneumococcus.

The numerous \pm symbols appearing in their tables show how frequently they found that the reactions varied; they frankly admit that one group insensibly fades into another and they state: "We venture to believe that some such conception of the streptococci, as we have set forth, is preferable to the idea that they are all one kind and that they present a hopeless chaos."

Hopkins and Arvilla Lang (5) from a study of 105 strains propose the following groups:—

- (a) Pyogenic group, characterised by the fermentation of lactose and salacin.
- (b) Four salivary groups, two characterised by the fermentation of raffinose, one by the fermentation of inulin and one by the failure to ferment salacin, raffinose, mannite or inulin.
- (c) Faecal group, characterised by the fermentation of mannite.
- (d) Equine group, characterised by the failure to ferment lactose.

The reactions produced by the streptococci from patients suffering from sprue were very variable, but none of them fermented mannite in the serum water of Hiss.

The accompanying charts, in which the cultural characters are given, demonstrate the inconstancy of their reactions, partly depending upon the media used, whether serum water or lemco broth. The reactions of some of the organisms have been tested at intervals after they have been subcultured weekly for several months, and reference to the charts shows that frequently they lose the power of splitting certain carbohydrates after repeatedly being subcultured.

When these tests were carried out on the same date, on all occasions portions of the same lot of media were used for each organism.

The reaction of several streptococci isolated from other sources is given in these charts for comparison.

I have isolated a streptococcus on several occasions which produced acid from all the nineteen carbohydrates noted, the carbohydrates being added in 1 per cent. strength to sugar-free lemco broth, a tube containing no added carbohydrate is inoculated for a control, but this organism belongs to the viridans group and produces no acidity from mannite and many other sugars when these are dissolved in the serum water of Hiss.

It is interesting to note how it slowly loses its power of producing acid from such substances as adonite, inosite, and inulin after it has been subcultured.

In these tests adequate controls were made, thus a recently isolated streptococcus which produced acid in all the media was controlled by one which had had this property but had lost it in respect to certain carbohydrates.

This particular streptococcus has been isolated from two cases of ulcerative endocarditis by blood culture, once from a skin disease, twice from cases of sprue and on two or three occasions from stools, and although at the time of isolation it had distinctive characters, after a few subcultures it became indistinguishable from streptococcus viridans which may be cultured from the healthy mouth.

I do not consider that the fermentation tests are of value for more than roughly grouping the strains of streptococci. To summarise therefore: the streptococci isolated from cases of sprue do not possess a capsule, they are non-hæmolytic, they are not lysed by ox bile, they do not produce acid from mannite in the serum water of Hiss and they produce green colonies on blood-agar. Indeed culturally they are indistinguishable from the streptococcus viridans of the normal mouth.

Serological tests.—Attempts have been made to base the relation of streptococci to disease upon their specific agglutination reaction. Baginshy and Sommerfield(6) found that the serum of patients who had scarlet fever contained specific agglutination for streptococci isolated from the throats of such patients.

Similar findings have been reported by Von Pirquet(7). Meyer(8) found that when rabbits were immunised with four of ten strains that cross agglutination occurred with the other strains, but he states that organisms from purulent processes were not affected by the immune sera produced by organisms from the throats of scarlet fever patients or persons suffering with rheumatic fever. Other investigators have

reported promiscuous agglutination between various streptococci and immune sera; from this Marmorek(9) concluded that all human pathogenic streptococci were of the same species.

Fischer(10) concluded that the agglutination reaction was valueless for grouping streptococci.

I have tested the sera of sprue patients with the organisms isolated from their mouths but the results have been so irregular and indefinite that I could form no conclusions in these cases.

The complement fixation test.—This test has been studied for two purposes: to classify streptococci and to prove its etiological rôle in a number of diseases.

Floyd and Wolback(11) concluded that there was a marked degree of specificity in the complement fixation with immune sera for antigen of similar cultural and fermentation reactions. But Kinsella(12) could find no apparent relationship between complement fixation properties of streptococci grouped according to their carbohydrate fermentation reactions, but he was able roughly to classify these organisms into three groups; later Kinsella and Swift(13) by this test classified non-hæmolytic streptococci into three groups.

For the second purpose much work has been done in connection with scarlet fever patients with varying results; Liviriatto(14) tested the sera of scarlet fever patients using the streptococci isolated from their throats as antigen, and compared these results with those obtained when a number of antigens from other sources were used. All gave positive complement fixation with the former antigen and negative with the others. Foix and Mullein(15) report similar results.

Castex(16) used sera from patients suffering from various streptococcal infections and obtained cross immunity reactions with all and concluded that various streptococci do not produce antibodies sufficiently specific to distinguish the strain of organism or to decide from where any particular organism may have been isolated.

Major(17) isolated a streptococcus viridans from a patient suffering from endocarditis and showed that the serum contained specific antibodies but the serum also fixed a hæmolytic streptococcal antigen.

Hastings(18) studying the bacteria from arthritis deformans states that twelve out of twenty-four sera tested gave positive fixation with streptococcus viridans antigen.

Finally Aschner(19) found that the sera of patients with streptococcal endocarditis gave strongly positive fixation with homologous antigen, but a negative with a mixed antigen of streptococci isolated from throat and other lesions.

I have tested the sera of three patients who showed all the definite clinical symptoms of

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Chart of the Characters of Streptococci isolated from various sources. This demonstrates the impossibility of classifying them by their fermentation reaction. These are selected from a very large number which have been tested.

LABORATORY NUMBER OF ORGANISM	FROM WHERE ISOLATED	MORPHOLOGICAL APPEARANCE IN GLYCERINE BROTH	APPEARANCE OF COLONY IN BLOOD AGAR	BILE TEST	PRECIPITATION TEST	DATE OF CARBOHYDRATE TESTS	MEDIA USED IN CARBOHYDRATE TESTS	LACTOSE	SACCHAROSE	DULCITE	ADONITE	INOSITE	INULIN	SALACIN	RAFFINOSE	DEXTRINE	ARABINOSE	SORBITE	ISODULCITE	AMYGDALINE	ERYTHRITE	GLYCERINE	MANNITE	MALTOSE	GALACTOSE	LAEVULOSE	GLUCOSE	INDOLE	V. AND P.	NEUT. RED	REDN. NITRATE	
361	SKIN ULCERATION	LONG CHAINS	GREEN.	0	+	4/6/7	LEMCO BROTH	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	0	0	?	+		
361	"	"	"	"	"	6/8/17	LEMCO BROTH	A	A	A	A	A	A	A	0	A	A	A	A	A	0	A	A	A	A	A	A	0	0	0	+	
361	"	"	"	"	"	17/5/18	"	A	A	A	A	A	0	A	0	0	A	A	A	A	0	A	A	A	A	A	A	0	0	?	+	
361	"	"	"	"	"	30/5/18	SERUM WATER	A	A	0	0	0	0	0	0	0	A ^S	A ^S	A ^S	A	0	A	A	A	A	A	A	0	0	0	+	
301A	ENDOCARDITIS	"	"	"	+	4/6/17	LEMCO BROTH	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	0	0	0	0	
301A	"	"	"	"	"	4/2/18	"	A	A	0	0	0	0	0	0	0	0	0	A ^S	0	0	0	A	A	A	A	A	0	0	0	0	
689A	SPRUE MOUTH	"	"	"	+	15/6/18	LEMCO BROTH	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	0	0	0	0	
689A	"	"	"	"	+	25/7/18	SERUM WATER	A	A	0	0	0	0	0	A	0	0	0	0	0	0	0	0	0	A	A	A	A	0	0	0	0
689A	"	"	"	"	+	26/7/18	SERUM WATER	A	A	0	0	0	0	0	A	0	A ^S	0	0	0	0	0	0	0	A	A	A	A	0	0	0	0
100	DYSENTERY	"	"	"	+	—	SERUM WATER	A	A	0	0	0	0	A	0	A ^S	0	0	0	A	0	A ^S	A	A	A	A	A	0	0	0	0	
633	PUS	SHORT CHAINS	HÆMOLYSIS	"	+	—	LEMCO BROTH	A	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A	A	A	A	0	0	0	0	
669	MOUTH	"	"	"	+	2/7/18	SERUM WATER	A	A	0	0	0	0	0	A	0	0	0	0	0	0	0	0	0	A	A	A	A	0	0	0	0
673	NORMAL MOUTH	LONG CHAINS	GREEN	"	+	18/6/18	LEMCO BROTH	A	A	0	0	0	0	A	0	0	0	0	0	0	0	0	0	0	A	A	A	A	0	0	0	+
673	"	"	"	"	+	2/7/18	SERUM WATER	A	A	0	0	0	0	0	0	A	0	0	0	0	0	0	0	0	A	A	A	A	0	0	0	+
X	SEPTIC TOOTH	"	"	"	+	2/7/18	"	A	A	0	0	0	0	0	A	0	0	0	0	0	0	0	0	0	A	A	A	A	0	0	0	0
631	PYRRHOEA	SHORT CHAINS	"	"	+	30/5/18	"	A	A	0	0	0	A	0	A	A ^S	0	0	0	0	0	0	0	0	A	A	A	A	0	0	0	0
632	"	LONG CHAINS	"	"	0	30/5/18	"	A	A	0	A ^S	0	A ^S	A ^S	0	A ^S	0	0	0	0	0	0	0	0	A	A	A	A	0	0	0	0
632	"	"	"	"	0	17/5/18	LEMCO BROTH	A	A	0	0	0	A	0	0	A	0	0	0	0	0	0	0	0	A	A	A	A	0	0	0	0
650	"	"	"	"	+	17/5/18	"	A	A	0	0	0	0	A	0	0	0	0	0	0	A	0	0	0	A	A	A	A	0	0	0	0
663	PUS	SHORT CHAINS	WHITE COLONY	"	+	17/5/18	"	A	A	0	0	0	A	0	A	0	0	0	0	A	0	0	0	0	A	A	A	A	0	0	0	+
408	LIVER P. M.	MODERATE LENGTH	GREEN	"	+	17/5/18	"	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	0	0	0	0	0
408	LIVER P. M.	"	"	"	+	30/5/18	SERUM WATER	A	A	0	0	0	0	A ^S	0	A ^S	0	A	A ^S	A	0	0	A ^S	A	A	A	A	0	0	0	0	0
667	NORMAL MOUTH	"	"	"	+	30/5/18	"	A	A	0	0	0	0	A	0	0	0	0	0	0	0	0	0	0	A	A	A	A	0	0	0	0
669	"	"	"	"	+	30/5/18	"	A	A	0	0	0	0	A	0	0	0	0	0	0	0	0	0	0	A	A	A	A	0	0	0	0

A=ACID.
O=NO CHANGE.

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Chart of the Characters of the Streptococci isolated from the mouths of patients suffering from Sprue.

LABORATORY NUMBER OF ORGANISM.	FROM WHERE ISOLATED.	MORPHOLOGICAL APPEARANCE IN GLYCERINE BROTH	APPEARANCE OF COLONY IN BLOOD AGAR.	BILE TEST.	PRECIPITATION TEST.	DATE OF CARBOHYDRATE TESTS	MEDIA USED IN CARBOHYDRATE TESTS	LACTOSE	SACCHAROSE	DULCITE	ADONITE	INOSITE	INULIN	SALACIN	RAFFINOSE	DEXTRINE	ARABINOSE	SORBITE	ISODULCITE	AMYGDALINE	ERYTHRITE	GLYCERINE	MANNITE	MALTOSE	GALACTOSE	LAEVULOSE	GLUCOSE	INDOLE	V. AND P.	NEUT. RED	REDN. NITRATE	
								A	A	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
94	SPRUE MOUTH	LONG CHAIN	LOST GREEN *	0	0	17/5/18.	LEMCO BROTH.	A	A	O	O	O	O	O	O	O	O	O	O	A	O	O	O	A	A	A	A	O	O	O	O	
639	SPRUE MOUTH	MODERATE CHAIN	GREEN	0	+	7/3/18.	SERUM WATER.	A	A	O	O	O	A	A	A	A	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O	
639	"	"	"	"	"	17/5/18.	LEMCO BROTH.	A	A	O	O	O	O	O	O	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O	
644	SPRUE MOUTH	LONG CHAINS	GREEN	"	0	7/3/18.	SERUM WATER.	A	A	O	O	O	O	A	A	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	+	
644	"	"	"	"	0	30/5/18.	"	A	A	O	O	O	O	A	A ^s	A ^s	O	O	O	O	O	O	A ^s	O	A	A	A	A	O	O	O	O
648	"	VERY LONG CHAINS	GREEN	"	+	7/3/18.	SERUM WATER.	A	A	O	O	O	O	O	O	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O	
648	"	"	"	"	+	17/5/18.	LEMCO BROTH.	A	A	O	O	O	O	A	O	O	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	+
648	"	"	"	"	+	30/5/18.	SERUM WATER.	A	A	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O
661	"	LONG CHAINS	" *	"	+	7/3/18.	LEMCO BROTH.	A	A	O	O	O	O	A	O	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O	
661	"	"	"	"	+	17/5/18.	"	A	A	O	O	O	O	A	O	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O	
661	"	"	"	"	+	30/5/18.	SERUM WATER.	A	A	O	O	O	O	A ^s	O	O	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O
641	"	VERY LONG CHAINS	" *	"	+	7/3/18.	"	A	A	O	O	O	A	O	A	A	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O	
641	"	VERY LONG CHAINS	"	"	+	17/5/18.	LEMCO BROTH.	A	A	O	O	O	O	A	A	A	A	O	O	O	A	O	O	O	A	A	A	A	O	O	O	O
660	"	MODERATE LENGTH	GREEN	"	+	7/3/18.	"	A	A	O	O	O	O	O	A	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O	
660	"	"	"	"	+	17/5/18.	"	A	A	O	O	O	O	A ^s	A	O	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O
660	"	"	"	"	+	30/5/18.	SERUM WATER.	A	A	O	O	O	O	O	A	O	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O
630	"	"	GREEN AND SLIGHT HÆMOLYSIS	"	+	25/7/18.	"	A	A	O	O	O	O	A ^s	A ^s	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O	
630	"	"	"	"	+	25/7/18.	LEMCO BROTH.	A	A	O	O	O	O	A ^s	O	O	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O
687	"	"	GREEN	"	+	25/7/18.	SERUM WATER.	A	A	O	O	O	O	O	A	O	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O
687	"	"	"	"	+	27/7/18.	LEMCO BROTH.	A	A	O	O	O	O	A ^s	A ^s	O	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O
688	"	"	GREEN	"	+	25/7/18.	SERUM WATER.	A	A	O	O	O	O	A	A	A ^s	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O
688	"	"	"	"	+	27/7/18.	LEMCO BROTH.	A	A	O	O	O	O	A ^s	A	O	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O
689	"	"	GREEN	"	+	25/7/18.	SERUM WATER.	A	A	O	O	O	O	A ^s	A	O	O	O	O	O	O	O	O	A ^s	A	A	A	A	O	O	O	O
689	"	"	"	"	+	27/7/18.	LEMCO BROTH.	A	A	O	O	O	O	O	A	O	O	O	O	O	O	O	O	O	A	A	A	A	O	O	O	O

* LOST GREEN PRODUCTION AFTER REPEATED SUBCULTURES.
 A=ACID.
 O=NO CHANGE.

sprue, and sera from two persons in normal health were used for controls, the antigen, a streptococcus viridans grown from a tongue ulcer of one of the patients, was prepared by centrifuging a 48 hours culture of ascitic 0.5 per cent. glucose broth, the deposit was washed twice with normal saline and each time again thrown down in the centrifuge, suspensions of various dilutions were made from this and tested for anticomplementary action, and one-tenth of the highest dilution which produced anticomplementary action was used. The volumes used in the test were 0.3 c.c. each. The following table shows the results:—

Amount of Patients' Serum.	.05 c.c.	.025 c.c.	.01 c.c.
1st Patient	0	++	+++
2nd Patient	+	++	+++
3rd Patient	0	+	++
1st Normal person	+++	+++	+++
2nd Normal person	++	+++	+++

0 No hæmolysis. + Slight hæmolysis. ++ Moderate hæmolysis. +++ Complete hæmolysis.

Thus .01 c.c. of the serum of patients suffering from sprue failed to fix the complement, whereas .05 c.c. produced complete fixation. Normal serum showed practically no power of fixing the complement.

Action of streptococcal vaccines in sprue.—Sir Leonard Rogers(25) in India has treated a number of patients with these vaccines, and although he makes no statement concerning the cultural characters of the organisms which he has used, as they were obtained from the mouth lesions, it is probable that they resemble those which I have dealt with above. The patients treated by him have included a number who were suffering from the disease in its advanced stages, and in all cases improvement resulted and in the majority there were complete cures.

I have now treated or have under treatment nine patients, and the results are so promising that I do not think that there is much doubt that they will be as satisfactory as with the patients of Sir Leonard Rogers, but it is too early to report definite results with the exception of the first three cases. Two of these were Europeans and the third was a Burgher.

I prepare the vaccine by growing the organism on an equal number of tubes of glycerine-agar and blood-agar, the growth is washed off the slopes and mixed.

The first injection consists of a dose of about 100,000,000 cocci, and this is repeated at intervals of five days, the number of cocci in each injection is gradually increased.

CASE 1.—A Burgher woman who had been suffering from sore mouth and frothy, fermenting, voluminous

stools for nine months. I prepared a vaccine from the streptococci of the mouth and injected increasing doses at intervals of five days; she stated that she noticed improvement from the commencement of treatment. By the time she had received six injections, her mouth appeared natural and the stools became smaller and less frequent. The improvement was maintained and at the end of the treatment her stools were normal.

CASE 2.—A male European who had been residing in India and had had a sore mouth and declining health for two years. For six months prior to treatment he had had attacks of diarrhoea and passed large, fermenting stools. He had lost 25 pounds in weight. Improvement commenced after the third injection and there were no signs of sore mouth after the fourth injection. He had remained in natural health for four months when I last heard from him.

CASE 3.—A male European who had been suffering from what was clinically a typical sprue sore mouth for over two years and had received numerous kinds of treatment. The mouth condition rapidly cleared up under the injections, and he was free from all symptoms for two months; at the end of this time, although there were no definite signs of recurrence, he requested a second course of twelve injections. These he had received and, to the time of writing there has been no recurrence.

Results of these cases, and others which have only recently been treated, are such that I can state that I know of no other disease which responds so readily to vaccine treatment.

Most of the patients whom I have injected with vaccines have developed a curious ruddy areola around the site of injection; this may be a specific cutaneous reaction.

When the numerous articles are studied, which have recorded the large amount of work that has been done with streptococci, and it is realised that the results are inconstant and variable for the morphological, cultural and serological tests, it becomes necessary to hold very broad views of the nature of these organisms.

Several workers have stated that all streptococci from human sources are the same, but that they produce different cultural reactions according to the circumstances under which they are living or have recently lived.

Others believe that transmutions may take place in a short period of time. Thus Davis(20) writes "transformation of one member into another within certain limits appears to be not an uncommon phenomenon."

Rosenow(21) has shown that hæmolytic streptococci from a wide range of sources can be converted into streptococcus viridans, typical pneumococcus, and even into streptococcus mucosus, and further he demonstrates that this takes place even when the cultures are made from a single coccus according to the method of Barber, and thus working from a "pure line" he avoids "mass selection."

There are several possible sources of error in his work, but it would require too much space to discuss them here.

It is possible that bacteria can possess but a limited range of properties and that with them further evolution cannot take place, in which case we must assume that they show differences at different times because a varying number of these properties are dominant or recessive.

On the other hand, if they possess powers of evolution, it would be extraordinary if in a short time they did not give rise to fresh species, for a micro-organism which can divide once every half hour will soon produce a vast number of generations, and the study of evolution and palæontology shows that many forms of life have been evolved from more primitive species in many less generations than most bacteria are capable of producing in a year.

However, with pathogenic organisms, we are concerned principally with their virulence and elective affinities for various tissues, and we know that streptococci are able to acquire or lose these properties.

Streptococcus viridans indistinguishable for the organism from normal mouths frequently causes endocarditis, and if the organism from the healthy mucous membrane or from various lesions is injected into rabbits it sets up endocarditis, myositis, or arthritis.

Heineman has described two strains of streptococci isolated from milk indistinguishable from each other as to form, and cultural reactions which nevertheless were quite different as shown by intravenous injections into animals—one localised in the muscles and joints and the other in the gall bladder.

These organisms are ever ready to invade the body, and this is shown by their frequent presence in the organs at *post-mortem* on persons who have died from various causes.

Moody (22) has shown that streptococci from alveolar abscesses, which are identical morphologically and culturally, differ widely in their degree of virulence for laboratory animals.

Sprue is almost confined to thickly populated countries in which the climate is humid and warm. The majority of the inhabitants of Ceylon are addicted to the habit of chewing, this conduces to the repulsive habit of spitting and there is every chance of streptococci being continually passed from one person to another whose mouths have been irritated by the chew.

It is not unreasonable to suggest that in this manner streptococci may increase in virulence and acquire an elective affinity for the alimentary mucosa.

The disease pellagra has much in common with sprue, there is the same wasting of the organs and thinning of the walls of the alimentary tract, and sore mouth and intractable diarrhoea are well-marked symptoms. The suggestion that an error in diet has prepared the way for a streptococcal infection of the alimentary tract

will explain many factors associated with this disease.

Morpingo (23) and Koch (24) believed that scurvy was due to a streptococcal infection and numerous experiments carried out by them supported this opinion. Here, again, possibly the absence of a vitamine from the food renders the body incapable of resisting a streptococcal invasion.

Many military medical officers have noted when on campaign that the number of cases of scurvy can be reduced to almost a disappearing point by strict attention to mouth cleanliness among the troops (25).

I venture to suggest that these speculative views help to bring these diseases into line and indicate many experiments which should have valuable and interesting results.

Much of the work for the production of the charts on the fermentation reactions was done by my laboratory assistant, Mr. Richard de Silva.

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ON A NEW METHOD OF STANDARDIZATION OF DISINFECTANTS.

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OWING to the extensive use, in recent times, of disinfectants in zymotic diseases by the hospital authorities and by the general public, an increasing number of firms are bringing out, in the market, a large number of chemicals supposed to possess disinfecting properties. To distinguish the spurious from the true ones, as well as to find out the effective strength of the latter, is a problem of highest importance both from the point of economy and of safety. With this end in view, Rideal and Walker have formulated a test for standardizing disinfectants. This test depends on the principle of determining the lowest dilution