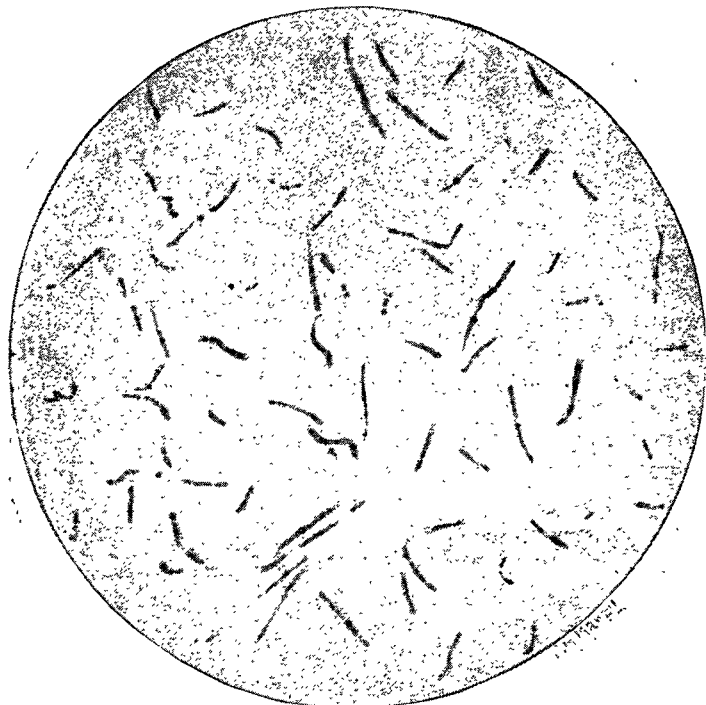


in a flask, poured into sterile test tubes, and set. To get a uniform mixture it has been my custom to set low down in Koch's steamer that coagulation may take place as quickly as possible before all the oil rises to the surface. Each tube is well shaken whilst being laid down in the steamer. Coagulation takes place in about three minutes, care being taken not to let the media rupture. It is then sterilised by steaming for about an hour on three successive days high up in the steamer.

In typical and most favourable growths the tubercle bacillus is altered. In shape it becomes plumper, much longer, and its ends terminate somewhat finely—this is best seen when stained by Gram. The protoplasm of the bacillus undergoes changes. It refuses to stain with carbol-fuchsin in certain parts. Figs. 1 and 3 illustrate these changes. The particular slides from which the figures were made were decolourised with acid-alcohol for about one minute, but the same appearance is given in some cultures, when after staining with carbol-fuchsin the slide is simply washed

FIG. 3.



A drawing of sperm oil tubercle bacilli as seen by the eye under the microscope $\times 1000$.

in water, without any further decolourisation. It will be seen that the bacillus is not stained except in certain parts. In many of the bacilli the staining to non-staining parts assumes some regularity, first a staining portion either in the form of a band, or "granule," then a non-staining band or zone, and so on, through the length of the bacillus, so that the bacillus looks extremely "beaded." These "granules" (Fig. 2) are large, round, refractile bodies, distending the body of the bacillus; they are extremely acid-alcohol fast, and usually are the last to go on decolourising with acid-alcohol, HCl 1 cubic centimetre, 70 cubic centimetres of 70 per cent. alcohol, and water to 100 cubic centimetres. The bacillus can be, within quite a short time of decolourisation, some few seconds, rendered colourless except for these refractile "granules." There does not appear to be any method in which the bands or "granules" are situated in the length of the bacillus. Sometimes there is only one round body at the end as the spore of a tetanus bacillus, or there may be one at each end giving a bipolar appearance, or there may be one or two, or more, situated

either close together or far apart. I may say here that a very similar appearance is given in a plate and photographs in a paper by Wherry.² The body and colourless portions of the bacilli refuse to stain with such dyes as methylene blue and Bismarck brown used as counter-stains. No doubt some of the staining portions of the bacilli are what are known as metachromatic granules, but an Ernst³ preparation does not give the same "beaded" appearance as a fuchsin one. The "beaded" appearance of a fuchsin preparation is brought out much clearer when decolourised with the usual decolourising agents; but decolourisation must not be carried too far, as the bacilli and "granules" may become so faint as to be scarcely visible. I have seen the bacilli completely decolourised as white shining masses within a period of two minutes or a little more. By Gram there is a very uniform picture of faint diaphanous forms, with violet-staining "dots" in the length of the bacillus.

This description applies to cultures which have grown with a rich, moist, greasy growth on the higher percentages of sperm oil, and where time has been given to let the changes come about—i.e., the older the culture the more it forms "granules." Fig. 3, a drawing, was from a culture not quite two months old grown on a 3.75 per cent. mixture of sperm oil and glycerine egg. It has been growing since October last on a 1.25 per cent. mixture, and has been subcultured twice till April, when it was subcultured a third time on to the 3.75 mixture. Although the drawing represents bacilli growing on sperm oil since October, yet the same changes occur and to the same degree in two months' time or less when grown on the higher percentages as 3.75 or 5. A strain of bovine bacilli kindly given me by Dr. J. C. G. Ledingham, of the Lister Institute, behaves apparently in the same way; it seems to give the same changes microscopically and is growing luxuriantly on the mixture of egg, sperm oil, and glycerine.

Most of this work was done whilst assistant clinical pathologist to the General Infirmary, Leeds, the remainder here.

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ANKYLOSTOMIASIS IN FIJI.

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THE methods adopted for the prevention and treatment of ankylostomiasis in the Navua district of Fiji during the year 1913 are, I think, worth a brief note in THE LANCET.

The Navua district of Fiji contains just over 2000 indentured Indian immigrants distributed among 12 large estates. The whole district is a large swamp with an annual rainfall of over 100 inches. For the three years previous to 1913 the general death-rate for the indentured Indians, excluding deaths from accident and violence, was as follows:

Year.	Adults.	Children.	Total (per 1000).
1910	75.7	237.8	96.6
1911	34.2	156.5	48.1
1912	36.7	137.9	50.3

On my appointment to act as medical officer to this district in February, 1913, it appeared that this

² Wherry, W. B.: Some Chemical Conditions favouring the Production of "Spores" in *B. tuberculosis*, *Centralblatt für Bakteriologie, Originale*, 1913, vol. lxx.

³ Staining the slide with Löffler's methylene blue and passing slide over a Bunsen flame for half a minute after steam begins to rise. The preparation is then washed and counter-stained for one to two minutes in watery Bismarck brown.

death-rate was almost entirely due to the excessive amount of ankylostomiasis among the coolies, the majority of whom showed marked signs of infection. In previous years a certain amount of work had been done for the prevention of the disease, but no really wholesale campaign had been undertaken.

My campaign included the following measures:—
1. Improved general sanitation in the coolie lines especially. 2. Greater care by the overseers that the latrines were used. 3. Portable latrines for use in the field. 4. Immediate (or as early as possible) treatment of all coolies obviously affected. Over 4000 treatments by thymol were given in the year. 5. Immediate treatment of the skin eruption. 6. Education of those in authority. 7. Explanation to the coolies. 8. Frequent inspection of all coolies for signs of ankylostomiasis. 9. Spraying of lines and neighbourhood of lines with 1 per cent. solution of ferrous sulphate. The Vancouver-Fiji Sugar Company detailed a gang of coolies with an overseer for this work. 10. Boots were tried as an experiment with the labour of one estate. This last measure has since been abandoned owing to the difficulty of supervision. The coolies take their boots off when the overseers are not looking. Measure No. 3 was not properly carried out. It is my opinion that Measure No. 8 is the most efficacious as regards immediate results.

The death-rate for 1913 per 1000, including deaths from accident and violence, was: adults, 19'47; children, 116'00; total, 29'31. Exclusive of deaths from accident and violence (notions of which vary with different observers) the death-rate per 1000 for that year was: adults, 18'42; children, 96'0; total, 26'29. Mr. L. A. Andrews, hospital superintendent at Tamanua Hospital, was responsible for a very large share of this work, whilst the manager and overseers of the Vancouver-Fiji Sugar Company gave all the help in their power. Without the coöperation of these gentlemen the result could not have been achieved.

Fiji.

EARLIER INDICATIONS OF GAS FORMATION BY COLIFORM ORGANISMS, WITH DESCRIPTION OF A MODIFIED FERMENTATION TUBE.¹

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AND

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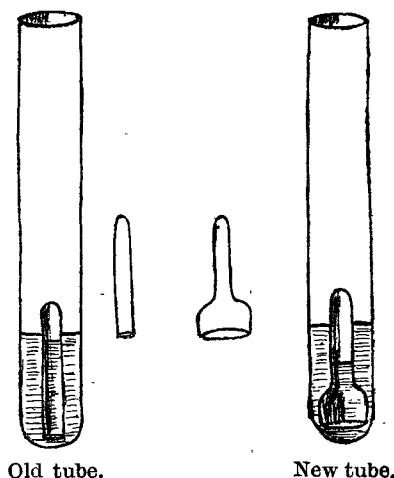
THE formation of gas during bacterial growth on nutrient media containing sugars, &c., has been used as an indication of the power of the micro-organism to hydrolyse and to utilise these substances. Bacteria differ in their capacity to break up monosaccharides, disaccharides, polysaccharides, glucosides, alcohols, &c., and this character has suggested the collection and identification of the products of cleavage as a means of differentiation and classification.

Of late years special attention has been directed to the quantity and quality of the gas produced, and the results obtained have led to a better knowledge

of the metabolic activities of *B. coli*, &c.² The apparatus generally employed for this purpose is somewhat complicated, and the organisms have been allowed to grow for about seven days prior to the analysis of the gases produced.³

For qualitative work, in order to demonstrate the presence of gas-forming organisms in clinical materials or during the examination of water or milk, a straight glass tube, known as Durham's tube, is frequently employed in preference to the U-shaped or similar tubes. By its use this stage in diagnosis is completed in from 12 to 24 hours. Many instances occur, however, in which the saving of a day or even of a few hours is of consequence to the laboratory worker, clinician, or patient. To lessen the time, therefore, Emrys-Roberts investigated the effect of increasing the sugar content of the media, and found that when the usual 1 per cent. of lactose was made up to 15 per cent. the gas formation was accelerated. With some slow lactose fermenters, which required 26 days with 1 per cent. solution, he obtained gas formation in two days when a 15 per cent. solution of lactose was employed.

The work now recorded has resulted in a further diminution of the time involved, making it possible to demonstrate the formation of gas in about four hours. It has also indicated certain differences in the rate and type of cleavage of the several substances. We have found that an advantage is gained by using a tube for the collection of the gas which is bell-shaped at its lower end and almost entirely fills the test-tubes (see Figure).⁴ The whole



of the gas formed in the lower stratum of fluid passes upward into the collecting tube, while convection currents are set up which cause gas evolved in the middle portion of the media to find its way into the dome-shaped cavity.

Elsewhere the advantage of neutralised pure silk peptone over Witte's peptone, or other complex mixtures, as bacterial food has been shown by one of us, and silk peptone has been employed with success in the present set of experiments.⁵ Table I. shows the comparison of Witte's peptone and silk peptone as media for growth of colon bacilli, and points out that the best results are got with a media composed of 2 per cent. silk peptone and 5 per cent. lactose—that is to say, gas becomes evident in 4 hours, as compared with 8 hours by the ordinary tube, or 10 and 12 hours when Witte's peptone is employed.

² Rogers, Clark, and Davis: *Journal of Infectious Diseases*, 1914, vol. xiv., p. 411.

³ Frieber: *Centralblatt für Bakteriologie, Orig.*, 1913, Band lxix., S. 437.

⁴ Made by Herr Firma Goetze, Härtelstrasse, Leipzig.

⁵ Walker Hall: *Journal of Pathology*, vol. xix., 1914.

¹ The cost of this work has been covered by grants from the Bristol University Colston Society.