With regard to the above, the case from the Male Medical Wards developed his first fever on the 26th February and as a hæmorrhagic case, he may have taken his infection from the cases admitted on the 20th or the 14th February or from fomites carried in with these cases. Of the two cases from the Female Wards, the first had only eight days since its first contact with the last case in the ward and the second an interval of 22 days. Both of these were obviously infected from fomites, and cannot be put down to direct infection. The four cases in the Female "Temporary" Ward all occurred in the course of about four weeks. It is not possible to say where she first got her infection from. But as the medical officers in charge of this ward also attend in the Small-pox Ward, it is possible that they may have carried infection to her. Or she may have had infection carried to her by others, such as Hospital servants or visitors. The second was a very old woman (aged about 80), and must have got her infection much as the first case and, as her eruption was advanced to the seventh day before she was transferred, it is more than likely that the next case caught its infection from her. For the fourth case no personal contact is traceable. The four cases in the Cholera Wards undoubtedly owe their infection to the following: (1) they are within a few yards of the Small-pox Hospital gate, (2) conveyances bringing small-pox cases stand close to them while waiting to be disinfected, (3) they are immediately next to the small-pox observation hut. The three cases in the Surgical Wards are all obviously quite distinct from each other and none of them can be said to have infected any other.

With all this, the striking feature is, to my mind, not that we had what we had, but that our wards escaped as they did.

The average daily strength of our individual wards from month to month, during the period under observation, has varied from 27·33 to 121·93, and the average stay of patients in hospital, including the moribund cases who die within a few hours of admission, is about eighteen days—so that we may, excluding these latter, reasonably take this figure at approximately twenty days. The male medical wards, with a strength of from 65 to 117 patients, averaging 20 days in the wards, had 32 cases of small-pox which between them spent 130 infective days in the wards, and of only one case can it be said—and that too is doubtful—that he got his infection from his fellow-patients. Similarly, the Female Ward, with an average varying from 46 to 121, harbours 20 cases over 83 infective days with only one doubtful infection; the Surgical Ward, with an average strength of from 42 to 115, has three cases, all in the middle of epidemic periods, during an aggregate of 47 infective days, counting incubation periods, and including 5 days of eruption and not a single infection. In the Female "Temporary" Ward the detail has been already given. The Male "Temporary" Ward again gives a daily average of from 54 to 66 patients, a total of 19 small-pox cases, during 37 infective days, and not a single infection. On all this evidence it appears to me that the mere presence in the wards for three or four days, of cases not farther advanced than the fourth or fifth day of eruption, was not followed by an appearance of the disease in the hospital. It would appear farther, that in actual practice, in the earlier stages of the disease, *i. e.*, up to the fourth or fifth day of the eruption, the real danger is not from the patient himself, but from the infection which he may be carrying mechanically, and which is derived not from his own person, but from the same source of infection which is responsible for having given him the disease.

The appended tables shewing the incidence of the disease in the wards of the Campbell Hospital speak for themselves, and shew the full detail on which the foregoing remarks are based. It remains to add that the patients in these wards were not in any special way or degree protected by vaccination. In this respect they were just an average sample of the general population of the town and suburbs of Calcutta.

(To be continued.)

A NEW LACTIC ACID PRODUCING STREPTOTHRIX.*

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SINCE Metchnikoff in his book "On the prolongation of life" and other similar publications brought to the notice of the scientific world, the beneficial action of lactic acid bacilli, when taken internally, on intestinal flora-fermented milk, prepared with one or other varieties of the bacilli, has come into extensive use as an article of diet, both by patients as well as by healthy men, and the study of fermented milk has received an impetus.

Metchnikoff who had been studying for some time the flora of human intestine, when on a visit to Bulgaria, found that a much larger percentage of people there reach to old age than those of other countries, and the only peculiarity he noticed in their diet was that they are accustomed to taking curdled milk prepared with a special ferment with their daily meal. By bacteriological examination of the curdled milk which goes by the name of Youghourt, it was found that the fermentation is brought about mainly by a bacillus, since named Bacillus Bulgaris, and experiments made with a pure culture justified the theory, put forward by Metchnikoff, that the beneficial action of the fermented milk, is due to the healthy action which the bacilli

* Being a paper read before the Medical Section of the Asiatic Society of Bengal, June 1909.

produce on the intestinal flora. These bacilli, which do not produce gas and are not proteolytic, replace the ordinary gas-producing and proteolytic bacilli present in human intestine used to ordinary diet. Experiments made on guinea-pigs by J. Belonosvkwy with a culture of this bacillus showed that the stool of animals taking ordinary diet when inoculated into sugar bouillon produces marked formation of gas and cloudiness of the broth; after feeding the guinea-pigs for a few days on this fermented milk containing the Bacillus Bulgaris, he found that bouillon inoculated with the stool of these animals showed distinct diminution of gas-formation and cloudiness. On the 21st day of feeding, the inoculated sugar bouillon showed absolutely no gas formation nor any cloudiness nor any smell. Animals fed with this milk from their birth were found to increase in weight much more than those fed with ordinary diet or with sterilised food. The utility of the action of Bulgarian milk can be thus explained.

In several countries the use of fermented milk is known from ancient times, though its rationale was not understood. In several European countries fermented milk is taken in the form of butter-milk—milk is allowed to ferment by keeping it in the open air for a certain time and then the butter is removed by churning. The same process is adopted even now in America and other places where in a slightly improved form "Starters" (pure culture of a bacillus) are used instead of leaving it in the open air.

But it is to the Eastern tropical countries that we must look for the special form of fermented milk, in which the milk is curdled by means of a special ferment which is kept in stock in every household and is handed down from generation to generation, the milk being taken in the shape of curd. These ferments are much more active and give much more solid curd of agreeable aroma than in the case of the fermented milk in use in Europe and America. The extensive use of one or other varieties of fermented milk, produced by means of a special ferment in Eastern countries, probably owes its origin to the difficulty of preserving milk in sweet condition for a long time, in comparison to cold countries; milk when undergoing spontaneous decomposition in hot climates becomes changed within a few hours to a foul-smelling fluid in which the casein and the fat have undergone liquefaction, whereas, when fermented by means of the special ferment, the decomposing, gas-producing, proteolytic bacilli are killed off by the more vigorous organism of the ferment which has no destructive action on the fatty or albuminous constituents of milk, so that by this means milk can be kept in a condition fit for consumption for a long time. In this way the economic problem of preservation of milk is solved. The following are some of the known varieties of curdled milk in use in Eastern countries, some of which have been made the subject of bacteriological study:—

Mazun of America, Kephyr and Koumiss of Russia, the Leben of Egypt, the Oxygala and Chiston of Rome and Greece and the Rayet of Algeria.

In India, curdled milk made on similar lines to the above is in extensive use; besides there is another variety of curdled milk which is prepared in an entirely different way; its use is entirely confined to Bengal; its prototype cannot be found anywhere else, so far as my knowledge goes. The production of this second kind of curd depends on the action of the products of a bacillus and not on the living bacillus itself. From this curd, a large number of delicacies are prepared by addition of syrup and sugar, etc., and there are very few Bengalee households in which food prepared from this curd is not in daily use, and a large trade is carried on in it.

The variety which is the subject of this paper is also in extensive use, and the best preparations are invariably served at every dinner party.

The first variety goes by the name of Dadhi and the second as Khilat. Both have originated in remote antiquity and have been mentioned in old medicinal works like *Bhaba Prokash*, in which have been described several varieties with their medicinal virtues. Even in old classical works 2,000 to 3,000 years old, these have been mentioned several times. The following is the orthodox method of preparation of the first variety (Dadhi); in some cases some modification is made. Pure milk is boiled for some time—then cooled to blood heat, and then from an old stock of Dadhi a needle pointful of stuff is taken and with this the milk is inoculated. The milk is covered with a blanket and kept in a warm place. After 12 hours the milk is found to have curdled. This unbroken curd is served as a dish and is taken with a little salt or sugar.

Before describing the Bacteriology of Dadhi I give below a description of different varieties of lactic acid bacilli and their action on milk.

LACTIC ACID BACILLI AND THEIR ACTION ON MILK.

A general knowledge of the composition of milk is necessary in forming a clear idea of the action of the bacilli on milk. Without going into details a short general idea of the composition of milk is as follows:—

Milk contains besides water some soluble salts of which the most important are the calcium monophosphate and sodium salts. There is also sugar of milk from which is produced the lactic acid—the process being a duplication of the atoms of lactose which is represented thus:—

$$C_6 H_{12} O_6 = 2\, C_3 H_6 O_3$$
$$180 \quad = \quad 2 \times 90$$

Then there is the fatty constituent of milk which is found in the form of minute globules distributed throughout the milk, the agreeable aroma of some fermented milk is due to a certain amount of change of fat producing an ester; much greater change with saponification of fat accompanies butyric acid fermentation to which the bad odour of decomposing milk is due. Then there are the albuminous constituents of milk. About the characters and nature of these, observers are not

agreed and widely divergent and contradictory opinions are held, both as regards the composition of the constituent parts as well as regards the interpretation of the phenomena of curdling brought about by (1) rennet, (2) lactic acid fermentation, or by (3) ordinary acids

To find out the truth from this chaos would have been a difficult task, had it not been for the monumental work of Duclaux, who has exhaustively dealt with the phenomenon of coagulation of milk. It is a well-known fact that there are marked differences in the characters of the precipitated casein produced by the action of acid, lactic acid fermentation and rennet. But to describe the difference in chemical technology is rather a difficult problem. The hitherto accepted opinion was that casein in chemical combination with the calcium phosphate remains in solution in ordinary neutral milk; when any acid is added to the milk, the compound is decomposed, the calcium salt combines with the acid added owing to which the casein is precipitated. When, however, rennet is added to milk, as the coagulation takes place in the absence of any acid and as also the presence of calcium salt in milk is necessary for the rennet to act (calcium free milk is not coagulated by rennet) one set of observers explain the action of rennet on milk as a splitting up of the original casein into a soluble albumose called lactoprotein, and another albuminous product which combines with the calcium phosphate and falls down as precipitate; thus, in the case of coagulation by acid, the casein which was supposed to be in solution in ordinary neutral milk is believed to be precipitated by forming a compound with calcium salt, the calcium salt combining with the acid; in the case of coagulation by rennet, on the other hand, it is supposed that casein goes into combination with the calcium salt to form the precipitate. Both explanations cannot be true at the same time as they are chemically contradictory.

Besides Duclaux has shown that after coagulation of milk by rennet, no increase of soluble albumin takes place, the whey of the milk which is separated by means of a porcelain filter shows on examination the same amount of soluble albumin as the whey separated by the action of rennet. He suggests that the calcium salt is not in chemical combination with casein in ordinary milk, but it helps by its presence in some unknown way the action of rennet on milk much in the same way as calcium salts are necessary for the formation of fibrin in blood by the action of fibrin ferment and the phenomenon of agglutination of bacilli by agglutinin. He further states that unchanged casein as a pure chemical compound, such as was first separated by Hammerstan, is insoluble in water, but is soluble in water in presence of calcium monophosphate and other neutral or partially alkaline salts, while acids decompose or precipitate the calcium monophosphate and cause the precipitation of casein. Casein as found in milk is not in a state of solution in the strictly chemical sense of the term, but being a colloid is held in suspension like mud in water and the action of an acid is to cause decomposition of calcium monophosphate which helps to keep it in suspension, while the action of rennet may be compared to the action of fibrin ferment on fibrinogen in blood, the calcium salt being necessary for the coagulation of casein, as is the case with fibrin ferment.

How do the lactic acid bacilli act on casein? Is the coagulation solely due to the chemical action of the lactic acid formed by the splitting of the sugar of milk brought about by the action of the bacilli? It has been proved in many cases of lactic acid fermentation that the amount of lactic acid formed is much too small to give rise to coagulation by its chemical action. Besides, it has been shown that when chalk powder is added to milk previous to inoculation by lactic acid bacilli coagulation of milk takes place, though the lactic acid formed by the action of bacilli combines with the chalk and no free acid is available to act chemically. Then it can be surmised that the action of the lactic acid bacilli on casein is due to the presence of a ferment which has not been separated as yet, aided by the lactic acid.

Varietes of lactic acid bacilli.—As regards the varieties of lactic acid bacilli, already more than 50 have been separated, many of which are not found ordinarily in milk but in connection with other ferments. Many of these produce other products such as alcohol, acetic acid, butyric acid, etc, while the formation of lactic acid is a minor function of the bacilli the quantity produced being very small. Leaving out of consideration these bacilli there is another class of bacilli which may be termed producers of true lactic acid fermentation, in accordance with the definition of Duclaux who assigns the term to those which produce lactic acid to the extent of 50 % of the total amount of byeproducts of the bacilli. Of this class of bacilli the first was discovered by Lord Lister; before this, coagulation of milk was supposed to be a process of oxidation, due to excess of oxygen taken by the cow, though Pasteur suggested the action of some living organism like yeast before Lister's discovery. To Hueppe belongs the credit of actually studying a pure culture of a lactic acid bacillus since named Bacillus Acidi Lactici (Hueppe) and from this period the study of milk fermentation dates. Escherich (1885) found another lactic acid bacillus in the intestine of infants taking milk, called Bacillus Lactis Aerogenes; Grottenfeld separated also a lactic acid bacillus besides a Micrococcus Acidi Lactici; Gunther and Thierfelder found in spontaneous fermented milk a bacillus which is identical with Lister's Bacillus Acidi Lactici, Heuppe's bacillus as well as with Leichmann's Bacterium Lactis found by Leichmann. This view of the identity of the several bacilli has been confirmed by Weigman. Besides these, a number of bacilli have been separated by Kozai, by Klaus and Utz. From the mass of literature dealing with the subject it is not possible to make out how many of these bacilli are identical with one another and how many are distinct separate bacilli, as the characteristic on which differentiation is based does not remain constant in one and the same bacillus. These groups of bacilli can, however, be clearly differentiated from the next class of Lactic Acid Bacilli, *viz.*, the bacilli found in connection with the curdled milk of the East and which form a class among themselves.

These latter are differentiated from the former by the formation of a larger amount of lactic acid, by the entire absence of gas-formation in milk, the entire absence or very little action on the fatty and albuminous constituents of milk (excepting the coagulation of casein) by refusing to grow in the ordinary culture media; this latter characteristic being a most important point. A short account is given below of the bacteriolology of the several varieties of special curdled milk, together with the distinctive characters of the specific bacilli found in connection with them. Freudenreich examined bacteriologically the fermented milk which goes by the name of Kephyr and separated two varieties of streptococci, a bacteria called the Bacillus Caucasina and a yeast; though combined action of all three is required to form the typical Kephyr, yet Freudenreich believes that streptococci are mainly responsible for the fermentation. The Bacillus Caucasina cannot alone ferment milk.

The Leben of Egypt has been thoroughly studied by R. Rest and J. Khoury, who found in it:—

(1) A big bacillus with square ends called the strepto-bacillus Lebenis.

(2) A fine bacillus with rounded ends called the Bacillus Lebenis.

(3) A Diplococcus called the Diplococcus Lebenis.

(4) An oval-shaped yeast called the Saccharomyces Lebenis.

(5) A long fungus called the Mycoderma Lebenis.

Of these the most important is the strepto-bacillus Lebenis. The bacillus Lebenis, the Saccharomyces or the Blastomyces Lebenis when separately inoculated into milk does not clot it. The Diplococcus Lebenis, however, rapidly coagulates milk. The strepto-bacillus Lebenis

is a straight rod-shaped bacillus, being 6μ to 7μ in length and $\frac{1}{2}\mu$ broad. It is nonmotile and takes all aniline stain. The protoplasm is homogeneous. In old cultures it is granular and takes Gram's stain. In the depths of glucose agar it dies quickly. In ordinary agar, there is absolutely no growth and in potato, peptone broth and ordinary bouillon, there is no sign of growth. In lactose or glucose agar it grows and shows visible colonies. It coagulates milk at 37° C. in 24 hours.

It produces 0·261 per cent. acid in terms of lactic acid.

The Armenian curdled milk Mazun, has been studied by Duggeli who found—

(*a*) A coccus.
(*b*) A yeast.
(*c*) A long bacillus.
(*d*) A thin short bacillus.

As the result of detailed study of the properties of all these organisms he has come to the conclusion that the yeast contributes to the palatable taste and aroma of Mazun.

The coccus participates in causing diminution of the unpalatable whey; the short bacillus gives rise to a certain amount of lactic acid, but none of these separately introduced into milk is able to curdle it: the long bacillus being the most active lactic acid producer and is alone able to curdle milk within 24 hours. This bacillus is about 3 to 10μ in length, ·1 to 1μ broad; the ends are rounded. In young cultures the protoplasm of the bacilli is homogeneous, but in old culture they are more or less granular. The bacillus takes Gram's stain and grows badly in glucose agar. No growth in bouillon—no growth in agar, nor peptone water, nor potato. It is a facultative anaërobe. Milk is curdled in 24 hours at 37° C., with slight separation of whey. It produces in milk 1·008 grams of lactic acid in 100 c.c. of milk in 24 hours.

Bulgarian milk has been studied by several observers. Bertrand and Weisweiller studied the action of the bacillus on the several constituents of milk. Belonovsky studied the action of the bacilli on intestinal flora of animals when fed with the bacilli. This has been referred to in the beginning. A. Cohendy and Luerson and Kuhn studied the bacteriology of Bulgarian milk. The later observers found three species of organisms in it:—

1. The Bacillus Bulgaris.
2. Bacilli granuleaux (Körnchen bacilli).
3. A diplococcus.

The Bacillus Bulgaris is rod-shaped, nonmotile, extremities rounded, takes Gram; the protoplasm shows no granules. In favourable media it forms transparent colonies about 2 to 3μ in diameter. In liquid media it forms a white precipitate. The bacillus is a facultative anaërobic. The best medium is milk. It coagulates milk very slowly.

2. Bacilli granuleaux are rod-shaped bacilli, larger than the above, nonmotile; they take Gram. The protoplasm is granular. They take Neisser's stain. Facultative aërobic and anaërobic. Sugar solutions and milk are the best media. Milk is rapidly coagulated. As regards the action of the Bacillus Bulgaris on the several constituents of milk, it has been studied thoroughly by Bertrand and Weisweiller. They found that the bacillus coagulates milk. The precipitated casein is slightly acted upon by the bacilli; after a month, there was diminution of only 1/10 part of casein. It does not saponify fat. By means of a ferment (lactase) formed by the bacilli, the sugar of milk is split up and forms two molecules of lactic acid without producing any intermediary products; the lactic acid formed is a mixture of dextrorotatory and laevorotatory lactic acid. The amount of lactic acid formed is shown in table I.

Description of the organism found in curdled milk of India which goes by the name of Dadhi.—For the purpose of finding out the specific organism in Dadhi, I procured several samples from the different shops from different localities in Calcutta and also samples from districts outside Calcutta reputed for their excellence in the preparation of Dadhi. Smear preparations were made from each sample on a slide, fixed and then stained with carbol-methylene blue. As all the samples showed a bacillus with definite characters in almost pure culture, mixed with some yeast cells, an attempt was made to separate the bacillus from several samples and study its character. The several bacilli separated from the different samples, were found to show uniform characters—being in fact the same organism. As a pure culture of the bacillus inoculated in milk was found to produce curdled milk similar in character to those got from the market, there is ample justification in assuming the bacillus as the cause of the fermentation.

The character of the Bacilli.—As found in the samples bought from the market and stained by methylene blue, there were found innumerable bacilli parallelly arranged with square cut ends about 7μ to 8μ in length, 2μ in breadth. The most peculiar character noticeable about these bacilli is the finding of pink-stained granules situated at equal intervals inside the blue-stained bacilli. Though for staining only pure methylene blue is used, the bacillis are doubly stained. It is, indeed, difficult to make out from which constituent of the methylene blue the pink colour is derived. The bacillus when stained with Leishman stain or thionin blue does not show the granules. Neisser's stain does not stain the granules. That these granules are not spores is apparent from the fact that the bacilli are easily killed at 60° C. within a few minutes. The granules are best seen in a 24-hour culture. In old cultures they are not so prominent. An explanation is furnished regarding the nature of the granules from the fact that yeast cells found in connection with these samples of curdled milk also show distinct pink-stained granules inside the cells. Some one suggested in a similar condition in connection with Bulgarian milk that the granules inside the yeast cells are composed of glycogen and the pink staining is due to the glycogen; the same may be the case with the granules found in this bacillus. The number of granules situated in each bacillus vary from 2 to 10. When they are two in number, they occupy the two ends of the bacillus. The bacilli take Gram's stain. They are nonmotile. Another marked peculiarity of the bacillus is that they refuse to grow in all ordinarily used culture media—nutrient agar, bouillon, potato, nutrient gelatine, peptone water, glucose or lactose peptone. In glucose or lactose agar, the bacilli grow, showing within 24 hours at 37° C. a fine streptococcus-like colony growth. In depth of glucose agar, a distinct growth takes place along the inoculation tract. After 72 hours the whole

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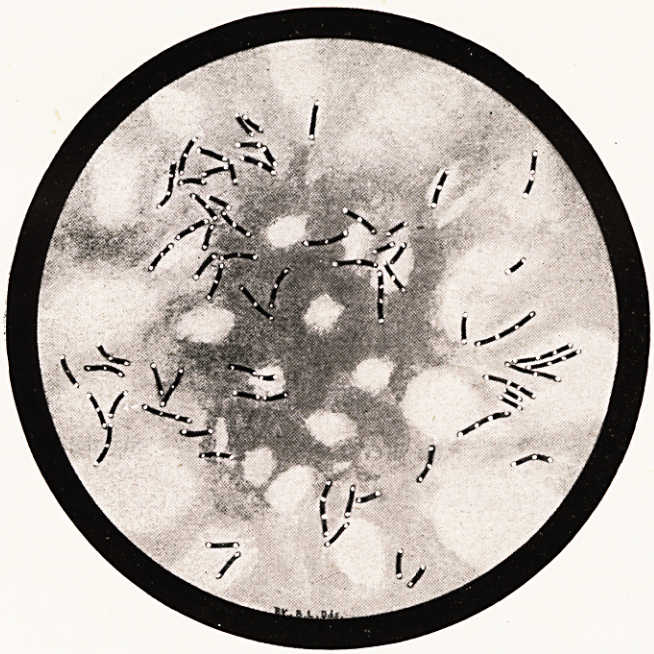

medium becomes clouded. Smear preparation from a solid culture showed bacilli which are of an entirely different character from the bacilli found in milk culture, so much so it seems at first difficult to believe that the two are the same bacillus. The smear from a glucose agar culture stained with methylene blue showed long thick bacilli in which there are no granules. The bacilli are peculiarly convoluted and twisted, some in corkscrew fashion, some convoluted like the edges of a leaf. The bacilli are long big filaments, some measuring more than 40 to 50μ. In some as many as 20 to 30 turns of the corkscrew can be counted. Besides these, fantastic appearances are seen in a smear preparation. Milk tubes inoculated from the peculiar shaped bacilli found in agar culture, show again the same granule-containing bacilli when stained with methylene blue.

Growth in Milk.—The organism grows rapidly in milk, curdling it in 12 hours, forming a solid coagulum, the upper surface of the milk being concave. There is no separation of whey. By violent shaking the clot can be broken and a few drops of clear whey can then be separated. The life of the bacillus in milk, after clotting is completed, is very short. After seven days the bacilli are themselves killed. As in the case of the other bacilli described above, the coagulation is not due to the sole action of the lactic acid, as can be easily determined by inoculating milk tubes containing chalk; the calcium carbonate neutralising the free acid, still coagulation takes place.

The sugar of milk is changed into lactic acid; no subsidiary products are formed. The bacilli do not decompose the whole of the sugar present in milk; even after several days the presence of sugar can be demonstrated. The fatty constituents of milk are not acted upon at all by this bacillus. Even after a month no smell of butyric acid can be perceived. The casein is precipitated, but there is absolutely no other action on the albuminous constituents, as even after a month not a trace of peptone can be found.

Regarding the nature of the organism, it is evident that it belongs to the class of bacilli having granules—the körnchen bacilli which have been placed in a separate class by Lehmann and Neumann; they are allied to streptothrix. The presence of long convoluted and twisted chains and the presence of granules prove it to be a streptothrix.

As regards the relation of this streptothrix to other similar bacilli found in the previously described curdled milks, *viz.*, Strepto-bacilli Lebenis, Long Bacilli of Mazun, the Bacillus Bulgaris and the Bacilli granuleaux, it is evident that this remarkable organism, though it resembles the above bacilli in several points, namely, the formation of large amount of lactic acid, similar action on milk (no gas formation, no saponifying action, no peptonising action), refusal to grow in ordinary media, yet this streptothrix has got sufficient peculiar characters to differentiate it from those enumerated: (1) the pink-stained granules in bacilli stained with methylene blue; (2) the peculiar character of the bacilli in agar.

The action of the streptothrix on pathogenic organisms.—A few experiments were made to determine the action of the bacilli on pathogenic organisms in culture tubes. The following are the results—

For this purpose, several sterilized milk tubes are taken and they are inoculated with a loopful of a culture of the streptothrix in milk and then the tubes were inoculated with a loopful from 24 hours' cultures of Typhoid, Shiga, Coli, Paratyphoid B, Comma, Gärtner's bacilli and Diphtheria bacilli. After 24 hours' incubation at 37° C., the tubes were examined by making smears as well as by inoculating in bouillon and agar, and in the case of cholera bacilli, in peptone water. After 48 hours the same procedure was repeated and also after 72 hours. The following are the results:—Comma bacilli were killed off within 24 hours, and no trace of the bacilli could be found. The agar tube inoculated with typhoid bacilli shows a growth of separate colonies showing the inhibitory action. After 48 hours, a few separate colonies were found; on the 3rd day the tube remained sterile. Diphtheria bacilli were killed off in one day. Coli, Shiga, Gärtner and Paratyphoid B, could be found up to forty-eight hours beyond which they died.

A milk tube was inoculated with Comma bacilli and incubated for 24 hours; Comma bacilli were found to have multiplied in the milk, then the streptothrix was inoculated. After 24 hours interval, no trace of the Comma bacilli could be found. My experiment in this direction as well as on animals and human beings have not been completed as yet.

Resumé—

1. The fermented milk of India called Dadhi resembles in all essential points the Bulgarian fermented milk as well as the Leben and other forms of fermented milk in use in the East.

2. The causative element of the curdling process of Dadhi is a streptothrix having characters similar to the Bacillus Bulgaris and Streptobacilli Lebeni, and Bacillus Causasina and the Long Bacilli of Mazun, in (1) not growing in ordinary media; (2) producing a large amount of lactic acid in milk; (3) producing besides coagulation of casein and splitting sugar of milk into lactic acid, no other change in milk; (4) not producing any indol, nor peptone, nor saponification of fat nor formation of any gas.

3. It differs from the above by showing peculiar pink-stained granules, when stained with methylene blue and showing peculiarly convoluted chains in glucose agar.

4. The importance of the organism lies in the fact that, as in the case of Bacillus Bulgaris, it kills all pathogenic non-sporing germs and also destroys all proteolytic gas-forming bacilli in milk.

TABLE I.

Table showing the amount of lactic acid produced by different lactic acid bacilli in 1 litre of milk, in terms of lactic acid,—the culture being kept at 37° C.

Name of the bacillus.	After 24 hours.	After 48 hours.	After 72 hours.	After 96 hours.	After a week.	REMARKS.
B. Lactic aerogenes.	1·8	...	10·08	...	...	Observed by Hall and Smith.
B. Coli Communis.	1·8	...	4·77	...	...	Do.
B. Bulgaris...	12·8 −·4	16·5 −·4	20·2 −·4	...	22 −4°	Observed by Gabriel Bertrand and Weisweller the initial acidity of the milk was 4.
Mazum Long stabchen B.	10·8	12·	...	...	...	Observed by Duggeli.
Streptobacilli Lebenis.	2·61*	...	...	...	...	Observed by Rest and Khoury.
Streptothrix Dadhi.	10·8	10·8	11·25	11·70	18·5	Med. Coll., Calcutta.

* In their studies on Leben in the Annales de Pasteur Institut of 1899, Rest and Khoury in speaking of the amount of lactic acid produced by Strepto-bacillus Lebenis in milk says "Nous avons mesure citte acidity dans une culture sur petit lait de 24 heures; ille etait de ogr, ·261 per cent. exprimée en acide lactique," which will make the amount of lactic acid produced in 1 litre of milk 2·61 grms. The production of this small amount of lactic acid does not tally with the ordinary view of the vigorous lactic acid producing power of the bacillus.

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(8) Aurther Leurssen et M. Kuhn "Youghourt, die bulgarische, sauer Milch C. B. Ab. II, Bd. XX, pp. 8-9, 1908.

ETIOLOGY OF DOUBLE QUOTIDIAN FEVER WITH SOME NOTES ON THE EARLY STAGE OF LEISHMAN-DONOVAN INFECTION.*

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BY double quotidian fever is meant the fever characterized by two rigors taking place within 24 hours with two rises of temperature, there being a period of complete apyrexia between the two onsets, and this occurring not for one or two days as accidents in the course of other diseases, but as a distinct disease occurring suddenly in perfectly healthy persons uncomplicated with other diseases. The disease as such is not common, but still enough cases of this disease occur which, on account of its peculiar distinctive features, strictly regular periodicity of the double rise of temperature uninfluenced by quinine, its long course, and invariable fatal termination, ought to be ranked as a distinct disease.

It is, however, strange that no mention of it is found in any of the treatises dealing with Indian fevers.

Fayrer in his exhaustive book on the then known Indian fevers does not mention it.

Manson in his treatise on tropical diseases mentions a quotidian type of fever caused by unpigmented parasites, but does not mention the double quotidian.

Major Rogers in his treatise on Indian fever mentions that in some cases of early Kala azar there is often a history of double rigors occurring in the course of 24 hours for some days as being remembered by the patients.

That this disease is not a recent arrival is proved by the fact that it is a disease well known to the old practitioners of Lower Bengal, who very much dread it on account of its invariable fatal termination; besides, the disease has been described in the well-known Sanskrit treatise *Susrutha* (32nd *Slokas*), as a *Bisama Jwar* (Grave fever).

In the course of the last five years, I came across 10 cases of this disease; the common peculiarities of these cases are that the persons attacked had been before the onset of the disease perfectly healthy, and with one exception, they are all residents of Calcutta.

1st case.—Hindoo male, aged 16, resident of Calcutta, for four years, before the onset of the disease, got a sudden attack of high fever with severe ague at about 9 A.M. in the morning, the fever lasted for about 9 hours, temperature rising to 105·6° followed by another attack of fever of the same type, 3 hours after complete cessation of the first fever.

This went on regularly for over 18 months with slight occasional breaks, during which the fever became continued for a few days, after which it assumed its old type again. Quinine did not influence the fever in the least, and when excessive doses were tried, the patient became prostrated and there was a slight irregularity in the course of the fever. The patient, when not taking quinine, would go about freely during the time of intermission, and even after several months' illness, was not much prostrated. Examination of blood made 6 times during the whole course of the disease, showed no parasite, nor any abnormality in the

* Paper read before the Medical Section of the Asiatic Society, April 1909.