

animal usually develops symptoms of disease and succumbs. A small percentage of mice, however, prove refractory to infection by this route.

2. If live cultures of this organism are injected intrapleurally or intraperitoneally into mice previously "vaccinated" intrapleurally or intraperitoneally, they are partially destroyed and held in check by the protective mechanisms of the animal body for two or three days. Subsequently, the rate of bacterial multiplication increases gradually until the death of the animal. The partial protection following this type of vaccination is entirely of a general nature; no evidence of a "local immunity" has been obtained.

Mice given 1, 2, or 3 subcutaneous doses of this organism vaccine show a similar relative increase in resistance to the subsequent injection of live organisms *per os* as intraperitoneally.

3. Feeding mice live or killed cultures of this organism induces a definite protection against subsequent intrastomachal and intraperitoneal injections of live organisms. The immunity developed in this way is also of a "general" as opposed to a "local" nature.

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#### Therapeutic application of *Bacillus acidophilus*.

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In previous communications to the Society (1920 and 1921) we stated that *Bacillus acidophilus* may be implanted in the human intestine by the oral administration of (1) minimum quantities of lactose or dextrin, (2) whey broth cultures of *B. acidophilus*, or (3) a combination of lactose and the *acidophilus* culture in which the amounts of each are cut in half. Early in 1921 the milk culture of this aciduric organism was substituted for the lactose- and whey broth cultures and subsequent implantation experiments have been carried on with the *acidophilus* milk.

In the work on pathological cases we received the friendly coöperation of practicing physicians, who not only supplied us with many of the most interesting subjects, but who furnished us

with a history of the individual cases, and in two instances with X-ray photographs. The subjects comprising the first group under observation may be divided for convenience into the following classes:

Chronic constipation with the symptoms of so-called autointoxication and other pathological conditions, some of them acute.....	20
Chronic diarrhea following an attack of bacillary dysentery.....	2
Colitis, at times bloody, and more or less mucous.....	2
Sprue.....	2
Dermatitis (eczema).....	3

These 29 cases are exclusive of those which have come under our observation within the past two months; nor do they include those which have been and are being studied in other institutions through our coöperation. Brief reference will be made to only a few of these 29 cases.

The subjects were instructed to bring to the laboratory one or two specimens of stool before taking the *acidophilus* treatment, and for a while daily samples, when procurable, after the first use of the *acidophilus* milk or of the milk plus stated amounts of lactose. Bacteriological examinations were made of these specimens and the results correlated with the clinical findings. Persons who had been afflicted with chronic constipation usually received one quart of the *acidophilus* milk plus 100 grams of lactose daily, the powdered lactose being added to the milk in the flask and the contents thoroughly shaken. The subjects were instructed to take the daily supply in three equal portions, and as nearly as possible two hours before or after meals. This schedule was at times varied to suit the particular needs of the cases. There were no restrictions as to diet, but the subjects were urged to refrain from the use of food which by experience or training they knew to be harmful.

In all of the diarrheal cases (including colitis and sprue) the treatment consisted in the daily administration of from 500 to 1,000 c.c. of the *acidophilus* milk without added milk sugar. The milk was well tolerated by the patients.

#### CHRONIC CONSTIPATION.

The first two cases, which had a long history of most obstinate constipation and in whom the symptoms usually accompanying

such condition were of the most aggravated type, responded within the course of less than a week to the use of one quart of *acidophilus* milk daily without any added lactose. A very close correlation between the clinical and bacteriological results was established. Two other subjects who for many years had had marked enteroptosis and a condition approaching at times intestinal stasis yielded readily to the administration of one quart of the milk plus 100 grams of lactose, and after the first few days required only 500 c.c. of the milk with as little as 25 to 50 grams of added milk sugar daily. A fifth subject, however, obtained little relief from the treatment until at least two weeks after the first application. Within a month his condition was greatly improved. Two other subjects acted somewhat similarly, and another required a quart of the *acidophilus* milk plus 150 grams of sugar daily before a satisfactory response was obtained. In every instance sufficient relief was obtained to enable the patient to dispense, for the time at least, with the use of a cathartic, and a general, though at times slow, improvement of the patient's condition was manifested. More recently, however, one subject failed to react appreciably to the treatment, even when the amount of sugar was greatly increased. We shall expect to find other exceptions.

#### CHRONIC DIARRHEA.

One of the two cases of chronic diarrhea following bacillary dysentery responded readily to the use of one quart of *acidophilus* milk daily. He was a Bohemian, male, forty-two years old, and had, with brief intermissions, suffered from the condition since 1907. The other was a returned Red Cross nurse who had contracted bacillary dysentery while on duty in the Balkans during the recent war. She obtained almost immediate relief, but experienced cycles of increasing and decreasing disturbance. She continued taking 500 c.c. of *acidophilus* milk daily for at least three months. During this time the more serious phase of the cycle became less and less acute until it became barely noticeable and the subject considered herself practically recovered. During the past two months she has reported from time to time, and consumed about one pint of the milk per week. She has had no recurrence of the diarrhea, and is able to devote her entire time to her occupation.

## COLITIS.

The two cases of colitis were of the acute type. One was uncomplicated, but had a long history of intestinal disturbance. The case responded to the treatment slowly and at the end of about four weeks all of the symptoms of colitis, which at times had been bloody, disappeared. He continued in apparently good health for about two months when he experienced a slight reversion.

The second case gave every evidence of improvement when, owing to a return of a serious nephritic condition, he required special hospital treatment and was compelled to discontinue the use of the *acidophilus* milk.

## SPRUCE.

Both of the subjects had contracted sprue while in China. The one, whose case was less severe than the other, took one quart of the milk for six weeks, during which time the feces changed completely from the clay-colored, soft and extremely offensive to the yellow, almost formed and odorless type. The gas disappeared from the colon, and the subject appeared in every way to approach normalcy.

The second case was extremely acute, with the various advanced symptoms, including tetany. He was very emaciated and subject to abdominal pains and gaseous distention. There was a history of tubercular infection also. He seemed from the time of beginning the treatment to show a gradual improvement. The pains became less severe and the tetany disappeared for a time. He was able after several weeks to leave his room and to take short automobile excursions. He gained at least four pounds in weight, and seemed to be on the way to recovery when he experienced a relapse and died.

## DERMATITIS.

All of the three cases of dermatitis were those of eczema. One responded completely to the treatment, though it required about a month to bring about the first indications of a clearing up of the face, which for many years had been subject to a form of eczema that had caused considerable disfigurement. He required a quart of *acidophilus* milk plus 100 grams of lactose daily to bring about the desired implantation in the intestine. After two months

following the beginning of the treatment all evidence of eczema had disappeared.

The second case showed some evidence of responding when the treatment had to be discontinued owing to an infection which developed in the hands which had been the parts mostly affected by the eczema, and to necessary medical treatment of the infected hands. The third subject was slow to react to the use of the milk and lactose and his condition showed little, if any, improvement.

The principles of the *acidophilus* treatment have been clearly set forth in different publications from the laboratory, and it is only when these principles are adhered to that favorable results should be expected. The ingestion of relatively small numbers of the bacilli should not be expected to lead to implantation and bodily improvement. Furthermore, the viability of the organism must be preserved in its preparation for therapeutic purposes. Finally, it should be understood that the *B. acidophilus* is not a panacea for all ills.

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**Growth and reproduction upon simplified food supply.**

**II. Influence of food upon mother and young  
during the lactation period.**

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Breeding rats were fed upon diets containing respectively one sixth whole milk powder to five sixths ground whole wheat or one third whole milk powder to two thirds ground whole wheat. Young were successfully reared on both diets and both would be regarded as adequate for growth, reproduction and successful suckling of the second generation. The larger proportion of milk in the second diet resulted in the following evidences of improved nutrition: (1) Increase in the number of young produced. (2) Increase in the percentage (and therefore also in the number) of young successfully suckled. (3) Better maintenance of the body weight by the mother while suckling the young. (4) Higher average weight of young at a standard weaning age of four weeks.