

with reveals. To sum up, the houses are given a good scouring out and then thoroughly repaired, and adequate provision is made for lighting and ventilation.

When all this has been done, when the reconstruction is complete, shall the tenants be contented, cleanly and desirable? This can only be determined by actual trial, for as Victor Hugo has wisely said, "Houses are like the human beings that inhabit them" ("Toilers of the Sea," Part I, Book I).

Enough has been written to show that the factors concerned in housing are very complex, and that our present method of dealing with the situation is a mere makeshift. Perhaps as education advances, when housecraft has become a compulsory subject in every elementary school and has developed a sturdy and elevating housepride, when labour problems are better understood and labour difficulties better adjusted, when the causes of economic and social disruptions are better defined and their evolution prevented, then perhaps shall the problem be satisfactorily settled on broad, generous, far-reaching and vitalizing principles. And there is no doubt that at last the nation is waking up and moving in the right way. The recent beneficent legislation, the public acts of the President of the Local Government Board, and the institution of labour exchanges are a first instalment of that large measure which is to secure to the country contentment within its borders, happy and healthy homes and peace and quietness within them.

AN ANNUAL REPORT OF UNUSUAL BREVITY.—The Editor of PUBLIC HEALTH has received the following annual report, from which, doubtless through an oversight, the name of the district has been omitted. The Editor will be glad to receive any information that may lead to the identification of the medical officer of health concerned in the production of this report:—

REPORT ON HEALTH OF BOROUGH  
(UNOFFICIAL).

Mr. Chairman and gentlemen, here please to see  
A report which is brief, as reports ought to be.  
The death-rate is nine, the birth-rate is double;  
Infectious disease has given no trouble;  
While the poor little infants (whose credit is  
high)

Have, luckily, shown small intention to die.  
Six waters were brought from wells in the  
borough

Which, after analysis searching and thorough,  
Were shown to be bad, and undoubtedly risky,  
Even when mixed with the Mayoral whisky.

## THE ACTION OF BORON PRESERVATIVES ON BACILLUS COLI AND ALLIED MICROBES.

By E. KLEIN, M.D., F.R.S.,  
Lecturer on Advanced Bacteriology at the Medical  
School of St. Bartholomew's Hospital, London.

THE inhibitory action of boron preservatives on the growth of bacteria in various food-stuffs (cream, butter, milk, sausage) has on several occasions within recent years been the subject of controversy. A few years ago a departmental committee appointed by the Local Government Board practically sanctioned the use of 0.5 per cent. boracic acid as a preservative for cream and butter. As to sausage and sausage-meat the addition of boracic acid has in several recent instances been made the subject of lawsuits. On all sides it is agreed that the addition of from 0.3 to 0.5 per cent. prevents putrefactive changes—i.e., inhibits the growth of those bacteria which, strictly speaking, cause putrid decomposition of proteids, recognizable at once by the putrid smell. Some medical officers maintain that under ordinary practice the addition of boron preservatives, by inhibiting and therefore preventing recognition of putrefactive changes, does not prevent the growth of pathogenic bacteria. Under this view the absence of recognizable decomposition does not eliminate the danger from specifically pathogenic microbes; moreover, they say the masking of the putrefactive change by the preservative makes the article appear sound and wholesome. Were it not for the inhibition by the boron preservative of the growth of putrefactive bacteria the articles would by the smell alone be judged unfit for consumption, and would be unsaleable, and they consequently deprecate boron preservatives on this ground alone.

The whole question, therefore, resolves itself into this: Does the addition of boracic acid in definite proportion—say, 0.5 per cent.—interfere in any way with the growth and multiplication of bacteria, which possess specific pathogenicity? That such addition does prevent and inhibit fermentative (formation of lactic acid, curdling of milk, and souring of cream) and putrefactive changes (decomposition of proteid with the evolution of malodorous gases) is agreed, and is an experience sanctioned by universal practice.

Now, the specific pathogenic bacteria, which in articles of food such as come here in question—milk, cream, butter, sausages—are

those belonging to the Coli Gaertner group—*i.e.*, bacteria which are capable of setting up digestive troubles, including acute gastro-enteritis.

In an article in the *British Medical Journal* of April 16th, 1910, page 929, Dr. Bernstein sums up the results of his experiments on boric acid as a food preservative thus:—

“Boric acid to the extent of 0.3 per cent. (20 grains to the pound) prevents objective decomposition, such as is detected by smell. If objective putrefaction has commenced it inhibits further changes of this kind, possibly leading to diminution in the smell. It has a marked selective activity on the various organisms, inhibiting the growth of yeasts and organisms of the *proteus* group, and possibly other harmless saprophytes, though not the organisms of the *coli* group. Hence it seems obvious that with the aid of boric acid stale meat can be used for the making of sausages, and even meat that has already started decomposing. If, then, to such meats Gaertner's bacillus has obtained access it will have had several days at least in which to grow, and, what is important, unhindered by the prolific saprophytes.”

These statements as to the organisms of the coli group are therefore those which, if true, affect the question of boron preservatives in a marked degree, and while in the paper published no experiments are given either in a general or in a detailed way as to the coli group, he refers to and relies at the beginning of the paper on some such preliminary experiments (*l.c.*, p. 928). He says:—

“Some months ago, whilst attacking the problem of boric acid as a preservative, at the request and suggestion of Dr. Allan, medical officer of health, Westminster, an entirely new aspect presented itself, which, if confirmed by subsequent research, must have an important bearing on the subject of food preservatives.

“The question centred itself around sausages adulterated with 20 grains of boric acid to the pound. Preliminary experiments showed that this amount of boric acid had a peculiar and unequal effect on the varying processes of putrefaction; it appeared that the saprophytic organisms, including those producing the odours of putrefaction, were inhibited, whilst the coli-form group of organism, including Gaertner's bacillus, were affected to a much lesser degree.”

In order that there may be no misunderstanding on this point, Dr. Bernstein says on p. 929:—

“To determine the action of boric acid on the various organisms, experiments have been carried out in nutrient media to which has been added boric acid in amounts of 0.2 to 0.6 per cent. The result of the preliminary experiments tends to show that whilst boric acid does inhibit to some extent all the organisms used, there is a marked inhibition of the organisms of the *proteus* group, but a much less effect on the organisms of the *coli* group. With the *Proteus vulgaris* and *Proteus zenkeri* very slight growths were obtained after some days in 0.3 per cent., and practically none in 0.4 per cent., whilst *B. typhosus* grew in diminishing amount up to 0.5 per cent.; but several strains of *B. gaertneri* grew readily in all percentages, though with diminishing prolixity as the percentage increased.”

As this subject undoubtedly possesses, from a public health point of view, far-reaching, practical importance, it is not sufficient to rely merely on some general tests, but it is necessary to arrange experiments bearing on this subject in a scientific, *i.e.*, accurate manner, by which the problem could be definitely settled.

In order to show the importance of accurate tests I will here give an illustration. We wish, for instance, to ascertain whether or not the addition to a nutritive medium, *e.g.*, broth, of a definite amount of boracic acid (or any other substance, for the matter of that) does or does not inhibit the growth and multiplication of a definite microbe, say *B. Coli*; broth being otherwise, *i.e.*, without the boracic addition, a suitable soil for the growth and multiplication of the microbe.

The experiment should be carried out in this manner: We add to the boracic broth (say to 10 c.c.) a definite number (say 1,000) of *B. Coli* per 1 c.c.—the number being ascertained by plate cultivation—and at the same time add to non-medicated broth (10 c.c.) the same number of *B. Coli* (1,000 per 1 c.c.) for control. Both—*viz.*, the medicated and non-medicated broth—are then exposed to the same conditions of incubation, say 70 deg. F.

From time to time the number of *B. Coli* are ascertained in both sets; thereby we can judge whether and to what precise extent an increase or a decrease of the *B. Coli* had taken place.

Supposing that in the non-medicated broth in two days at 70 deg. F. the *B. Coli* had increased from the original 1,000 per 1 c.c. to several millions per 1 c.c., while in the medicated broth there was at the same time a

decrease from 1,000 to 500, we should be justified in concluding that the boracic acid had a strong inhibitory effect—*i.e.*, was capable of preventing multiplication—and, moreover, had actually caused the death of a good many of the *B. Coli* originally present. But, on the other hand, if from this medicated broth (without having ascertained that it now contained only 500 *B. Coli* per 1 c.c.) we inoculated, say with one drop, one fresh normal broth tube, and incubated this, we should, of course, get in it a copious growth of *B. Coli*. If from this we concluded that the medicated broth contained living *B. Coli* we would be right. But we would be entirely wrong if from this positive subculture we concluded that the medication (boracic acid) left the *B. Coli*, originally added, unharmed, and therefrom concluded that the boracic acid did not interfere with the growth of the *B. Coli*. This is somewhat the manner in which Dr. Bernstein, judging from his experiments described on page 929 (*l. c.*), would draw his conclusion. While he would be right in saying that under the medication some *B. Coli* were still present after two days, he would be wrong in saying that the boracic acid had no inhibitory or inimical action on the *B. Coli*.

I have made experiments in this direction on *B. Coli* and on *B. Gaertner*, and by determining the action of a definite amount of boracic acid—0.5 per cent., as sanctioned by the Report of the Departmental Committee of the Local Government Board—on definite numbers of either of these microbes added to definite substances, a precise knowledge of this subject has been gained. I propose here to give the details and the results of these experiments.

*Series I.*—Sterile faintly alkaline “nutrient broth” (beef broth, peptone, salt), such as is used in bacteriological laboratories for the growth of bacteria of all kinds, was prepared. One lot was contained in test tubes, each charged with 10 c.c. This will be designated “ordinary broth.” The other lot was in bulk first charged with Douglas’s boron preservative—equal to 100 per cent. boracic acid—to the amount of 0.5 per cent., then decanted into test tubes, each receiving 10 c.c.: this will be designated “boron broth.”

One tube of sterile ordinary broth was infected with a trace of *B. Coli Communis* from an active agar surface of laboratory stock culture. This stock culture was some months previously derived from a plate culture of

normal human sewage, and had, of course, shown all the tests positive for *B. Coli Communis*.

Similarly one tube of sterile ordinary broth was infected with a trace of *B. Gaertner* (typical) from an active agar culture. This stock was given to me some months previously by my colleague, Dr. Horder, who isolated it from the blood and the spleen of a fatal case. This case was one of a group of twenty-five girls that had all been attacked by acute gastro-enteritis after eating a particular broth.

Both broth cultures were incubated at 37 deg. C. for two days (forty-eight hours), then numerical determination by the ordinary methods of dilution was made—for *B. Coli Communis* by surface plates of neutral red, bile salt, lactose, peptone, agar; for *B. Gaertner* by surface plates of Conradi-Drigalski medium. It was found that the broth cultures—very turbid—were pure cultures of these microbes, and contained them in the following numbers: The *B. Coli* broth culture contained 568 millions\* *B. Coli Communis* per 1 c.c.; the *B. Gaertner* broth culture contained 1,082 millions *B. Gaertner* per 1 c.c.

At the same time (48 hours) that the above determination by plate cultures was made, one ordinary broth tube (10 c.c.) and one boron broth tube (10 c.c.) were charged with an amount of dilution of the above *B. Coli* broth culture and the above *B. Gaertner* broth culture, which was equal to 800,000 *B. Coli* per 1 c.c. in one set (ordinary broth and boron broth), and to one and a half millions *B. Gaertner* per 1 c.c. in the other set (ordinary broth and boron broth).

In other words, one tube containing 10 c.c. of ordinary broth and one tube containing 10 c.c. boron broth each received 8 millions *B. Coli Communis*, while on the other hand one tube containing 10 c.c. ordinary broth and one tube containing 10 c.c. boron broth each received 15 millions *B. Gaertner*.

These four tubes were placed in the incubator and kept at 70-71 deg. Fahrenheit. This temperature was chosen as representing the average summer temperature—that is, a temperature in which the inhibitory action of the boron preservatives, if any, will fully be able to declare itself, since it is in the summer temperature that not only are these microbes capable of rapidly multiplying, but also this is the temperature against which the preservative has its most useful practical application.

\* It is not necessary to describe in detail the methods of dilution and calculation here, because every bacteriologist experienced in the determination of numbers in different materials knows that they are as simple as they are exact.

Two further points have to be mentioned before detailing the results. In selecting sterile broth as the medium—that is to say, the medium free of all other than the test microbes—the conditions of experiment are not only simplified, but in addition they offer the best chances for the growth and multiplication of the test microbes, these being unhampered, unsuppressed, and not interfered with by other microbes. It is a well-known experience in bacteriology that highly specialized and particularly pathogenic microbes like those we experimented with, other conditions being equal, grow, multiply and survive best if they have, as it were, the field all to themselves.

The second point to be mentioned is this: It was considered advisable to extend the period of the test to ten days—that is to say, to watch the cultures as to increase or decrease of the test microbes in the medicated broth for a period somewhat beyond that in actual practice; such articles as sausages, or milk preserved by boron preservatives, would rarely, if at all, be kept unsold for such a long period.

A. Experiments with *B. Coli Communis* in ordinary broth and in boron broth, inoculated with 800,000 *B. Coli* per 1 c.c., then incubated at 70-71 deg. F.

*In Ordinary Broth.*

At starting, 800,000 per 1 c.c.  
After 48 hours,\* 440 millions per 1 c.c.  
After 7 days, 12,800 millions per 1 c.c.

*In Boron Broth.*

At starting, 800,000 per 1 c.c.  
After 48 hours, less than 600,000 per 1 c.c.  
After 3 days, less than 80,000 per 1 c.c.  
After 4 days,† 3,000 per 1 c.c.  
After 7 days, 1,000 per 1 c.c.  
After 10 days, 200 per 1 c.c.

B. Experiments with *B. Gaertner* in ordinary broth and in boron broth, inoculated with 1.5 millions *B. Gaertner* per 1 c.c., and then incubated at 70-71 deg. F.

\* Five cubic millimetres (1/200 of a cubic centimetre) of the culture were added to 10 c.c. of sterile salt solution—that is to say, each cubic centimetre of this salt solution contained 1/2,000 part of 1 c.c. of the broth culture; of the salt solution 1 cubic millimetre was rubbed over the surface of the "neutral red, lactose, bile salt, agar" set in the plate; in other words, the plate received a two-millionth part of the original broth culture. In this plate 220 colonies (red) of *B. Coli* (no others) made their appearance on incubation at 37 deg. C. after 24-48 hours. Consequently the original broth culture must have contained 440 millions *B. Coli* per 1 c.c.

† Of the boron broth culture five cubic millimetres (1/200 c.c.) were rubbed over the surface of the Drigalski medium set in a plate. Fifteen colonies (blue, no other) came up in the plate; therefore the boron broth culture contained 3,000 *B. Gaertner* per 1 c.c. I give these two tests in order to illustrate the mode of procedure.

*In Ordinary Broth.*

At starting, 1,500,000 per 1 c.c.  
After 48 hours, 130 millions per 1 c.c.  
After 7 days, 2,400 millions per 1 c.c.

*In Boron Broth.*

At starting, 1,500,000 per 1 c.c.  
After 48 hours, less than 1 million per 1 c.c.  
After 3 days, 640,000 per 1 c.c.  
After 5 days, over 400,000, but less than 500,000 per 1 c.c.  
After 7 days, less than 1/2 million per 1 c.c.  
After 8 days, 400,000 per 1 c.c.  
After 10 days, over 2 millions.

From this series it appears, then, that 0.5 boracic added to broth possesses a marked and powerful inhibitory action on the life of *B. Coli*. Although the broth contained at starting the enormous number of 800,000 *B. Coli* per 1 c.c., not only was there on incubation at 70-71 deg. F. no increase in their number, but a rapid diminution—i.e., death of crowds of them; thus in three days their number had decreased tenfold, after seven days eight hundredfold, and after ten days four thousandfold. The conclusion, therefore, arrived at by Dr. Bernstein from his preliminary experiments with *B. Coli* were not confirmed by our experiments with boron beef broth.

As regards *B. Gaertner* the results were less striking than those concerning *B. Coli*. As to the former (*B. Gaertner*), no increase but a decided decrease took place during the first eight days. From one and a half millions per 1 c.c. at starting, a decrease during the first forty-eight hours to less than a million per 1 c.c., after five days to less than half a million per 1 c.c., and about the same number was found after eight days; only after ten days was there a slight increase noticed.

In these experiments the boron broth cultures both of the *B. Coli* and of the *B. Gaertner*, although charged with enormous numbers of the microbes, showed no apparent alteration in their limpidity. Bacteriologists will understand that the presence of such minute microbes as the two test microbes, even when present to the amount of 800,000 or a million and a half per 1 c.c., does not reveal itself to the unaided eye, and that such presence does not appreciably affect the limpidity of the broth; the boron broth *B. Gaertner* culture, when inspected after ten days' incubation and compared with a normal broth tube, showed a very slight diminution of its limpid condition, so slight that it could hardly be called turbidity.

Now, it will be admitted that under natural

conditions it will hardly occur that any food material—in a fairly fresh condition—would contain, *i.e.*, have been infected with, as many as 800,000 *B. Coli Communis* per 1 c.c. or one and a half millions *B. Gaertner* per 1 c.c. The experiments just recorded would, therefore, represent an extreme case such as is not likely to occur under actual conditions. A second series of experiments was, however, instituted, which would more approximate to what might occur under natural conditions, and which would at the same time confirm, or otherwise, the above first series.

*Series II.*—In this series boron broth was infected with *B. Coli Communis* and *B. Gaertner* in much smaller amounts: namely, *B. Coli* 6,400 per 1 c.c., *B. Gaertner* 1,200 per 1 c.c. The tubes were then incubated at 70-71 deg. F.

A. Experiments with *B. Coli Communis*.

*In Boron Broth.*

At starting, 6,400 per 1 c.c.

After 48 hours, less than 500 per 1 c.c.

After 3 days, less than 200 per 1 c.c.

After 5 days, less than 20 per 1 c.c.

After 7 days, less than 10 per 1 c.c.

After 9 days, less than 2 per 1 c.c.

After 10 days, none per 1·5 c.c.

Here again the decrease and final disappearance of *B. Coli* in broth containing 0·5 per cent. boracic was decisive and rapid; in 48 hours at 70-71 deg. F. a more than tenfold decrease took place, and this decrease continued till after 10 days 1·5 c.c. contained none of the 6,400 per 1 c.c. originally introduced. Here also Dr. Bernstein's assumption was not correct: not only did the life and growth of *B. Coli* not remain unaffected by the addition of boracic, but on the contrary this substance had a marked deleterious effect on the life of this microbe.

B. Experiments with *B. Gaertner*.

*In Boron Broth.*

At starting, 1,200 per 1 c.c.

After 48 hours, less than 500 per 1 c.c.

After 3 days, less than 200 per 1 c.c.

After 5 days, 140 per 1 c.c.

After 7 days, 240 per 1 c.c.

After 9 days, 400 per 1 c.c.

After 10 days, 500 per 1 c.c.

From this it will be seen that also in this series *B. Gaertner* was markedly affected by the boracic, although to a less degree than *B. Coli*. The former (*B. Gaertner*) showed nothing of an increase during the first five days; on the contrary, its decrease was marked and steady, although not so great as in the case of *B. Coli*. The *B. Gaertner* during

the first five days decreased about ninefold, whereas the *B. Coli* under the same conditions decreased more than three hundredfold. In seven days *B. Gaertner* showed an increase on that of five days, and this was more pronounced in ten days, but even at this period their number was less than half the initial number.

Half per cent. boracic possesses, then, in beef broth a decided inhibitory, restraining and disinfecting action on the life and growth of *B. Coli* and of *B. Gaertner*.

*Series III.*—In this series the experiments were conducted on the same principle as in the former series, but the medium to which the microbes *B. Coli* and *B. Gaertner* were added was sausage-meat. Mr. E. A. Fuller, of the firm of Messrs. W. Fuller & Son, preserved provision manufacturers, of Homerton, was kind enough to allow me to be present when sausage-meat was prepared—pork, veal, spices and bread. After the material had been thoroughly minced, and before any preservative had been added, I was allowed to take away in my sterile bottles a quantity of this minced substance. In the laboratory I separated it into two portions—(a) one which received 0·5 boron preservative (Douglas's), and (b) one control which remained without any addition of preservative. In order to mix the meat well and uniformly with the boracic it was necessary to place the meat in a sterile mortar, and to thoroughly stir it with a sterile pestle while gradually adding the boracic powder. This mixing and stirring was kept up for more than ten minutes, as it was intended to thoroughly impregnate the material with the preservative. Owing to the extremely cohesive and viscid nature of the material (due to the bread), and in order to deal with it in such a manner that it could be poured into test tubes in definite amounts and that quantitative accurate analysis could be made, it was necessary to further thoroughly mix and stir it with sterile water in the proportion of 1 volume of the sausage-meat and 2 volumes of sterile water.

Both lots—the control lot and the boron lot—were placed in test tubes, each tube receiving about 10 cubic centimetres of the material.

The tubes were then kept at a temperature of 70 deg. Centigrade for half to one hour in order to destroy all non-sporing bacteria which might, and no doubt would, interfere with the growth and multiplication of the special test microbes—*B. Coli* and *B. Gaertner*—which had to be added. I have already stated that the

object of these our experiments was to give to the added test microbes the best chances of growing and multiplying, and therefore it was necessary as a preliminary to the experiments to remove from the culture medium as much as possible other saprophytic microbes which could interfere and prevent the growth of the test microbes. When the tubes had been again cooled, infection of the sausage material was proceeded with:—1. One set of non-medicated sausage-meat—to be designated “ordinary” sausage-meat—and one set of “boron” sausage-meat were each (10 c.c.) infected with a definite number of *B. Coli Communis*. 2. Similarly 10 c.c. of “ordinary” and 10 c.c. of “boron” sausage-meat were infected with a definite number of *B. Gaertner*.

The stock beef broth cultures from which the infections were made contained—one about 400 millions *B. Coli* per 1 c.c., the other 31 millions *B. Gaertner* per 1 c.c. By plate cultivation (see Series I) it was ascertained that the number of *B. Coli* added to each of 10 c.c. of “ordinary” sausage-meat and of “boron” sausage-meat was 10,000, or 1,000 *B. Coli* per 1 c.c. of the meats, and the number of *B. Gaertner* added to each of the 10 c.c. of “ordinary” and of “boron” sausage-meats was 780, or 78 *B. Gaertner* per 1 c.c. of the meats.

The so-infected tubes were then placed in the incubator at 70-71 deg. F., and kept therein for forty-eight hours and four days respectively; determination of the test microbes was made with the following results:—

A. Experiments with *B. Coli Communis* in “ordinary” and “boron” sausage-meat, inoculated with 1,000 *B. Coli* per 1 c.c.

*In Ordinary Sausage-Meat.*

At starting, 1,000 per 1 c.c.

After 48 hours, 22 millions per 1 c.c.

After 4 days, over 150 millions per 1 c.c.

*In Boron Sausage-Meat.*

At starting, 1,000 per 1 c.c.

After 48 hours, less than 20 per 1 c.c.

After 4 days, none per 1 c.c.

It appears, then, from these tests that, while in the “ordinary” sausage-meat the multiplication of the added 1,000 *B. Coli* per 1 c.c. was very great and proceeded unimpeded, amounting to 22 millions per 1 c.c. in two days, and rising to over 150 millions per 1 c.c. in four days, there was at once a considerable inhibition and destruction of the microbe in the medicated sausage-meat, so much so that of the added 1,000 *B. Coli* per 1 c.c. less than twenty were

present per 1 c.c. after two days, and none could be discovered in 1 c.c. after four days.

B. Experiments with *B. Gaertner* in “ordinary” and “boron” sausage-meat inoculated with 78 *B. Gaertner* per 1 c.c.

*In Ordinary Sausage-Meat.*

At starting, 78 per 1 c.c.

After 48 hours, 36 millions per 1 c.c.

After 4 days, over 200 millions per 1 c.c.

*In Boron Sausage-Meat.*

At starting, 78 per 1 c.c.

After 48 hours, less than 20 per 1 c.c.

After 4 days, none per 1 c.c.

It appears, then, from this that while *B. Gaertner* in the “ordinary” sausage-meat multiplied to an extraordinary degree—from 78 per 1 c.c. to 36 millions per 1 c.c. in two days, and to over 200 millions per 1 c.c. in four days—in the medicated sausage-meat the *B. Gaertner* dwindled down to none per 1 c.c. in four days.

Series IV.—Owing to the difficulties due to the viscosity (bread) of the sausage-meat, I simplified the matter by preparing a broth from the chief ingredients generally used for the sausage-meat, leaving out the bread and the spices, and using only veal and pork. This not only simplified the experiment, but enabled me to conduct the experiments with great accuracy and in favour of the solution of the problem whether any inhibition—and, if so, to what extent—of the growth of *B. Coli* and *B. Gaertner* occurs in the medicated material. The growth of *B. Coli* and of *B. Gaertner* obviously depending on the meat portions of the sausage-meat, and not on the added spices or bread, these latter two materials could be left out as immaterial for the solution of the problem.

Equal amounts of fresh veal and fresh pork were minced and then mixed with water and boiled so as to form a nutrient broth (1 lb. of meat to a litre of water). This, after filtration, was sterilized and ready for use as stock veal-pork broth. The stock material was now divided in two lots: Lot *a*, “ordinary” veal-pork broth, was decanted in test tubes, 10 c.c. in each tube. Lot *b* was mixed with boracic powder (Douglas's) to the amount of 0.5 per cent. and decanted in test tubes, 10 c.c. in each tube—“boron” veal-pork broth. The tubes were then heated for twenty minutes to 70 deg. C. in order to sterilize them. Of the “ordinary” veal-pork broth tubes and of the “boron” veal-pork broth tubes, one of each was infected with 4,080 *B. Coli* per 1 c.c. and with 860 *B. Gaertner*

per 1 c.c. respectively. They were then placed in the incubator and kept there at 70-71 deg. F.

A. Experiments with *B. Coli Communis* in "ordinary" and in "boron" veal-pork broth, each inoculated with 4,080 *B. Coli* per 1 c.c.

*In "Ordinary" Veal-Pork Broth.*

At starting, 4,080 per 1 c.c.

After 48 hours, 190 millions per 1 c.c.

After 7 days, 960 millions per 1 c.c.

*In "Boron" Veal-Pork Broth.*

At starting, 4,080 per 1 c.c.

After 48 hours, 600 per 1 c.c.

After 4 days, 100 not 200 per 1 c.c.

After 7 days, 60 not 100 per 1 c.c.

After 10 days, less than 10 per 1 c.c.

From this it follows, then, that also in the veal-pork broth the addition of 0.5 per cent. boracic preservative has a marked inhibitory and disinfecting action on the *B. Coli*. Whereas in the veal-pork broth without preservative the multiplication of the *B. Coli*—originally 4,080 per 1 c.c.—reached in seven days at 70-71 deg. F. the enormous number of 960 millions per 1 c.c., *i.e.*, about 240,000-fold the original number, in the veal-pork broth with the preservative the original number of 4,080 *B. Coli* per 1 c.c. not only did not increase, but on the contrary dwindled down to 60 per 1 c.c., and in ten days to less than 10 per 1 c.c.

B. Experiments with *B. Gaertner* in "ordinary" and in "boron" veal-pork broth, inoculated each with 860 *B. Gaertner* per 1 c.c.

*In "Ordinary" Veal-Pork Broth.*

At starting, 860 per 1 c.c.

After 2 days, 210 millions per 1 c.c.

After 7 days, over 800 millions per 1 c.c.

*In "Boron" Veal-Pork Broth.*

At starting, 860 per 1 c.c.

After 2 days, 1,500 per 1 c.c.

After 3 days, 6,200 per 1 c.c.

After 4 days, 8,400 per 1 c.c.

After 7 days, 7,800 per 1 c.c.

In this experiment the inhibition in the growth and multiplication of the *B. Gaertner* by the addition of 0.5 per cent. boracic preservative, as compared with the enormous multiplication of the microbe in the "ordinary" or non-medicated veal-pork broth, was distinct, although, it must be added, considerably less so than was the case with the *B. Coli*. Whereas in the ordinary or non-medicated veal-pork broth *B. Gaertner* multiplied from 860 per 1 c.c. to over 800 millions per 1 c.c.—*i.e.*, nearly a million times—in seven days, in the medicated broth the multiplication was

only about ninefold, or about 100,000 times less than in the ordinary broth.

C. In order to confirm this result, and also to see whether, as indicated in this experiment, the inhibition of the *B. Gaertner* in the medicated veal-pork is markedly less than in the medicated beef broth (see experiments in Series I), a second test was made, using the same boron veal-pork broth as in the above Experiment B.

Boron veal-pork broth inoculated with 8,000 *B. Gaertner* per 1 c.c., and kept in the incubator at 70-71 deg. F.: the non-medicated veal-pork broth from which this subinoculation was made was the same as used in the preceding Experiment B; it had been kept at 70-71 deg. F. for eight days, and contained over 1,200 millions *B. Gaertner* per 1 c.c.

*Boron Veal-Pork Broth.*

At starting, 8,000 per 1 c.c.

After 2 days, 8,400 per 1 c.c.

After 4 days, 8,000-10,000 per 1 c.c.

After 6 days, 13,000 per 1 c.c.

After 8 days, 28,000 per 1 c.c.

From this experiment it will be seen that in our boron veal-pork broth there did occur a slight increase of the *B. Gaertner*, very slight indeed, as compared with what occurred in the control or non-medicated veal-pork broth. The question is, How is it that in beef broth medicated with 0.5 per cent. boron, not only no increase but a very marked decrease occurs (see Experiment B in Series I and II) during the first seven or eight days, whereas in our boron veal-pork broth *B. Gaertner* does undoubtedly show a slow, gradual increase? The reason for this difference is probably due to the following: The addition of 0.5 per cent. boracic to our nutrient beef broth causes no turbidity, whereas such addition to the veal-pork broth causes marked turbidity, which turbidity increases markedly when the broth was heated (see above) for the sake of sterilization; on cooling, a whitish powdery precipitate was deposited, the supernatant broth remaining fairly clear. The non-medicated veal-pork broth tubes on heating did not show this marked turbidity and precipitated hardly any sediment. The explanation for this seems to be that part of the added boracic combines with some substance present in the veal-pork broth into an insoluble material, and thereby the amount of the available, *i.e.*, dissolved and active, boracic acid in the broth becomes reduced; the broth contains now, not 0.5 per cent., but considerably less than 0.5 per cent. available boracic acid. This not occurring in



the beef broth the available amount of added boracic acid remains unchanged, *i.e.*, 0.5 per cent., and therefore the inhibitory action is much more marked.

#### ADDENDUM.

While this paper was passing through the Press I had the opportunity of testing the effect of boracic acid on the *B. Typhosus*.

Ordinary beef broth and boracic (0.5 per cent.) beef broth, each received 50,000 *B. Typhosus* per 1 c.c.—the *B. Typhosus* had recently been isolated from the urine of a typhoid convalescent in this hospital. The result of incubation at 72 deg. F. was as follows:—

#### *Ordinary Beef Broth.*

At starting, 50,000 per 1 c.c.

After 1 day, 284 millions per 1 c.c.

After 2 days, over 1,200 millions per 1 c.c.

#### *Boron Beef Broth.*

At starting, 50,000 per 1 c.c.

After 1 day, 100 but not 1,000 per 1 c.c.

After 2 days, 10 but not 100 per 1 c.c.

After 3 days, 1 but not 10 per 1 c.c.

After 4 days, none per 1 c.c.

From this it follows that the addition of 0.5 per cent. boracic acid to broth has a very marked restraining and disinfection action on the *B. Typhosus*.

#### THE RESIGNATION OF DR. SEATON.

DR. SEATON has resigned his post as County Medical Officer of Health of Surrey—a post he has filled with distinction for the past twenty years. His resignation, however, will not entail his retirement from active public health work, for the County Council have appointed him Consulting Medical Officer of Health at a salary of £300 a year, and he hopes to find time for private consultative work, for which from his long and varied experience he is well fitted.

Dr. Seaton has been a member of the public health service for nearly forty years. He was appointed the first medical officer of health of Nottingham as long ago as 1872, and resigned in 1884 on being appointed medical officer of health of Chelsea. In 1890 he became County Medical Officer of Health of Surrey. The Surrey County Council was the first county council to appoint a medical officer of health, and Dr. Seaton had, therefore, the distinction of becoming the first county medical officer of health. Dr. Seaton's public health work is well known. He was

one of the pioneer workers for the compulsory notification of infectious disease and for hospital isolation, and it is largely due to his influence that the county of Surrey is so well equipped with isolation hospitals. He has given much attention to the subject of water supply—a subject which the geological conditions of Surrey render of special importance in that county, and his reports have been greatly esteemed by his colleagues. Dr. Seaton was one of the early workers in the housing movement, and in 1890 was appointed by the Home Office to report on an insanitary area in the East End of London.

Dr. Seaton has for many years been an active member of the Society of Medical Officers of Health, and was President of the Society in the session of 1897-98. His many friends in the public health service will wish him a long period of continued success in his new sphere of work.

**CHEAPER HOUSES WANTED.**—It seems somewhat anomalous that good as the original intention was of compelling three bedrooms, it should have reacted so as to really cause worse housing than formerly, and I think a revision of the by-laws allowing houses with only two or even one bedroom to be built would be distinct advantages if proper safeguards were enforced. There is a great demand within this district for good workmen's cottages at a rental which the average labourer, with from 18s. to 24s. per week can pay say 2s. 6d. to 3s., and as our by-laws require three bedrooms it is clear that none can be built to pay any interest for that rental. The result is that all the old cottages are eagerly sought after, and as they are becoming derelict and scarce the shortage is more acute. Many couples have no family, many widows are left with one or two small children. These and all newly married couples could very well do with a house which had only one bedroom, and it is evident that numbers of families could be amply served with two. If houses were allowed to be built with one living room and one bedroom of a definite size and structure, to be laid down in by-laws, and each house to have a plot of ground enclosed and entirely devoted to itself with a lean-to or even a wooden washhouse, pantry, and coalhouse, and thoroughly efficient sanitary conveniences and drainage, with also a plentiful water supply, it could unquestionably meet a very acute want, and if similar safeguards were extended to two bedroomed cottages there is no doubt that a thoroughly good class of tenants would be secured, with very great advantage to all dwellers in the district.—*Annual Report of Dr. Gough, Medical Officer of Health, Northwich.*