Brilliant green enrichment with such a scheme as has been indicated for the further investigation of strains isolated appears to give the most consistent results, and it is suggested for use where a single routine method is required. A series of concentrations of the dye ranging from 1 in 125,000 to 1 in 500,000 has been found to be satisfactory. It must be noted, however, that in our work, as in that of Gray (1929), positive results were obtained by other methods when brilliant green enrichment failed. The use of Wilson and Blair's plating method in addition undoubtedly increases the possibility of isolating organisms of the enteric group. Our results suggest that the methods are to some extent complementary in that factors which militate against the success of one do not appear to operate when the other is used.

Discussion.

The areas drained by those sewers from which *B. paratyphosus* B was isolated could be divided into two groups. Four sewers yielding positive results were associated with adjoining districts comprising the whole port area of the city (District I). The remaining three drained part of the southern suburban area, the district being again well defined (District II).

By the courtesy of the medical officer of health for Edinburgh the incidence of cases of *B. paratyphosus* B infection in these districts was ascertained for the five-year period 1925-29 inclusive. The total number of cases notified in the city, excluding imported cases and those arising in institutions, was also available for the same period. Cases on diagnosis were, as a rule, removed at once to the City Hospital, so that recognized sufferers from the disease did not contribute to the discharge of organisms in sewage. The total number of cases arising in Districts I and II amounted to 46, while 103 cases had been notified during the same quinquennium for the whole city. Thus some 44.6 per cent. of the city cases occurred in these districts. It must, however, be noted that the population of these areas, as far as could be ascertained from available data, was approximately 30 per cent. of that of the whole city. It will thus be seen that, on a consideration of a prolonged period of time, little correlation is possible between the localization of enteric cases and the presence in the sewage of the specific organism in numbers sufficient to render isolation possible. This lack of correlation was further accentuated when the cases for the four years prior to that during which the examination was made were considered. During 1925-28 inclusive only 18.2 per cent. of the city cases originated in Districts I and II (8 out of 44 cases).

The figures for the year 1929, however, showed a more significant relationship to our findings. During this year 59 cases of *B. paratyphosus* B infection were traceable to infection within the city, and of these 38 appeared in Districts I and II. Thus approximately 30 per cent. of the city population provided 66.4 per cent. of the total number of cases. This would appear to show a marked relationship between the presence of paratyphoid bacilli in sewage and the topographical distribution of the disease.

Taking the finding in the case of each district separately further light was thrown on this subject. District I had an estimated population which was 19 per cent. of that of the whole city; 34 cases of *B. paratyphosus* B infection occurred in this district in 1929, or 57.9 per cent. of the total city cases. District II, on the other hand, representing 11 per cent. of the city population, provided only 6.7 per cent. of the total cases. Thus the two districts, from both of which specific organisms were being discharged in enormous numbers, gave widely divergent results in respect of case incidence.

The explanation of this may be in the difference between social conditions of the two population groups. District I represents a congested tenement area, while District II comprises for the most part a residential suburban area of modern construction. Probably the best index available for the expression of this factor is the population density. The most recent figures available are those of the annual report by the medical officer of health for the city for 1928. District I showed a mean density of approximately 48.8 persons per acre, subdivisions varying from 35.4 to 98.1, while that for District II was 5.8 persons per acre.

It seems probable that the finding of organisms of the enteric group in sewage indicates the presence of a potential or active source of infection, but that under conditions of life as found in an upper-class residential district the habits of the people are such that spread from such foci does not arise. In an overcrowded tenement area, however, the presence of a concentration of carriers, as indicated by the possibility of demonstrating the organism in sewage, is reflected in a high incidence of cases.

The sewer from which Gray isolated the organism in 1928 drained a district in which an outbreak of the disease had occurred in 1927. At the time of the present work (1929) this sewer yielded negative results. In the same way we were unable to demonstrate the specific organism in the sewage of other districts in which outbreaks of enteric fever had occurred during previous years. These findings would suggest that the permanent or chronic carriers which might be expected to result from such outbreaks are not sufficient to account for the massive discharge necessary to ensure isolation of the organism from a main sewer.

If any conclusion is possible from the present work it is that the presence of organisms of the enteric group in sewage indicates a concentration of missed cases, convalescents, and transient contact carriers in the general population. Such a circumstance may be found in association with, or immediately following, an outbreak of the disease. From a consideration of an upper-class suburban district it is suggested that such a focus may exist without any frank outbreak of the disease at the time of the examination or preceding it.

Summary.

1. A series of 57 specimens of sewage, which included samples from all main sewers of a city, has been examined with a view to the isolation of organisms of the enteric group.

2. By the use of three different methods of selective culture *B. paratyphosus* B Schottmüller was isolated from seven samples.

3. A simple routine method for isolating enteric organisms from sewage is indicated.

4. A comparison has been made between the incidence of *B. paratyphosus* B infection in areas drained by sewers giving positive results, and in the city as a whole.

We wish to acknowledge our indebtedness to Professor T. J. Mackie for the interest he has taken in this work; also to those of the sanitary staff of the city who have assisted in obtaining the necessary sewage samples.

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FOOD POISONING DUE TO EGGS.

BY

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ONE habitually regards an egg as one of the safest and most wholesome forms of food. When the Three Musketeers had just escaped by a chance from death by the poisoned wine arranged for them by Lady Clarick, they sought safety in plain boiled eggs, and water drawn by Athos in person from the public fountain. But there is strong reason to believe that this innocence of the egg is, after all, only relative, and that, in fact, eggs are responsible for many cases of food poisoning which remain mysterious—that is, cases of severe or fatal gastro-enteritis due to salmonella infection in which none of the usually suspect articles can be incriminated. During the last three years there have been quite a number of instances of this kind, affecting both single individuals and groups of people. It has never been possible to bring absolute

proof; for this, some part of the infected egg must remain for examination and yield the specific salmonella in culture. But circumstantial evidence has been so strong in most of those instances that the absolute proof becomes quite unnecessary.

Let me briefly describe a few examples. The first that came my way was in 1926, a solitary case, a young woman in Stepney, who died with an *aertrycke* septicaemia after thirteen days of gastro-enteritis, which began six hours after eating a fried duck's egg. All the other articles of food and drink which could possibly have conveyed the infection had been shared with impunity by others. In 1927 a trifle was consumed by ten out of a party of twelve in Darlington. All the ten were seriously ill owing to an *aertrycke* infection, while the two who had had no trifle but had shared in all the other food remained well. The cream of the trifle had been prepared by whipping the white of ducks' eggs: none of it remained for examination, but another trifle made at the same time by the same person and of the same composition was found free from infection. The only components not common to the two trifles were the ducks' eggs, which were whipped in separate batches.

A custard made with ducks' eggs was responsible for a most violent gastro-enteritis in Portslade in the same year. A family of three adults who finished the dish were so ill that they lay unable to call for help for two days: one of them died with an *aertrycke* septicaemia; as usual, none of the custard could be obtained for examination.

The largest outbreak in which egg is suspected occurred in 1927, in the neighbourhood of Bath. It involved over 300 persons, with one death, the vehicle being ice-cream. Here again, though proof is not quite complete, it seems certain that a duck's egg, infected with *B. aertrycke* and used in the confection of the ice-cream, was responsible; the ice-cream contained abundant *B. aertrycke*, while none of the other ingredients of the mixture, except the eggs, could be suspected.

Altogether in the last three years or so there have been at least seven outbreaks in this country in which circumstantial evidence points to eggs as the cause—in each instance to ducks' eggs; there have been, in addition, numerous solitary cases, often fatal, in which no particular article of food was suspected except, as I shall suggest, an egg.

When I came to look into the matter of food poisoning from eggs, I found to my surprise that there was quite a literature on the subject of which I had been totally ignorant. My colleague the late Dr. Spencer Low had collected many references which he put at my disposal, and, in particular, he passed to me a monograph, published in 1906 in Paris by A. Lecoq, on poisoning caused by whipped cream. In this monograph Lecoq shows that the poisoning properties of such creams prepared by mixing cream, gelatin, and white of egg have long been known. He shows that these poisonous properties appear most commonly in summer, that they are not due to metallic poisons—copper, tin, or lead dissolved from the mixing utensils—as it was once the fashion to suppose, nor are they due to putrefactive products, ptomaines, tyrotoxin, etc.—the later fashionable hypothesis—but that they are due to bacterial infection of the egg albumen. The method of infection which Lecoq thinks most likely is introduction of infective material into the oviduct of the hen or duck during copulation, with infection of the albumen as it is being deposited round the yolk; he recites numerous observations of foreign bodies—straws, seeds, stones, etc.—found embedded in eggs and obviously introduced in this manner, and explains the greater frequency of infection of ducks' eggs by the fact that ducks "practise their amours" in ponds and ditches, where specific contamination of the water may easily be present.

Another method of infection of the egg, however, is possible, and was suggested by Spencer Low in an investigation which he conducted on a food-poisoning outbreak in 1913 in the Yeadon district of Yorkshire, due to cream buns. Low proved conclusively that the infecting component must have been present in one or more of a batch of cooking eggs, the white of which was used to

make whipped cream. He discussed Lecoq's hypothesis and suggested that infection of the ovary, oviduct, and egg with salmonella could take place as part of a general infection of the bird, such as has been assumed to occur in parrot subjects of psittacosis. As is now well known, the salmonella infections peculiar to fowls—namely, *B. pullorum*, *B. gallinarum*, and *B. sanguinarum*—are, in fact, associated with specific infection of the egg, though there is no case recorded where infection with these salmonellas has given rise to food poisoning in man. On the other hand, Rettger and Scoville¹ in 1920 described an epizootic among ducklings resembling the *pullorum* outbreaks in chicks with transmission due to infection of the egg. They isolated from the ovary of a duck among the suspected flock a salmonella which they called *B. anatum*, but which is, in fact, probably *B. aertrycke*.

I intended to demonstrate this method of egg infection by direct experiment, but found it impossible to get ducks to lay eggs in the animal house available. I feel sure it can be done under suitable conditions, and I recommend the experiment to those who have facilities.

There is still another way in which eggs may become infected with a salmonella, and it is one which is easy to show experimentally. Eggs, both of ducks and of hens, kept dipped in cultures of *B. aertrycke* can become infected within a few days. If the culture is simply allowed to dry on, infection fails; part of the shell must remain moistened for penetration to occur. At first *B. aertrycke* multiply rather slowly in the egg and special cultural measures are necessary to detect them; one supposes that the strong bactericidal action of fresh egg albumen is the explanation. But as the infected egg becomes staler, say in a fortnight or so at room temperature, the salmonella multiplies rapidly and an egg then may come to represent an enormous dose, a loopful of albumen or yolk—for both seem to become infected—yielding countless colonies of *B. aertrycke*. Such an egg may appear to the sense of smell as no more than slightly stale, and might certainly be regarded by the less discriminating cook as usable.

All eggs are not readily infected in this manner. Some can be dipped in a culture for as long as six weeks and remain either sterile or with only the common non-lactose-fermenting bacillus which is characteristic of staleness in eggs and is non-pathogenic; one out of fifteen was of this kind, resistant to the specific penetration.

The question now arises, Can such infection of eggs occur in ordinary farming practice? Here again I regret to say that I have made no direct experiment, such as leaving eggs in an infected duck pen. All I can say is that ducks fed with cultures of *B. aertrycke* or *B. enteritidis* continued to discharge these salmonellas in enormous numbers in their dejecta for at least a week. During this period their bedding, allowed to remain moist, became the equivalent of a rich culture of the specific bacilli, so that an egg left in it might as readily be infected as in the more artificial conditions. Domestic ducks are well known to lay in the most casual fashion, dropping eggs often in the water of the ponds and ditches in which they feed, and such eggs may be gathered and marketed after specific contamination has occurred. In the case of fowls which lay in dry surroundings, this method of infection probably occurs rarely, if ever, and to account for a salmonella infection of a hen's egg one must bring in one of the other two methods; these, though possible, are, as a matter of fact, much less likely to occur in the hen than in the duck. The duck's egg, however, has quite definite opportunities of infection in all three ways, and care should be taken in using them in any manner in which thorough cooking is not involved—for example, in the making of creams, ices, custards, or even lightly boiled. That the risk is comparatively remote is not to be doubted; it is hard to estimate what proportion of the millions of eggs consumed each day in this country consist of ducks' eggs, but it must, at least, be many thousands, while food poisoning from eggs is so comparatively rare that it has hardly hitherto been regarded seriously. I am inclined, however, to think that salmonella infections from eggs are, in reality, a little more common. The spectacular instances, of course, are rare, but there are many attacks

of gastro-enteritis which are never investigated. When food poisoning occurs, the usual history is that several people are attacked nearly simultaneously by severe sickness; they compare notes and decide that a certain article of food or drink or a certain dish must have been the cause. Generally speaking the suspicion is found on inquiry to be justified, and, when specimens are available for bacteriological examination, it is usually possible to complete the proof by isolating one of the salmonella types both from the suspected food and from the sufferers. But not uncommonly acute gastro-enteritis attacks a single individual in a household, and suspicion is not directed to food or drink as the cause, more especially as it often happens that meals have all been in common and the commensals escape illness. Such cases may evade investigation entirely. Occasionally, however, the person so attacked may die after an illness lasting from one to fifteen days, and may become the subject of a coroner's inquest and a pathological examination. The result may be that a salmonella is found in the alimentary canal and throughout the organs, exactly as in the fatal cases in a larger food-poisoning outbreak. The source of infection in these solitary fatal cases almost always remains undiscovered; the sufferer may be too ill to be questioned, or suspicion may not even arise till after the fatal ending and the bacteriological report. What I should like to suggest is that the cause of some of these solitary cases is an infected egg. Obviously the solitary nature of the infection, no one else suffering in the family or among those sharing the same meals, indicates an unshared dish as the vehicle: an egg is one of the commonest and most conspicuously unshared of such unshared dishes in ordinary life, and in spite of its notorious innocence should not escape suspicion.

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THE TREATMENT OF VARICOSE VEINS BY INJECTION.

BY

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THE treatment of varicose veins by injection originated over seventy-five years ago, but, although Professor Sicard of Paris treated a large number of patients by this method from 1915 onwards, it was not generally recognized in Great Britain until a few years ago. It was introduced at the Waterloo Hospital in 1925 by Mr. Rodney Maingot as a routine treatment; in that year the Varicose Vein Clinic was inaugurated, and the number of cases has steadily increased until we are now dealing with some thousands a-year.

We use an ordinary 5 c.cm. Record syringe with a No. 16 needle. As we treat a large number of patients in each clinic it is impossible to sterilize the syringe and needle by boiling. After each injection the syringes and needles are washed out with distilled water and are placed in spirit; they are then ready for the next patient.

The ideal position of the patient is prone upon a couch; the veins are collapsed and therefore more easily injected. This is only possible, however, when the veins are large and remain very apparent even when the patient is lying down. In most cases the patient is treated while sitting on an ordinary chair. But in a certain number of cases neither of these courses is practicable, and it is then necessary for the patient to stand on a low stool with the weight of the body on the affected limb.

The skin over the vein to be injected is sterilized with spirit. It is not desirable to use a tourniquet because it produces venous engorgement, it is difficult to manage single-handed, and it causes considerable pain to the patient.

Three solutions are in general use at present—namely, (1) quinine urethane (quinine bihydrochloride 4 grams, urethane 2 grams, and distilled water to 30 c.cm.); (2) lithium salicylate 30 per cent. with tutocaine 0.75 per cent.; and (3) sodium chloride 20 per cent. with tutocaine

0.75 per cent. The one in most use, as far as we are concerned, is the lithium preparation; it scleroses well, and produces no symptoms. The only practical objection to its use is that it does not keep well; as a rule after about ten days it starts to turn brown from exposure to light and heat, and has to be thrown away. The sodium chloride preparation is very good for the injection of small veins, especially if they are thin-walled and the skin over them is atrophic; in these cases it is impossible to inject the other solutions, which will not be tolerated. It should, however, never be used in large healthy veins. From the point of view of thrombosis quinine urethane is the best preparation, but many patients cannot tolerate it, even in the smallest doses. Any dose over 2 c.cm. is always liable to give rise to buzzing in the ears, flushes, headaches, and hypogastric pains; these occur almost immediately after injection, and may even lead to loss of consciousness. Although the patient recovers quickly and the symptoms rapidly disappear they give rise to a certain amount of apprehension as to future treatment, and are also very undesirable when there are other patients in the room. For this reason we have abandoned the use of quinine urethane except in cases of the "twin injection," with which I shall deal later on.

The dosage is important. The usual dose of lithium and sodium chloride is 4 c.cm. and of quinine urethane 2 c.cm. It is never advisable to give more than 2 c.cm. of quinine at one sitting, and at first 1 c.cm. of any solution is the most that should ever be injected. It is important to see how the patient reacts; by starting with small doses, and thereby minimizing the pain, confidence is won, and larger doses can be reached without any untoward effect. Injection of the full dose of 4 c.cm. at the first sitting might produce pain and cramp, and, in a certain number of cases, cause the patient to cease attending for further treatment.

In injecting the solution into the vein it is advisable as a rule to work from below upwards. The skin is sterilized, the selected vein is steadied by the left hand, and the needle is then inserted obliquely from below upwards in the line of the vein. When it is felt that the vein has been entered, the plunger of the syringe is cautiously pulled out, and, if the needle is in the vein, blood will flow easily into the syringe. Injection can then be performed. If the operator is uncertain whether the needle is in the vein he should repeat the procedure of pulling out the plunger. If air bubbles appear it is a sign that the needle has gone through the vein or that its point lies in the subcutaneous tissues. He must then either alter the position of his needle until he has successfully secured re-entry, or, in any case of doubt, withdraw it and try again. It is always advisable to inject in one spot, if possible, and small doses in multiple punctures should be avoided. During injection the point of the needle must be held perfectly steady, since the slightest deviation will probably cause complete penetration of the vein and the subsequent discharge of the solution into the surrounding tissues. The solution should be injected slowly and steadily. When the injection has been completed a pad of wool should be held over the site during withdrawal of the needle to prevent the leakage of blood. The limb is then raised, the site of injection is wiped dry with spirit on a small piece of cotton-wool, and either ordinary plaster or "elastoplast" is fixed to the spot. There is no necessity for the patient to lie up after the injection. There may be a certain amount of pain or cramp persisting for a few minutes, but as a general rule patients can walk away immediately after the treatment.

Immediate Local Effects.—These are as follows: (1) the vein may collapse or dilate after injection; (2) the vein may become hard at once; (3) there may be severe pain at the time of injection; (4) there may be external haemorrhage and/or subcutaneous bruising; (5) there may be no change; (6) thrombosis may occur and a satisfactory result ensue. Thrombosis usually takes place in from six to twenty-four hours.

Immediate General Effects.—Shock may occur, also collapse and fainting. In cases of quinine injection there may be buzzing of the ears, headache, etc.