ing of the intellect, perverse action of the digestive apparatus indicate abnormal chemical changes in high degree.

Nicati and Reitsch, Villiers, Pouchet, have all made similar investigations with the bacteria of cholera. According to Pouchet, chloroform extracts of cholera dejections furnish an easily oxydisable and intensely poisonous oily substance which is certainly a ptomaine. Mere traces of it introduced into the bodies of frogs induce retardation of the pulse, with speedy death attended by muscular rigidity.

Villiers also succeeded by the method of Stas in isolating a ptomaine from the intestines, kidneys, liver and blood in two cases which had succumbed to cholera. It was abundant in the intestines, but very scant in the blood. It had a sharp taste and an odor like the flowers of the white thorn. It had no effect upon frogs, but caused in guinea pigs retardation of the pulse, tremor and death.

According to the same author cultures of the cholera bacteria have a peculiar ethereal odor which is not unpleasant. Solutions of this culture not over eight days old in bouillon or gelatine filtered free of bacteria, injected into the blood of dogs induces diarrhoea and great depression, with dyspnoea, disturbances of motion and sometimes death.

These experiments are cited merely as samples to show the direction of research at the hands of the most advanced observers in the past year. They indicate the lines of study by means of which we shall be able to combat the cause of infectious disease in a direct way. They show us that the time is at hand when, as Brieger observes, we may as practitioners of medicine no longer be compelled to rely upon a raw empiricism, when we may find a specific therapy, if not remedy for a specific cause, since we have already learned that the accumulation of certain products of bacteria kill them. They show us that inflammation is not the cause but the effect of disease which is caused by infection. They show us the direct road to cure through comprehension of the nature of infection.

ORIGINAL ARTICLES. *

SUGGESTIONS ON THE PURITY OF CHICAGO DRINKING WATER.¹

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No question of local sanitation has been more often and less intelligently discussed in Chicago, than the purity of our drinking water. While alarmists have filled the newspapers with sensational exaggerations, our authorities have denied all danger on grounds insufficient to prove the point.

The starting-point of any discussion must, of course, be the fact, that the sewerage of this enormous city is carried into the lake—the source of our drinking water, whenever the current of the river runs towards the lake, which occurs a large part of

the time. Now, as there is no direct evidence that any one disease or class of diseases are due solely to the drinking water thus contaminated, how can we decide whether any danger to health lurks in this water? Chemical examination can only tell us whether organic material exists to a larger extent in our drinking water than it does in other parts of the lake remote from our shore, or than it did in the same waters many years ago.

But a positive result of such analysis would not necessarily condemn the water unless there were an excess of albuminoid ammonia larger than the limit shown by experience to be safe in drinking water.

On the other hand, when the analysis shows no marked change in the quantity of organic constituents in the water, it does not decide the question as to the safety of the water. For there is no reason to think that in our present case, where the sewerage is diluted by the enormous body of water in the lake, there can be enough of any chemical substance present to produce any poisonous effects. A chronic poisoning or a cumulative effect produced by the continued ingestion of an *organic* poison in such small quantities as not to produce any immediate sensible action is not known, and such a possibility is a gratuitous assumption not based on clinical evidence. We are forced, therefore, to look for living micro-organisms in any suspicious water—for at the present no other *direct* causes of diseases are known.

The algæ and diatoms, and occasional infusoria, figured by amateur scientists in the newspapers as existing in our drinking water, are about as harmless as any other vegetable or animal tissues we might eat as food. It has never been shown that they are really poisonous or parasitic to the body. The micro-organisms which demand our attention as suspicious, are the bacteria. Since they are not numerous in any but stagnant water, the direct examination of the water with the microscope teaches very little. Besides, hardly any variety likely to exist in the water could be identified on finding a specimen or two with the microscope.

In order to tell what there is in the water, we must do exactly as if we had a few seeds mixed with a lot of sand, and were unable to recognize them. We would sow them over a large surface of ground free from other plants and wait for the result,—identifying the plants as they grew up.

I have made a few such analyses of our lake water, according to the methods devised by Koch. The sample bottles with flat sides which I show you here, are thoroughly cleansed and boiled, and then partly filled with a small quantity of nutrient gelatine and their mouths plugged with cotton. The bottles and their contents are then sterilized by heating them in a steam bath for a few minutes on several successive days. This being properly done, they will keep forever without the occurrence of any bacterial growth in them. If now one or more drops of water flowing from the faucet or received in a sterilized beaker are dropped into these culture bottles while momentarily lifting the cotton plug, any bacteria or their spores thus introduced with the water will grow in the gelatine. If the drops of water are thoroughly mixed by shak-

¹ Read before the Chicago Medical Society, May 3, 1886.

ing with the gelatine liquefied by gentle warming, the germs will be separated from each other, and on letting the mixture suddenly congeal on the large surface of the flat side of the flask, and keeping the flask at a temperature of 18 to 22° C., the number of colonies of bacteria growing in the gelatine will indicate the number of germs contained in the water. Within 36 to 72 hours according to the temperature, the colonies grow sufficiently large to be counted with the naked eye.

In order to identify the species we must note the appearances and size of each colony, and then examine with the microscope the cells composing such a colony, both in the fresh state and after staining. If this be insufficient to recognize the variety, we must make fresh cultures from such a colony in other and different cultivating media, or finally test for pathogenic properties by experimentation on living animals.

There is, however, a limit to the capability of this method, viz.: our want of familiarity with all the pathogenic species of bacteria. Apart from cholera we know only one disease which has been traced in some instances to impure drinking water, and of which we can identify the causative parasite, viz.: typhoid fever. It is very likely that there are other intestinal disorders of parasitic origin—the different forms of enteritis and dysentery, the germs of which may be at times introduced by means of impure drinking water. But this could not be proven at present, because we do not know as yet the presumable germs of these diseases. It is also not impossible that the bacilli of tuberculosis, or their spores, may sometimes enter the system through the alimentary canal. Whether any other but intestinal affections can be started by entrance of their causative parasites through the digestive tract, is not known in the case of any diseases of man, but judging from the mode of introduction in animal anthrax, which is most frequently intestinal, this is not an improbable occurrence.

In the culture analysis which I have made, I have counted from 35 to about 50 germs per drop of our hydrant water—equivalent to about 1000 to 1500 germs per cubic centimetre. This is much more than Frankland found in London drinking water (from 8 to 70—extreme 382), and more also than was obtained by the German Board of Health from the Berlin water (usually from 20 to 100 or 200—sometimes to 400, exceptionally), though the latter contained as much as 1000 germs in each centimetre, before filtration in the water works. However, as bacteria exist in all fresh waters on the surface of the earth, there is nothing in this indicating any special impurity, for as we can judge from every-day experience, the immense majority of these bacteria are harmless. In my earliest observations, last summer, I counted six different varieties in my flasks. Since then my time and facilities did not permit me to continue the very tedious microscopic research necessary for differentiating the colonies. But from the gross appearances of the colonies with which the first observations made me familiar, I would say that only three or four kinds of baccilli are common, while other kinds of baccilli and occasional micrococci and spirilla are

less frequently found. Many, if not most of the micro-organisms in our hydrant water exist in the form of spores, which are not killed by momentary boiling. On staining the residue of a few drops of water evaporated on a slide, there are indeed very few developed forms found. I need hardly add that I have not identified any pathogenic varieties.

Although these few analyses would, therefore, not entitle me to say that our water contains any deleterious matter, I do not see how we can escape the conclusion that there is really danger, however slight, in the use of our lake water. There were last year about 500 deaths from typhoid fever in this city. This means, perhaps, 5,000 to 6,000 cases of that disease. The discharges of all these patients contained typhoid bacilli, which were carried into the lake. Though the bacilli may die speedily in the water, their spores persist for days, if not for weeks and months. Is it at all conceivable that the currents should not carry at least some of them at times into the crib and water-pipes. I will not insist on the possibility of the discharges of different forms of diarrhoea and dysentery reaching us in a diluted form in the drinking water, because, as I said before, we are not yet familiar with the germs of these diseases, and do not know whether they produce persisting spores. Indeed, outside of typhoid fever, I could not name any danger threatening us in the water, if I depended *only on the known facts*, but analogies and probabilities suggest a great deal more. The enormous dilution to which the sewerage is subjected when carried into the lake, reduces, of course, the probability of infection through drinking water very much, but does not remove it. The self-purification of water, which undoubtedly occurs through the starvation of the micro-organisms, and their deposition, and perhaps oxygenation, pertains principally to the developed forms and not nearly so much to the spores. In short, we cannot but reason that of the millions of disease-germs poured into the lake, some few must find their way back into the systems of some of those who drink it.

Of all the purifying processes of drinking water, boiling is the simplest. About twenty minutes vigorous boiling deprives the water completely of all living germs. But the flatness of boiled water, as well as the turbidity which the Chicago water commonly presents, renders filtration desirable. Frankland has found that sand or coke, or spongy iron, in layers of about six inches thickness, remove nearly, if not all micro-organisms from the water filtering through them, but that this retaining power decreases steadily in the course of weeks. As far as I have learned, most of the filters here in the market contain sand or charcoal, and as I have been told by parties using them, many do not furnish water as clear after some weeks or months as they do at first. The layer of filtering material is neither thick enough nor sufficiently packed to retain all bacteria, and should besides be changed from time to time. One charcoal filter which I tested gave a clear water, containing, however, nearly as many germs as the original hydrant water.

A filter on a different plan, and which I have exam-

ined more minutely, is the Mallié Aerifilter (French patent), similar to the one devised by Pasteur's assistant, Chamberland. It consists of a cylinder, with conical end, made of unglazed white clay, screwed water-tight to the faucet, and surrounded by a protective glass cap. If there be sufficient pressure in the pipes, the water filters through this clay cylinder drop by drop, to the extent of some two to four gallons per day (in Chicago). All visible solid particles are left in the interior of the cylinder, in the form of a slimy coat, which should be washed out once in two to four weeks. The muddy washings from this cylinder gives one a rather exaggerated idea of the dirt we are forced to drink. The microscope shows it to consist of about half of living bacteria and brilliant particles (presumably spores), the other half being clay and sand, with occasional vegetable cells and fragments. The water furnished by this filter is of remarkable transparency. The very residue in the filter shows that very few bacteria can have passed through into the water; but I cannot say that it is absolutely perfect, as would appear from a testimonial given this filter in the Municipal Laboratory at Paris. On testing the water, by allowing drops to fall from the filter into gelatine flasks, I have found that when the filter was well cleansed within some hours the water was entirely free from micro-organisms—but when the filter was left undisturbed for days and weeks, a few colonies were invariably obtained, usually less than one-tenth the number contained in the original water. There were, moreover, not so many varieties as in hydrant water—generally but one or two. I have some reason to think that most of these bacteria found in the filtered water did not pass through the filter, but that the very few germs which did pass through, or which possibly came from the air, multiplied to some extent in the film of water between the clay cylinder and the surrounding glass, for it is well known that even distilled water allowed to stand for hours harbors numerous bacteria. I judge so from the fact that after cleaning the surface of the clay cylinder with a sterilized brush and with water previously boiled, and readjusting the glass cap after purification by boiling water, the filtrate was usually free from micro-organisms for several hours. This multiplication of bacteria on the surface of the filter does not detract from its merits, because in a film of water containing as little organic matter as ours, no bacteria of parasitic habitat, and hence, at all dangerous, could multiply.

MEDICAL PROGRESS.

THE ACTION OF UNNA'S PLASTER-MULLS.—In his observations (*Deutsche medicinische Wochenschrift*, December 17, 1885) L. HOFFMAN refers especially to the gutta-percha plasters. These have advantages over the salve-muslins (*Salbenmulle*); they are permanent, adhesive, comfortable, cleanly, and are more active.

The boric acid plaster proved of value in leg ul-

cers. A new plaster, large enough to cover the hardened border of the ulcer, was applied daily; later, after the surrounding parts had become somewhat softened, it was applied to the ulcer only. The ulcer became gradually smaller, the last part being healed by a weak nitrate of silver ointment. Four cases are given, in all of which the result was favorable. In the treatment of bedsores this plaster also acted admirably.

Chrysarobin plaster (18 per cent. strength) gave excellent results in psoriasis. In its use there was no danger of the chrysarobin-conjunctivitis; and the erythema produced by the drug did not extend beyond the parts covered by the plaster.

In several cases of eczema in which the disease was dry and circumscribed, oxide of zinc plaster was employed and effected rapid cures. In the more severe forms the zinc and tar plaster was found efficacious. In obstinate cases naphthol plaster (10 per cent. strength) was tried with satisfactory effects. This last plaster proved useful also in a case of beginning lichen ruber.

Salicylic acid plasters are recommended for the treatment of infiltrated patches of eczema, also in verrucous and sclerous patches. This plaster also acts well in epidermal hypertrophies, as clavus and callositas. In clavus salicylic acid and mercury plaster is preferred on account of its being less painful. Salicylic acid plasters were found of value in the vegetable parasitic diseases, also in lupus and acne rosacea. The pain that the stronger salicylic acid plasters sooner or later give rise to, may be moderated by the use of those containing 15 per cent. of extract of *cannabis indica*.

The mercury and carbolic acid plaster gave good results in furuncles. It acts differently according to the stage of the lesion. If applied in the beginning, the furuncle is aborted; if suppuration has set in, the same continues, but the process is painless. The frequency of renewal of fresh plaster depends upon the amount of suppuration. This plaster acts equally well in other phlegmonous inflammations.—*American Journal of the Medical Sciences*, April, 1886.

COCAINE IN CIRCUMCISION.—DR. JOHN MADDEN, of Wisconsin records a case in which he used a 4 per cent. solution of muriate of cocaine in circumcision.

Four points, practically equidistant, were selected upon the line of the intended incision, the hypodermic needle inserted, and about one-fourth of a drachm of the solution was injected beneath the skin at each of these points. A piece of absorbent cotton was then saturated with the fluid, and placed in contact with the preputial mucous membrane. Testing the sensibility of the parts from time to time, by pricking with a needle, in about twenty minutes the sense of feeling was almost entirely abolished. The foreskin was then drawn forward, held between the blades of a pair of dressing forceps, and quickly ablated with a knife. The patient declared that the operation gave him no pain nor sensation of any kind, excepting in one small place on the left side. I noticed, however, that the solution had filled the subcutaneous tissue beneath this place. The mucous membrane