diagnosis. Because of a change of residence, the patient then passed out of my direct observation.

The history since then has been one of variable states; at times the patient has been overwhelmed with sensations of "sinking" exhaustion, sometimes immediately followed by comfortable days. There have been no attacks of dyspnea, although as remarked above, the intercostal muscles and diaphragm were apparently affected. As far as I have been able to learn there has been no profound change in the condition in the past six months.

In conclusion I would call attention to four facts which I consider worthy of reiteration:

1. The disease is now of nineteen years' duration, and the patient is not at present in an alarming state. I believe that in point of time it is the longest case reported.
2. There was sixteen years' interval between the appearance of the first objective sign, that is, ocular paresis and ptosis, and the throat and jaw symptoms.
3. During these sixteen years the patient suffered only from what she considered a low state of vitality induced by eye-strain; managed her household and had three normal labors.
4. Passive manipulation of the general muscle-groups produced at times great exhaustion.

ABSTRACT OF DISCUSSION

DR. GEORGE A. MOLEEN, Denver: Myasthenia gravis has been a subject of particular interest to me inasmuch as one of my early cases was distinctly one, I think, of myasthenia gravis from the clinical point of view. It was reported, however, by me, owing to the findings later, as one resembling Addison's disease. It began twenty-four years prior to the time I saw it, with muscular weakness, ease of fatigue, dysphasia, and some ocular symptoms which I do not recall now. There were remissions from time to time. The patient was examined at that time by Dr. Church of Chicago, who thought that it was then a progressive muscular atrophy. Some six years later he again had opportunity of seeing the case, when he concluded that it was one of myasthenia gravis. The attack was in its height when I first observed the case in Denver in one of the summer months. A considerable dysentery was the reason for my being called. When we find a patient in Colorado with a blanket over his shoulders, suffering with dysentery and unable to move because of extreme weakness our first impression is—tuberculosis. My question as to how long the lung condition had existed was met with the prompt response, "I have no lung trouble, it is muscular weakness." I found that this was true. There was profound fatigue, dysphasia and dysarthria; the reflexes were normal, but rapidly enfeebled by examination. In short, the examination as carried out revealed a tenderness in the right hypochondrium, and catheterization of the ureters also showed that the pus that was in the urine came solely from the right kidney. An operation was advised, and a large perinephritic abscess was opened, the poles of which could not be reached, but it was fair to presume that the upper pole of this abscess compressed the adrenal between the abscess cavity and the liver. Evacuation of the abscess was followed by prompt relief. In the course of four or five days after leaving the hospital the patient walked from his residence some eleven or twelve squares and returned, progressing from that time on, and is conducting a business in one of the middle states at present. This case would suggest the relation of the internal secretions at least. Further than this I have nothing to say. I was struck by the statement that thyroid had been used and aggravated the symptoms. It might be pertinent then to suggest that the adrenal substance might be used in this case. I have been very frequently reminded of my experience in this one case, which was unique, and which is, I think, at least worthy of mention in association with Dr. Karpas' case.

THE NECESSITY FOR RESTRICTION AND CONTROL OF SEWAGE POLLUTION OF THE GREAT LAKES SYSTEM *

ALLAN J. McLAUGHLIN, M.D.

Chief Sanitary Expert and Director of Field Work for the International Joint Commission

WASHINGTON, D. C.

The success of any sanitary improvement depends on public opinion, and before we achieve any decided improvement in the condition of our sewage-polluted sources of water-supply there must exist a healthy sentiment in favor of such improvement. There has been considerable popular clamor in favor of "prevention" of pollution, but by demanding the impossible these well-intentioned enthusiasts did more harm than good.

Absolute prevention of pollution of waterways on an inhabited watershed is impossible. Speaking generally, water-supplies taken from streams and lakes which receive the drainage of agricultural and grazing lands, rural communities and unsewered towns are unsafe for use without purification, but are safe for use if purified.

If pollution on uninhabited watersheds is inevitable and water taken from such sources must be purified, why, asks the practical city engineer, may we not utilize the streams for sewage disposal and avoid expensive methods of sewage treatment?

In waterways where some pollution is inevitable and where the ratio of the volume of water to the volume of sewage is so large that no local nuisance can result, the method of sewage disposal by dilution represents a natural resource, and the utilization of this resource is justifiable for economic reasons, provided that an unreasonable burden or responsibility is not placed on any water purification plant and that no menace to the public health is occasioned thereby.

Thus the whole question of how much or how little sewage treatment is necessary in an equitable adjustment between sewage treatment and water purification hinges on "what constitutes an unreasonable burden to impose on a water purification plant."

In order to estimate what constitutes an unreasonable burden or responsibility for a water purification plant we must first have a clear idea of the ultimate result expected of the plant, namely, a safe drinking water.

WHAT IS SAFE DRINKING WATER?

To be absolutely safe in answering the above query we would say that a safe drinking water must be a sterile water. However desirable this ideal may be it is not practicable in the public supplies of large cities. We must accept a slight occasional pollution as inevitable. Instead of attempting to find the germs of typhoid fever, Asiatic cholera and dysentery in water, we accept the presence of the *Bacillus coli* as an index of pollution with sewage, for the reason that the chances of finding the *B. coli* are very much better than the chances of finding the specific germs in the small quantity of water examined.

When we consider the grossly polluted water-supplies used by many of our large cities until recent years, we must admit that even if the present effluents from filter plants do not show constant absence of

* From the United States Public Health Service.

B. coli, they must be classed as reasonably safe, or relatively safe water.

In order to secure statistics from some of our largest filtration and purification plants a circular letter was sent out to about forty cities.

About fifteen responded, and in most instances the statistics covered at least one year. The list included mechanical, or rapid sand filtration, slow sand filtration, precipitation and disinfection, and disinfection alone.

TABLE 1.—SHOWING AVERAGE NUMBER OF BACILLUS COLI PER HUNDRED C.C. IN BOTH RAW WATER AND FILTERED OR TREATED WATER OF CERTAIN CITIES

City	No. of Samples	Type of Filtration	Average Number of <i>B. coli</i> per Hundred C.C.	
			Raw Water	Filtered or Treated Water
Toledo, Ohio	342	Mechanical	804	0.02
Minneapolis, Minn. .	418	Mechanical	75	0.1
Grand Rapids, Mich. .	365	Mechanical	92	0.3
Cincinnati, Ohio ..	240	Mechanical	1,175	1.4
Birmingham, Ala. .	205	Mechanical	196	1.0
Binghamton, N. Y. .	174	Mechanical	400	0.2
Columbus, O.	420	Mechanical	59	1.2
Washington, D. C. .	365	Mechanical	606	1.3
Providence, R. I. . .	348	Slow sand	2,501	1.4
Reading, Pa.	600	Slow sand	732	4.3
Baltimore, Md.	138	Slow sand	68	5.8
Richmond, Va.	306	Alum and calcium hypochlorite	1,349	2.5
	237	Alum and calcium hypochlorite	460	8.0

Following a sanitary survey of the cities and towns in the basin of the Great Lakes, I recommended, among other things necessary, that a standard for filtered or treated water be established which should be a minimum requirement for the prevention of the spread of water-borne disease in interstate traffic, and that a standard of not more than 2 *B. coli* per 100 c.c. of water, taking the average of many samples by the Phelps' method,¹ should be adopted.

The surgeon general of the United States Public-Health Service in 1913 appointed a commission, consisting of the most eminent experts in the United States, to fix a standard for water-supplies used by common carriers in interstate commerce. This commission recommended four negatives out of every five tests of 10 c.c. each or the equivalent of 2 *B. coli* per 100 c.c. reckoned by Phelps' method. This standard was to be a minimum to prevent the spread of water-borne disease in interstate traffic and was purposely lenient because of the difficulty of enforcing a more rigid standard over the wide area from which common carriers in interstate commerce must secure their water-supplies.

Allowing a sufficient margin of safety, filter plants with a good raw water should produce effluents of less than 2 *B. coli* per 100 c.c. and it is my opinion that a modern water purification plant which delivers an effluent which has more than 2 *B. coli* per 100 c.c. is either inefficiently operated or is dealing with a raw water which imposes an unreasonable burden on the plant. Accepting tentatively the standard of less than 2 *B. coli* per 100 c.c. as a good drinking water, although perhaps not an ideal or a safe drinking water at all times, the results indicate

that this standard is attained by both rapid and slow sand plants, even with a very bad raw water. Cincinnati and Washington, D. C., are good examples of each type.

TABLE 2.—SHOWING BY MONTHS THE AVERAGE NUMBER OF *B. COLI* PER HUNDRED C.C. IN BOTH RAW AND FILTERED WATER IN WASHINGTON, D. C.

Month	Number of Days' Samples	Average Number <i>B. coli</i> per 100 c.c.	
		Raw Water	Filtered Water
1913			
January	25	4,582	7.4
February	23	502	1.0
March	25	2,871	0.5
April	26	20,910	4.1
May	26	661	0
June	25	910	0
July	26	5	0
August	24	88	0
September	25	412	0.5
October	27	622	4.7
November	23	1,167	0.5
December	25	538	0.5
1914			
January	25	640	0
February	23	211	0.5
January, 1913, to February, 1914.	348	2,501	1.4

Washington, D. C., has a slow sand filtration plant. There is a large reservoir capacity, and some alum is used in times of high turbidity. No hypochlorite or chlorin is used at any time. The general average for the Washington plant for 348 samples shows 1.4 *B. coli* per 100 c.c., which must be classed as a very good effluent. A close study of the results for individual months shows that there is a great fluctuation in the character of the raw water. There was a bad raw water in January, 1913, and April, 1913, and the results show that this unusual burden was probably too much for the purifying capacity of the plant.

TABLE 3.—SHOWING BY MONTHS, AVERAGE NUMBER OF BACILLUS COLI PER HUNDRED C.C. IN BOTH RAW AND TREATED WATER IN CINCINNATI

Month	Number of Days' Samples	Average Number <i>B. coli</i> per 100 c.c.		
		Raw Water	Filtered Water	
			Without "Hypo"	With "Hypo"
1913				
September	28	964	2.1	...
October	31	358	1.5	...
November	30	1,990	2.7	...
December	31	1,841	3.0	...
1914				
January	31	1,232	9.1	0.6
February	28	1,260	3.5	1.2
March	31	825	2.4	0.06
April	30	933	20.0	0.4
September, 1913, to April, 1914	240	1,175	5.6	1.4

The Cincinnati plant utilizes plain sedimentation followed by coagulation and mechanical filtration. Sulphate of iron and caustic lime are used, the latter to assist the action of the iron sulphate and not for softening purposes. Calcium hypochlorite is added to the filtered water for about five months in the year. Hypochlorite is used during January, February, March, April and May, which covers the period of muddy water and high bacterial counts.

1. Phelps, Earle B.: A Method for Calculating the Number of *B. coli* from the Results of Dilution Tests, Reports and Papers of the American Public Health Association, 1907, xxxiii, Part 2, pp. 9-13.

An efficiency of 98 per cent. with a raw water containing 500 *B. coli* per 100 c.c. would give an effluent containing 10 *B. coli* per 100 c.c. This could not be considered safe water, especially if this were an average for a considerable period, because, of necessity, the maximum and other days included in the period would show greater pollution than 10 *B. coli* per 100 c.c. Ninety-nine and one-half per cent. efficiency with 500 *B. coli* per 100 c.c. in the raw water would leave 2.5 *B. coli* per 100 c.c. in the effluent. Thus, even with the highest limit of filter efficiency which may be expected in practice, raw water with 500 *B. coli* would not reduce the limit of what may be considered a reasonably safe effluent.

Degree of Pollution in the Raw Water	Percentage of Bacteria Removed by Plant	Result
500 <i>B. coli</i> per 100 c.c.	98	10 <i>B. coli</i> per 100 c.c.
500 <i>B. coli</i> per 100 c.c.	99	5 <i>B. coli</i> per 100 c.c.
500 <i>B. coli</i> per 100 c.c.	99.5	2.5 <i>B. coli</i> per 100 c.c.
200 <i>B. coli</i> per 100 c.c.	98	4 <i>B. coli</i> per 100 c.c.
200 <i>B. coli</i> per 100 c.c.	99	2 <i>B. coli</i> per 100 c.c.
100 <i>B. coli</i> per 100 c.c.	98	2 <i>B. coli</i> per 100 c.c.

A close study of water-supply statistics will show that if the raw water exceeds 500 *B. coli* per 100 c.c. the filter plant is likely to be overtaxed and produce an effluent with an average of more than 2 *B. coli* per 100 c.c., unless extraordinary assistance is given the plant in the way of large storage, preliminary filters and especially the liberal use of chlorin or hypochlorite. When the raw water averages less than 200 *B. coli* per 100 c.c. the plants seem able to reduce this count to less than 2 *B. coli* per 100 c.c. without extraordinary assistance.

The raw water should be of such character that after reasonable purification (not demanding extraordinary efficiency every hour of every day in the year) the effluent would show a satisfactory average.

Reasonable purification of drinking water is the degree of efficiency which may be expected of standard types of filtration plants, properly designed and constructed and efficiently operated. This may be rated as the removal of from 98 per cent. to 99.5 per cent. of the bacteria. This reasonable purification is not construed to include chlorination. In my opinion, raw water should be of such a character that a standard type of filtration plant properly designed, constructed and operated, could consistently produce therefrom a reasonably safe effluent without recourse to chlorination. I am further of the opinion that chlorination should be reserved to increase the necessary margin of safety in handling polluted water, to cope with fluctuations in the character of the raw water and to protect against accidents to the plant or interruptions in its ordinary efficiency.

The question becomes one of the size of the margin of safety. With water of 500 or more *B. coli* per 100 c.c. there is practically no margin of safety. With raw water of 100 *B. coli* or less per 100 c.c., there is an ample margin of safety, and by the use of chlorination an ideal drinking water with almost entire absence of *B. coli* may be expected. A standard of 500 *B. coli* per 100 c.c. for raw water would necessitate the use of chlorination or some other extraordinary assistance to filtration processes in order to secure an effluent of less than 2 *B. coli* per 100 c.c.

It is clear that the standard of 500 *B. coli* should only be considered as a maximum and not as an average. The exact limit of safety in raw water probably falls between the maximum of 500 *B. coli* and 100 *B. coli* per 100 c.c., but it is difficult to fix.

There is a strong tendency in America to accept any raw water, however bad, as a source of supply for a municipal filtration plant. This often imposes an unreasonable burden and responsibility on the water purification plant. Now, filter plants are not infallible. They are mechanisms which must be properly constructed and efficiently operated under careful bacteriologic control in order to secure a safe effluent. They are operated by human agency and subject to the results of human error. It is true that properly constructed and efficiently operated filter plants can produce safe water from a bad raw water, especially by the use of hypochlorite or liquid chlorin as an adjuvant. The responsibility of effecting such purification every hour of every day in the year is unreasonable and unfair. Many plants are now struggling with a raw water of such a character that a safe effluent is obtained only at the price of eternal vigilance, perfect operation every day in the year, and the free use of auxiliary chemicals. The raw water demanding such extraordinary treatment is like a sword of Damocles constantly threatening disaster. There is no margin of safety under such conditions.

I believe that a sufficient margin of safety should be given to all filter plants by reducing the pollution of the raw water to a point at which it would not impose an unreasonable burden or responsibility on the plant.

While prevention of all pollution is not feasible, control of pollution and its reduction in certain areas is imperatively necessary. In grossly polluted waterways used as sources of public supply the reduction should be to a point somewhere between 500 and 100 *B. coli* per 100 c.c.

How far shall we go in providing a proper margin of safety? This depends largely on the cost.

The pollution, for example, of the Niagara and Detroit Rivers reaches to thousands of *B. coli* per 100 c.c. of water, as shown by the Progress Report of the International Joint Commission. The cost of the sewage treatment measures which would be necessary to reduce existing pollution to a standard of 500 *B. coli* per 100 c.c., would not be greatly increased if reduction to 100 *B. coli* were carried out. In other words, the cost of removing 75 per cent. of the *B. coli* in sewage is considerable, but the cost of removing an additional 15 per cent. or 20 per cent. would not be great. The removal of the additional 15 per cent. or 20 per cent. would be little more than the cost of the additional hypochlorite of lime necessary.

It is not deemed advisable to state definitely at this time what percentage of *B. coli* in the crude sewage of Detroit or Buffalo must be removed in order to bring the water in the lower river below 500 *B. coli* per 100 c.c. A study of the degree of pollution, however, will show that the reduction necessary will be at least 75 per cent. To provide a proper margin of safety the *B. coli* in the raw water should be reduced to a point somewhere between 500 and 100 per 100 c.c. Judging from the pollution found in the lower Detroit River this would correspond to an elimination of *B. coli* in Detroit sewage of from 75 per cent. to 95 per cent. As pointed out in a preceding paragraph the difference in cost between 75 per cent. removal of *B. coli* and the higher percentages up to 95 per cent. is relatively slight and well worth the expenditure in providing a proper margin of safety.