nent failure shows what their system really was, an attempt by frail human beings, with very little to guide them, to devise the most difficult of all human institutions, the government of a country. The corruption of our municipal governments is another clear proof of the fallibility of our forefathers, for all these faults result from the environment which they created, and mean that it misfits human nature in these respects.

Naturally erring in the direction of overguarding against the governmental fault from which they were smarting, irresponsibility and consequent tyranny, they devised a government which, as we now see, is so weak as to be terribly helpless, indeed in danger of an impotence which may prevent it from defending itself efficiently against aggressors.

It is this weakness that has put us in our present peril. When Germany began her attempt to conquer the world, her purpose was evident to every broadminded man, and must have been foreseen clearly by many of our political leaders. It was indeed pointed out repeatedly by contributors to the newspapers, and was neither denied nor questioned, but only ignored, with the result, which was clearly inevitable and as clearly predicted, that she has been able to fight her enemies in detail. A government made strong by the fundamental law of the land would have exposed this peril to the voters, and we should not have had for allies an impotent Russia, a crushed Belgium, Servia and Rumania, and a sorely pressed France and Italy. Indeed, it was the known weakness of our system that made the war possible.

A curious contradiction is that the weakness of the government is matched by a tying of the peoples' hands. Not only are we debarred from selecting our rulers and confined to choosing between candidates administered to us by irresponsible organizations, but once we have chosen both we and our representatives are impotent to remedy an error in choice, by compelling a change in administration, as is done with great profit in Britain, France, and elsewhere. Frankly, we should face squarely the fact that our governmental system, as the first of the great experimental democracies, was the work of apprentices, and we should strive earnestly to mend it as soon as we have passed our present frightful peril.

The system and checks and balances, in weakening the people, their representatives, and the administration alike, has put the power taken from them into the hands of irresponsible organizations, the political machines.

I criticize none. The errors of individual officers, from the constable to the President, flow from our system itself. It is the system that needs betterment.

Henry M. Howe

FOOD-BORNE INFECTIONS[1]

Gastro-intestinal disturbance traceable to some food eaten shortly before is a common occurrence and is indeed part of the experience of many persons. Not long since, the majority of such attacks were declared due to "ptomain poisoning" and were deemed to be sufficiently explained by this designation. It was believed, though never, it must be confessed, on very good evidence, that the foods responsible for the trouble had been kept too long or under improper conditions and had undergone bacterial decomposition or spoiling. This decomposition was supposed to have resulted in the formation of ptomains, a

[1] Address of the Vice-president and Chairman of Section K, Physiology and Experimental Medicine, American Association for the Advancement of Science, Pittsburgh, December, 1917.

name given by Selmi to certain basic compounds formed in the later stages of protein disintegration. Interest in the ptomains was especially stimulated by the work of Brieger, who isolated and stuided (1882–1888) the properties of many of these bodies.

Confidence in the sanitary significance of ptomains has been shaken by many facts. For one thing, ptomains are formed in the later stages of protein decomposition, and by the time they are present, the organoleptic evidences of decomposition have become pronounced. There is little doubt that food containing ptomains would be almost invariably condemned by the senses as nauseating and unfit for use. On technical grounds numerous criticisms have been made with respect to the methods used for isolating and extracting ptomains and for determining their clinical effect. Perhaps the principal reason, however, for the decline in the belief that ptomains have any important share in the production of food poisoning has been the discovery that in many instances the responsibility can be placed definitely upon other factors. Those outbreaks of food poisoning that have been most thoroughly investigated have been found to be due not to the use of spoiled food containing ptomains but either (1) to the presence of true bacterial toxins comparable to the toxins of the diphtheria and tetanus bacilli and not to be regarded as the simple products of decomposition, or (2) to infection with specific bacteria borne in or upon the implicated food article.

Poisoning from bacterial products in food, when it occurs at all, seems to be due to the accidental and occasional presence of toxigenic microbes which give rise to specific toxins. Little is known about the conditions under which the relatively rare toxigenic bacteria find their way into food stuffs. In the best-known example of this type, the severe poisoning due to the products of *Bacillus botulinus*, certain facts seem to indicate a regional distribution of the microorganisms. In this country 17 of the 22 recorded outbreaks have occurred in California. There is no record of a single case in Great Britain.[2] All told, demonstrated instances of food poisoning due to bacterial products are not very numerous.

On the other hand, the careful investigation of food-poisoning outbreaks has brought to light a very large number of instances of apparent poisoning which are in reality cases of infection with some pathogenic microorganism. The distinction is practically important. The measures that need to be taken to prevent infection are of a different nature from those designed to prevent the use of food containing the products of bacterial growth.

There are still many questions about the use of spoiled foods that need settlement. Some foods such as cheese and sour milk that are loaded with the products of microbic activity appear to be used with impunity, but while we are not yet able to specify with precision the differences between harmful and harmless bacterial action, there can be little doubt that the almost universal preference for fresh food containing as few bacteria as possible rests on a sound physiological basis.

Food-borne infections are essentially of two separate and quite independent classes:

[2] A number of obscure points in botulism intoxication remain to be cleared up. The discoverer and leading student of the biology of the botulism bacillus, Van Ermengem, states that the spores are destroyed by 15 minutes' heating at 85° (185° F.) or by 30 minutes' at 80° (176° F.), but Dickson (*Jour. Amer. Med. Association*, 1917, 69, p. 966) has recently reported observations indicating much greater heat resistance. Further investigation of this important question is urgently needed.

those in which the pathogenic organisms are present in the food at its origin, without human intervention; and those in which the food has become contaminated from human sources during the process of preparation, transportation or serving.

The contamination of food with disease germs on its way from source to consumer may occur through direct contact either with a person suffering from disease or a convalescent or a healthy carrier. From such an individual the specific pathogens may be conveyed to the food by mouth-spray or by contaminated fingers.

It probably does not often happen that such contamination is brought about by a person seriously ill with a specific infection except in the initial or later stages of the malady. The incapacitating effects of most infectious diseases tend to prevent the active participation of the patient in marketing or serving food. Mild or atypical cases, however, of such diseases as typhoid fever are a source of danger, and instances are on record where food-borne infections have originated from definitely affected persons. From the public-health standpoint infection from this source is important and must be guarded against with great vigilance.

In a variety of human infections convalescents constitute an important source of food contamination. As is well known, pathogenic organisms may be present in the nose or throat, in the intestines or in other organs, for some time after clinical recovery has taken place. It is possible in diphtheria and some other infections to determine with a high degree of certainty when the specific germs finally disappear from the body, but unfortunately this knowledge is not always taken advantage of in actual practise. There is reason to believe that in typhoid fever, for instance, patients frequently are released from the hospital while they are still discharging typhoid bacilli from the bowels or bladder. The hospital authorities often do not inform their clients or themselves on this point, and the germ-bearing convalescent is not warned of the danger to family and associates which his condition involves. In some infections the length of persistence of the specific germs can not be determined by present methods, and consequently only rule-of-thumb methods of quarantine are practicable. As matters stand, it is plain that food-handling by those recently convalescent from any infectious disease is always to be avoided; knowledge of this fact should be spread as widely as possible.

It is not necessary to dwell at length on the significance of the true "carrier" in food-borne infections, since in recent years the nature of the disease-carrier problem has been given wide publicity. The term disease carrier is commonly applied to those in whom the specific germ persists far beyond the usual period of convalescence and also to those who harbor a disease-producing microbe, although they have apparently never suffered from a clinical attack. It is evident that this latter group constitutes a peculiarly insidious source of infection, since the possession of disease-conveying power is often entirely unsuspected by the persons affected, and is only revealed by investigations following an actual outbreak.[3] The majority of the

[3] A remarkable instance of a typhoid carrier has been reported by Jundell (*Hygiea*, Festband, 1908; editorial, *Jour. Amer. Med. Assoc.*, 1909, 52, p. 388). The grandmother, 79 years old, of a large family was found in 1908 to harbor typhoid bacilli and had apparently been responsible in her lifetime for some thirty-two cases of typhoid fever in members of her family and in servants and other persons in the household. The period during which this carrier was capable of conveying infection apparently extended over fifty-four years,

"healthy carriers," however, are known to have been recently in contact with patients or convalescents.

Efforts to keep down the number of food-borne infections due to the contamination of food by sick persons, convalescents or carriers are therefore mainly directed to placing the ordinary food manipulations in the hands of healthy persons and of those who have not been recently in contact with the sick. This task is somewhat simplified by the rather limited number of diseases likely to be conveyed through such agencies. The chief food-borne infections hitherto traced to human contamination are typhoid fever and the various paratyphoid infections. To these must be added certain infections transmitted in milk which are rarely, if ever, conveyed in other food-stuffs. Outbreaks of diphtheria, scarlet fever and streptococcus sore throat due to milk have been reported in considerable numbers, but foods other than milk probably seldom serve as the vehicle of these diseases. In the majority, if not in all, of these cases, the specific germ enters the milk directly from human sources. It is probable, however, that in some instances a secondarily infected cow must be held responsible. It is theoretically possible for the bacillus of human tuberculosis to be transmitted by food, but evidence of the frequency of such transmission is not readily forthcoming. Even the contamination of milk by a tuberculous milker is not easy to prove. Since it is almost impossible to trace most cases of tuberculosis to their origin, any precise evaluation of source of infection in this disease is at present out of the question. Technical difficulties, however, should not be allowed to override the application of analogies drawn from other diseases. It seems entirely reasonable to suppose that milk and other foods can become contaminated in the course of their collection or handling by a person discharging human tubercle bacilli. In the recent examination in New York City of 1980 food-handlers, 10 cases of active tuberculosis were found. The agency of flies in bringing about the contamination of food both with tubercle and typhoid bacilli must also be taken into consideration.

It can not be forgotten that there is a possibility of the multiplication of pathogenic bacteria in food. In general, microorganisms pathogenic for man do not increase freely outside the human body, and when discharged into the air, water or soil, quickly perish. But in many foods conditions obtain very much like those in the artificial culture media used in laboratories. If such foods become contaminated with pathogenic bacteria, a considerable increase in bacterial numbers may occur. In point of fact, it has been observed that multiplication of this sort does take place. There are many instances where the incriminated food, when fresh, gave rise to little or no injury, but after standing 24 hours or less without visible signs of decomposition produced numerous cases of illness. Especially significant is the large number of outbreaks in which such foods as meat jellies, meat pies, salads and made dishes generally have been inculpated. A very large proportion of the recorded outbreaks has been traced to foods that have been prepared for the table and then allowed to stand before being eaten, or that have kept over to a second or third day as remnants after the first serving. Cooking, so far from surely destroying all bacteria, may in some cases provide a favorable temperature for bacterial multiplication, as in the celebrated California

1854–1908. The disease was confined strictly to this one family, and the neighborhood was free from typhoid fever during all these years.

outbreak of 93 cases of typhoid infection due to a dish of baked spaghetti. Here it was found by subsequent experiment that the degree of heat reached in the interior of the dish was an incubating rather than a sterilizing temperature. Milk, which is an excellent culture medium, is a food particularly liable to become dangerous through the multiplication of bacteria. The mixing of milk from many farms at a central station tends to disseminate any contamination present through the whole supply. One typhoid carrier on a single farm may therefore lead to the contamination of a large volume of raw milk and to an extensive epidemic. The pasteurization of milk offers a satisfactory method of meeting this danger.

Besides the various modes of direct contact there are more roundabout methods of food contamination from human sources of infection. One possibility is the transmission of typhoid infection by vegetables grown on land fertilized by night soil. The practise of manuring truck gardens with human excreta is not unknown in this country and is believed by some to be increasing. Melick[4] has shown that typhoid bacilli may remain attached for several weeks to lettuce and radishes grown in contaminated soil, a period quite sufficient for the maturing of these vegetables. He also showed that the bacilli are not removed from the surfaces of the vegetables by the ordinary methods of washing used in preparing such foods for the table.

The second type of food-borne infection, that in which the food itself is contaminated at its origin and does not simply pick up contamination en route to the consumer, is especially exemplified in the case of certain infections of the ordinary food animals. Food plants are not attacked by any microorganism pathogenic to man, with perhaps the single exception of the coconut palm, in which a disease called bud-rot is said to be caused by a variety of *B. coli*, an organism usually harmless but under some conditions slightly pathogenic for man. The rather numerous species of bacteria that cause the diseases to which the common garden vegetables are subject are none of them, so far as known, pathogenic for man or other animals. On the other hand, many food animals suffer from bacterial infections that may be communicated to man.

Milk is probably the animal food that serves most commonly as the vehicle of this type of infection. It has been definitely established that the bacillus of bovine tuberculosis may be present in the milk of a diseased cow and that the use of such milk in a raw state is a source of human infection, particularly in young children. Milk from diseased animals may also produce infection in foot-and-mouth disease, in Malta fever (goat's milk) and in some other diseases. In many cases the condition of the animal is such as to give ample warning, in others the danger is not so readily apparent. Adequate pasteurization of the milk is a safeguard against this mode of infection as well as against infection with milk contaminated from human sources.

Other food products originating from diseased animals may contain pathogenic bacteria. A noteworthy number of outbreaks of meat poisoning have been traced to the use of meat from animals ailing at the time they were slaughtered, and later discovered to have been definitely infected. Bacilli of the paratyphoid-enteritidis group are found in a large proportion of these cases, both in the meat of the diseased animals and in the organs or excreta of the persons affected. This class of food infections is of special interest, since in their

[4] *Jour. Infect. Dis.*, 1917, 21, p. 28.

sudden onset and acute gastro-intestinal symptoms they present the characteristic features of what is popularly supposed to be ptomain poisoning. They are in reality genuine infections with pathogenic bacilli. Cattle and swine are apparently particularly prone to infection with bacteria of this group, and by far the larger number of meat-poisoning epidemics are due to meat from these animals. The meat of sheep is rarely implicated. It is noteworthy also that a large proportion of the recorded meat poisoning outbreaks are due to raw or imperfectly cooked dishes. Sausages, especially such as are made of raw meat and eaten without cooking, have been incriminated in a significantly large number of cases. Internal organs like the liver and kidneys are more apt to contain bacteria than the masses of muscle commonly eaten as "meat." Unfortunately, inspection of the meat may not give any warning of the presence of pathogenic bacteria. Meat in appearance quite normal to the trained eye of the veterinary has been known to give rise to a meat poisoning outbreak. Neither is it always practicable by a system of live-animal inspection to prevent the marketing of meat from infected animals. Thorough cooking is probably the best means of preventing this as well as all other forms of food-borne infection.

While paratyphoid seems to be the most common form of meat-borne infection, there is a possibility that other kinds of pathogenic bacteria present in the bodies of diseased food animals may sometimes be transmitted to man in meat or meat products. The possible conveyance of tuberculosis in this way has been thoroughly investigated, and it is now pretty generally agreed that in most civilized countries the danger of contracting tuberculosis from meat is not serious. Under any ordinarily careful system of inspection tubercle-infected carcasses are not likely to be marketed without restriction, and the thorough cooking to which meat is commonly subjected is a further and efficient safeguard. It is apparently true also that very large numbers of tubercle bacilli are necessary to produce infection of human adults through the alimentary tract. Altogether the concurrence of favorable conditions for the transmission of tuberculosis by meat is probably rare. Bacilli of the "bovine" type are seldom found in adults. Although theoretically possible, there does not seem to be any convincing evidence that cases of tuberculosis have actually resulted from the use of meat.

In several acute diseases of food animals caused by bacilli pathogenic for man the possibility of human cases being food-borne is even more remote than in tuberculosis. Anthrax is not at all likely to be transmitted through food. Many diseases, such as hog cholera, swine erysipelas and pleuropneumonia of cattle that affect various domestic animals are not known to be transmissible to man in any way. Conversely, typhoid fever and Asiatic cholera are not diseases from which the lower animals suffer, and consequently are not infections that can originate with any food animal.

The chief infections therefore that are known to be due to food infected at its source are those—mainly meat-borne—caused by the group of paratyphoid-enteritidis bacteria and those resulting from the use of infected milk. The methods for preventing food infection are not those of simple inspection of food products. It has been questioned whether the amount of disease prevented by the ordinary methods of food inspection is at all commensurate with the outlay. Chapin[5] in considering the

[5] "The Relative Values of Public Health Procedure," *Jour. Amer. Med. Assoc.*, July 14, 1917, 69, p. 90.

relative values of health work has estimated the value of food sanitation (exclusive of milk) at 10 on a scale of 1,000. He adds:

> The small value here assigned may arouse protest, but who will argue that the laboratory is not five times as important, or baby nurses eight times as important, or the direct control of contagious diseases ten times as important as is food sanitation?

The prevention of food-borne infection at present can be best effected by (1) thorough heating, including especially milk pasteurization; (2) employment of healthy persons for food preparation and serving; (3) examination of food animals at or shortly before slaughter; (4) general cleanliness of surroundings where food is prepared or served; (5) use of food in a fresh condition.

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SCIENTIFIC EVENTS

THE GENERAL MEDICAL BOARD OF THE COUNCIL OF NATIONAL DEFENSE

The general medical board of the Council of National Defense held a regular stated meeting in Washington on January 13. The meeting was an unusually enthusiastic one, even despite the fact that not a few members caught snowbound in the blizzard en route were unable to reach Washington on schedule time. The following members responded to the roll call: Dr. Franklin Martin, member of the advisory commission of the council, chairman; Dr. W. F. Snow, secretary; Surgeon General William C. Gorgas; Surgeon General William C. Braisted; Rear Admiral Cary T. Grayson; Dr. Victor C. Vaughan; Dr. William H. Welch; Dr. Thomas S. Cullen; Dr. Edward P. Davis; Dr. Robert L. Dickinson; Dr. Philip Schuyler Doane; Dr. Joseph Rilus Eastman; Dr. John G. Clark; Dr. Duncan Eve, Sr.; Dr. S. McC. Hamill; Dr. W. H. G. Logan; Dr. Fred Bates Lund; Dr. John D. McLean; Dr. Rosalie Slaughter Morton; Miss M. Adelaide Nutting; Dr. Albert J. Ochsner; Dr. Hubert A. Royster; Dr. J. Bentley Squier; Dr. George David Stewart, and Dr. W. C. Woodward.

For the Army, Colonel Deane C. Howard, dealt at length with the recent perturbing epidemics of measles and pneumonia, but furnished the comforting news that both of these epidemics were at the present moment under adequate control. The admission rate for the past week was lower than it had been in some time, and it was hoped that both morbidity and mortality would in the very near future show a corresponding drop. Colonel Howard also pointed out the satisfactory status of the troops in regard to the venereal problem.

Admiral William C. Braisted, for the Navy, furnished assurance that the health conditions were all that could be desired, considering the factor of seasonal disease. The Navy also has been troubled with pneumonia, and was not a little concerned regarding the question of meningitis. Admiral Braisted expressed great gratification over the fact that his request for a meningitis segregation camp in Florida had been granted. It is hoped to isolate in this camp all meningitis carriers, and to care for them until they are once again safe and serviceable individuals.

Dr. Joseph Schereschewsky, for the Public Health Service, submitted a report detailing the health conditions in the various cantonment zones and what the Public Health Service has been doing to maintain these various zones in a state of good health.

Dr. T. Clark, who reported for the Red Cross, described the establishment of the four sanitary units that are cooperating with the other sanitary forces of the government in a most worthy attempt to aid in the maintenance of a high tone of public health, in addition to cooperating with those officials concerned in the direct maintenance of a low morbidity rate in the Army and Navy proper. Dr. Clark made it perfectly plain that the Red Cross was glad and willing to expend all that was legitimately necessary to accomplish any worthy purpose. If more than the present appropriation called for were needed, it would be forthcoming. If less were needed, there would naturally be a curtailment.

Major William F. Snow reinforced the earlier remarks of Colonel Howard on the prob-