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WITH AN ABSTRACT OF THE RECORD OF PROCEEDINGS

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NOTE BY THE SECRETARY.

THIS volume constitutes the thirteenth in the regular series published by the Association. Like all of its predecessors it contains matter invaluable to the physician, the sanitarian, and in fact to all persons interested in the prevention of disease, and the amelioration of evils resulting from unsanitary and unhygienic environments and practices. These thirteen volumes constitute in themselves a library on public health questions as well as upon domestic sanitation, and the demand for complete sets, by individuals and public libraries, indicates that in the near future a set cannot be obtained.

In addition to the above the Association has published two independent volumes,—one the "LOMB PRIZE ESSAYS," and the other (just issued), "DISINFECTION AND DISINFECTANTS: *Their Application and Use in the Prevention and Treatment of Disease, and in Public and Private Sanitation.*"

Inquiries regarding the publications of the Association may be addressed to the Treasurer or to the Secretary.

The next meeting of the Association will be held at Milwaukee, Wis., November 20—23, 1888.

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FIFTEENTH ANNUAL MEETING.

I.

THE PRESIDENT'S ADDRESS.

BY GEORGE M. STERNBERG, M. D.,

Major and Surgeon U. S. Army.

I am sure that all the older members of the American Public Health Association feel, as I do, that our meeting this year has a special interest, due to the locality in which we meet. We feel that the good city of Memphis is, in a manner, a protegé of our Association, because in her hour of distress she appealed to some of our most distinguished members for sanitary counsel, and acted upon the advice given; and we recognize the fact that in more than one way our relations to this city are exceptional.

It was due to the yellow fever epidemic of 1878, in which Memphis was the chief sufferer, that steps were taken at our meeting of that year, in the city of Richmond, to urge upon congress the importance of a National Board of Health. Recognizing the fact that epidemics do not respect state boundary lines, and that an efficient sanitary service in times of emergency requires a liberal expenditure of money and unity of action on the part of sanitary officials, we urged the formation of a central health board, and for a time it seemed as if our well meant plans would be crowned with success. Indeed, they were crowned with partial success, for all must recognize that in the early days of its existence the National Board of Health accomplished much good. It is unnecessary for me to refer to the various circumstances which conspired to paralyze the effective energy of this board. Unhappily it is a thing of the past, and the hopes which we had founded upon this our bantling are but a memory of the past. But we should not be discouraged that our first effort has failed. A careful consideration of the circumstances which led to this failure may enable us to mature a better plan. Such a plan, endorsed by the judgment of the experienced sanitarians here assembled, and properly presented to our national legislators, could not fail to receive respectful attention.

One thing appears to me to be clearly demonstrated by the experience of the past, namely, that a central health board, to be efficient, must be attached to one of the departments of the government now in existence, so that it may be under the protection of a cabinet officer. It would be useless to ask at the present time that the sanitary interests of the country may be represented by an additional cabinet officer, a minister of public health, although there can be no doubt that the interests involved are sufficiently important to justify such an innovation. But we may at least demand that the sanitary interests of the people of the United States shall receive the same consideration from the national government that is accorded to the educational interests, the agricultural interests, etc. We may at least ask for a bureau of public health, with a commissioner at its head, and with the necessary secretaries and clerical force to make it efficient; and attached to such a bureau should be a well equipped laboratory, in which expert bacteriologists, chemists, and sanitary engineers should be employed in the experimental investigation of unsettled sanitary problems, such as the natural history of disease germs, the best methods of destroying them, protective inoculations against infectious diseases, problems in sanitary engineering such as the disposal of sewage, domestic sanitation, etc., food adulterations, and a variety of other questions of equal importance which will readily occur to you. I do not approve of the plan of having a central board of health composed of members located in various parts of the country. Such an organization is cumbersome; and it cannot be expected that a board which is only assembled at long intervals, and of which the members are occupied by various pursuits which claim their time and best thought, will render the most efficient service. On the other hand, by diversity of opinions they may greatly embarrass their executive officer, who must necessarily be located in Washington. Nor in my opinion would a board composed of officials at the head of various departments in Washington, such as the surgeons-general of the army, the navy, and the marine hospital service, as has been suggested, be much better. These officials are fully occupied with the duties pertaining to their office, or at least have not sufficient leisure to undertake the executive work of a central health bureau. I would therefore expect better results from the untrammelled action of a single commissioner, who would be responsible directly to the cabinet officer to whose department his bureau was attached, and who would necessarily be controlled by the law defining the nature of his duties. In this case it is evident that the good accomplished would depend largely upon the fitness of the man selected for the special duties entrusted to him, and that a political appointment in the first instance, or the removal of a suitable man for party reasons, would entirely defeat our object.

We may, however, ignore this possibility, and trust to the good judgment of the chief executive, and the growing public sentiment in favor of retaining efficient bureau officers without respect to party changes.

In connection with a bureau of public health, it would certainly be desirable to have an advisory board of health, to which the commissioner could refer questions for consideration, or which could advise him of new measures, or desirable changes in his regulations, which after full discussion commended themselves to the judgment of the board. Such a board should have no executive power, and the members should receive no pay, beyond their actual expenses in attending the appointed meetings. I would suggest that such a board should consist of the surgeons-general of the army, the navy, and the marine hospital service, and of the presidents of state boards of health. One annual meeting in Washington would probably answer the purpose for which a board would be constituted, except in case of an actual or threatened epidemic, when it might be convened at the suggestion of its president or of the commissioner of health.

I request your careful consideration of the plan here suggested, and, if it meets your approval, would urge the importance of taking such action at the present meeting as will insure its being properly brought before the congress of the United States.

My reference, at the outset of my address, to the Richmond meeting of this Association will recall to those of you who were fortunate enough to be present at that meeting the very great interest which attached to the reading of reports upon the epidemic of that year, and especially will you recall the scene when our lamented colleague, Dr. Samuel M. Bemiss, of New Orleans, occupied the platform. Surrounded by diagrams showing the topographical features of the towns in the great Mississippi valley, which had suffered most from the epidemic, and with tabular statements of population, mortality, etc., Dr. Bemiss, with the clearness and precision which characterized his delivery, passed in review the terrible record of the devastating pestilence. His genial and rugged face, aglow with humanitarian zeal and an intelligent appreciation of the sanitary lessons conveyed by the stern facts which he presented to us, made an impression upon my mind which will not soon be effaced. Alas! that he is not here with us to congratulate the good citizens of Memphis upon the favorable change which has occurred in their sanitary surroundings since the date of which we are speaking.

Sanitarians recognize the fact that epidemics are often blessings in disguise, just as great fires may be in badly built cities. Certainly not a blessing for those who suffer directly from the scourge;—but the traveller who sees broad and well paved streets, substantial and well ventilated dwellings, and a healthy looking population, where formerly narrow, filthy streets and crowded tenement-houses occupied the ground, may be excused for looking upon the conflagration which cleared the way for such improvements as a blessing. So, too, sanitarians, recognizing the fact that in many instances nothing short of an epidemic will arouse the people to take action with reference to sanitary improvements, cannot fail to see that the benefits which result from an epidemic of cholera or of yellow fever, in the long run, may more than compensate for the distress and loss of life which attend them. A cholera epidemic which decimates the population of a town without sewers or proper water-supply will prove a blessing in the end if it leads to the introduction of an ample supply of pure water and of a system of sewerage by which the mortality from typhoid fever and other endemic diseases is greatly reduced. But this mode of obtaining sanitary improvements is an expensive one, and rather hard on the victims of the epidemic.

The members of this Association, therefore, actuated by a humanitarian spirit, desire to secure these benefits for every town in this broad land, if possible in advance of the scourge which is sure to come some day if their warnings and the lessons of past experience do not suffice to arouse the inhabitants of insanitary towns to a sense of the risks they run. It is a remarkable fact, that in matters of this kind individuals and corporations are slow to profit by the experience of others, and that it is commonly only when the fatal results of neglect are brought under their immediate observation that they are ready to apply the remedy, which is necessarily more or less expensive. We all remember how promptly the people of Memphis responded when the epidemic stimulus was applied, and we have heard much of the sanitary improvements which have been made in this city since the memorable year 1878. Many of us are here for the first time; and, as I have said, this meeting possesses special interest for us because it enables us to see for ourselves what has been done and what remains to be done in order to put Memphis in a state of defence in the event of another yellow fever epidemic in the Mississippi valley.

Do not allow yourselves to fall into a state of inaction and false security because for several years our foe has been kept at bay. Although it is now evident that yellow fever is not endemic in any portion of our land, and we have learned by recent experience that by proper measures it is possible to exclude it for a series of years even from the city of New Orleans, yet there are so many possibilities of its introduction, in spite of the vigilance of those who have charge of the gateway of the Mississippi valley, that it would be folly to neglect those local measures of sanitation which remove the vulnerability of cities in the presence of the germs of pestilential diseases. Shutting the door is of prime importance, and while the keys are in the hands of our energetic and able colleague, Dr. Holt, we may feel comparatively safe. But the efficient president of the Louisiana State Board of Health cannot guarantee that all avenues of approach are securely guarded, inasmuch as some of these avenues are quite beyond his control. This is exemplified by the Biloxi epidemic of 1886. Local outbreaks, such as that at Biloxi, and the epidemic at Key West and at Tampa during the present year, show that the conditions upon our gulf coast are no less favorable to the prevalence of yellow fever than they were in former years, and that our immunity depends solely upon the exclusion of an exotic germ. Unfortunately, also, the Biloxi epidemic illustrates the very great liability of physicians to fall into error with reference to the diagnosis when yellow fever unexpectedly makes its appearance at a place outside of its habitual range. History repeats itself in this particular. The early cases in an epidemic, which are often mild, are pronounced to be malarial fever, and this diagnosis is often sustained by those who have committed themselves to it, when no reasonable doubt remains in the minds of unprejudiced physicians as to the nature of the malady.

The question whether it is practicable to make a city, which lies within the area subject to invasion, proof against epidemics of yellow fever and cholera, is one of very great importance. At the International Sanitary Conference of Rome the delegates from England and from India opposed all quarantine restrictions as unnecessary, and pointed to the fact that for years there has been constant and free communication between cholera-infected ports in India and the seaport cities of England, but that cholera has not effected a lodgment in that country. Dr. Thorn Thorn, of the Local Government Board, a delegate to the Conference, ascribed this immunity to the sanitary improvements which have been carried out in England during the past ten or twelve years. He stated that during the period included between the years 1875 and 1884, an amount exceeding six and one quarter millions sterling per annum had been expended in England "under private and public acts mainly of a sanitary character." Dr. Thorn Thorn, in his report of the proceedings of the Conference referred to, says,—

"Lastly, I would note that I took occasion to explain to the technical commission that expenditures such as I have referred to are, with only very trivial exceptions, voluntarily incurred in the interests of public health.

"I then went on to show, in connection with this expenditure, that the average annual mortality for England and Wales was now only 19 as opposed to 22 per thousand in the decennial period 1861–'70, and this notwithstanding increase in population of some five millions; and taking the continued fever mortality of this country as that which, in point of causation, most nearly resembled cholera, I pointed out that whereas in the five years 1865–'69 this mortality was at the rate of 934 per million living, it has steadily fallen to 428 per million during the period 1880–'82, and that it was now only 307 per million."

In a later communication, published in the "Practitioner" for October, 1887, Dr. Thorn Thorn gives fuller details of the English system of protection against cholera as follows: "Having deliberately abandoned the system of quarantine, we began many years ago to organize the system of medical inspection with isolation. The medical inspection comes first into operation on our coasts. The customs officers board the vessel coming into our ports, and they at once communicate to the sanitary authority the occurrence of any case of cholera, choleraic diarrhœa, or suspected cholera. A vessel so affected is detained until the medical officer of health has examined every member of the crew and passengers. Those actually sick of cholera or choleraic diarrhœa are at once removed to the port sanitary hospital, and any person certified to be suffering from any illness which that officer suspects may prove to be the cholera is detained for a true period of observation not exceeding two days. The medical inspection is thus followed by isolation of the sick. Unlike a quarantine system, this process does not interfere with the healthy, or expose them to risk by herding them together with the sick, but the names of the healthy and the places of their destination are taken down, and the medical officers of health of the districts in question are informed of the impending arrivals. This part of our system has been named our first line of defence, but it would be of little value if we stopped there. Our main trust is in the promotion of such local sanitary administration in every part of the country as shall rid us of the conditions under which alone cholera can spread. In periods of emergency, as during the past three years, a special medical survey of such districts as are most exposed to risk is organized under the supervision of the medical officer of the local government board, and where needed the sanitary authorities are urged to action. Important as have been the results of the recent survey, they would go for little were it not for the steadily maintained work of sanitary authorities and their officers throughout the kingdom; and we who have been taunted abroad for opposing quarantine because its restrictions touched our commercial interests and our pockets, may justly feel proud that in England and Wales alone, the people have, during the last ten years, of their own accord and apart from government dictation, spent by way of loan or in current expenditure over eighty millions sterling, for purposes mainly of a sanitary character. And we may fairly ask whether any corresponding expenditure has in other countries given evidence of real faith in a quarantine system."

Without denying the value of the sanitary improvements which have been carried out in England, and the possibility that her immunity from cholera is largely due to them, the delegates from more exposed countries, such as France and Italy, demanded a quarantine station upon the Suez canal, and pointed out the fact that their seaport cities were not in such a sanitary condition that they could hope to escape the ravages of the pestilence in case of its introduction, and that to place them in such a state of defence would require time and the expenditure of large sums of money. It was noticeable that those countries, such as Turkey, Egypt, and Spain, where sanitary improvements have made the least progress, were the most exacting with reference to quarantine restrictions. They evidently looked upon these as their only hope, and were advocates of the old-fashioned time quarantine, which as carried out in these countries has often been attended with barbarities which are intolerable for civilized nations. Self-preservation is indeed the first law of nature, but it is barbarous to sacrifice the life of another to save our own; and in guarding the lives of a community we are bound to show due consideration for the health and comfort of those who are believed to be the possible bearers of disease germs.

Recognizing this humane principle, a majority of the delegates to the Sanitary Conference of Rome were anxious to effect a compromise between the old-fashioned time quarantine and the English practice, which they could not rely upon for the countries of southern Europe. It was believed that such a compromise was practicable, and that the plan agreed to by a majority of the delegates present was more reliable than a simple quarantine of detention. I must refer you to the published transactions for the details of this plan, but, in brief, it consisted in a sanitary supervision of ships at the port of departure, when this was an infected port, or in communication with an infected locality; in the sanitary supervision of ship and passengers while *in transit*, by a properly qualified physician upon all passenger ships; and in such detention at the port of arrival as might be necessary for the disinfection of the ship, the personal effects of passengers, etc. If one or more cases of cholera should appear on board during the voyage, they were to be isolated, and rigid measures of disinfection carried out, and the action of the health authorities at the port of arrival was to depend largely upon how effectively this had been done. In short, the treatment of the vessel and its passengers was not to be determined in advance by arbitrary rules, but was to be governed by an intelligent consideration, by an expert, of all the circumstances relating to the sanitary history of the ship from the date of its departure from the infected port. This rational quarantine service, which is far less burdensome to the commerce of a country than the arbitrary time quarantine of former days, has proved itself to be also more effectual in accomplishing the end in view. This is amply proved by recent experience in our own country, where to a large extent the principles indicated control the action of the health officers of our principal seaports. Look at the city of New Orleans, where epidemics of yellow fever were formerly so frequent as to lead to the belief that the disease was endemic, and a necessary evil appertaining to the situation of the Crescent City. Happily, under an efficient quarantine service, she has now a record of seven years' exemption from the dreaded pestilence.

It is perhaps too soon to speak with confidence with reference to the action taken by the sanitary officials of the port of New York upon the recent arrival of two cholora infected vessels from the Mediterranean, but we have good reason to hope that the measures taken will prove sufficient, and that this pestilential disease, which has for several years been threatening us from a distance, has not effected a lodgment upon our shores.

Whether it would be practicable to put our seaports in such a state of sanitary defence that it would be safe to open the door and defy the foe is extremely doubtful. I have never believed that yellow fever was excluded from New Orleans in 1862 and 1863 by the sanitary regulations enforced by General Butler, as has been claimed. The exemption from this disease enjoyed by the unacclimated soldiers from the North who filled the hospitals in that city at the time mentioned was due, in my opinion, to the absence of commerce during the military occupation of the city, and to the rigid enforcement of quarantine restrictions.

But I do believe that this and other cities similarly located can be preserved from such devastating epidemics as have too often occurred in the past, and that by the carrying out of needed sanitary improvements, and the constant supervision of expert sanitary officials, supported by an enlightened public sentiment, and sufficient appropriations, the ravages of pestilential diseases may be restricted within very narrow limits.

As regards cholera, the system of local defence is even simpler than in the case of yellow fever. Ample evidence demonstrates that the epidemic extension of this disease depends largely, if not exclusively, upon the water-supply. Where this is subject to contamination by the discharges of the sick, there cholera is liable to become epidemic. On the other hand, cities like Rome, in Italy, which have an ample supply of pure water drawn from a source not liable to be contaminated, seem to be cholera-proof, notwithstanding the filth and squalor in which a considerable portion of the population live. The same thing is seen in Naples, which in 1884 suffered terribly, but which since the completion of its new system of water-works in 1885 has enjoyed a comparative immunity, notwithstanding the fact that cholera still prevails in Italy, and that we have evidence of its presence in a malignant form in the city referred to. When I was in Naples, in 1885, the mayor of the city invited a number of the delegates to the Sanitary Conference to the municipal palace, for the purpose of conferring with them with reference to projected sanitary improvements, and especially with reference to the best system of sewerage for the city, which up to the present time remains destitute of sewers, and which, I may add, is a noted stronghold of typhoid fever. In the course of the conversation I suggested to the mayor Col. Waring's American system, which has been tested with such favorable results in this city. My recommendation was sustained by the distinguished German bacteriologist, Dr. Robert Koch, who was one of the delegates present. I may remark that I have recently received a letter from Dr. Koch, asking me to give him full particulars with reference to the details of this system as carried out in the city of Memphis.

I am not willing to leave the subject of quarantine, to which I have briefly referred, without placing myself upon record with reference to a matter in connection with it which I consider one of the greatest importance. The practice which has come down to us from former times, when questions relating to abstract justice and individual rights had but little consideration in face of a danger to the community, of taxing commerce for the support of quarantine establishments, I consider wrong in principle, and unjust to those who are required to bear the burden. It seems to me to be evident that the people protected should pay the cost of such protection, and that quarantine establishments should be supported at the expense of the national government, or of the states in which our seaports are located, and not by a tax upon the shipping entering these ports. I am not so much concerned, however, with the unjust tax upon ship-owners as with the gross injustice to passengers, practised at many ports in various parts of the world, when they are so unfortunate as to be detained at a quarantine station. Humanity demands that a sick person who is detained for the protection of a community should receive the best possible care; and justice requires that both sick and well, while detained at a quarantine station, should be well fed and well lodged without expense to themselves. Moreover, at a quarantine establishment which is supported by a tax upon ships and upon the passengers detained, an unscrupulous official may add to the hardships of passengers the barbarity of an unnecessary detention from a venal motive. I trust that such things do not happen in our country; but to show

how unjust the principle of taxing the passenger for his support while under detention in quarantine is, I will mention a circumstance which recently fell under my own observation:

When I left Brazil in the month of August last, small-pox was epidemic both in Rio de Janeiro and at Para; our ship touched at Para, and five days later at Barbadoes. A passenger for this port was not allowed to land, because of the prevalence of small-pox in Brazil. Proceeding to St. Thomas, less than two days' sail from Barbadoes, our passenger was again refused permission to land, except to go to the quarantine station for a certain number of days. This was all right, but the conditions upon which he would be received seemed to me to be all wrong. Either he himself or the ship must guarantee the payment of the quarantine fees, which would be $3 a day for his board and $5 a day to the quarantine physician if he were alone. If others were at the station at the same time, this fee would be divided between them. One can easily imagine what a hardship such a tax would be for a person of limited means, who had only provided himself with funds for the journey he had undertaken. The agent of the ship refused to take any responsibility, and our passenger had no resource but to submit to the imposition, or to come on to New York, paying his passage to that port.

As another illustration of the evils arising from the present system of supporting quarantine establishments, I will mention a circumstance which occurred upon our arrival at the port of New York. With the deputy health officer who boarded our ship came a man with a jug. I was informed by one of the officers of the ship that he was to disinfect the vessel. Being somewhat curious to know the method of disinfection employed, I asked the ship's surgeon to go with me to inspect, when, after a detention of less than one hour, we had started from the quarantine station for our wharf. We found that the man with the jug had lowered a bucket by means of a rope through one of the hatches between decks. Upon pulling up this bucket I found that it contained two or three pounds of some powder which had been wet, probably with an acid solution, and which gave off an odor of chlorine. No doubt when first lowered between decks there had been a considerable evolution of chlorine, but in the vast space to be disinfected it was so diluted that at the end of an hour I did not detect the odor of chlorine gas when I lifted the hatch, and it was only by approaching my nose to the bucket that I was able to ascertain what disinfectant had been used. The most curious part of the story is, that I was informed that the bucket had been lowered between decks to disinfect a quantity of hides which were stored in the hold. What was the object of this "disinfection"? Evidently not to disinfect, for no one at the present day would think of maintaining that the hides in the hold had been disinfected by the procedure of the man with the jug.

The only object that I can conceive of depends upon the fact that there is a fee for disinfecting, which must be paid by the agents of the ship: at least I was so informed by one of the officers of the ship.

Gentlemen, we cannot control the action of sanitary authorities abroad, and if we are ever so unfortunate as to be thrown into a lazaretto in one of those countries where the rights of the individual are counted as nothing, God pity us! for the fact that we are American citizens will be of no avail. But we can at least correct abuses, if such exist, at our own seaports, and set an example to other nations of an enlightened policy, which will not only redound to our credit, but will directly benefit our languishing commerce.

The most enlightened nations of Europe recognize the importance of a uniform system of quarantine administration, based upon past experience and recent progress in sanitary science; and this has been one of the principal objects in view in the assembling of expert delegates from the various countries interested for international sanitary conferences.

The first International Conference was that of Paris in 1852. A second sanitary conference assembled in the same country in 1859 for the purpose of revising and simplifying the conclusions adopted in 1852. The next conference was that of Constantinople in 1866; and this, like the last conference assembled in Rome in 1885 at the call of the Italian government, followed immediately after an epidemic of cholera, and had special reference to the restriction of this disease. The conference at Vienna followed in 1874, and that of Washington in 1881. The latter following after our yellow fever epidemics of 1878 and 1879 had the special object in view of establishing an international system of notification of the appearance of epidemic disease in all parts of the civilized world, and of the sanitary condition of seaport cities, and especially of ships sailing from infected ports.

Unfortunately all attempts to establish an international code of quarantine regulations have thus far failed, owing to the very diverse opinions held by the delegates from the several nations who have been assembled for this purpose, and to the conflicting interests of some of the great powers. While as a nation we have taken part in these sanitary conferences, and have advocated an enlightened and uniform policy of quarantine administration, and international notification of infectious diseases, we have as yet no uniformity in the quarantine regulations of our own seaport cities, and no central health bureau. Gentlemen, it is well to consider these matters, and to point out to our legislators the present unsatisfactory condition of affairs with reference to the subjects referred to.

As I have already intimated, the exotic pestilential diseases to which I have referred are the levers which move corporations to make necessary sanitary improvements. But for sanitarians, aside from their effect in this way, they are of secondary importance. The number of victims which they claim is a small matter compared with the number who succumb to certain indigenous or naturalized infectious diseases which are equally subject to control by well known sanitary measures. The chief aim of the American Public Health Association should be to ascertain what measures are most effectual for the restriction of these endemic maladies, such as typhoid fever and the malarial fevers, and for the banishment of all diseases in which the contagion is given off from the persons of the sick, such as scarlet fever and small-pox. So far as diseases of the class last mentioned are concerned, we may safely say that we know how they may be banished from a community, viz., by isolation of the sick and disinfection of all infectious material, and in the case of small-pox by vaccination. Our main mission therefore is to insist upon the thorough execution of these measures.

But our mission does not cease here. We have not only to teach the American public how to guard against infectious diseases by quarantine restrictions, isolation of the sick, disinfection, and municipal sanitation, but also to teach them the principles of personal hygiene. Not only will their individual susceptibility in the presence of an epidemic depend largely upon their personal habits and mode of life, but we must show them how often organic and functional diseases of the various organs essential to life are induced by excesses in diet, improper food, the habitual use of spirituous liquors, etc., etc. I conceive that a most important part of our work in the future should consist in popularizing information of this kind. The noble examble set by our generous colleague, Mr. Lomb, of Rochester, should be followed by our Association if its finances permit, or at least we should present the subject to philanthropists, who, like Mr. Lomb, may desire to be guided by our counsel in their efforts to do good to their fellow-men. As a matter of fact, our limited means will not justify us in offering prizes for essays on sanitary subjects, and the most that we can afford is to print and distribute at cost such essays as may seem suitable for popular distribution.

In another direction, however, we may accomplish much good with comparatively small amounts of money whenever our treasury will admit of it. I refer to special investigations in sanitary science, committed to expert investigators who are willing to devote their time to the work, and who would ask only for such sums as might be necessary to cover the actual expenditures for apparatus, material, etc.

The exact knowledge which has been obtained during the last decade with reference to the etiology of the infectious diseases has been promptly applied in a practical way by sanitarians, and every addition to our knowledge in this direction is of the greatest importance to sanitary science, which, so far as we can see, will reap far more benefit from a precise knowledge with reference to the essential characters of each specific disease germ than can be hoped for by the clinician.

It is not creditable to us as a nation that so small a share of the progress in this direction is due to American investigators. In the absence of any department of the national government having the power and disposition to support investigations in this field of science, the few who have pursued bacteriological studies in this country have worked under disadvantages which were not only discouraging, but absolutely incompatible with the most efficient work and fruitful results. But the future is more hopeful. Individual munificence, in several of our large cities, has supplied the means which should have been provided long since by the national government, for pursuing investigations in bacteriology and in experimental pathology.

In Baltimore we have a well equipped bacteriological laboratory, under the direction of the able professor of pathology of the Johns Hopkins University. In New York, Boston, Philadelphia, and, I believe, in several other cities, bacteriological laboratories have been established in connection with well known medical schools.

In Brooklyn, the Hoagland laboratory, now in process of construction, under the immediate supervision of the gentleman who provides the funds required for the building and its equipment, will supply all of the facilities, both for students and for advanced investigators, which can be found in the best equipped laboratories of Europe. I am informed, also, that our colleagues from the state of Michigan, who are always in the front rank in urging upon their legislature measures which will advance the sanitary interests of the state, have secured the establishment of a bacteriological laboratory in that state. We have to thank one of our colleagues from the state mentioned for a most important discovery in the field of sanitary science. I refer to the discovery of tyrotoxicon by Professor Vaughan. With a well equipped laboratory under his direction, there is good reason to believe that this discovery, so creditable to American science, will not stand alone to the credit of the good state of Michigan.

Our Association has already taken the initiative in encouraging and assisting, from its slender treasury, investigations in sanitary science. The Committee on Disinfectants, appointed at the St. Louis meeting in 1884, has made an extended experimental research with reference to the value of various agents for the destruction of disease germs. The final report of this committee will be submitted at the present meeting. I say final, because in my judgment all the necessary data are now at hand for determining the agents most useful for disinfecting purposes under various circumstances, and I think the conclusions of the committee may be accepted as a safe guide for future practice. It is true that more work can be done to advantage in this direction, and it will be desirable to test from time to time new agents which may be suggested for disinfecting purposes; but the main object of the Association has been accomplished, and we now know what agents can be relied upon for the destruction of disease germs of various kinds, and in what proportion these agents must be used to be efficient.

In consideration of the limited means at our disposal for encouraging the scientific investigation of sanitary problems, I would suggest that the Association raise a special fund for this purpose, by calling for contributions from its members, and from others who may be willing to aid us in our efforts in this direction. If you approve of this suggestion, I trust that some member will introduce the necessary resolutions.

One of the subjects which might be taken up by a committee appointed for the purpose and aided from the special fund would be a biological investigation of the water-supply of towns and cities in the United States.

Evidently such an investigation would be a protracted one, and it would be advisable to begin with those towns which have a notoriously bad water-supply. Perhaps it could be arranged that a portion of the expense, at least, would be paid by the town or city whose water-supply was examined, as the inhabitants of such town or city would be especially interested in the result of the investigation.

Another question of the greatest interest to us is that which relates to the possibility of protecting individuals from fatal infectious diseases by inoculations with an attenuated virus.

Protection from small-pox is no longer a solitary instance of prophylaxis by inoculation. In anthrax, in swine-plague—*rouget*—and in pleuro-pneumonia, protective inoculations have been practised upon a large scale, and the value of the method is fully demonstrated. The evidence in favor of Pasteur's inoculations for the prevention of hydrophobia is such that we can scarcely doubt that it has a relative value, notwithstanding the considerable number of deaths that have occurred among those who have been inoculated. The recent report of the English commission, made after a thorough investigation, is favorable to the method, which may perhaps hereafter be modified so as to give still better results.

In the various infectious diseases of the lower animals, which have been studied during recent years, including those forms of septicæmia which are only known to us by laboratory experiments, we have much evidence that protective inoculations with an attenuated virus may be successfully practised. And there is good reason to hope that in all diseases in which a single attack protects from future attacks, protective inoculations may be practised when once we have succeeded in isolating and cultivating outside of the body the specific infectious agent. We know already four methods by which the virulent potency of disease germs may be attenuated, viz., by exposure to oxygen, by exposure to heat, by exposure to the action of certain chemical agents, and by passing through the body of certain animals.

The last mentioned method is that practised by Pasteur in attenuating the virus of *rouget*. He finds that the virulence of the microbe is diminished by passing it through a series of rabbits, and that by this means an attenuated virus suitable for protective inoculations in swine may be obtained.

The possibility of attenuating a virus by exposure to the action of certain chemical agents was discovered by myself in 1881, in the course of a series of experiments upon disinfectants in which the virus used was the blood of a rabbit just dead and containing the micrococcus found in the buccal secretions of man, which I have named *M. Pasteuri*.

Among the diseases in which there is good reason to hope that a method of prophylaxis by inoculations with an attenuated virus might be successfully practised, if we could once succeed in isolating and cultivating the specific germ of the disease, is yellow fever, a disease in which, as a rule, a single attack protects.

As you know, it has been claimed both by Dr. Domingoes Freire of Brazil, and by Dr. Carmona Y. Valle of Mexico, that the yellow fever germ is discovered, and that a method of prophylaxis by inoculation has been experimentally demonstrated. As I have just returned from a special mission, the object of which was to investigate the claims of these gentlemen, you will naturally expect to hear from me at this time with reference to the results of my investigations. I regret to say that I am unable to gratify you in this natural expectation. My orders explicitly direct me "not to make publication of my investigations and of the conclusions reached by me" until I have submitted my final report to the president of the United States.

I have already occupied so much time in speaking of matters which I consider of prime importance, that I cannot attempt to make any general review of recent bacteriological researches which have a bearing upon public hygiene. As a matter of fact, all additions to our knowledge of pathogenic micro-organisms are of special importance to us as sanitarians, and it is now generally recognized that the only safe basis for practical sanitation is that which is afforded by an exact knowledge of the etiology of infectious diseases, and of the biological characters of the specific infectious agents in these diseases. Since the importance of these studies has been generally recognized, and the methods of research have been perfected, the number of trained workers has rapidly increased, and at present the greatest activity prevails in the laboratories of Europe. This is shown by the number of memoirs relating to experimental investigations made in this department of science which are constantly appearing in the journals devoted to medicine and hygiene in all parts of the world, but especially in Germany, in France, and in Italy. The Jahresbericht of Baumgarten, for the year 1886, contains abstracts of 533 papers relating to micro-organisms.

With reference to *cholera*, I may say to you that recent researches give support to the conclusions of Koch, as to the pathogenic role in this disease, of the spirillum discovered by him in the intestine of cholera patients. Its constant presence in this disease seems to be demonstrated, and it is now generally admitted by bacteriologists that there are definite characters by which it may be distinguished from similar organisms obtained from other sources, such as the Finkler-Prior spirillum, and the cheese spirillum of Deneke, which closely resemble it.

Lustig, director of the cholera hospitals at Trieste, examined the dejecta in 170 cases of cholera, and found the spirillum of Koch in every case; on the other hand the bacillus of Emmerich was only found in 40 out of the whole number of cases examined. Tizzoni and Cattani also found Koch's spirillum in the contents of the intestine in twenty-four cases examined by them during the epidemic at Bologna in 1886. At Padua, also, researches made by Canestrini and Morpurgo gave the same result: the spirillum was constantly found in the dejecta in recent cases. These observers state that the cholera spirillum retains its motility and reproductive power for a considerable time in sterilized distilled water. They were able to obtain cultures after two months from such water. This important fact has been verified by Pfeiffer, who found, however, that in the presence of common saprophytic bacteria the cholera microbe soon died out. Hueppe has shown that the cholera spirillum forms reproductive elements, which he calls arthrospores. These are not so readily destroyed by desiccation as are the fresh baccilli, but they have nothing like the resisting power to heat and chemical agents which characterizes the endogenous spores of the bacilli. The exact proportion in which various disinfecting agents are destructive of the vitality of the cholera spirilla has now been determined with great precision, and will be stated in detail in the report of the Committee on Disinfectants for the present year. This committee has also made extended experiments of the same kind in which the typhoid bacillus, and various other pathogenic organisms, have served as the test of germicide power. The chemical products developed in cultures as a result of the vital activity of the cholera spirillum have been studied by Bitter, Buchner, and Contani. The last named author claims to have demonstrated the presence of a poisonous ptomaine in cholera cultures, which when injected into the peritonæal cavity of dogs gives rise to symptoms resembling those of cholera. A recent observation of value is that of Bujwid, who finds that *bouillon* cultures of the cholera spirillum have a peculiar chemical reaction by which they may be distinguished. According to this author, the addition of a $\frac{5}{10}$ per cent. solution of hydrochloric acid to such a culture gives rise, within a few minutes, to a rose-violet culture, which subsequently when exposed to light changes to a brownish shade. The reaction does not occur in impure cultures. The Finkler-Prior spirillum is said to give a similar reaction after a long time, but the color first developed is of a more brownish hue.

The question of the etiological role and biological characters of the typhoid bacillus discovered by Eberth in 1880, has occupied numerous bacteriologists during the past year, and very important additions have been made to our knowledge with reference to this organism. The researches of Beumer and Peiper, of Seitz, and of Frankel and Simmonds, are especially worthy of notice, but time will not permit me to give an abstract of the results reached by these and other investigators. I can only say in a general way that the earlier researches of Eberth, Koch, and Gaffky are confirmed as regards the presence of this bacillus in the intestinal glands, the spleen, and other organs in typhoid cases, and that very little doubt exists among bacteriologists as to the etiological relation of this organism to the disease in question, although no satisfactory proof by inoculations in lower animals has yet been found. This, however, is not surprising, inasmuch as we have no evidence that any of the animals experimented upon are liable to contract the disease, as man does, by drinking contaminated water.

According to Wolffhügel and Riedel the typhoid bacillus and various other pathogenic organisms tested retain their vitality for a long time when preserved in ordinary well or hydrant water, and even undergo a considerable development in such water. Frankland, also, has found that certain pathogenic bacteria tested by him increased rapidly in numbers in the water of the Thames, and even in distilled water. Meade Bolton, on the other hand, found that micrococcus tetragonus, staphylococcus aureus, the typhoid bacillus, and the anthrax bacillus, not only did not increase in number in sterilized water, but soon perished, while certain non-pathogenic species commonly found in water increased rapidly in numbers in sterilized distilled water. A more recent research is that of Kraus, who employed well water and hydrant water from the city water-works of Munich, which, without being sterilized, was infected with pure cultures of various pathogenic organisms diluted with distilled water. The infected water was kept during the experiment at a temperature of $10\frac{1}{2}°$ C. Plate cultures were made from day to day. The results were as follows: The typhoid bacillus had disappeared by the 7th day, the cholera spirillum could not be found in plate cultures after the 2d day, the anthrax bacillus had disappeared at the end of four days; in the meantime the ordinary water organisms had increased enormously in number. From these experiments, considered in connection with those of Bolton and of Wolffhügel, Kraus concludes that the rapid destruction of pathogenic bacteria in non-sterilized water is a direct result of the action of ordinary water organisms. If this be true, it is evident that these water bacteria are conservative from a sanitary point of view, and that the biological test of drinking-water, which gives the number of colonies which are obtained from a given quantity, has no special value in the absence of an exact statement of the kind of bacteria and their pathogenic potency. The time has come when we must demand that those who undertake the biological examination of water with reference to its potability shall give some more definite information than that a certain number of colonies were found, some of which liquefied gelatine and some did not. Up to the present time we have but few instances of the finding of known pathogenic bacteria in water used for drinking purposes. Koch found his spirillum in a water-tank in India, and several observers have reported the finding of the typhoid bacillus in drinking-water. Recently Beumer examined the water of four wells in a vicinity where cases of typhoid fever had repeatedly occurred. From one of these wells colonies were obtained by the plate method, which proved to have all of the characters of the typhoid bacillus. The distinguished German chemist Brieger has succeeded in obtaining a toxic ptomaine from cultures of the typhoid bacillus, which has the composition of $C_7 H_{17} NO_2$.

The question of the etiology of croupous pneumonia has received much attention during the past year, and it is now evident that the bacillus of Friedlander, which has been cultivated for some years in the laboratories of Europe under the name of "Pneumococcus," is not entitled to this distinctive appellation. On the other hand, evidence is accumulating that a micrococcus which I have described under the name of *M. Pasteuri*, and which is found in normal human saliva, is far more frequently found in the exudate into the alveoli during the acute stage of croupous pneumonia than is that of Friedlander. I first experimented with this micrococcus in 1880, and isolated it in pure cultures in 1881, but it was not until January, 1885, that I discovered its presence in pneumonic sputum, and made inoculations in rabbits with this material.

The record of my first successful experiment, published in the *American Journal of the Medical Sciences*, for October, 1885, is as follows: "Jan. 2, 1885. Inoculated two rabbits subcutaneously with pneumonic sputum, collected with great care by my friend, Dr. Rohé, and brought to me at once, from a white male patient, aged nineteen, in the seventh day of illness, second day of bloody expectoration. Both rabbits were found dead on the morning of January 4th. In both, the pathological appearances were identical with those constantly observed by me in rabbits killed by the subcutaneous injection of my own saliva, viz., extensive inflammatory œdema extending from point of injection, enlarged spleen, and presence of oval micrococci in blood and in effused serum in the subcutaneous connective tissue." In the same paper I say,—

"It seems extremely probable that this micrococcus is concerned in the etiology of croupous pneumonia, and that the infectious nature of this disease is due to its presence in the fibrinous exudate into the pulmonary alveoli. But this cannot be considered as definitely established by the experiments which have thus far been made upon lower animals. The constant presence of this micrococcus in the buccal secretions of healthy persons indicates that some other factor is required for the development of an attack of pneumonia, and it seems probable that this other factor acts by reducing the vital resisting power of the pulmonary tissues, and thus making them vulnerable to the attacks of the microbe. This supposition enables us to account for the development of the numerous cases of pneumonia which cannot be traced to infection from without. The germ being always present, auto-infection is liable to occur when from alcoholism, sewer-gas poisoning, crowd poisoning, or any other depressing agency, the vitality of the tissues is reduced below the resisting point. We may suppose also that a reflex vaso-motor paralysis, affecting a single lobe of the lung, for example, and induced by exposure to cold, may so reduce the resisting power of the pulmonary tissues as to permit this micrococcus to produce its characteristic effects.

"Again, we may suppose that a person, whose vital resisting power is reduced by any of the causes mentioned, may be attacked by pneumonia from external infection with material containing a pathogenic variety of this micrococcus having a potency, permanent or acquired, greater than that possessed by the same organism in normal buccal secretions."

The extended researches of Frankel and of Weichselbaum show that this micrococcus is very commonly if not constantly present in the exudate of croupous pneumonia, and both of these investigators are inclined to attribute to it a specific pathogenic role in connection with the malady in question. Frankel's first paper was published in 1886. In this paper he says,—

"Finally, as regards the relative frequency of the two hitherto investigated microbes, in cases of pneumonia, no positive statement can yet be made. Nevertheless, I am inclined to regard the lancet-shaped pneumonia-coccus, which is identical with the microbe of sputum-septicæmia, as the more frequent and the usual infectious agent of pneumonia, on the ground that this organism is so much more frequently found in the sputum of pneumonic patients than in that of healthy individuals. This conclusion is further supported by the circumstance that it has not hitherto been possible to isolate directly from the rusty sputum Friedlander's bacillus."

Weichselbaum reports that he has found this organism in ninety-four cases of pneumonia, eighty of which were primary, and fourteen secondary. On the contrary, he only found Friedlander's bacillus in nine cases; in three of these cases it was associated with the diplococcus above referred to, and in only three instances was it obtained alone in pure cultures.

Weichselbaum arrives at the conclusion that pneumonia may be induced by several different organisms, but that the diplococcus which I have called *M. Pasteuri*—a name, by the way, which none of the German authors have been willing to accept—is by far the most frequent cause of genuine croupous pneumonia.

Whatever may be the final conclusion with reference to the specific etiological *rôle* of this or other micro-organisms in pneumonia, we must recognize the importance of secondary causes which control the endemic and epidemic prevalence of the disease; and these have recently been worked out in a very satisfactory manner by a distinguished member of our Association, Dr. Baker, of Michigan.

Among the most important investigations of the past year are those of Councilman of Baltimore and Osler of Philadelphia, with reference to the presence of micro-organisms in the blood of malarial fever patients. Both of these observers confirm the discovery of Laveran, who in 1880 announced, as the result of extended researches made in Algeria, that blood drawn from the finger of such patients during a febrile paroxysm contains a parasitic infusorium, which presents itself in different phases of development, and which in a certain proportion of the cases was observed as an actively motile flagellate organism. Osler and Councilman have found all of the forms described by Laveran; and the last named observer reports that in recent researches, in which blood was obtained directly from the spleen, the flagellate form was almost constantly found. Whether the amœboid "plasmodium" found by Marchiafava and Celli of Rome represents an early stage in the development of this organism, or whether it simply represents a change in the red blood corpuscles, which occurs also in other diseases, as is claimed by Mosso, has not yet been definitely determined. It is somewhat curious that just when we are receiving satisfactory evidence of the presence of the parasite of Laveran in the blood of malarial fever patients, the bacillus of Klebs and Tomassi-Crudelli, which appeared to be dead and buried, has again been introduced to our notice by the distinguished

German botanist, Ferdinand Cohn. In his paper, published in June last, he gives an account of the researches of a young physician named Schiavuzzi, who has made researches in the vicinity of Pola, a malarial region in Istria. The method followed was that of Klebs and Tomassi-Crudelli, viz., examination of the air and water in malarial localities, and inoculation experiments in rabbits.

The bacillus was constantly found in the air, and the rabbits inoculated presented symptoms and pathological lesions believed to be identical with those of malarial fever in man. I cannot at the present time go into a critical discussion of the evidence presented, but would refer you to an experimental research made by myself in New Orleans in the summer of 1880, in which I repeated the experiments of Klebs and Tomassi-Crudelli, and arrived at the following general conclusions:

"Among the organisms found upon the surface of swamp-mud near New Orleans, and in the gutters within the city limits, are some which closely resemble, and perhaps are identical with, the bacillus malariæ of Klebs and Tomassi-Crudelli; but there is no satisfactory evidence that these, or any of the other bacterial organisms found in such situations, when injected beneath the skin of a rabbit, give rise to a malarial fever corresponding with the ordinary paludal fevers to which man is subject."

I see no reason to modify the opinion here expressed, notwithstanding the endorsement given by Cohn to the results announced by Schiavuzzi. These researches relating to organisms in the air and water, and experiments upon rabbits, especially in the hands of an inexperienced investigator, cannot have any great scientific value in the elucidation of an etiological problem. The sources of possible error are too numerous, and the method is in any case inadequate for the complete solution of the problem. It is essential that the infectious agent, especially one so easily demonstrated as this bacillus, be proved to be present in the blood or tissues of malarial fever patients; and in the absence of such proof, experiments upon rabbits and researches in the air of malarial regions can have but little weight. It may well be that in the swampy districts of warm climates, where malarial fevers prevail, one or more species of bacillus will be found in the air or in the water, which are absent from the drier air and running waters of non-malarious uplands; but this is simply an interesting fact in natural history, relating to the distribution of organisms of this class, and by itself cannot be accorded any value in a consideration of the important question of etiology. The method of research pursued by Laveran, by Marchiafava and by Celli, by Councilman and by Osler, is the true one, and none of these gentlemen have encountered the bacillus of Klebs and Tomassi-Crudelli in their extended researches. On the other hand, they are in accord as to the presence in the blood of a peculiar flagellate organism, and of certain spherical and crescentic bodies which are believed to represent different stages in the life history of this infusorium.

If time permitted I would be glad to continue this review of the recent progress made in the interesting field in which I have been for some time an enthusiastic worker, but your patience would be exhausted long before I could reach the end of the story.

The importance attached by the profession to studies of the nature of those referred to, is well stated in a recent editorial in the London "Lancet," relating to the International Hygienic Congress recently assembled at Vienna. The editor says,—"The Vienna meeting will serve the double purpose of indicating the necessity of skilled investigation of the causes of disease, and of encouraging statesmen to rely upon work of this character rather than upon collective opinion. The excellent work which is carried on in the continental laboratories has undoubtedly had its effect in teaching the value of exact knowledge, but there was none the less too great a desire at Vienna to record by resolution the opinion of members, regardless of their fitness to exercise any proper judgment upon the points at issue."

Before concluding my address, it becomes my sad duty to remind you of the losses which our brotherhood of sanitarians has sustained during the past year; to speak of those whose voices will no more be heard among us, who have joined the great army of the dead. Happily for us they have left a record behind them of honest endeavor and earnest words spoken in behalf of their fellow-men. Their names are not simply recorded in the list of our members, but also in our hearts, and a permanent record of their contributions to sanitary science will be found in the papers to which their names are attached, which are contained in the volumes of our Transactions.

Unhappily the list contains the names of several of our most highly esteemed members. As the Committee on Necrology will make a report for publication in our annual volume, in which the important facts relating to the lives and services of these deceased members will be stated, I shall content myself at the present time with the mere mention of their names:

Hon. Erastus Brooks died at West New Brighton, Staten Island, N. Y., November 28, 1886, in the seventy-second year of his age.

Dr. Joseph Gibbons Richardson, Professor of Hygiene in the Medical Department of the University of Pennsylvania, and member of the Board of Health of Philadelphia, died of apoplexy in that city, November 13, 1886, in the fifty-first year of his age.

Dr. John P. Gray, superintendent of the New York State Lunatic Asylum at Utica, died November 29, 1886, at the asylum in that city.

Dr. Joseph C. Hutchinson, LL. D., of Brooklyn, N. Y., died of pneumonia, July 17, 1887. He was born in Old Franklin, Mo., in 1827.

Rev. John D. Beugless, chaplain in the U. S. Navy, died at his station on board a government ship, the Brooklyn, while stationed at some Chinese port, in July, 1887.

Dr. Edward W. Germer, a member and ex-president of the Pennsylvania State Board of Health, and health officer of the city of Erie for fifteen years, died at his home August 21, 1887, aged fifty-four years.

Dr. Oscar Fallon Fassett, of St. Albans, Vt., died July 22, 1887.

Dr. V. H. Taliaferro, secretary of the Georgia State Board of Health in former years, aged fifty-four years.

Nicholas Jones, Esq., member of the Board of Health, Pittsburgh, Penn., died May 17, 1887, aged sixty-five years.

Dr. William Stephenson Robertson, president of the State Board of Health of Iowa, died at his home in Muscatine, Iowa, January 20, 1887, in the fifty-sixth year of his age.

Dr. George Engs, of Newport, R. I., died July 7, 1887, of heart disease, aged forty-five.

And now, Gentlemen of the American Public Health Association, having already exceeded the limits which I had intended to place upon the length of my address, nothing remains but to thank you for the kind patience with which you have listened to me, and for the high honor which you conferred upon me at Toronto, in electing me your president for the present meeting.

II.

ADDRESS

By GOVERNOR TAYLOR, of Tennessee.

Mr. President, Gentlemen, and Members of the American Public Health Association:—As the chief executive of the state of Tennessee I have come to welcome you to our borders, in the name of all the people. I have not come to make you a speech. I could not make a speech on medical topics, because I know as little about medicine and disease as one of our able liniment African divines, who, in a recent sermon, eloquently proclaimed the presence of a terrible disease. His text was in these words: "And multitudes came unto Him, and He ehaled them of divers diseases." Said he,—"My dying congregation, this is a terrible text: disease is in the world. The small-pox slays its hundreds, the cholera its thousands, and the yellow fever its tens of thousands; but, in the language of the text, if you take the divers, you are gone. These earthly doctors can cure the small-pox, cholera, and yellow fever, if they get there in time; but nobody but the good Lord can cure the divers."

Gentlemen of the Association, you are welcome, thrice welcome, among us. Coming, as I know you do, on a mission of love and mercy, to promote the health and happiness and to increase the longevity of your fellow-men, you have, of course, left the knife and the saw and the dreadful medicine-case behind. In doing this you have, like good and true citizens, dutifully complied with our statute law, which positively forbids the carrying of concealed weapons. If I correctly understand the object of your Association, it is the prevention and suppression of disease in the human family. This being true, we regard your honorable body as a marvel of unselfishness and philanthropy. In this you have shown a nobility of character rarely ever exhibited by humanity. Now, the farmer wears a broad smile of triumph and satisfaction and self-complacency when he sees all the crops fail but his own, because he knows that he can sell at his own prices. The manufacturer is delighted to see the wares and machinery in use breaking down and going to destruction,—and it has been hinted that he often plants in them the seeds of early mortality himself, before they leave the shop; for he knows that that means a steady demand for new wares and machinery which he will be called upon to furnish for cash in hand. The merchant rejoices to witness the daily grand procession of patches and rents of threadbare and shabby genteel raiment, of gaping shoes and seedy hats, because they prophesy for him a ready market for more goods at higher prices. The lawyer shrugs his shoulders in mysterious ecstasy when he beholds his two neighbors quarrelling over on oyster; for he knows that he will ere long get the oyster, and leave his neighbors each a half shell. But contrary to the dictates of all this human nature, which seems so universal in man, your noble-hearted Association, composed for the most part of physicians, is seeking to banish disease from the world, and thus cut off our doctor's bills. If every doctor in Christendom could be persuaded to join in this glorious work, I believe that all the ills of mortal flesh would vanish forevermore, and the millennium would dawn upon the world. All honor to those who are willing thus to sacrifice their own occupation for the good of their fellow-man.

I congratulate you, gentlemen, upon your happy location of a place for your deliberations this year. The recent history of this beautiful and healthful city of Memphis is a practical demonstration of the correctness of the principles and efficacy of the means which you are seeking to introduce for the prevention of disease and pestilence. The strict observance and application of sanitary principles, the rigid enforcement of measures insuring cleanliness, the establishment of a splendid system of drainage, have, within a few short years, converted Memphis into one of the healthiest and most delightful cities in the world. Our whole state of Tennessee, by reason of its temperate climate and its physical contour, is preëminently blessed with all the conditions most favorable to the health and happiness of its people. So perfect are these natural conditions, that we may say with truth that we are, to all intents and purposes, exempt from infectious and contagious epidemics, except when they are sometimes imported in the soiled linen of some outside barbarian. The western division of our state is absolutely impervious to extraneous diseases, because of the fact that drainage and democracy, *quinia* and *spiritus frumenti*, are so popular in this region, that even malaria has been forced in recent years to retreat beyond the Mississippi to find protection and business in the swamps of Arkansas. (Please do not repeat this last remark to the governor of Arkansas.)

The middle division of our state is a great blue-grass region, and is scarcely ever afflicted with any other disease than pink-eye, scratches, bots, and blind staggers. This last disease sometimes attacks man, and usually originates in the excessive use of *spiritus frumenti*. I believe the usual remedy among the medical profession is a little more *spiritus frumenti*, though a recent strong effort has been made to introduce a remedy, which would be called, in medical parlance, *aqua prohi*. But I am forced to confess to you, Gentlemen of the Association, that the most unhealthy part of our state (to Democrats) is the eastern division, for there Republicanism

> "Rides on every passing breeze,
> And lurks in every flower."

I hope this Association can evolve some antidote for this awful malady. I trust you will pardon me for these frivolous pleasantries. I started out to welcome you to our midst.

Organizations like yours, looking to the amelioration of the condition of humanity, like the preservation of health and the consequent promotion of happiness in this world, challenge our profound admiration, sympathy, and gratitude. As a class, I regard the men and women of the medical profession as among the very best citizens of this world. The prime object of all their study, and investigation, and painstaking, and effort, from day to day, is to heal, to soothe, to assuage the sufferings and miseries of wretched and afflicted humanity, and to make life more tolerable. With the broad shield and the trenchant blade of medical science and skill, the physician is ever standing like a dauntless soldier between us poor mortals and our last great enemy, parrying his thrusts, and turning aside his fatal shafts, that we may survive a little longer. He is, indeed, a soldier and a hero, greater than those who fight on fields of blood; for, does he not face the fell Destroyer and give him battle on every inch of life's narrow ground? Does he not boldly meet and combat the grim "pestilence that walketh in darkness and the destruction that wasteth at noonday"? From time immemorial he has stood like a man of iron and fought dreadful enemies, from which whole armies flee in terror and dismay. When duty calls, the honest physician knows no fear. He will not shrink from the awful conflict, but is ever found in the forefront and thickest of the fight.

> When the blessed seals that bind the pestilence are broke,
> And crowded cities wail its stroke,
> How often have we seen him there
> Fight with the courage of despair!
> Nor from the fray once inch would yield
> Till thence was borne upon his shield.

All honor to the physicians of the world! All honor to the men of thought and action! All honor to the friends and benefactors of our race! All honor to this grand body of men who are engaged in this labor of love for their fellow-men!

Gentlemen of the Association, again I extend to you a thousand hearty welcomes to Memphis and to Tennessee. And I trust that when your labors are done on this earth, your rewards will be sweeter than those prophesied by a country preacher, who, in his prayer, said,—"We thank Thee, our Heavenly Father, that when our trials are over here below, and we pass over the river of death, and stand in the sweet fields of Eden, there will be no trouble, no tears, no sorrow there; and we thank Thee, O Lord, there will be no doctors there."

III.

ADDRESS

By HON. J. W. CLAPP, of Memphis.

Mr. President and Gentlemen of the American Public Health Association:—The chief executive officer of our municipal government being, much to his regret and my own, unable to be present on this occasion, the duty of extending to you a welcome as the guests of our city, has, as you have just been informed, at his request and that of the committee of arrangements, devolved upon myself; and it is one that I discharge with the greatest pleasure, as I am not wholly unacquainted with the history, purposes, and influence of this Association. A somewhat irregular membership and attendance upon its meetings enable me to testify that it is composed, in the main, of earnest, practical, philanthropic, and learned men, some of whom are lights of the medical profession, and others who have made sanitary science a matter of long and thorough study. Annually, for the last sixteen years, has the Association assembled and given to the country and the cause of humanity the time and services of its members, and the rich benefits of its labors, without fee or reward, except that which the generous heart experiences from the exercise of the noblest qualities of our nature. Such an organization is certainly entitled to the profoundest respect and admiration of all, and nowhere should those who compose it receive a warmer recognition or a more hospitable reception than in the city where you are now assembled; and in proof of this, instead of indulging in remarks as to the importance of sanitary science in the abstract as a beneficent instrumentality for relieving, or, what is infinitely better, preventing, the physical ills that afflict society, and thus contributing to the sum of human happiness and the average duration of life, I can better meet the purposes of the occasion by a brief reference to the experience of Memphis within the last few years.

When this Association held its annual meeting in Nashville, in November, 1879, for two successive years had Memphis been desolated by the dreadful scourge of yellow fever, and so desperate and hopeless did its condition appear, that, in one instance at least, the heartless and incendiary suggestion was offered that the flames be made to consume what the pestilence had spared; and thus, in one huge holocaust, Memphis, like its prototype upon the Nile, should become a thing of the past. Along with Drs. Porter and Thornton, whose names, without disparagement to others, are deserving of special mention in connection with the sanitary redemption of Memphis and her present prosperity, I attended the meeting referred to; and after an address from a prominent member of the Association, meant, we will suppose, in kindness, but in which our people were represented as steeped in filth and criminally negligent of the most ordinary precautions, I addressed the Association in vindication and exoneration of our city and its stricken inhabitants, maintaining that we did not occupy the position of culprits, or of beggars for public charity, but were unfortunate rather than blamable, and that the two gentlemen named and myself were in attendance upon the Association with a view to learn the source of the calamities that had befallen us, and how to apply the remedy. And the assurance was given that when this information, of a reliable character, was obtained, prostrated and impoverished as we were, our people were heroic enough, by the help of God, to struggle through our labyrinth of trouble, and our city should be no longer a by-word and term of reproach. For the attainment of our object, we desired that the Association should appoint, or recommend, a committee competent to investigate our situation and advise us as to the measures of relief proper to be adopted. This request was, with a kindly expression of sympathy, complied with by the Association; and just there was the turning-point in our history.

And now, Mr. President and Gentlemen of the Association, gratefully remembering your considerate feeling and action in the hour of our sorest need, we greet your presence here with unfeigned pleasure, and with warrantable pride and satisfaction invite you to contrast the melancholy wreck of 1879 with the busy, prosperous, and, in some respects, model city that now joyfully hails you as its honored guests. Then it was upon the verge of bankruptcy and financial ruin; now its indebtedness has all been provided for, and its credit is above par. Then nine miles of decaying wooden pavement filled its streets; now we can exhibit, in its stead, twenty-five miles of substantial stone and gravel. Then there were within the city limits four miles of private and defective sewerage; now the vaults that perforated our soil have all been filled, and there are forty-five miles of sewerage, unexcelled in quality, belonging to the corporation, with corresponding sub-soil drain tiles. Then there were some ten or twelve miles of horse-car street railway; now there are thirty-five miles of the same kind, and, in addition thereto, thirteen miles operated by steam. Then it was the terminus of four lines of trunk railways; now, the converging point of more than double that number, radiating to every point of the compass, with several others in process of construction; and to accommodate the traffic of these grand arteries of commerce a viaduct across the mighty river that forms our western boundary is an assured event of the early future. Then the value of our annual wholesale and jobbing trade was less than $70,000,000, and the aggregate annual receipts of cotton less than 400,000 bales; now the same character of trade for the last commercial year aggregates $160,000,000, and the receipts of cotton were upward of 660,000 bales, and for the current year will be between 700,000 and 1,000,000 bales, constituting Memphis the largest inland cotton market in the world, and third only, if not second, to any Southern seaport. Then, with a population reduced by death and removal to less than 34,000, as appears from the United States census; now, with a marvellous increase to 75,000. Then, a normal death-rate of thirty-five per thousand; now, of the resident population, nine per thousand of the white, and twenty-six of the colored.

These remarks might, I am well aware, be deemed out of place and in bad taste before any other audience of strangers than this; but, addressing as I do an association that in a special manner represents the sanitary interests and physical welfare of the whole country and all its parts, it will not, I am sure, be deemed irrelevant or uninteresting to refer, with some particularity, to so notable an illustration as this city affords of the practical value of sanitary science, when its principles are intelligently and earnestly applied. Here is a great and growing city, whose vital statistics now challenge comparison with those of any other in the Mississippi valley, that less than a decade ago was generally regarded as a pestilential hot-bed, whose doom was irrevocably fixed, and whose very existence was considered as a menace to the general welfare; and surely it cannot fail to interest this enlightened and philanthropic assemblage to learn that this doom was averted and their city placed upon the highway to prosperity by the indomitable energy and unsparing self-sacrifice of its citizens, who, when overwhelmed with affliction and stinted in the very means of living, expended more than a million of dollars in local sanitation. And while, with grateful hearts, we recognize the beneficent hand of Him who holds the scales of destiny, yet, if we refer to our trials and our triumphs with something of self-glorification, we feel assured that the weakness will, at least by this Association, be deemed a pardonable one.

And now, Mr. President and Gentlemen of the Association, it only remains for me, on behalf of the city of Memphis and all of her citizens, to reiterate the assurance of our sympathy and very high regard, and bid your Association an earnest Godspeed in its benign and noble mission; and if you shall find our sources of entertainment limited, we can only regret that they are not as ample as the room we make for you in our hearts.

IV.

THE PREVENTION OF MICROPHYTIC DISEASES BY INDIVIDUAL PROPHYLAXIS.

By EZRA M. HUNT, M.D.,

Secretary New Jersey State Board of Health, Trenton, N. J.

During the last twenty-five years no subject has been more prominently before the students and practitioners of hygiene than the consideration of new methods, or new applications of old methods, for the prevention of disease.

This inquiry, to some extent, involves investigation into the specific entity of disease. But a still more hopeful direction of investigation is to find out what fertilizes it, or makes it more likely to be severe; what sterilizes it, or makes it more likely to be mild; or what will make the human system resistful to the sedation or propagation of the disease so that it will not occur.

The first great discovery, in this direction, was that of the modifying influence of inoculation. It could not have been merely the cathartic and the changed diet of a few days that reduced the mortality from inoculated small-pox to such a minimum. The prevalence of the custom was at once the certification of the terror of the caught disease and the innocency of the conferred or inoculated disease; yet it was the same disease without any effort at attenuation.

It was the introduction of the virus into the *skin* or areolar tissue, instead of by *inhalation*, that seemed to result in modification. Its approach was through the periphery, instead of by a central and vital organ. The chief safety was in the fact that the involvement of the lungs and the secondary fever were avoided. Somehow, by the metastasis, or diversion, or mode of attack, the system grew tolerant of the malady, and was able to throw it off with comparative harmlessness.

It has fallen to my lot frequently to see the same remarkable mitigation in the inoculation of cattle with the virus of contagious pleuro-pneumonia. When the infection is conveyed by the breath, it seizes upon the lungs and pleura. Frequently, in three days after it is manifested, the spongy organ, of two or three pounds, has become so solidified with tenacious lymph that it has a weight of thirty pounds, and death is the speedy result. But introduce this virus into the muscular tissue of an extremity, and all symptoms are more gradual. There are local swelling, the throwing out of lymph amid muscular tissue, and slight constitutional disturbance; but the lungs escape, and fatal cases are exceedingly rare.

Not only this, but other animals will not contract the disease, and immunity is secured.

These facts, as to the effect of the different modes of conveyance of a disease, have their practical bearings, and still invite investigation.

It was another wonderful fact when *scurvy* yielded to the preventive art. The great naval hospital at Haslar, England, had been built with special reference to the fearful inroads that this disease was making amid the British fleets. When, in 1796, Sir Gilbert Blane and other medical officers of the navy obtained the order that lime-juice be supplied to the seamen, the terror of that disease was taken away. Studying the facts by the history and peculiarities of that disease, we cannot dismiss it as a mere error of dietetics. It was not simply that fruits and fresh vegetables prevented the disease;—it was a far-reaching lesson as to how diseases may be modified by medicines as well as by foods; how the presence of something *administered* may prevent a disease.

As to the next wonder of the preventive art, that of Jennerian vaccination, it is so often presented as to need only our passing recognition; yet it is to be remembered that it is a subject not yet exhausted. Whether something of the modification is owing to the mode and place of introduction; whether it is a modified small-pox; whether it is attenuated virus, and may be in different degrees of attenuation, and so differently protective,—these, and other questions, are left over to be determined in this period when the microscope, the pathological, the chemical, and the biological laboratories, have come to the aid of the clinician, and we can study and compare the accumulated facts.

The *Pasteurian vaccination* may stand next, if not in order of time, since Pasteur opened his Copenhagen address by profound acknowledgment of his indebtedness to Jenner as the great forefather of preventive medicine. Here the mode and place of introduction, degree, and permanency of effect, and the nature and cause of the so-called attenuation, are still before us with unanswered inquiry.

Next, while the doctrine of the prevention by *isolation* is old, yet new methods and new results, as to it, almost make it a *new preventive* art. Sea and land quarantines are modified, and ought to be. How far it is to be isolation of the person, or only isolation of the personal effects, is unsettled. What the forsaking of an infected house or ship will do; what the camping out of all the well from a sick city will do; what isolation alone will do, as in Leicester, with small-pox; and what is the most perfect plan of organized, systematized isolation,—all these are before every health officer as large and most practical questions.

Next comes *disinfection*, in all it means by the new light of biology and the study of micro-organisms, whether it be the destruction of animal or vegetative parasitic life—of these as larvæ, as spores, or as spore-less plants, at any and all stages of existence and development; also what is meant by inhibiting or thwarting action, even when we do not destroy life; also what disinfectants can do with the surroundings in destroying the pabulum or nutrient media; also what these can do *in* *the system*, either to destroy the microbe, which is setting up pernicious activity there, or in some way to deprive it of its food, or limit its power.

For the present we confine ourselves to the last item. So soon as it became certain that many diseases depend upon or are associated with micro-organisms, the inquiry was in order whether there could not be some method utilized and applied by which the presence or activity of these in the blood-tissues or secretions could be so interfered with as to prevent or mollify disease. Passing, for the present, certain facts as to septic and non-pathogenic organisms, which, introduced into the system, may, of themselves, or by their ferments or alkaloids (ptomaines), cause disease, we confine our inquiry to the question whether it is possible to thwart the action of the *specific* or *pathogenic* micro-organisms in their attempt to invade, or after they have invaded, the system. We get some light, or some analogy as to this, from considering the life-history and behavior of these organisms outside the system.

First of all, we find that pathogenic organisms are "dependent for their growth on the presence of the suitable nourishing material." In this respect they are far more selective than the septic organisms, which "find in almost all animal and vegetable fluids the substances necessary for nutrition." It is further found that there are substances which inhibit the growth of, or altogether destroy, these micro-organisms, such as corrosive sublimate, salicylic acid, etc. To do this, they do not always need to be germicides. Far *short* of *destruction*, such substances are capable of restraining the morbid action so far as to thwart their pernicious activity, which, in the case of an invading disease, is really the gravity of the disease.

Klein gives abundant evidences and references, on page 208 of his book on "Micro-organisms and Disease," to show that "pathogenic micro-organisms are capable of suffering some modifications in their morphological and physiological behavior." He adds,—"Now it is known of many micro-organisms, bound up with infectious diseases, that temperature, the medium in which they grow, and the presence or absence of certain chemical compounds, are capable of materially affecting them" (Klein, p. 207).

Inasmuch as this growth and multiplication are known to go on in the bodies of living animals, and to constitute the identity and gravity of many diseases, it is a radical and very essential and hopeful inquiry whether we may not, by some change in the animal, or in some of those chemical compounds referred to, either destroy the micro-organism, or inhibit its activity.

It is very suggestive of the possibility of this to remind ourselves of the probable reason why some are unsusceptible to disease. Dr. Klein (p. 247) argues that it is because there is "something or other present in a particular tissue to which the latter owes its immunity." He infers that although this is "dependent upon the life of the tissue, it is not identical with any of the characters constituting its life." He says,—"The most feasible theory seems to me to be this, that the inhibiting power is due to *the presence* of a chemical substance produced by the living tissues." This puts the body in such a condition that in the particular case "the organisms cannot thrive and produce the disease." It is true that he suggests that the germicide or inhibitive material is a product of living tissue. This is not necessarily so, or if so would not necessarily be a product of the living tissue of the human body.

If the non-activity of the organism, and so the non-occurrence of the disease, is owing to "the presence of a chemical substance" in the tissues or blood, it is a very pertinent and natural inquiry whether we cannot and do not produce the same result by putting, and for a time sustaining, in the system certain "chemical substances," which, so introduced, interfere with the processes sought to be set up, and which would constitute the disease.

The analogy is strengthened by the fact that chemical products are so much coming to be suspected or recognized as constituting the virus or specificity of diseases in which the micro-organisms are the initiative factors. Still more, however, it behooves us to find out whether, either in chemical or laboratory experience, there has been any confirmation of such views. In clinical experience, we have long had not only the fact that quinine will cure chills and fever, but that it is a substance which, introduced into the human system in advance, will prevent those processes which constitute the disease. So soon as it was made probable that the malarial diseases belong to the species or genera of microphytic diseases, so soon it seemed probable that the result was due to this inhibitive effect of the alkaloid.

As a result of experiences with epidemics of diphtheria and scarlet fever, so long ago as at our Chicago meeting in 1877 (see vol. iv, American Public Health Association, p. 348) I presented a paper on this mode of arresting and preventing pestilential diseases (see, also, two articles on the subject in the *Medical Record*, vol. ii, 1877).

The next year the subject was more fully presented in a paper read at the Richmond meeting. In the intermediate time Professor Cabell was so impressed by the facts presented as to note it in his address before the American Medical Association in the spring of 1878. A reference to the paper of 1878 will show how fully this idea was insisted upon and illustrated. It was claimed that by the use of certain medicines we could prevent the sedation, or interrupt the development, of that which constituted the infection. Many of the facts in support of this view at that time were collated; and since then, from time to time, medical men have corroborated these views from their own experience. It is of value that since then we have come into a knowledge of several other diseases as microphytic; and this has greatly fortified the position then taken.

Says L. Brunton,—"Facts seem to point to ferments or enzymes as the agents by which the tissues are built up and pulled down in their constant change, which continues during life; and the action of drugs on these enzymes is becoming one of the most important questions of pharmacology." (See American Public Health Association, vol. vi, p. 103.)

From time to time in the last five years the journals have contained records as to this possibility of individual prophylaxis. But all this was only the clinical experiences of physicians. Too often these are not accorded the same consideration as what are called crucial or laboratory experiments.

It has recently been necessary for Sir James Paget, as president of the Pathological Society of London, to contend that clinical observation is scientific, and that the sick-room is a laboratory, with its crucial experiments, as real as those in which culture-experiments are instituted. But now experimental tests have come directly to our aid in determining the effects of prophylactic remedies. Before this we knew that arsenic, potassium chloride, quinine, excess of iron, etc., could be made constant for days and weeks in the blood by medication.

In 1884, under the direction of the Local Government Board of England, Dr. J. T. Cash instituted a series of experiments as to chemical disinfectants, and made report thereon. The object of the earlier investigations, recorded in a late report, was to inquire whether certain substances belonging to the aromatic series, when introduced into the body of a living animal, were capable of preventing the development of a particular virus within that animal. Later research was extended to a metallic salt (corrosive sublimate), which acts otherwise than aromatics with regard to albuminous bodies. It was with this that the most decided result was secured. The result sought was to find "its power of resisting, in the condition in which they occur within the animal body, the multiplication of the active principle of the virus against which they are directed to such an extent that the virus is destroyed, or only reproduces itself so fully as to cause a modified or abortive attack of the disease in the animal body experimented on." The disease chosen for the experiments was *anthrax*, the severest test of all. The result of the first series of experiments was such as to show that the previous administration of corrosive sublimate may considerably modify the course of the anthrax disease in rabbits. The paper concludes by saying that "although these few experiments are not conclusive, they cannot fail to encourage the hope that we may yet succeed in creating with precision, within the animal economy, by the action of this and perhaps other drugs, a temporary condition of resistance (in this case seven weeks), which may so far limit the activity of the anthrax virus that it will merely produce a passing, and, at the same time, protecting disorder, instead of a fatal disease."

The next year (1885) Dr. Cash made to the Local Government Board a further report on mercury as a means of prophylaxis to anthrax. In this he says,—"I have followed up the investigation of the prophylactic action of the perchloride still further, and the favorable opinion I was before led to entertain of its efficacy has been abundantly confirmed."

Dr. Klein has also satisfied himself of the restraining powers of the perchloride of mercury. Tomassi-Crudelli and others claim that arsenic has the same control as a preventive of malaria. These results may be taken as a confirmation of the clinical evidence given, and of the view we long since expressed as to the coming importance of various allied modes of prophylaxi in the prevention of various communicable diseases.

Heretofore we have mentioned some other prophylactics which we believe to have been effectual in preventing or mitigating some of the parasitic diseases. With this new evidence, I believe the time has come for a thorough testing, both by the practitioner and the biological investigator, of this new method of preventing and controlling disease. There are now many who believe that the real action of some of our most successful remedies is just this: The mitigation or prevention of a microphytic disease does not necessarily mean the destruction of the organism, but its inhibition *in loco*, or the modification of its chemical action on the tissues or of its products so as to render it harmless. It is a part of that antiseptic medication which Professors Yeo and Brunton, and many others, recognize as steadily gaining ground for approval.

If, in an individual case of exposure, or an outbreak in a family or a neighborhood, this kind of prophylactic treatment is available, it is easy to forecast the wonderful beneficence of the result. If, for instance, in an outbreak of diphtheria in a family or in a neighborhood, we can put all persons exposed to it for a few days upon a prophylactic treatment, or if, in the first outbreak of cholera in a locality, all exposed persons can be rapidly brought under the inhibitive effect of a prophylactic administered promptly and continuously, we shall have in our possession a mode for the limitation or prevention of epidemics far more likely to have practical application than any system which involves the cutting of the skin, or the introduction in any form of the actual virus of the disease. At any rate, with two such modes of defence at hand, we might hopefully expect to substitute the word sporadic for epidemic, and to bring many a vagrant pestilence within the range of our control.

The present age of advancing medical art will be rendered still more notable if it can be found that simple and active medication, on the outbreak of any communicable disease, will protect all those exposed thereto from contagion, or so modify its effect as to make the attack benign.

V.

THE NECESSITY OF INSPECTION OF ANIMALS REQUIRED FOR FOOD.

By CARL H. HORSCH, M. D.

Dover, N. H.

Among the number of persons who have made efforts to prevent the eating of diseased animal food, Moses was the first well known.

The commands in the Talmud are,—

1. The animal shall be killed with a sharp knife, and with three cuts. If the knife has a jagged edge, or the animal breaks a leg when falling at the time of butchering, the meat is condemned.
2. To eat no meat from a diseased animal.
3. From an animal which has died suffering with tympanitis.
4. Animals which have jaw worm.
5. Lameness from any cause.
6. No meat from calves under eight days old.
7. No meat from sheep suffering with tetter.
8. Diseases of the lungs; abnormal formations; more lobes on one side than on the other—on the right, 3, 5, 7—left, 4, 6, 8; adhesions; indurations; patches; water blisters; matter in the vessels;—if the lungs are flabby, dry, black, yellow, whitish, fleshy, or if coagulation of dark, stringy blood is found in the vessels.
9. No suppuration or other diseases of the liver, spleen, or kidneys.
10. No sharp things in the stomach, which perforated the tissue of the walls, and have pus on them.

Meat from healthy animals, and where the large vessels have been cut out, is called kausher.

Regarding eating pork, and no fish without scales, was most likely a dietetic regimen for the conditions of the Israelites. In tropical regions, and against prevailing diseases as leprosy and other forms, it would be well if the rational parts of those commands were obeyed by all nations.

Dr. Most says,—"Only healthy animals should be butchered, and their meat used for food. The signs of health are,—the animal moves around, and appears lively; by applying a gentle pressure on the back does not bend the ears or tail; the eyes look clear and bright; the body is well formed and nourished; rumination of the cud is carried on well; no saliva flowing from the mouth; no blisters or pustules on the mucous membrane; breathing is normal; no cough, groaning, or gasping; the skin is not tightly grown to the body; free from pustules, scurf, or scales; temperature normal; the hair is glossy. After skinning the animal, we find no boils, tumors, pustules, and no black spots; the meat is firm, and has the characteristic fresh smell.

Meat is not fit to eat from too old, too young, or from sick animals. Such meat is hard, tough, or soft, pale, watery, or greasy; the fat is soft, green, or yellow. By opening the chest of healthy animals, there is no putrid, bad-smelling exudation, no white patches or ulcers, no difference in color, and no disease in the surroundings of the lungs. In the stomach and bowels we find no red spots, soft, gray-black places, no dry, dark-looking remains of food. The best meat comes from healthy animals of middle age. The appropriate age to fatten oxen is from five to eight years old. Calves should be at least three to four weeks old,—dropped the umbilical cord, and have the last milk teeth. Veal and mutton should be kept from two to four days; beef and pork, four to six days; venison, four to ten days; fowl, two to four days. Fish should be cooked soon after they are killed.

The meat of animals which have been driven fast before slaughter is darker, heavier, contains more blood, and decomposes sooner. The meat of animals killed by lightning is not good for food. Some butchers inflate mutton to make it look plump, but such meat may contain the fetid breath of some person.

Dr. Most cites the following cases: A man contracted a malignant fever, and died after salting the meat from an ox which had been sick with (Viehseuchs) murrain. A family died after eating the meat from a hog which had been sick with (Braüne) angina. In Marburg Steinmark several persons died with hydrophobia, who had been eating meat from cattle which had been bitten by a mad dog.[1]

In 1869 I was called to see a patient in Dover, N. H. The gentleman was seventy years old, a man of regular habits; had been most of the time of his life healthy and strong, until March, 1869, when two of the lymphatic glands on his neck and several of the inguinal glands became enlarged. After examination and deduction of other diseases, I had to diagnose scrofulosis. The patient was a reliable, intelligent observer. He stated that he never had had any sign of said disease in his life, and that there was no case of scrofulosis on his father's or his mother's side. After I found out where my patient bought his meat, I ascertained that his butcher had slaughtered and sold the meat of an ox which had a large swelling near one of his ears. The gentleman who saw the animal called it a wolf. This was a case where I found no other cause than that diseased meat.

Two years ago a farmer brought a fat, well looking turkey into my house. When it was prepared for roasting, my wife found a very large liver, with white patches about as large as a cent all through the tissue. On further examination, it was determined that it was fatty degeneration

[1] Ausfuhrliche Encyklopadia der gesammten Staats arzweikunde von Georg Friedrich Most, Doctor der Philosophie, Medicin, Chirurgie, und Geburtshülfe, etc., etc.

of the liver; and decided that the rest of that fowl would perhaps be better relished by the worms.

Glanders, hydrophobia, malignant pustule, splenic fever, tuberculosis, trichina, and other diseases are dangerous, and communicable from animals to man; but when we consider the diseased animals and their meat used for food, there is not only the aversion which we have against eating diseased meat, but certainly more danger to man of contracting diseases by the meals.

Prof. D. E. Salmon, Chief of the Bureau of Animal Industry, sent the following answer to a letter from Mr. James W. Bartlett, of Dover, N. H.:

WASHINGTON, Feb. 12, 1887.

SIR:—In reply to your communication of the 9th instant, referred to me by the commissioner of agriculture, I would state that, so far as I know, there is no systematic and complete inspection of cattle killed for beef in any state in the Union. Many states have beef inspectors, but, as a rule, they do not inspect all the beef; and in most cases do not see the animal before it is slaughtered, or the internal organs when they are removed. They simply look at the beef after the carcass is dressed. Such an inspection is not sufficient to discover all cases of disease from which carcasses should be condemned. I have no special information in regard to the inspectors or inspections in Omaha or in Montana.

Very respectfully

D. E. SALMON, *Chief of Bureau.*

In an interview with Dr. S. H. Durgin, physician of the City Board of Health, Boston, Mass., Mr. James W. Bartlett ascertained that Boston, Mass., has had inspection of cattle and meat three years. All the cattle are inspected two or three days before the slaughtering, and the inspector sees the animal killed. If he *suspects* any disease, he inspects the heart, lungs, liver, etc., but does not make a general practice thereof. In case the animal shows evident signs of disease before killing, it is slaughtered in the rendering-house, away from all healthy animals. In the case of a dispute, it is referred to the City Board of Health, whose decision is final. Dr. Durgin stated also that a large amount of tuberculosis in cattle, especially in cows, had been found.

In order to have a better safeguard for the prevention of the use and sale of diseased animal food, every animal should be inspected by competent persons before slaughtering, and the internal organs thoroughly examined afterwards. The members of the American Medical Association, medical societies, National Board of Health, American Public Health Association, state and local boards of health, and every well meaning medical practitioner and citizen, will see the importance of such sanitary measure, and make an effort to impress it upon the minds of the representatives of the United States, states, counties, cities, and towns, that it is for their own and the safety of over sixty millions of inhabitants, and thousands of persons travelling in this country, to pass a law and make appropriation for such protection, and to give the able ones of eighty-five thousand six hundred and seventy-one physicians, and the veterinary surgeons, a chance to carry out that very much needed part of state medicine.

VI.

THE MEAT FOOD-SUPPLY OF THE NATION, AND ITS FUTURE.

BY AZEL AMES, JR., M. D.,
Of Chicago, Ill.

In offering this paper to-day,—which I do by the grace of the officers of the Association, whose abounding courtesy I beg to acknowledge,—out of line, as it is, with the topics specially assigned for discussion at this meeting, permit me to plead in apology the great and pressing demand for consideration which certain features of the subject of our animal food-supply just now present, and their grave need of such influence and aid as this Association can lend.

The American Public Health Association may justly refer with pride to its remarkably honorable record, both as to the early date and the high character of its efforts in behalf of the animal food-supply of the nation, its contributions to the literature of Texas, on splenic fever among cattle, being still everywhere recognized as the best of their class. Its influence, too, in support of enactments for the protection of kindred interests, has more than once been felt in state and national legislatures. It is therefore with something of the self-gratulation of Paul before Agrippa, upon the experience and wisdom of those who this day sit in judgment, that I submit to this Association, at whose hands I have experienced so much kindness in former years, some consideration of "The Meat Food-Supply of the Nation, and Its Future."

Every sanitarian will unhesitatingly admit that the food-supply of a nation is its first, its chief, concern; for "health, the first wealth," as Emerson puts it, yea, even life itself, depends upon the food-supply. To-day no problem affecting the health, even the life, of the people, calls more imperatively for the earnest attention of sanitarian, statesman, or economist. Closely related to the welfare of the nation, and to its food products, lie the questions of their export trade and transportation traffic, through which much of our wealth and its attendant advantages is secured. They are not easily divorced, and add dignity and importance to the subject. No exact and entirely reliable census has ever been taken of the wealth of the nation in food animals; and even had there been, the terrible inroads of disease, and the great losses of the herds of the South-west and North-west from severe droughts and winter hardships in the past two years, would have seriously effected its footings. A sufficient approximate has, however, been made, to furnish a reasonable basis for the calculations we shall consider, while the near approach of the decennial census of 1890 prompts the hope of that thorough reënumeration and classification which are so essential, and upon which so much depends.

Whatever the sum of this animal wealth may actually *have* been, it has surely been considerably reduced, and is now more seriously threatened than ever before by causes both natural and abnormal, which affect alike its character, its abundance, and its price. Our abundant national resources have not only made possible our own gigantic populative increase, but have brought to our shores the ill-starred millions of the whole world, who have settled up the country from ocean to ocean.

We now number a population of 60,000,000, which is at present doubling itself every twenty-five years, and whose geometrical power of increase is simply appalling. Hitherto the vast prairies and rich pastures, the broad corn-belt and the widespread ranges, with their wonderful native grasses, have been equal to the support of a store of animal life that seemed to guarantee for generations the meat-supply of this and other lands. Steadily, however, the march of westward-sweeping population has narrowed the free-grazing areas: as steadily the corn lands and rich fields of the Eastern states have become too valuable for grazing. With equal pace, and with the distribution of wealth, the consumption of meat *per capita* has increased, while an export trade in cattle and swine and their products, with the markets of western Europe, has grown year by year till it has become enormous, and is to-day our chief reliance to bring foreign revenues to our shores.

Almost unconsciously, but nevertheless with great rapidity, we are approaching those conditions, as between population and food-supply, which are the chief anxieties of European nations. The problems of the old world are fast becoming ours. It is declared by high authority that so closely related are food-supply and demand in Belgium, so narrow the margin of surplus food above the immediate wants of her people, even under extreme economy, that by consulting the prices current of her staples at a period twenty years back, her war office can determine with great accuracy not only the number of young men for the army who can be drawn from a given province, but what their average height will be. Webster, in his famous "turnip speech," pointed out how the failure of that crop in Great Britain could provoke disaster in her money centres, and that the destruction of the pea crop alone in France was equivalent to bread riots and barricades in the streets of Paris. While we are yet generations removed ftom such narrow limits, we are unmistakably moving rapidly toward conditions, especially as to the meat food-supply, which challenge our most earnest attention, and invoke every aid to defer and lessen, so far as possible, their effects.

The United States Commissioner of Agriculture has stated officially that whereas in 1860 we had 814 head of neat cattle to the 1000 population, in 1885 we had but 722 head to the 1000, and this, notwithstanding the facts that in 1860 there were no herds west of the Missouri, where now there range millions of cattle; and that since that date the holdings of the Eastern states have more than doubled. So rapid has been the advance of our population, and so great the losses to our herds, that there are to-day undoubtedly less than 700 head to the 1000 of population as compared with 814 in 1860.

In but one direction alone does science seem to have been able to affect the force of the Malthusian doctrine, that "while population increases geometrically, food increases only arithmetically." Where the ovum, from which life is derived, can be fecundated or incubated outside the producer, science has been able to greatly multiply results,—in fish-spawn 90 per cent. being now fertilized by artificial aids in place of only 10 per cent. by natural methods. With poultry eggs the incubators are able to indefinitely multiply the product; but with the progeny of mammals no rapid road to increase is found. It still takes three years to make a steer; and it is a significant fact that while the calf that is born to-day is becoming a three-year-old, fit for beef, the population of the United States, that is to eat him, will increase nearly seven and a quarter millions of people—nearly twice the population of the whole country at the breaking out of the Revolutionary war. Not only is our population thus enormously increasing, but our consumption of meat *per capita* is at the same time steadily mounting up. We consume to-day 150 lbs. of meat *per capita* against 111 lbs. in 1860, while the consumption of Great Britain has advanced in the same time from 77 lbs. *per capita* to 109 lbs.

America makes good to-day the deficiency of the meat-supply of western Europe by an astonishing total of 800,000 tons. It needs but little arithmetic to show that to give our people twenty years from now the same amount of beef alone per head they at present consume, we must carry our present holdings of less than 40,000,000 head of cattle to 70,000,000—a thing in itself impossible. It seems well-nigh certain that in twenty years there will be as few people able to eat beef twice a week in our great cities as are now able to afford it in the great manufacturing towns of Lancashire and Lincolnshire in England.

The first stomach of the ruminating animal demands "long food," that the "chewing of the cud" may furnish that flow of saliva, with its contained ptyalin, which the cereals and other food require for digestion. Grass, and its cured product, hay, have so long constituted this "long food," that it had come to be an apothegm that "the extent of the grazing area is the limit of the beef-producing capacity of the land." Increase of scientific attention to breeding, feeding, etc., has established the fact that for the production of a larger animal—of 1,600 lbs. upon four hoofs instead of 1200—for the quick maturing of this animal and his best results in "marbled beef,"—the streak of fat and streak of lean, as against the laying on of tallow fat,—the corn-belt must supplement the grazing area, and corn-fodder extend the product of the pasture and range. The rapid occupation of the range country, by settlement, soon caused the herds grazing upon it to become too numerous, and "overstocked" was a general complaint. The "spaying-knife" was called into requisition as the alternative to starvation, and tens of thousands of matrices thus destroyed to make the range equal to the support of those that remained. Texas, with superior advantages for cheap and prolific breeding, but having no native grasses on which to fatten her herds, had long found a ready market for them upon the ranges of the North-west. These now "overstocked" and favoring a better class of animal, fearful of the damages of Texas fever (now rendered greater than ever by the closing of the trail and the increased transit by rail), have no further use for the Southern cattle; and Texas, as a source of bovine food, has become, and must still further become, a lessening factor in its supply, though she may, instead, give us our mutton.

It is evident from the foregoing statements, the practical accuracy of which cannot be seriously questioned, that the second important staple in our food-supply, and the principal one of our export trade,—meat,—is rapidly diminishing from three natural causes:

1. The enormous increase of population, and its consumption;
2. The diminishing grazing area; and
3. The increased cost of production.

But aside from these natural influences, two that are distinctively abnormal additionally threaten and depress the industries which produce flesh food. The first of these is disease, which, of several types and of varying powers of communicability and destruction, has wrought havoc in the past five years upon the cattle and swine of the country. The second consists in old and new enactments of congress and state legislatures, and the unwise and unjust administration of these laws.

To these untoward influences may be added another, which is always potent for good or ill, and in this connection has been productive of no little harm, viz., the unfriendly attitude of the press, which, without malice, but from lack of information as to the real value and dignity of the interests it criticised, forgetting the deep concern the whole people must have in all that relates to the food-supply, have hurt oftentimes where they should have helped; have misrepresented because they did not know; and failed to aid where every ounce of assistance was demanded for the common good.

Wastefulness, too, has made, and still makes, its outrageous deductions in astonishing totals from the dressed product of the shambles. European economies in the use of food are yet unknown to our native, and to a part of our foreign, population. The inevitable results are, the loss of an enormous percentage of excellent flesh-food that has cost money to produce, prepare, and transport, gives no equal return, and places considerable increase of price upon all that is consumed. Unfortunately, as a nation, we make little use of soups, stews, or *ragoûts*,—those excellent forms of concentrated food which nourish so well, cost so little, and utilize so admirably the portions we now so wickedly waste.

I have said that the first of the purely abnormal influences which threaten and depress our animal food-supply is disease in its varying forms. Chief in the list stands pleuro-pneumonia, which, purely exotic in its character, has, in its outbreaks of the past five years, inflicted a direct loss upon the country of between $20,000,000 and $30,000,000; has taken $10 per head from the price of every steer shipped abroad, as now slaughtered on the docks of his port of entry; has deprived the land of a large amount of valuable food; and if it shall ever reach the Western ranges, must inflict great damage upon the cattle industry and our food-supply, perhaps repeating its history in southern Africa and Australia where its march could only be stopped with the utter extinction of the herds.

For four years the great cattle industry of the nation, as represented in its Consolidated Association, has made vigorous and steadfast war upon the disease, first setting up, with the help of this Association, as an instrumentality, the Bureau of Animal Industry, which, with the enlarged powers and means secured for it from the last congress, has been able to accomplish most gratifying work.

Those of varying interests and large stakes in the cattle business have, however, of late years, urged the establishment of a commission, to be named by the president of the United States, upon whom congress could and would confer degrees of power they refuse to vest in a department bureau, and which would not only have the eradication and prevention of disease as its sole duty, but would give representation to the practical stock-grower, the middleman, and the scientist alike.

There has been a difficulty in harmonizing the several views held, and a consequent loss of results as compared with what should have been; but it is no small pleasure to be able to state that at the convention of stock-growers, under the auspices of the Consolidated Association of the United States, just closed at Kansas City, all factions united in complete harmony upon the support before congress at its approaching session of the so-called Miller bill, providing for a commission, so amended as to make the Commissioner of Agriculture *ex officio* a member, and its chairman. It is no small cause for congratulation among sanitarians and state boards of health, as well as stock-growers, as it no doubt practically insures the speedy enactment of a law which creates an adequate and special power to deal with disease, able to take the field and prosecute the work all along the line at once, and leaves those who have been overburdened with its administrative work to the freer discharge of those scientific and other duties which are of such infinite value.

Inasmuch as the eradication and prevention of disease rest upon a purely scientific basis *ab initio*, the features of the bill which make ample provision for scientific experts, than whom none has done better service than the present able chief of the Bureau of Animal Industry, who is unaffected thereby, will be appreciated by all sanitarians.

As indication of the conviction held by the great majority of those who have large investments in stock-raising, that the further present introduction of the disease should be effectually stopped, it may not be amiss to mention that the Kansas City convention voted almost unanimously to urge upon the Secretary of the Treasury the total prohibition of importation of cattle for the present.

The second of the abnormal influences I have named as actively operating to depress and injure the producer of meat, resides in unwise laws, and in their still more unwise administration, state and national.

That the country may have its meat-supply abundant, and hence cheap, every facility for raising it must be afforded, and the cost of its production be kept at the minimum.

The Commissioner of Agriculture has well said,—" It is only the new region that has so recently been developed west of the Mississippi that has enabled the increase of our cattle to keep pace with the population. In the older settled states the agricultural class has not held its own in its relation to the other classes of our population. Farms have been divided and sub-divided; and cattle-raising, and particularly beef production, has given way to grain raising and to fruit and truck farming."

It is plain that by so much as the cheaper and prolific methods of the cattle-grower of the range are hampered and rendered expensive under the operation of needless and unwise law, the more difficult to obtain and the higher priced will be the meat-supply of the consumer.

Whoever has crossed the continent, or been familiar with the great arid wastes and their contiguous mountain regions, knows how utterly worthless for any purpose but that of an open grazing country this part of the public domain is. The home of the buffalo and elk should become the habitat of the grazing steer. Yet to-day the restrictive policy of the general land office, in opposition to the broad and liberal traditional policy of the government since its foundation, which has built up a nation as it were in a day, withholds these lands from the only use to which nature has adapted them, or man been able to apply them, in behalf of the imaginary settler who will never come. The hand of government, which should be put forth to foster and protect all the interests of production, itself has overturned an industry which, as the distinguished officer in charge of its Agricultural Department says, " could alone give meat in adequate supply and at low prices to the people."

The long series of disaster, which has crippled and well-nigh paralyzed this great industry, was precipitated by the uncalled-for and unwise action of the administration itself, and the intelligent men of all political parties, who know the facts, deprecate and condemn this action as short-sighted, and detrimental to the nation in the highest degree.

In the great territory of Montana only three per cent. of its area is arable land, and less than three per cent. more can be made so only by those large combinations of capital which alone can bring it under irrigation and cultivation. Against this, as against the producer of cheap beef upon the wild public domain, the government has set its face; the industry languishes; and the people, in the end, pay the price. It is time that, in the interest of truth and the general good, in behalf of the great cities and our fast doubling population, the real facts should be known and understood; that with the wiser regulation of our Indian affairs the vast areas now assigned to the nomadic savage, without benefit to him and in detriment to the whole people—six thousand acres to every warrior, squaw, and papoose in Montana—should be made available, under proper restrictions, for the production of cheap food for all. To this subject as worthy the honest investigation of every sanitarian, I invoke your attention, confident of the result and its influence upon your future action.

It was reserved for the 49th Congress of the United States to enact the first law ever passed in the history of our government to depress and ruin one great food-producing industry for the benefit of another.

While every sanitarian endorses, as wise and right, every law which properly secures the wholesome character of any article of food, or prevents fraud in its manufacture and sale, he must equally deplore any enactment whose force and purpose are to prohibit the manufacture and sale of an article which both science and practical use has unmistakably proven to be a cheap, sound, and wholesome addition to the food-supply.

Oleomargarine, butterine, and other simulants of butter and cheese, as regulated by law in their creation and exposure for sale, are no longer subject to the suspicion and condemnation of the well informed man. They have passed under the ægis of governmental protection as wholesome and proper articles for the people's use. The ablest chemists have endorsed them, the Commissioner of Internal Revenue, after a year's experience with them under an all-powerful law, declares that there is no complaint as to their quality; and the poor man, who cannot buy the best butter at its ruling price, would gladly and thankfully buy and use them if he could. But with a purblindness that history will note with a shudder of surprise, some states have actually totally prohibited their being made or vended in their borders; others have stopped only just short of this; while congress, by imposing a special tax upon the retailer of $48 per year, and of $480 upon the wholesaler, has compelled thousands of dealers to remove them from their stock, and has driven the poor man to the use of poisonous "glucose" syrups, cheap "fruit butters," self-denial, or the purchase of high-priced butter, which he cannot afford.

Either such men, in whom we place confidence, as Professors Chandler, Atwater, Sharples, Babcock, and a host of others, are all strangely and simultaneously deceived; the fact that not a single case, well attested, can be adduced of its having wrought harm, must go for naught; or, as sanitarians, men of common-sense, and earnest well-wishers of our fellow-men, it is time for us to stand upon the truth, and for the common weal urge the revocation of those features of the laws, which, taxing a helpful addition to our food-table, higher even than tobacco, put it out of reach of those to whom it is a blessing and a boon. Even the hoped-for benefit to the dairyman, in whose interest these laws were enacted, has failed to result; and only the makers of sour, cheesy, and rancid butter, and the speculator who chemically treats them and defrauds the community, profit thereby.

From the evidence given, it is plain that, extend the grazing areas to the utmost by the larger use of the public domain and the addition of the unused excess of the Indian reservations; supplement it by the enlarged use of fodder-corn and the finishing processes of the corn-shed, by breeding and feeding put upon every four hoofs the largest possible amount of "marbled beef;" stimulate the hog producer by all devisable means; secure the better utilization and economy of our dressed products,—and still the steady onward sweep of the tide of population will constantly outrun our supply, and these agencies will but serve to check, retard, and lessen, for a time, the great and inevitable disproportionate decadence in our meat-supply.

But it is much to bring into full play all these forces, and to secure for all even the longer enjoyment of the abundance we now possess. No nobler work commands our efforts, and to you, I know, it commends itself.

Against disease and its baleful effects I need not invoke your earnest and continued warfare, for the history of the Association is ample proof of your zeal and endeavor. I venture the hope, however, that the expression of this body, which has heretofore been known and felt in the halls of congress, will again be given in aid of that legislation for the suppression of pleuro-pneumonia, upon which all contending forces are now a unit, and which will, it is confidently believed, not only rapidly complete the work of eradication already well begun, but leave "on deck" an authorized agency, clothed with power, ready and able to cope with any outbreak of the future.

I am not ready to believe that this Association, which stands as a mentor and leader upon all subjects that effect the sanitary well-being of the public, will keep silence upon laws that deprive the poor man of a valuable article of food, in the interest of another product; and I am the more ready to voice this belief from the fact that my own pecuniary interests lie more with the dairy than the beef industry.

And finally, I beg to express my earnest hope that we shall do ourselves the justice, as on a former occasion, in the interest of vital statistics, to press upon congress, by resolution, the wisdom and necessity of making adequate provision in the laws providing for the taking of the United States decennial census of 1890, for a full and complete enumeration and classification of our food-animals, and tabulation of their products which enter into our food-supply.

VII.

THE NECESSITY OF BURIAL PERMITS AND INSPECTION OF THE BODIES OF DECEASED PERSONS.

By CARL H. HORSCH, M. D.,
Dover, N. H.

In this great country we find an aggregation of people from all civilized and also from uncivilized nations. The forefathers had to settle so many vital points for the establishment of a free nation and its subsistence that they had only a small amount of time for the development of arts, science, and state medicine. In older countries the artists, scientists, and professional men had not to spend as much time for the establishment and maintenance of a free nation as free American citizens were compelled to do. When the brave Dr. Warren wielded the musket against oppression he had no time to invent a stethoscope, or to inspect the bodies of his fallen comrades before his own body fell among them; but if he could be with us now he would be likely to consider it his imperative duty to do his part toward state medicine, and to bestow on his deceased patients and their families that humanitarian measure of examining the bodies, to convince the relations and himself that the persons were really dead. Among the ancient nations we find various efforts to guard against premature burial. The Egyptians embalmed their dead; the Romans cut off a finger before they put the dead bodies into the fire; in other nations the dead bodies were washed, rubbed, and anointed.

In 1791 the celebrated medical practitioner, Dr. Hufland, made his excellent efforts for the inspection of the bodies of deceased persons. In an address he said,—"The holiest duties of humanity, our self-preservation, the love of children, parents, husbands, and wives, demand of us that we shall not neglect those means, and the only ones by which the loved ones can be saved from the terrible fate which only a tyrant can forge upon his victim, the only ones whereby in the future the groans in the grave, the dreadful accusers of our negligence, may be averted."

The first *leichenhaus* (house for the dead) was erected in Weimar, Germany, in 1791. Now we find such institutions, where the bodies of deceased persons are kept until the time of burial, in many of the cities and towns of Germany. In those buildings we find convenient arrangements for isolation and disinfection of contagious and infectious cases, and for *post mortem* examinations. When I was in Germany, in 1884, a nephew of mine died in Lindenau, a town near Leipzig. I was present when the *post mortem* examination was made in the *leichenhaus*, and found everything as well arranged as we find in hospitals. If I had the money I would consider it one of the best efforts of my life to found and provide for all the conditions of such an institution.

Dr. Granville P. Conn, the president of the State Board of Health of New Hampshire, requested me. in the meeting of said board, March, 1883, to introduce burial permits in Dover, N. H. I proposed that measure to the city councils of our city, and likewise the inspection and examination of the bodies of deceased persons. The following amendments to the city ordinances were passed:

Ordinance in amendment of Chapter XVII, City Ordinances.

Be it Ordained by the City Councils of the City of Dover:

That Chapter XVII of the City Ordinances (relating to vital statistics and funeral undertakers) be amended after section 2, to read as follows:

SEC. 3. Whenever any person shall die within the limits of the city, it shall be the duty of the physicians attending such person during his or her last sickness, to examine the body of such deceased person before the burial thereof; and to make out and sign a certificate setting forth, as far as the same may be ascertained, the name, age, color, sex, nativity, occupation, whether married or single, duration of residence in the city, cause, date, and place of death of such deceased person; and it shall be the duty of the undertaker, or other person in charge of the burial of such deceased person, to add to such certificate the date and place of burial, and, having duly signed the same, to deposit it with the city clerk and obtain a permit for burial; and in the case of death from any contagious or infectious disease, said certificate shall be made and forwarded immediately.

SEC. 4. Whenever a permit for burial is applied for, in case of death without the attendance of a physician, or it is impossible to obtain a physician's certificate, it shall be the duty of the city physician to make the necessary examination, and to investigate the case, and make and sign a certificate of the probable cause of death; and if not satisfied as to the cause and circumstances attending such death, he shall so report to the mayor.

SEC. 5. No interment or disinterment of the dead body of any human being, or disposition thereof in any tomb, vault, or cemetery, shall be made within the city without a permit therefor, granted as aforesaid, nor otherwise than in accordance with such permit.

No undertaker, superintendent of cemetery, or other person shall assist in, assent to, or allow any such interment or disinterment to be made until such permit has been given as aforesaid; and it shall be the duty of every undertaker, superintendent of cemetery, or other person having charge of any burial-place as aforesaid, who shall receive such permit, to preserve and return the same to the city clerk within forty-eight hours from the time of said burial.

No dead body of any human being, from without the limits of the city, shall be received into or allowed to be buried in any cemetery, or other place of interment in said city, unless the person in charge, superintendent of cemetery, or undertaker, shall have first obtained a permit from the city clerk; said permit to be issued upon the certificate of the physician who attended the deceased during his or her last sickness.

Section 4 of this chapter shall be numbered section 6.

Section 5 shall be altered to read as follows:

Any person violating any of the provisions of this chapter shall be fined not less than ten nor more than twenty dollars.

Passed April 10, 1883.

An Ordinance in amendment of Chapter XVII, Section 3, of the City Ordinances.

That the fee for examining and inspecting the bodies of deceased persons, as required by Section 3, Chapter XVII, of the City Ordinances, be and hereby is established at one dollar for each inspection, which shall be paid by the city of Dover.

Passed October 4, 1883.

The inspection and examination of the bodies of deceased persons are necessary for the following reasons:

1. It is the best safeguard against the possibility of premature burial, and also that the apparently dead may not be placed in cold rooms or on ice and frozen to death.

2. Cases of concealed contagious and infectious diseases will be detected. and an epidemic may be averted.

3. Murder and suicide may be detected; and if cremation, the surest method for the destruction of disease germs, is generally established, there will be also less danger that the body of a murdered person will be cremated and the crime concealed.

4. Life insurance frauds may be prevented.

5. Where the fear exists of being buried alive, the family physician can overcome that fear by examination, and by his assurance that the loved one is dead.

6. In order to sign a certificate for a burial permit legally, that inspection gives the most important evidence. If a physician gives his signature to such a certificate without seeing the body, he may be brought into the following unpleasant position: He is called into court; the certificate is laid before him, and the questions asked, Did you sign that certificate? Answer. Yes. Did you know that the person was dead? The only answer could be, The undertaker, or somebody, so informed me. Then the culprit is brought before him, and the fact revealed that he indirectly aided a criminal who tried to defraud a life insurance company.

WHAT ARE THE SIGNS OF DEATH?

Orfila Most and Vilerme give the following: "Marble cold, rigidity, no pulse, breathing, motion, and no sensation; the sphincter muscles are relaxed, the blood from an opened vessel does not flow, the eyes are sunken, the cornea is covered with a film, the skin is pale and dry, yellow or lead-colored, forehead wrinkled, nose drawn up, the edges are often black or brown, ears hanging, red or dark spots on several parts of the body (todenflecke), death spots. On placing the hands before a light, we do not find the red color between the fingers, they are less transparent; the first joint of the thumb is bent toward the middle of the palm of the hand, the other fingers are bent and stand apart; when putrefaction commences, which is the surest sign of death, we have the characteristic smell of a corpse."

There are various methods for the detection of life in cases of asphyxia and where we are uncertain whether the person is dead or not:

1. To tie a string around the middle of a finger: if there is life the part will turn red and we find capillary action.

2. Holding a looking-glass or a piece of polished metal before the mouth, we may find the condensation of the vapor on exhalation.

3. A candle-light or a feather held before the mouth or under the nose will show motions if there is respiration.

4. Setting a tumbler full of water on the chest and keeping the surroundings quiet, we will see a motion on the surface of the water if there is feeble breathing.

5. Opening a vein, and if the blood flows there is life.

6. Vesicatories and irritating applications will produce blisters or redness on the skin.

If we find either one of those signs of life, we should try the various methods for resuscitation:

1. Remove the slime from nose and mouth.

2. Blowing in pure air through the nostrils carefully and gently.

3. Apply pressure againt the chest and abdomen, and imitate the motions of the thorax and abdomen during respiration.

4. Percussing the body and other methods of massage.

5. Rubbing the parts of the body upward.

6. Application of warm flannels.

7. If we ascertain respiration, put the patient in a warm bath, and make after that irritating applications.

8. Apply electricity. Dr. Most relates a case where he used electropuncture;—he inserted the needle half an inch deep in the sixth intercostal space on the left side, and after applying the electric battery twenty minutes the lips became red, sighing and breathing commenced, and the child one and a half years old, who had been apparently dead for an hour and a half, recovered.

Haller, Brinkmann, and others give a number of cases where the person had almost all the signs of death, and after days and weeks recovered. Heim confesses in his letters that he pronounced a child four years old dead, and after twelve hours his patient came to and recovered. Haller communicated cases where persons had so much command of their will that they could voluntarily appear like dead persons; he found them stiff, cold, without pulse or breathing. Pinching, burning, and puncturing the flesh made no impression, and it seemed as if they did not feel it. Haller gives the names of two gentlemen who had that power of will,—Rev. Mr. Rhodiginus and Col. Townsend.

Mr. Hiram Hoitt, of Dover, N. H., told me, on December 11, 1886, after I had inspected the body of his deceased wife, that his aunt, Nancy Reed, of Barrington, N. H., was apparently dead two days after having a fit, and when the preparation for the funeral was going on she manifested signs of life, and after some efforts recovered. Mrs. Reed was then nineteen years old, and she died about five years ago aged eighty years of age.

Henke, Hufland, and others found that apparent death occurred mostly in newborn children, in the female sex, weak persons, persons who have epilepsy, hysteria, hypochondria, asthma, small-pox, hemorrhages, losses of the fluids of the system by chronic diseases with profuse discharges, and persons suffering from spasms.

All citizens, gentlemen, who have the welfare of humanity at heart, rejoice that the time has come when state medicine can and does receive more attention; and let us hope that this humanitarian and sanitary measure—the inspection and examination of the bodies of deceased persons—will be carried out faithfully by all medical practitioners, and that the medical profession will receive assistance and full appreciation from the people.

NOTE. The historical facts are taken from Dr. George Friedrich Most's Complete Encyclopædia of State Medicine, Crusführliche Encyklopædie der gesammten Staatsurzneikinde, Leipzig, 1838 and 1840.

VIII.

THE ORIGIN OF SOME DISEASES.

By EZRA M. HUNT, M.D.,
Secretary New Jersey State Board of Health.

The class of diseases variously known as contagious, transmissible, or communicable, has ever attracted the most earnest consideration of medical men and of all sanitarians. By the quickness and often obscurity of their invasion, by the malignant type they too often exhibit, and by the large areas over which they extend, they not only make large demands upon the skill of the profession, but arrest the attention of all mankind.

The study of epidemiology has enlarged their numbers, and now shows us that many diseases once regarded as constitutional or septic are in reality specific and pathogenic, or mostly parasitic. The prevention and limitation of this class of maladies must ever therefore largely occupy the attention of all those who study the causes, the courses, and the results of disease. The study of their etiology is always a fundamental inquiry. While to a degree it is possible to treat a disease skilfully without knowing its causes, it is always more satisfactory and generally more skilful to know something of the causes.

But what do we mean by etiology or causes? Surely not always, not generally, the beginning, or efficient, or final cause. Prof. Semmola, of Naples, at the recent meeting of the Medical Congress at Washington, may have startled some by these words: "Medicine, like all other sciences, never demands why, well knowing that the first causes of things are inaccessible, and that to every scientist it should suffice to know in which physical and chemical conditions this or that phenomenon manifests itself, so that he can modify and govern it at his will." This is true. The best that we can generally hope is to find the conditions, physical, chemical, or biological, in which phenomena manifest themselves. The word cause is often in the same sentence used in two or three different senses. In our etiology we must remember that by cause we mean mostly the "conditions under which phenomena manifest themselves." Also, that these conditions (thus called causes) mean the modifying influences present in the host or person, and the modifying influences of surroundings, much oftener than they mean anything in the specific entity which we are so often calling the germ and then calling it the cause.

While reaching back toward the beginning, even though we seldom reach the starting-point, we do come to see how it is true of every disease, as of every living thing, that it must have had a beginning. It is not a mere platitude to say that there was a day when the first case of smallpox occurred.

Nor does it necessarily belong to the sphere either of creation or spontaneous generation. A case of some new disease may put in an appearance, as did cholera on the Ganges; or a case of a known and existing disease may happen that is not derived from another precisely like it, but occurs because analogous conditions to those which gave rise to the first case of the kind have again occurred, and produced a pronounced deviation.

So it is possible that at the same time, as to some one disease, we may have cases of a communicable disease, which have arisen from previous cases, and other cases that have resulted from a combination of influences or conditions such as gave rise to the first case. There are at least two reasons why the old dictum of *omne vivum ab ovo* cannot now be applied with the precision, or with the finality, with which it used to be quoted.

I. There is such a thing as evolution, which, while recognizing an original type, also recognizes departures from the normal, which may have come to be so representative and paramount as to constitute newness in all essential particulars. Since we have come to recognize that many diseases are but developments and cultures of microphytic or microbic life, we very appropriately turn to the facts of botany, not only for illustration, but for verification of our theories. And what a change has taken place in its facts since the days of Linnæus! We no longer cling to the divisions of orders, genera, and species so closely as laid down by him. We recognize two forces—nature or heredity, and environment. A plant inherits a likeness which it tends to retain, but it is often so modified by environment as greatly to change, and so sometimes as even to lose, its identity. Environment comes to predominate over heredity. The horticulturist often takes a plant which he has found to be subject to variations, and fixes and perfects it in some one of them by cultivation.

Prof. Huxley has recently contributed to the Linnæan society a paper on the classification of gentians, in which he claims that gentians are all specialized,—that is, become gentians from some other form. Permanency of type has so many exceptions, that variations of type, and the power to give fixity to some of these variations by means of cultivation or environment, must be accepted as a doctrine and a fact. Species and genera have variations, sports, and modifications not dreamed of by the earlier botanists. Some of these departures are so marked and so predominant as to obscure the relationship, and so far ignore it as to have individuality of their own. If, as we know, cultivation or surroundings can change a poisonous plant into a mild one, or can wholly modify it, it is not remarkable that a microphytic disease should lose its apparent identity, and at length, in a new culture-medium, or under special conditions, become specialized. It is a law abundantly illustrated in the vegetable world, that environment causes variations, and that some of these variations tend to fixity of type, while others do not. All the wonderful facts of evolution show full well that we may, in this way, have what, in respect of symptoms and treatment, is a new disease. Yet it is not a *de novo* origin in an absolute sense; or, if practically *de novo*, it is not *de nihilo*. It is, that a series of changes has been evolved by environment, by conditions in persons or in surroundings, until the result of some of these changes becomes self-assertive, and prevails over its heredity so as to secure for a longer or shorter period a fixity of its own. This fixity may be a new disease.

II. The history of hybrids, the so-called accidents of their occurrence, and the fertility of hybrids are such that we are forced to look upon them as new forms of life—as becoming established into an autonomy or individuality of their own.

The horticulturist, in some of the wonderful productions of new plants in the last score of years, has come to be familiar with hybridisms that wholly obscure origin, and that come to have a fixity of their own as much as some new diseases with which we have to deal, or as much as cases of diseases which we cannot trace to a contagious source. All this has been greatly emphasized by what we have come to know as to the fertility of hybrids.

Not over thirty years ago the generel view of botanists was that hybrids were sterile. But so numerous are the exceptions, and so abundant have been the results of new cultivations, that this view is fully disproven. Says a recent botanical authority,—"Among plants there are many instances of hybrids between species being perfectly fertile, and continuing so for an indefinite period. Experiments during the last twenty-five years have increased the number of such fertile crosses manifold. . . . Fertility of hybrid plants is the rule, and sterility the exception. So far as plants are concerned, there is not the slightest ground for considering sterility as a distinctive bar, separating species. These hybrids come to have a specificity of their own so different from the parentage as to be unrecognizable, and so specialized as to be permanent. As another expresses it, 'The hybrid becomes an individual not responsible to its species.' Nor is this confined to plants with spores. Some of our most skilful horticulturists are now producing varieties of ferns by hybridism, and every now and then some so-called chance growth or sport shows wide departures."

The bearing of all this on the parasitic forms of disease is not far to seek. If, as now seems so nearly proven, so much of disease has to do with elementary and minute forms of vegetative life, it is to see how the facts of evolution and hybridism have a bearing upon the appearance and propagation of disease. The light of the botanical world, and its marvellous revelations as to the actualities and possibilities of the origination of new forms distinct from the parentage, penetrates the hidden sphere of disease-origin, and shows how some diseases cease, how others arise, how some lapse back to their heredity, while others are made permanent or are specialized by their environment, and how others still are hybridized into specific forms and acquire a fertility and fixity of their own. This range of deviation is so wide as to account for very many of the anomalies of disease, and for the organization, cessation, or modification of form or type.

In reply to my inquiry on this particular point, Mr. Mehan, the distinguished botanist of Germantown, Penn., writes me,—"All hybrids, that we know by actual experiment are hybrids, are fertile as far as I know, and reproduce their originals just the same as if they were 'original' species. I think almost every botanist of note believes in abundant, fertile hybrids in nature. Coming down nearer to your own line of thought, I believe it is conceded that all lichens are hybrids between fungi and algæ. It is tenable that new forms of disease are continually coming into existence, which can only arise from new forms of disease-producing plants (microscopic fungi) being evolved from older species; but I do not know whether there is an opinion that these new forms are the result of hybridization, or of that natural law of change which seems to be a constituent part of existence—in vegetation, at least."

In a paper read by Dr. M. W. Taylor before the Epidemiological Society of London, April 13, 1887, he notes the fact that many of the fungoid varieties were but "conversions of elementary states of pencillium and oïdium. It is also maintained by Zopf (the botanist) that there may be a *pleo-morphism* amid pathogenic micro-organisms, and that there are stages of intermediate forms resulting from the nature of the nutrient media." (See *Lancet,* May 7, 1887, pp. 933, 934.)

The view is, we believe, gaining ground, that harmless microphytes may become pathogenic, and that the different forms of micro-organisms present have relation to each other, and that the culture-medium in disease, viz., the person and his surroundings, determines the character of the micro-organisms fully as much as the micro-organisms determine the character of the disease.

If the views as to the microphytic origin of most of the communicable diseases are correct, the study of the laws of this evolution and hybridism is vital. We believe it is in this direction that we are to account for the origin of new diseases, or for such variations in type as obscure or destroy identity. If we can, through this study, arrive at the evidence that in this sense many diseases begin, we have a new department of study, in that we are called upon to define with accuracy how and why this origin takes place, in order that we may thwart or circumvent the conditions.

If it is the result of evolution through a long series of changes, it behooves us to study the process, and to watch and record all the gradations by which the unfriendly result is attained, so that at some stage we may intercept the progressive and threatening changes that are occurring, or ascertain what condition of the person, or what condition of surroundings, constitutes the influence which brings about the change, or provides the fertilizing medium for the disease, and causes it to break forth. If it is the result of a hybridism, which occurs spontaneously or rapidly, we need to study precisely what forms of vegetative life thus incline to coalesce, under what condition the union occurs, and how their conjunction, development, and fertility are to be interrupted.

If special conditions of some parts—as the throat, for instance—or certain conditions of the secretions, furnish a special soil or culture-fluid for the propagation of low forms of vegetative life, these are to be studied with exactness.

In each of these lines the same method of technical study and close record and analysis of facts by competent observers, which has prevailed in the study of minute plant-life by botanists, and which has obtained in many other sciences, will, in this comparatively new field of biological and botanical research, accomplish equally valuable results. In it we are attempting to find out how much, and under what circumstances, micro-organisms imperil human life. The practical value of such an inquiry is apparent, for sooner than is the case with most of the studies of nature the results will be applicable in the prevention and treatment of disease. It will be a great gain if we can come to know that, either under the laws of evolution, or as the result of admixture or hybridism, symptoms and pathological effects become specialized so as to constitute a new disease which maintains its type.

As examples of how proximity of different diseases may modify symptoms, we have many suggestive facts in the history of disease. Yellow fever is believed by many to be a mongrel, born on the high seas by admixture of the jungle fever of Africa with the typhus of the pent-up hold of the filthy vessel. It is not certain that typhoid fever was not once nearer to typhus, until it came to be called abdominal typhus, and then to have modifications because surroundings and the acquired power of self-propagation gave it an autonomy of its own.

It is not even now certain that there are not grades of cesspool and other adynamic fevers that will some day declare another well marked departure from what we now call typhoid, and come to have an individuality of their own.

It is not certain that when Sydenham treated scarlet fever and measles as one disease, their lines of difference were as well marked as now.

Diphtheria so often seems to have a localized origin, and common forms of sore throat are so often seen to pass away from their general into a special type, that it will not be strange if we come to the law of departure. (See views expressed in the "Sanitary Record" of August 15, 1887, p. 88, and the contribution of Dr. Wordin, in the "Connecticut State Health Report" for 1887, that diphtheria results from the special virulence of a micrococcus which is not specific, but present in forms of foul or septic sore throat.)

While typho-malarial fever has no pathognomonic lesion to distinguish it from the ordinary typhoid, yet we do know it has symptoms to distinguish it.

The advances of biological investigation have put us in regions of new possibilities that do not involve spontaneous generation, but yet do render probable what is equivalent to the *de novo* origin of cases of disease, which afterward are chiefly communicated by the first and succeeding cases. Having settled that such origins do take place, we shall then pry into the secret of the laws of combinations and the conditions which favor the evil evolution or the facts of hybridism, and seek to combat these by starting similar processes in opposite directions, or by sterilization, neutralization, disinfection, and all the details of radical sanitation.

Such a view of the occurrence of old or new diseases, and of the reasons for fixity in some and changing forms and types in others, leads to several practical results:

1. The study of parasites, or germs, as they are called, is only one of the methods of informing ourselves as to the phenomena of disease, and in itself is not primarily the key to rational and successful treatment.

2. Our attention should be directed far more than now to the study of conditions and circumstances under which new forms appear; to the influence of persons and surroundings, instead of to the mere finding of a specific form. The latter would, of course, be most valuable as one of the facts in the chain of evidence, but we should not, as now, seek so much to look to it as the cause of disease, as to inquire what conditions have *caused* this or that particular microphyte to be present.

3. We should be able to account for the occasional occurrence of a disease independent of any previous case, and for changing types of disease and new diseases, and would come to treat diseases less by their names and more in view of their type, and the effect of surroundings upon them.

4. The tendency of all this is to magnify the importance of close observation, and to lead us to feel that success in warding off disease, and in treating it when it appears, depends mostly upon close observation, and that experience which is derived from actual practice.

If we are looking to the biological laboratory for the natural history of disease, or to the chemical laboratory for the application of remedies, we shall surely fail. The science or art of sanitation has far more to expect from a study of the conditions of persons and surroundings under which diseases or types, and modifications of disease, manifest themselves, as also from a study of the prevention or obliteration of such conditions, than it has to expect from the finding of microphytes as the source of disease, and seeking to cure disease by expelling micro-organisms or attenuating them.

Our only design in this paper is to awaken inquiry as to modes of accounting for the localized origin of disease, without any antecedent case, on the proposition that the laws of evolution, environment, hybridism, or modification by culture, give rise to diseases so different from their prototypes as to have individuality and permanency of their own.

Because such inquiry is relevant to prevention, there is good reason to believe that by ascertaining the laws of these transformations and modifications of type and of the origination of special varieties, we shall ere long find new means for the prevention or limitation of many diseases.

IX.

SANITARY WORK BY THE HEALTH DEPARTMENT OF BROOKLYN, N. Y.

I.

While sanitary science has made great progress, and many practical appliances have been introduced for the protection of the people against the inroads of contagious and infectious diseases, it is a fact too well known that all the efforts so far have been only partially successful in mitigating the spread of those diseases coming under the above catagory.

The germ theory of infection, while almost universally accepted, in all cases is not quite satisfactory. In the food and water supplies are diligently sought the causes of many cases, and in many instances these are found to be contaminated with some foreign elements inimical to the healthy functions of the body. Yet at times the sudden development of contagious or infectious diseases, without our being able to trace the cause, shows us that we are yet only on the threshold of certainty as to what really does cause disease.

Malaria among the doctors, and sewer-gas among the sanitarians, have become the harbors of refuge in which they anchor safely, and maintain their theories against all comers. And yet this refuge is sometimes visited with a tidal wave, that, with the force of the cyclone, carries them from their moorings.

Epidemics of diphtheria, typhoid and scarlet fevers, breaking out in regions remote from sewer-gas, and where examinations of air, food, and water entirely fail to throw light on the origin of the outbreak, are familiar as a part of the history of these diseases.

To show how far protection protects in the suppression of small-pox, where it breaks out among a dense population, part of whom have views on the protective powers of vaccination, others, fears of being taken from their homes and sent to a hospital, the following statement of the conduct of the cases and abstract are given. In the management of these cases with us, as soon as they are discovered and diagnosed and confirmed, the patients are removed to hospital without delay, often in the middle of the night, the importance of time being fully recognized. Fumigations follow without delay, and physicians vaccinate all who can be reached, not only in the houses where the outbreaks occur, but around the entire block, and, following so far as possible the steps of the patients immediately before the attack, vaccinating, so far as they can be reached, all with whom they had come in contact, with the above precautions applied.

The following table shows that a period of more than fourteen days of quarantine must be observed before the restriction can be cancelled with safety. First, a concealed case occurred in a tenement house.

June 25.	78 North 5th street, first case.
July 25.	78 North 5th street, second case.
July 2.	76 North 5th street (next door), three cases.
July 2.	76 North 5th street, four cases.
July 3.	76 North 5th street, four cases.
July 5.	76 North 5th street, two cases.
July 8.	76 North 5th street, two cases.
Oct. 26.	173 Troutman street, one case.
Nov. 8.	173 Troutman street, three cases.
Oct. 25.	106 Elm street, one case.
Nov. 7.	106 Elm street, one case.
Nov. 9.	106 Elm street, one case.
Oct. 26.	305 Broadway, one case.
Nov. 5.	305 Broadway, one case.
Nov. 14.	305 Broadway, one case.
Oct. 29.	1856 Fulton street, one case.
Nov. 24.	1856 Fulton street, two cases.
Dec. 25.	160 Third Avenue, two cases.
Dec. 27.	160 Third Avenue, two cases.
Dec. 29.	160 Third Avenue, one case.
Jan. 3.	160 Third Avenue, one case.
Jan. 5.	160 Third Avenue, one case.

HOSPITAL FOR CONTAGIOUS DISEASES.

After prolonged efforts the proper legislation has been effected for the "establishment of a contagious disease hospital" in Brooklyn. In the "Budget" of 1887 was included the sum of fifty thousand dollars ($50,000) towards the expense of beginning this enterprise.

The aggregate number of contagious diseases, as contained in the last annual report, was 5,927. By prompt removal, where these cases occur in hotels, boarding-houses, or densely populated tenement districts, the establishment of such an hospital will afford great relief, and lessen the labors of the department, and be a source of protection to the people. A site has been selected and a building planned for the use of the vaccinators' bureau, where persons coming from houses that have been infected can be vaccinated without coming in contact with people who have business in the public departments, the form of Pavilion hospital being considered the most suitable for the above purposes.

PRECAUTIONARY MEASURES.

A corps of vaccinators are employed from October to May who make house visitations, and vaccinate all who need and will receive it. Parochial schools are visited, and the scholars examined, and all are vaccinated who need it. When cases of small-pox occur, the patients as a rule are sent to the county hospital. All materials carrying germs are fumigated or destroyed, and the rooms thoroughly fumigated with sulphur two or three times at intervals of three or four days. Where locations have appeared to be centres of diphtheria or typhoid fever the sewers have been flushed, and disinfected with chloride of lime and some well known germicide and fluid disinfectant.

PLUMBING.

A corps of plumbers are constantly examining plumbing, both old and new, and ordering the necessary alterations and repairs where defects are found, and seeing that all water-closets and waste-pipes are properly trapped, and closets thoroughly flushed and ventilated. The food-supply is jealously guarded by competent inspectors under the supervision of the chemists of the department.

In reference to the prevention of cholera or other contagious diseases from entering the city by means of vessels passing quarantine no vessel having had such sickness aboard, and released from quarantine, is allowed to discharge at our wharves before a special inspection; disinfection is again had, and goods, as rags, wool, jute, cotton, or such materials, are not allowed to be discharged under any circumstances from an infected ship. This may seem hard, and an obstruction to commerce, but the commissioner has felt that his duty was rather to err on the safe side while protecting the lives of the citizens of this great city.

In order to maintain a rigid surveillance of the city, it is divided into districts, each one having a physician as sanitary inspector, whose duty is to visit all houses in his district where contagious or infectious diseases are reported to the department according to law by the attending physician, by the police, or other sources; then see that proper isolation of the patient is had, and, while not interfering with the attending physician, confine himself to giving sanitary advice to the household, and to prohibit the children therein from attending school for the time being. It is also part of his duty to send a postal card at once to the ascertained schools, notifying the teachers not to receive children from these houses until they shall bring a certificate from this department to the effect that all danger is over. There is also a list of the contagious diseases reported during each day, sent to every school.

In addition to the sanitary inspectors, there is also attached to each district a plumbing inspector, whose business is to examine and see that all new buildings are put up in accordance with plans filed in this department and approved by the same; also to examine any and all buildings where complaint has been made of defective plumbing, and order the necessary alterations or repairs to be done.

Each district has also a nuisance inspector, whose duties are to examine houses to see that especially those of the tenement classes are kept clean, to report on open, dirty, sunken, undrained, and unfenced lots, and to see that these sources of offence are remedied.

The vaccinating corps are also so districted, and are in summer used as a summer corps to make house to house inspections, and give advice and free medication to the needy. Besides this, all the inspectors of either class, and the auxiliary corps, are instructed to coöperate with each other in the carrying out of the sanitary ordinances.

II.

DISPOSAL OF REFUSE MATTERS.

In 1875 the removal from the city of Brooklyn of all garbage, night-soil, dead animals, and offal was under one contract, and carried out at an expense to the city of $22,750.

In 1877 the city was divided into four districts, and each district was given to one man, thus making four men do the work.

In 1881 the removal of night-soil was assigned as a separate contract to one man, who did the work for $5,000 per annum. In 1881 the contract for dead animals and offal was assigned under one man for $5,500.

For a time licenses were granted to collect garbage free of charge to the city, but this not proving satisfactory, in 1882 a contract was entered into at $140 per month to collect from neglected districts.

At the present time, 1887, the contract is given to one man to remove garbage, at an expense of $70,000 per annum. The number of houses collected from is 88,861. Twenty-six double-horse trucks, water-tight and covered, are employed. The distance of streets in miles is about 700. The average tonnage of garbage is sixty-five every twenty-four hours. Collections are made from hotels and the like daily; from houses twice a week in winter, and three times in summer. The garbage is removed to sea.

The removal of night-soil to sea is effected without charge to the city.

Dead animals are removed at a nominal expense of $800 per year, they being utilized as a fertilizer.

The public health and comfort are greatly conserved in all large cities where there is an adequate supply of pure water; where the best known laws of sanitary science are applied to the proper drainage of low lands; and adequate sewerage, proper plumbing and ventilation of houses, cleanliness of streets, and disposition of night-soil and garbage are obtained. The putting away of the refuse matters of great cities is the question of the hour, and its proper solution a demand upon the practical man of this generation. Where night-soil cannot be utilized as a fertilizer, or garbage for stock, the only solution remaining is removal to the sea, or cremation; and it is to the development of this latter method that we must look for future aid.

The progress already made in this department is most encouraging, and it is hoped and believed that the utilization of petroleum oil will meet the requirements of intense heat and due economy, both of which are so essential to the success of cremation on a large scale.

The disposal of stable manure has been a serious question with us, owing to the great number of horses employed in Brooklyn,—somewhere in the vicinity of 26,000,—making at a low estimate some 182 net tons of droppings, which, with the particles of straw intermingled, brings the quantity into the neighborhood of 200 tons daily. In the early spring the neighboring farmers removed it promptly, but as the summer advanced, the farmers, occupied in attending and marketing their crops, had no time, and its shipment in bulk was interfered with for like reasons. To enforce the ordinances under these conditions was impossible practically.

It was then suggested that experiments be tried to bale it, like hay and straw. A series of experiments, continuing from early spring until recently, were made under the directions of the department. The result has demonstrated that by taking it fresh and throwing it into the box of the press until it is filled, then using the bale sticks and wire from the bales of hay or straw, the cost and time were in large stables not more than that of carting it to the manure pile. The cost of purchasing sticks and wire was 4½ cents per bale. The advantages of this method are,—

1. Reducing bulk into compact space.

2. By reason of the compression, *preventing* fermentation or fire-fanging, thereby enhancing its value as a fertilizer by retaining the ammonia.

3. The *permitting* its removal and shipment at any season without causing offence.

All our car stables and large livery stables are now preparing to adopt this plan of saving their manure.

III.

ANIMAL DISEASES DANGEROUS TO MAN.

All persons knowing of glanders or pharcy in horses are required to report such cases to this department. When the cases are confirmed, the animals are destroyed. All cases of pleuro-pneumonia in cattle are reported to this department, and either kept under a rigid quarantine, or, if the disease is too far advanced to expect recovery, they are destroyed by an officer of this department, who holds a certificate under the U. S. Dairy Commission.

Copy from Minutes of the Department of City Works, page 209.

BROOKLYN, October 16, 1886.

WHEREAS, The Commissioner of City Works and Commissioner of Health did issue specifications and advertise for proposals for contract, to run from one (1) year to five (5) years, nine bidders offering proposals, which bids ranged in prices from forty-eight thousand (48,000) dollars to seventy-five thousand (75,000) dollars for one year, and from the sum of two hundred and twelve thousand (212,000) dollars to three hundred and seventy-five thousand (375,000) dollars for five years; and

WHEREAS, The bidders were summoned by the commissioners to make known the means and modes proposed by them to accomplish and carry out the specifications as advertised; and

WHEREAS, After due consideration and deliberation none of the bids so offered are considered satisfactory and for the best interests of the city; therefore

Resolved, That all bids offered be and the same hereby are declared unsatisfactory, null and void, and all such bids are hereby rejected, and that the deposit money accompanying the said bids be returned to the bidders.

Resolved, That a new set of specifications be prepared as a basis for reädvertising for proposals for removing garbage from the city.

On motion, adjourned.

APPENDIX L.

New Specifications for the Removal and Disposition of Garbage from the Streets, Avenues, Alleys, and Vacant Lots of the City of Brooklyn.

SPECIFICATION 1. The contractor shall collect throughout the entire city, or parts thereof, and remove from the city to such place or places as shall be approved by the Department of Health, all kitchen and other garbage which shall be obtained by   or of which   shall receive notice, or which shall be offered to him from any house, building, place, street, or alley within the city, or shall be upon any vacant lot in the city.

2. The collection and removal of garbage herein provided for shall be as follows: Daily from hotels, restaurants, groceries, stores, boarding, lodging, and club houses; and from all other buildings twice a week during the months of January, February, March, April, November, and December, and three times per week during the months of May, June, July, August, September, and October of each year, except that the removal of garbage from the vacant lots of the city shall be made on notification to the contractor from the Commissioners of Health or Department of City Works to remove garbage from vacant lots of the city, which notice shall state the location of the lot or lots.

3. The contractor shall call regularly and remove promptly, as specified in sub-division two of these specifications, all kitchen or other garbage, and shall, in passing through each street, road, lane, alley, or avenue of the city give due notice by the continuous ringing of a bell, six inches in diameter, to the occupants of all buildings that the garbage carts or wagons are about to approach for the removal of kitchen or other garbage: the said bell to be rung by some person or persons in such manner as may be approved by the conjoint Departments of Health and City Works. All garbage to be removed shall be placed upon the sidewalk, near the curb-stone, by occupant or occupants of each premises, and shall be removed by the contractor and placed in the garbage carts or wagons in as cleanly a manner as possible, and without spilling upon the street or sidewalk, or causing any nuisance, and the receptacles when empty shall be returned to their several places upon the sidewalk from whence they were taken in a careful manner, except that from tenement houses the contractor shall, when required, take the garbage from the back yards of said premises, and return receptacle to sidewalk of said premises. The contractor shall also collect and remove all kitchen and other garbage which may be upon any sidewalk, court, street, alley, or avenue in said city, or on any vacant lot or lots of the entire city, by whomsoever there placed. No garbage shall be collected from houses earlier than 6:30 A. M., except that it may be collected at any time from hotels and restaurants. It is further provided and understood that the contractor shall collect, clean up, and remove from the streets of the city all garbage that may have been by accident or otherwise overturned or spilled out of any receptacle of garbage.

4. The contractor shall provide, and at all times keep, at   own cost and expense, such help and such appliances as shall be necessary for the prompt and faithful performance of such collection and removal of garbage, and no person in charge of any such appliance or vehicle shall be under the age of twenty-one years.

5. All kitchen and other garbage shall, when received by the contractor, be immediately placed in receptacles so constructed as to prevent the escape of any of the material or offensive odor while within the city limits.

6. All appliances provided to be used in the collection and removal of garbage shall, before being used by the contractor or any of his agents, be approved and marked as directed by the Department of City Works, and shall be subjected to reinspection from time to time, as may be required by the conjoint Departments.

7. The contractor must report at the office of the Department of City Works daily, at 10 o'clock A. M. and at 2 o'clock P. M., or as often as is required, prepared to execute any special order with reference to the removal of garbage. The contractor shall sign his name and the date of his report upon a book to be provided for that purpose. He shall make weekly reports of the number of cubic feet of garbage removed from each ward.

8. Payments shall be made monthly, upon certificates from the proper officers, on the tenth day of each month.

9. This contract may at any time be terminated by the said conjoint Departments whenever the contractor shall refuse or neglect to perform any of the stipulations thereof, and as to the fact of such refusal or neglect, the said Departments reserve to themselves the exclusive right of judging, but the contract shall not be terminated until a fair investigation shall have been made, of which investigation the contractor shall have ten days' written notice, at which shall be allowed to appear in person or by attorney.

10. In case the contractor shall neglect to remove any garbage called for to be removed under any one of these specifications, the Department of City Works may cause such removal to be made, and the cost of such removal shall be paid from any moneys due the contractor at that date.

11. In addition to the bond of thirty thousand dollars required to be given by the contractor for the faithful performance of his contract, the contractor shall deposit with the City Comptroller the sum of five thousand dollars, which sum shall be expended, after the money at the time due to the contractor is exhausted by the Commissioner of the Department of City Works, to meet the expenses of the removal of garbage rendered necessary by the neglect of the contractor under the preceding specification numbered 10. Any moneys thus spent in excess of the said five thousand dollars may be charged against the contractor and recovered from him and his sureties, or charged against any moneys to become due the contractor under his contract.

12. Proposals will be received for the removal and disposition of garbage from the entire city for a term not to exceed five years. Proposals to state price for each year or term of years.

13. In making proposals, each bidder must state a distinct price for the collection, removal, and disposal of garbage in the three following methods:

a. The collection of garbage in accordance with the foregoing specifications, and the burning (cremating) the same in such manner as to create no nuisance.

b. The collection of garbage and removal by boats, and the depositing of the same at sea, so as to create no nuisance.

c. The collection and depositing not less than one mile outside of city limits of all garbage.

14. The sureties to the contract will be held for the strict performance of each and every stipulation thereof or condition therein set forth.

Advertisement to Contractors.

REMOVAL OF GARBAGE.—Abstract from ordinance of the Common Council in relation to deposits to be made by proposers for work, &c., passed April 9, 1877. Each proposal must be accompanied by a deposit of $2,000 in money or by certified check payable to order of the president of the Board of City Works (now the Commissioner of the Department of City Works), to be returned to the bidder in case his bid is rejected by the Board of City Works (now the Commissioner of the Department of City Works). In case the party or parties to whom the contract may be awarded shall neglect or refuse to enter into contract, the amount deposited, as above specified, will be retained as liquidated damages for such neglect or refusal.

DEPARTMENT OF CITY WORKS, COMMISSIONER'S OFFICE,
Municipal Department Building (Room 15),
BROOKLYN, October 20, 1886.

Sealed proposals will be received at this office until November 4, 1886, at 12 M., for the collection and removal of garbage from the city of Brooklyn for a term of five (5) years or less, as may be determined by the conjoint Departments of Health and City Works. Each bidder must state a definite price for each year, from one year to five years Specifications may be seen, and forms of proposals can be procured, on application at the Department of City Works. Proposals will not be considered unless accompanied by the deposit aforesaid, and also by an undertaking, in writing, of two sureties on each proposal (who shall qualify as to their responsibility in the sum of $30,000), that if the contract be awarded to the party or parties proposing, they will become bound as his or their surety for its faithful performance; and in case he or they shall neglect or refuse to execute the contract, if so awarded them, that they will pay to the city of Brooklyn the difference between the price so proposed and the price at which the contract may be made with any other person or persons. Proposals to be indorsed "To the Commissioner of the Department of City Works" (specifying work). The said proposals will be publicly opened and announced on the 4th day of November, 1886, at the hour of 12 o'clock M., provided that the Commissioners of Health and City Works are present. In case of the absence of both, then on the first day thereafter when either is present. The Commissioners reserve the right to reject any and all bids.

GEO. RICARD CONNER,
Commissioner of the Department of City Works.

ANDREW OTTERSON,
Commissioner of Health.

[Attest.]
D. L. NORTHUP, *Secretary.*

These, in brief, are the working details of the means taken to preserve the public health in Brooklyn, and we have the satisfaction of knowing that with a sudden increase of citizens from the annexation of the town of New Lots, with its additional 26,000 inhabitants, the public health has been maintained, and the rate of mortality has been as low as ever in its past history.

WM. C. OTTERSON, M. D.,
Deputy Commissioner.

LOUIS C. D'HOMERGUE, M. D.,
Sanitary Superintendent.

COMMITTEE ON DISINFECTANTS, 1887.

REPORT OF THE CHAIRMAN OF THE COMMITTEE.

INTRODUCTION.

Various circumstances prevented the Committee on Disinfectants from undertaking any experimental work during the year intervening between the meeting in Washington (1885) and that in Toronto (1886). But having learned at the Toronto meeting that a small fund, contributed mainly by state boards of health, was subject to its orders, a continuance of the experimental work commenced in 1885 was determined upon, and by a vote of the committee was entrusted to the chairman.

In the report previously submitted, the committee, after considering the experimental evidence available, recommended for practical use, in the disinfection of clothing, excreta, dwellings, ships, hospitals, etc., a limited number of chemical agents, and the use of steam or boiling water in those cases in which disinfection by heat was practicable. Specific directions were given for the use of the various agents recommended (*vide* Vol. XI, Reports and Papers of the A. P. H. A., pp. 272–282). The following agents were recommended in the report referred to:

CONCLUSIONS.

The experimental evidence recorded in this report seems to justify the following conclusions:

The most useful agents for the destruction of spore-containing infectious material are,—

1. *Fire.* Complete destruction by burning.
2. *Steam under pressure.* 110° C. (230° Fahr.) for ten minutes.
3. *Boiling in water for one hour.*
4. *Chloride of lime.* A 4 per cent. solution.
5. *Mercuric chloride.* A solution of 1 : 500.

For the destruction of infectious material which owes its infecting power to the presence of micro-organisms *not containing spores*, the committee recommends,—

1. *Fire.* Complete destruction by burning.
2. *Boiling in water* half an hour.
3. *Dry heat*, 110° C. (230° Fahr.) for two hours.
4. *Chloride of lime*, 1 to 4 per cent. solution.
5. *Solution of chlorinated soda*, 5 to 20 per cent. solution.
6. *Mercuric chloride.* A solution of 1 : 1,000 to 1 : 4,000.
7. *Sulphur dioxide.* Exposure for twelve hours to an atmosphere containing at least 4 volumes per cent. of this gas, preferably in presence of moisture.
8. *Carbolic acid*, 2 to 5 per cent. solution.
9. *Sulphate of copper*, 2 to 5 per cent. solution.
10. *Chloride of zinc*, 4 to 10 per cent. solution.

The agents named in this list are all comparatively cheap, and leave scarcely anything to be desired from a practical point of view, if they are efficient in the proportions named, and for the purposes specifically stated in the report referred to.

The immediate reason for appointing a Committee on Disinfectants was the prospect that our country might soon be invaded by cholera, and the general desire among sanitarians to have some reliable data upon which to base their practical efforts to restrict the progress of this and other infectious diseases. Keeping in view this object, and the fact that the funds at the disposal of the committee have been for the most part contributed by state boards of health, it has seemed advisable to make further tests of the agents heretofore recommended rather than to seek new and possibly expensive chemical agents, which might have equal or superior potency for the destruction of pathogenic organisms.

The object in view in our first series of experiments was to obtain as quickly as possible data which might serve to guide us in making practical recommendations in advance of the threatened epidemic of cholera. After making a very thorough search of the literature of the subject, and tabulating the experimental data from various sources, the experimental work recorded in our previous report was carried out. It will be seen, upon reference to the record of experiments made, that the test employed in a considerable proportion of these was the power of the agent to destroy the vitality of the bacteria of putrefaction, as found in "broken down beef tea." The writer was aware that this test was open to the criticism that the material to be disinfected did not contain any pathogenic organisms, and for this reason cultures of the anthrax bacillus were added to the putrefying beef infusion in a certain proportion of the experiments; and other experiments were made upon pure cultures of the anthrax bacillus, as well as upon cultures of micrococci from various sources, some no doubt pathogenic. But the writer's own previous experiments, and a consideration of the literature of the subject, had convinced him that all known pathogenic organisms have less resisting power to heat and to chemical agents than have the spores of various bacilli commonly found in putrefying beef tea, which has been freely exposed to the air. Among the pathogenic organisms known, the anthrax bacillus, in the spore-stage, has the greatest resistance to destructive agents. The test employed was therefore believed to be the most severe one available, and the data obtained to be applicable in a general way to all pathogenic organisms of the same class.

As the time and money at our disposal did not admit of an extended experimental inquiry as to the resisting power of each known pathogenic organism to each of the agents tested, the more general test referred to was employed. In resuming our experiments, however, it has seemed best to test our conclusions, based upon the data indicated, by experiments made with the same agents upon pure cultures of the various pathogenic and non-pathogenic bacteria available for such purpose.

It is a matter of general scientific interest, as well as of practical importance, to know whether various organisms of this class differ greatly as to their resisting power to the same agent, or whether an agent which is fatal to one of these organisms, in a certain proportion, is capable of destroying all others in something near the same amount. The wide difference in the resisting power of spores, and of micro-organisms in the absence of spores, was fully brought out in our previous report. In recording the experimental work accomplished by myself and under my direction during the past year, I shall discuss in succession the data relating to the several agents named in the above quotation from the previous report of the committee, in the order therein given. My own time has been given chiefly to experiments relating to the thermal death-point of micro-organisms. Other duties have prevented me from giving as much time to laboratory work as I could have wished. But I have been fortunate in securing the services of a gentleman well qualified for carrying out that part of the work which it was impossible for me to do myself. The experiments upon chemical disinfectants have been made under my direction by Dr. Meade Bolton, who returned from Germany about the time that I was ready to commence these experiments. Dr. Bolton had spent a considerable time in the laboratories of Prof. Flügge in Göttingen, and of Prof. Koch in Berlin, and his special training and published papers are a sufficient guaranty as to the scientific accuracy of his work.

TEST ORGANISMS EMPLOYED.

Pure cultures of the various organisms which have served as a test of the germicide power of the agents tested have been obtained, for the most part, from the laboratories of Germany, and especially from that of Prof. Koch in Berlin. The purity of the cultures has been maintained, when necessary, by the plate method, and the identity of each species has been verified by a careful study of its morphological and biological characters, and a comparison of the same with those given in standard works upon bacteriology.[1]

As some of these organisms are scarcely known except to bacteriologists, a brief account of the characters by which they may be distinguished will be given here.

SPIRILLA.

1. *Spirillum of Asiatic cholera* ("comma bacillus," of Koch). This organism, discovered by Koch, in 1884, in the rice-water discharges of patients suffering from cholera, is now pretty generally believed to be the essential etiological factor in the causation of this disease. It must be admitted that the experimental proof that this is the case is not as satisfactory as could be desired, but the constant presence of the "comma bacillus" in the alvine discharges of cholera patients seems to be well established, and the weight of evidence is certainly in favor of the view that it bears a causal relation to the disease.

[1] *Eisenberg*, "Bakteriologische Diagnostik. *Flügge*, "Die Mikro-Organismen," 2d ed.

The stock which has served for our experiments upon this organism was brought by Dr. Bolton from Germany. Our experiments were made during the winter months, and every precaution was taken to prevent accident. The possibility of accident from the careless handling of such material is evident, and in one instance it is said to have occurred in the case of a student in one of the German laboratories, who suffered an attack of cholera while working with cultures of the spirillum under consideration. It is reported that the organism was found in abundance in his alvine discharges. The danger to the individual is, however, a small matter compared with the responsibility which rests upon the experimenter in view of the possible danger to the community. This responsibility I have had constantly in view; and having completed my experiments during the winter months, I have taken the precaution to destroy all of the cultures in my hands.

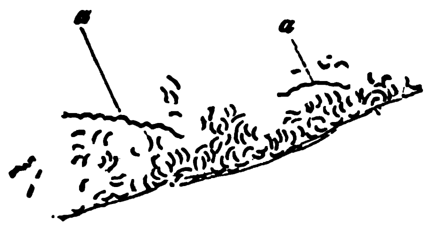


Fig. 1. From "Die Mikro-Organismen," p. 341.

The morphology of the cholera spirillum is shown in Fig. 1, which is taken from the recent work of Flügge.[1] The drawing is from a cover-glass preparation of a pure culture in beef-infusion (after Koch). The amplification is 600 diameters.

The cholera spirillum grows best at a temperature of 30–40° C. (86–104° Fahr.). At 16° C. (60.8° Fahr.) growth appears to cease

Fig. 2. "Die Mikro-Organismen," p. 346.

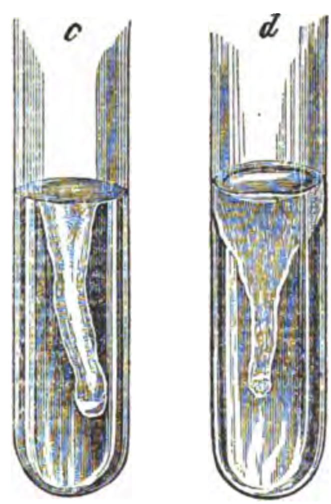


Fig. 3. "Die Mikro-Organismen," p. 383.

(Eisenberg). It is not destroyed by exposure for some hours to a temperature of —10° C. (—18° Fahr.). It grows readily in a variety of media, and is endowed with active movements. It liquefies solidified blood-serum and gelatine. It is distinguished from allied species—cheese

[1] "Die Mikro-Organismen," p. 341.

spirillum and Finkler-Prior spirillum—by its growth in gelatine and by the form of very young colonies in gelatine plate-cultures.

Figure 2 represents the growth of the cholera spirillum in flesh-peptone gelatine at the end of two and of four days. Fig. 3[1] represents the growth of the Finkler-Prior spirillum in the same medium at the end of the same time.

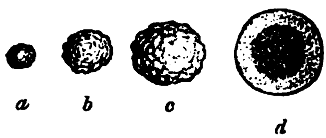


Fig. 4. "Die Mikro-Organismen," p. 345.

Figures 4, 5, and 6, also taken from Flügge's recent work, represent the colonies as seen upon gelatine plates of the cholera spirillum (Fig. 4), the Finkler-Prior spirillum (Fig. 5), and the cheese spirillum of Deneke (Fig. 6).

In Fig. 4 we have at *a* the appearance of a colony at the end of 20 hours, at *b* of 30 hours, at *c* after 36 hours, at *d* after 48 hours. Liquefaction of the gelatine has already commenced at *c*, and at *d* the colony has sunken to the bottom of the funnel-shaped depression in the gelatine, caused by liquefaction about it.

In Fig. 5, *a* represents a colony at the end of 16 hours, *b* after 24 hours, *c* after 36 hours. It will be observed that not only is the appearance of the young colonies different, but growth is more rapid, and complete liquefaction around the colony has occurred at the end of 36 hours.

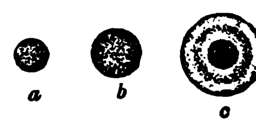


Fig. 5. "Die Mikro-Organismen," p. 383.

Figure 6 represents colonies of the cheese spirillum at the end of similar intervals of time—*a* 16 hours, *b* 24 hours, *c* 36 hours.

There is no evidence that the cholera spirillum, or the allied organisms referred to, form endogenous spores during any part of their life cycle. It has been claimed, however, by Hueppe, that reproductive bodies of another kind—the so-called arthrospores—are formed under certain circumstances. These are spherical bodies, which are developed from the spiral filaments, and not in their interior. It is still a question whether these spherical bodies are the result of retrograde changes in the spirilla, or whether they are reproductive elements, as Hueppe claims to have demonstrated by direct observation. The numerous experiments of Koch and his pupils show that the cholera spirillum is very promptly destroyed by desiccation, and this fact is opposed to the view that it forms spores. In a moist condition the spirillum may retain its vitality in culture media for many months (at least nine).

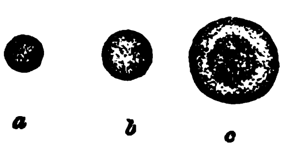


Fig. 6. "Die Mikro-Organismen," p. 387.

2. ***Finkler-Prior spirillum.*** This organism, obtained by Finkler and Prior from the dejections of patients suffering from sporadic cholera—*cholera nostras*,—was at first supposed by them to be identical with the "comma bacillus" of Koch. This has been shown not to be

[1] Figures 2 and 3 are taken from "Die Mikro-Organismen," pp. 346 and 383.

true, and the researches of Koch and his pupils have established the fact that there are constant differences in the mode of growth in gelatine, etc., which make it apparent that this is a distinct species, or, at all events, a well established variety.

3. *Cheese spirillum* of Deneke. This organism, which was obtained by one of Flügge's pupils in some old cheese which had been kept for some time in the laboratory, resembles the cholera spirillum even more closely than does the Finkler-Prior spirillum. There is, however, a very perceptible and constant difference to be distinguished in the appearance of the young colonies in gelatine plate-cultures. According to Flügge, this spirillum does not grow upon cooked potato either at the room temperature or in the incubating oven. Deneke, in a limited number of experiments upon Guinea-pigs, failed to obtain any evidence that this spirillum is a pathogenic organism. In a comparative experiment made upon six Guinea-pigs with pure cultures of the three species of spirillum referred to, by injection into the duodenum (Koch's method), Deneke obtained a negative result from the two animals inoculated with the Finkler-Prior and in the two inoculated with the cheese spirillum, while both of those inoculated with the cholera spirillum died.

BACILLI.

1. *The bacillus of typhoid fever.* This bacillus, first described by Eberth in 1880, is constantly found in the spleen of typhoid fever cases, both post mortem and during life. The bacillus is also present in the liver, the mesenteric glands, and in a certain proportion of the cases in the kidney. The appearance of colonies in stained sections of the spleen is shown in Figs. 7 and 8.

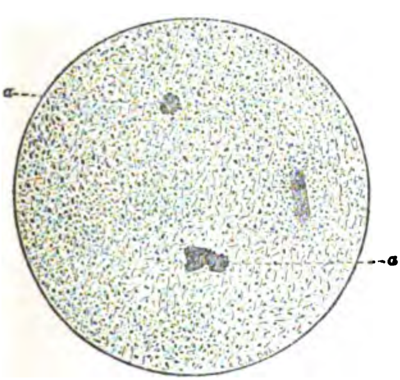


Fig. 7.

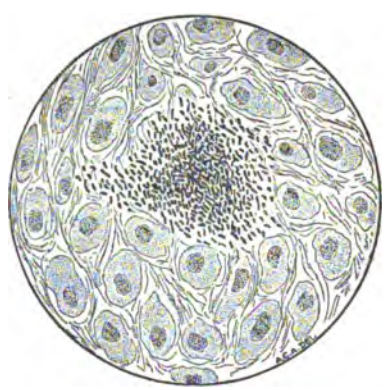


Fig. 8.

Two colonies are seen in Fig. 7 (at *a a*), as they appear under a low power—about 60 diameters. In Fig. 8 one of these colonies is seen more highly magnified—about 500 diameters.[1]

[1] These figures were drawn for the writer by Dr. A. C. Abbott to illustrate a paper read before the Association of American Physicians in June, 1886.

As in the case of the spirillum of Asiatic cholera, experiments upon the lower animals have not served to prove in a satisfactory manner the etiological relation of this bacillus to the disease with which it is associated. But the fact that the lower animals are not susceptible to certain specific infectious diseases to which man is subject, is in accord with our knowledge relating to infectious diseases in general. A failure to obtain experimental proof of the etiological relation of a micro-organism, by experiments upon animals which do not suffer the disease under investigation in a natural way, is by no means opposed to the view that such etiological relation exists. And, in the present state of science, it may be said that the probabilities are altogether in favor of such a relation when a specific organism is found to be constantly present in the tissues involved in a specific morbid process. The very extended researches made during the past two or three years justify the belief that the bacillus in question is the cause of typhoid fever, and on account of the wide prevalence of this disease in the United States, and the importance of measures of disinfection for its restriction, it has been largely

Fig. 9. From " Die Mikro-Organismen."

used as a test organism in the experimental research recorded in this report.

The characters by which this bacillus may be recognized are given by Eisenberg[1] as follows:

[1] Bakteriologische Diagnostik.

MORPHOLOGY.—Bacilli, three times as long as broad, with rounded ends, may grow to long threads—*scheinfäden*—and are also found as very short rods; are mobile, and probably possess flagella; take the aniline colors less intensely than most similar organisms.

GROWTH.—*Upon gelatine plates:* superficial grayish-white colonies with serrated margins; under a low power these resemble glass-wool, and have a brownish lustre. *Stick-cultures in gelatine:* growth, for the most part superficial, in the form of a grayish-white layer with serrated margins; but little growth along the track of the needle. *Upon agar-agar:* superficial growth of a whitish color. *Upon potato:* invisible growth; after forty-eight hours the pieces of potato have a moist appearance; when the surface is disturbed with a platinum needle, one receives the impression that it is covered with a cohering film; under the microscope this is found to consist of long spore-bearing threads of typhus bacilli. *Upon blood-serum:* grows only along the track of the needle as a milk-white layer; grows slowly.

SPORE-FORMATION.—At 32°–40° C. spores are formed in the course of three or four days; these are located at the ends of the rods. At 20° C. spores are formed after a longer period; at lower temperatures than this, spores are no longer formed.

2. *Bacillus anthracis.* This is an organism which is pathogenic for man as well as for many of the lower animals. It does not form spores within the body of an infected animal, but in artificial culture-media, in the presence of oxygen, it forms endogenous spores which have great resisting power to heat and to chemical agents.

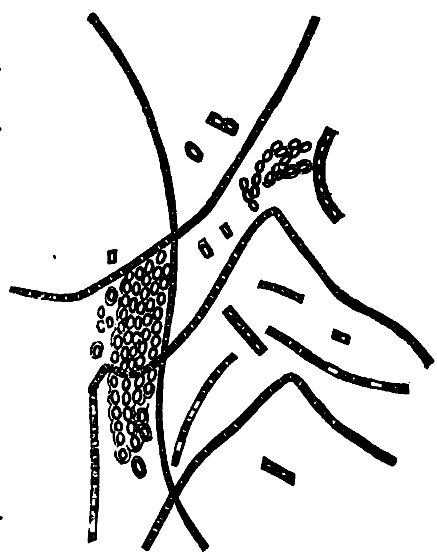


Fig. 10. Klein's "Micro-Organisms and Disease."

Fig. 9, taken from Flügge's work, shows the anthrax bacillus in a thin section from the liver of an animal dead from the disease. The amplification is 700 diameters.

In Fig. 10[1] the formation of spores in an artificial culture medium is represented.

In Fig. 11 the appearance of a colony in a gelatine plate-culture is shown. At *a* a colony 24 hours old, and at *b* one at the end of 48 hours (from Flügge op. cit.).

3. *Bacillus of rouget* (Pasteur).

4. *Bacillus of schwinerothlauf* (Lõffler, Shutz).

5. *Bacillus of mouse-septicæmia* (Koch).

Schwinerothlauf of the Germans, and *rouget* of the French, are no doubt identical diseases. My cultures, obtained in the first instance from Pasteur's laboratory in Paris and Koch's laboratory in Berlin, show no differences in the morpholgy or mode of growth of the organisms as obtained from the two sources. The bacillus of mouse-septicæmia, first

[1] From Klein's "Micro-Organisms and Disease."

described by Koch in 1878, is also apparently identical with the above. Eisenberg says, with reference to the bacillus of *schwinerothlauf*, that "in its form, as well as in its behavior to culture media, it is very similar to the bacillus of mouse-septicæmia, perhaps identical." Flügge also refers to the similarity in form and pathogenic properties, but describes the bacilli under different headings. I have not been able to discover any difference in the morphology of the bacillus in my pure cultures from Koch's laboratory under the two names, or in the mode of growth in gelatine.

Eisenberg describes the bacillus of mouse-septicæmia as follows: Very small rods—0.8 to 1.0 μ long, 0.1 to 0.2 μ thick—frequently united in pairs; motionless; growth in gelatine slow, in the form of white, delicately blending clouds, which are diffused through the gelatine (along

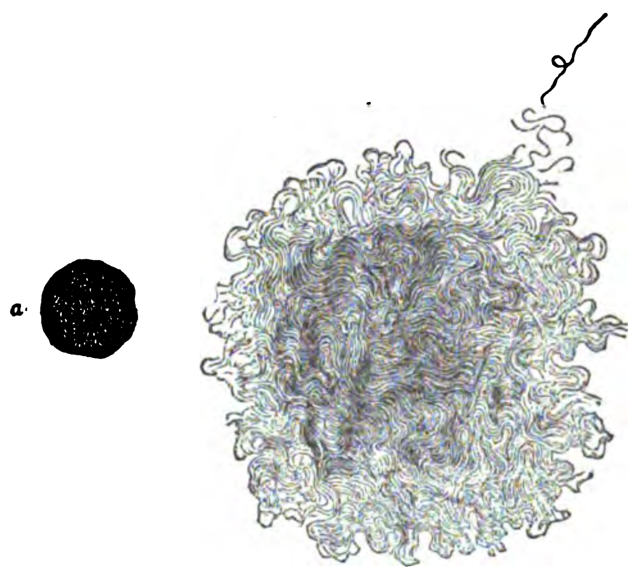


Fig. 11. From "Die Mikro-Organismen."

the line of puncture in stick-cultures). The gelatine is not liquefied, and the bacillus is said to form spores.

The bacillus of *schwinerothlauf* and mouse-septicæmia is pathogenic for swine, for field-mice, for pigeons, and in a less degree for rabbits. Sheep and young cattle are also said to be susceptible (to the rothlauf bacillus). Guinea-pigs and domestic fowls are insusceptible.

The bacillus of mouse-septicæmia is shown in Fig. 12, which has been copied from Koch's original memoir,[1] in which it is described as follows:

> The bacilli lie singly or in small groups between the red blood corpuscles, and have a length of .8 to 1 μ. Their thickness, which cannot be measured accurately, but only approximately estimated, is about .1 to .2 μ. . . . One often sees the bacilli in septi-

[1] "Traumatic Infective Diseases," Sydenham Societies' Translation, 1880.

cæmic blood attached to each other in pairs, either in straight lines or forming an obtuse angle. Chains of three or four bacilli also occur, but they are rare. . . . Without the use of staining materials, the bacilli can only with extreme difficulty be recognized in fresh blood, even when one is familiar with their form; and I have not been able to obtain any certain evidence as to whether they move or not. Their relation to the white blood corpuscles is peculiar. They penetrate these, and multiply in their interior. One often finds that there is hardly a single white corpuscle in the interior of which bacilli cannot be seen. Many corpuscles contain isolated bacilli only; others have thick masses in their interior.

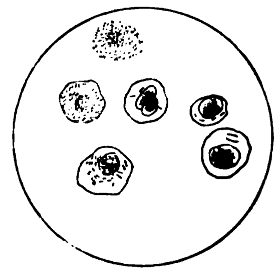
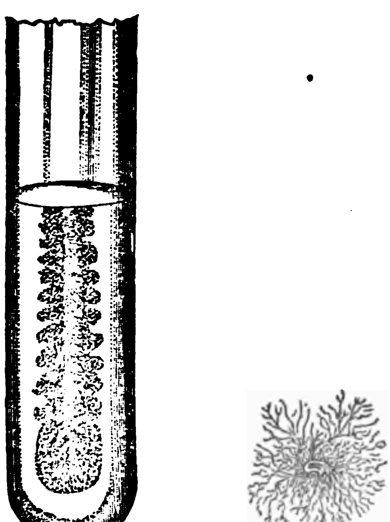


Fig. 12. White blood-corpuscles from one of the veins of the diaphragm of a septicæmic mouse. × 700.

The appearance of the growth in a gelatihe "stick-culture" is shown in Fig. 13, which is taken from Flügge's work, heretofore referred to. In the figure, *a* represents a culture of the *schwinerothlauf* bacillus in gelatine, and *b* a colony of the same bacillus upon a gelatine plate.

6. *Emmerich's bacillus.* This is a pathogenic organism obtained by Emmerich from the blood and organs of individuals who died of cholera during the Naples epidemic of 1884, and supposed by him to be the cause of the disease. He has failed, however, to establish any etiological relation between this bacillus and cholera, and Koch and his pupils have shown that the same bacillus may be obtained from the intestinal contents of individuals dying from various other diseases. When injected in considerable quantity into the sub-cutaneous connective tissue of Guinea-pigs, or into the cavity of the abdomen, death follows in from 30 to 48 hours.



a *b*

Fig. 13. From "Die Mikro-Organismen."

7. *Brieger's bacillus.* This bacillus, obtained by Brieger from feces, is pathogenic for Guinea-pigs. The animals die within 72 hours after a sub-cutaneous injection, and the bacillus is found in the blood. The bacilli are short rods, about twice as long as broad.

8. *Bacillus of Friedlander.* The so-called "pneumococcus" of Friedlander is described by recent German authorities as a bacillus. The claim that it is the specific agent concerned in the etiology of croupous pneumonia is not sustained by Friedlander's experiments, or by the researches of subsequent investigators. The most that can be claimed for it is that it is one of several micro-organisms which are frequently found in the exudate into the alveoli

in cases of pneumonia, and which possibly bear a causal relation to the disease. This bacillus is pathogenic for mice and for Guinea-pigs, but not for rabbits. Stick-cultures in gelatine present the appearance of a nail, the body being formed by the growth along the line traversed by the platinum needle in making the puncture, and the head by a rounded mass which develops upon the surface of the gelatine around the point and where the needle entered. This mode of growth is not peculiar to the bacillus in question. The so-called capsule which is seen especially in preparations (stained by Gram's method) of blood from an animal recently dead, is also not peculiar to this bacillus. Friedlander's bacillus grows readily in a variety of culture-media. The cultures, which have served for my own experiments and those of Dr. Bolton, came originally from Koch's laboratory.

9. *Bacillus crasssus sputigenus.* This is a pathogenic bacillus obtained by Kreibohm from sputum. It grows readily in various media, and, in gelatine stick-cultures, presents the nail-like growth which Friedlander at first supposed to be a distinguishing character of his "pneumococcus." Small quantities injected sub-cutaneously kill mice within 48 hours. It is fatal to rabbits when injected into the circulation through a vein of the ear.

10. *Bacillus alvei.* This is a bacillus which Watson Cheyne has demonstrated to be the cause of "foul brood" in bees. The larvæ become infected, and die in the cells of the comb in which they are enclosed. The bacillus is also pathogenic for mice and for Guinea-pigs. It liquefies gelatine, and grows rapidly in a variety of culture-media. Very large oval spores are developed in the rods, which then have a spindle form.

11. *Tubercle bacillus.* This bacillus is now generally recognized as the cause of tuberculosis in man and in the lower animals. It is so well known that a description of its characters is scarcely necessary. On account of its slow growth and the difficulties attending its cultivation in artificial media, it has not been used in our disinfection experiments.

12. *Bacillus pyocyanus* (B. of green pus). This bacillus is classed by Eisenberg with the pathogenic organisms, and the statement is made that it kills Guinea-pigs when injected into the abdominal cavity. It liquefies gelatine, and gives to it a fluorescent green color. The bacilli are slender rods of various lengths, resembling in form the bacillus of mouse-septicæmia, but somewhat thicker.

In addition to the pathogenic bacilli named, experiments have been made with the following non-pathogenic bacilli.

13. *Bacillus Indicus.* Obtained by Koch, while in India, from the stomach of a monkey. Forms a bright red pigment when it grows upon the surface of a culture-medium, freely exposed to oxygen.

14. *Bacillus prodigiosus.* Well known under the name of "micrococcus prodigiosus," but now classed by Flügge among the bacilli.

Forms a deep red pigment when freely exposed to the air; liquefies gelatine.

15. *Bacillus syncyanum* (B. of blue milk). This bacillus forms a grayish-blue pigment, which in cultures is diffused through the culture-medium. The rods are motile, and of varying length—from 1 to 4 μ long, and 0.3 to 0.5 μ broad. This bacillus is said by Eisenberg to form spores.

16. *Fluorescent bacillus.* Obtained from water. Forms a fluorescent greenish-yellow pigment. In gelatine cultures the pigment is absorbed by the gelatine. Growth occurs chiefly upon the surface, and very little along the track of the needle in stick-cultures. The bacilli are short and slender rods, with rounded ends; they are not motile, and so far as is known do not form spores.

17. *Bacillus acidi lactici.* This is the lactic acid ferment. The rods are short and comparatively thick—1 to 1.7 μ long, and 0.3 to 0.4 μ thick (Hüppe). They are usually united in pairs, and are motionless. This bacillus does not liquefy gelatine. According to Eisenberg, it forms spores, which are developed at the extremities of the rods and appear as highly refractive spherical bodies.

18. *Bacillus butyricus.* This is the butyric acid ferment (Pasteur). It quickly liquefies gelatine. The rods vary greatly in length, and often grow out into long filaments. Spores are formed at a temperature of 35° to 40° C.

19. *Wurtzel bacillus.* Obtained from earth. Short bacilli with rounded ends, about three times as long as broad; motile; liquefies gelatine; forms spores.

20. *Bacillus subtilis.* A widely distributed species. The rods are about three times as long as thick, and have rounded ends. They are often united in chains made up of several elements, or grow out into long filaments. They are motile, and have been shown by Koch to be provided with flagella. This bacillus forms spores which have great resistance to heat and chemical agents. It liquefies gelatine.

MICROCOCCI.

1. *Staphylococcus pyogenes aureus* (micrococcus of osteo-myelitis). This micrococcus is the species most commonly found in the pus of acute abscesses. It was first isolated in pure cultures and accurately described by Rosenbach in 1884. Becker had previously (1883) obtained the same coccus from the pus of osteo-myelitis, and cultures of the organism from this source have been kept separate in the bacteriological laboratories of Europe. Eisenberg describes the organism under the two headings given above, but makes the remark that they are probably identical. This is now generally admitted. In my experiments and those of Dr. Bolton the cultures have been kept separate, but I see no good reason for continuing to treat as two species an organism obtained from two different sources. Vignal, in a recent study of the organisms found in the mouth in healthy persons,[1] has in a certain number of cases obtained both the

[1] "Archives de Physiologie," Nov. 15, 1886.

staphylococcus pyogenes aureus and the *staphylococcus pyogenes albus* from this source. This fact is not at all in conflict with the view that these organisms are concerned in the production of the abscesses and phlegmons in which they are found.

The *staphylococcus aureus*, when injected into the abdominal cavity of rabbits, usually causes death within 24 hours. The cocci vary considerably in size; the average diameter is given by Eisenberg as 0.87 μ. They are commonly found in irregular masses, but are also found in pairs, in groups of four, and in short chains of three or four elements. Upon the surface of a solid culture-medium the colonies have an orange-yellow color. It liquefies gelatine, and grows readily at the room temperature. In the writer's previously recorded experiments,[1] most of which were made before Rosenbach had published the admirable memoir in which he has defined the characters of the pus micrococci, cultures obtained from the pus of an acute abscess are constantly spoken of as "pure cultures of the micrococcus of pus." These cultures were obtained by inoculating fluid media with a minute quantity of pus from an acute abscess, at the moment of opening it, with antiseptic precautions. As a result of such inoculations I constantly obtained cultures containing only micrococci, and, like other investigators whose work was done prior to Rosenbach's demonstration of the fact that there are several pus micrococci, similar in form but differing in color and other particulars, I inferred that my cultures contained a single species of the genus micrococcus which I designated "the micrococcus of pus." These cultures may have contained the three species of staphylococcus—aureus, albus, and citreus (they did not contain the streptococcus of pus); and it is evident that, with our present knowledge, they are no longer entitled to be called "pure cultures." But so far as my experiments were concerned they served the purpose of a pure culture, for they contained only micrococci, and micrococci obtained from the source mentioned. As my object was to determine the resisting power of micrococci, as compared with that of bacilli and spores, for the various chemical agents tested, the cultures employed were a perfectly satisfactory test. In the experiments recorded in the present report, the object in view has been to ascertain the resisting power of various *species* of micrococci and bacilli, for the same agents, with a view to ascertaining whether this resisting power varies greatly in different species. In other words, my previous experiments related to the comparative resisting power of micrococci, and bacilli, and spores, in a general way, while the experiments herein recorded are designed to fix the exact resisting power of various species of micrococci, and bacilli, and spirilla, and of the spores of several species of the genus *bacillus*.

2. *Staphylococcus pyogenes citreus*. This is similar to the *staph. pyog. aureus* in its morphology and in its biological characters, but is distinguished by the fact that it forms a citron-yellow color. As this character is constant, it must be considered a distinct species.

[1] "Am. Jour. of the Med. Sci.," Philadelphia, April, 1883. Report of Committee on Disinfectants of the A. P. H. A., Vol. XI, 1885.

3. *Staphylococcus pyogenes albus.* This also resembles the two preceding species, with which it is frequently associated in the pus of acute abscesses, but it is distinguished from them by the absence of pigment.

4. *Streptococcus erysipelatos.* Obtained by Fehleisen from the skin in cases of erysipelas, and demonstrated by him to be the cause of this disease. This coccus is distinguished from the preceding species by the fact that it divides in one direction only, and often forms long chains, especially in cultures in liquid media. It does not liquefy gelatine, and in gelatine plate-cultures it forms small, round, finely granular colonies. According to Flügge this coccus resembles very closely the streptococcus of pus, which is present in a considerable proportion of the cases in the pus of acute abscesses; but differences are to be observed in its growth in gelatine "stick-cultures," and in its pathogenic properties as tested by experiments upon animals.

Fig. 14. From "Die Mikro-Organismen," p. 151.

Fig. 14 is copied from Flügge's recent work, and represents a section of skin from a case of erysipelas, in which the lymph-vessels are invaded by the streptococcus in question. The amplification is 700 diameters.

5. *Micrococcus tetragenus.* This is a coccus which divides in two directions, forming groups of four elements. It is often found in the buccal secretions of healthy persons, and is quite common in the purulent expectoration of phthisical patients. The cocci are about 1 μ in diameter. In gelatine plate-cultures it forms small white colonies; it does not liquefy gelatine. Koch and Gaffky have shown that this coccus is pathogenic for mice, which die within 3 to 10 days after subcutaneous inoculation with the smallest quantity of a pure culture. The cocci in groups of four are found in the blood and tissues.

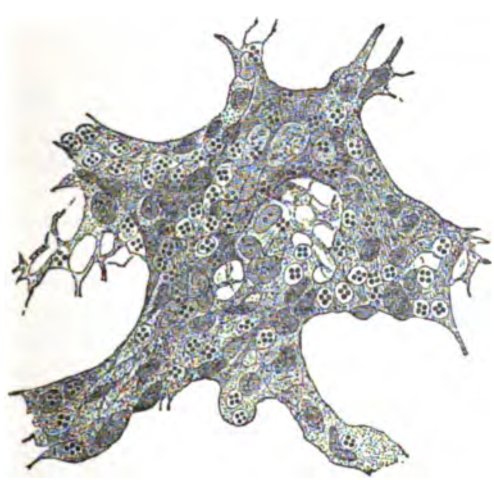


Fig. 15. From "Die Mikro-Organismen;" p. 163.

Fig. 15 represents this coccus in a section of the lung of a mouse (× 800, after Flügge).

6. *Micrococcus gonorrhœæ.* This coccus, discovered by Neisser in

the pus of specific urethretis, is now generally recognized by bacteriologists as the cause of gonorrhœa. The researches of Bumm, especially, have made this to appear almost certain. In the second edition of the memoir of this author the statement is made that a characteristic urethral inflammation and discharge resulted, in a female, from an experimental inoculation with material from a 20th culture.

Bumm has shown that the "gonococcus" does not grow in the liquid and solid culture media usually employed in laboratory work, which furnish a favorable soil for the various species of micrococci above described. Those authors who had previously obtained cultures in *bouillon*, and upon flesh-peptone gelatine, by inoculating these media with gonorrhœal pus, were doubtless mistaken in the inference that the coccus obtained in their culture was identical with that in the pus cells. As a matter of fact, the researches of the author quoted have shown that several different species of micrococci may be obtained from this source. According to Bumm, the true "gonococcus" grows very slowly upon blood-serum as a thin, often scarcely visible, layer, of a grayish-yellow color. He has been most successful in cultivating it upon human blood-serum.

Fig 16. "Die Mikro-Organismen," p. 157.

Fig. 16 is copied from Bumm's work, published in 1885. The amplification is 800 diameters—*a*, free-lying cocci; *b*, cocci in pus cells; *c*, cocci in an epithelial cell.

7. *Micrococcus Pasteuri.* This is a pathogenic micrococcus found in the mouths of certain individuals, which was discovered by the writer, in 1880, in the blood of a rabbit which died as a result of a subcutaneous injection of a small quantity of saliva. At a temperature of 35–38° C. this coccus grows readily in blood-serum, or in *bouillon* made from the flesh of a rabbit. It may also be cultivated in agar-agar. The smallest quantity of such a culture, or of the blood of an animal recently dead from the infectious disease to which it gives rise, causes death within forty-eight hours when introduced beneath the skin of a rabbit. This coccus is present, in a large proportion of the cases at least, in the exudate into the alveoli of the lungs in cases of croupous pneumonia; and there is good reason for believing that it is concerned in the etiology of this disease. Under certain circumstances it is surrounded by a transparent material, which has been described by some authors as a "capsule," This is well shown in Fig. 17, which is copied from a paper by Salvioli, published in the "Archive per le Scienze Mediche" (Vol. VIII).

Fig. 17. From "Archive per le Scienze Mediche."

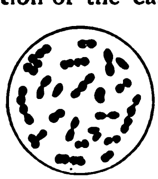


Fig. 18.

Fig. 18 is from a drawing carefully made for the writer by Dr. A. C. Abbott, and represents *M. Pasteuri* as seen in the blood of a rabbit which had been inoculated with fresh pneumonia sputem, obtained from a patient in the seventh day of the disease. The amplification is 1000 diameters.

SARCINÆ.

Experiments have been made upon two species of the genus *Sarcina*, one of which is distinguished by a yellow color, while the other has a bright-orange color. These are not pathogenic. The sarcinæ are distinguished from the micrococci by the fact that division occurs in three directions forming groups of eight elements.

METHODS OF RESEARCH.

In the experiments recorded in the report of the Committee on Disinfectants for 1885 liquid cultures were employed, the culture-fluids being enclosed in hermetically sealed glass flasks, such as the writer has been in the habit of using for a number of years. The manner of making and using these flasks is described as follows in "Bacteria:"[1]

The writer described, in a paper read at the meeting of the American Association for Advancement of Science, in August, 1881, a method of conducting culture experiments which he has found extremely satisfactory, and which has the advantage of assuring the greatest possible security from contamination by atmospheric germs. The culture-flasks employed contain from one to four fluid drachms. They are made from glass-tubing of three or four tenths inch diameter, and those which the writer has used in his numerous experiments have all been home-made. It is easier to make new flasks than to clean old ones, and they are thrown away after being once used. Bellows, operated by the foot, and a flame of considerable size—gas is preferable—will be required by one who proposes to construct these little flasks for himself. After a little practice, they are rapidly made; but as a large number are required, the time and labor expended in their preparation are no slight matter. . . . After blowing a bulb at the extremity of a long glass tube, of the diameter mentioned, this is provided with a slender neck, drawn out in the flame, and the end of this is hermetically sealed. (See Fig. 19.) Thus one little flask after another is made from the same piece of tubing, until this becomes too short for further use.

Fig. 19.

To introduce a culture-liquid into one of these little flasks, heat the bulb slightly, break off the sealed extremity of the tube, and plunge it beneath the surface of the liquid. (See Fig. 20.) The quantity which enters will, of course, depend upon the heat employed, and the consequent rarefaction of the enclosed air. Ordinarily the bulb is filled to about one third of its capacity with the culture-liquid, leaving it two thirds full of air, for the use of the microscopic plants which are to be cultivated in it.

Fig. 20.

The culture-fluid in the flasks is next sterilized in a water-bath or a steam-sterilizer. Usually I am in the habit of placing a quantity of the little flasks in a water-bath, maintained at a boiling temperature for an hour or more, and, to ensure destruction of all spores, the boiling is repeated the following

[1] Wm. Wood & Co., N. Y., 1884.

day. The flasks are then placed in an incubating oven, at 38° C., for several days, to prove that the culture-fluid contained in them is sterile.

The test of disinfection is made by introducing into these flasks a small amount of material containing the test-organism, after having exposed this for two hours to the action of the disinfecting agent in a determined proportion. It has been my practice throughout to mix a given quantity—usually 5c.c.—of the culture containing the test organism with an equal quantity of an aqueous solution of the disinfecting agent. Dr. Bolton has been governed by the same rule in making his experiments.

In the mode of experimenting above described, a complete absence of growth in the sterile culture-medium will be evidence that all of the test-organisms introduced into the flask have been destroyed by the action of the disinfecting agent, when the experiments have been conducted with a due regard to the possible restraining influence of the germicide agent, which if introduced in sufficient amount might simply prevent growth by reason of its presence, and lead to the mistaken inference that the vitality of the test-organism had been destroyed. This error is to be avoided by diluting the germicide agent so largely with the sterilized culture-fluid into which it is introduced, along with the test-organisms which have been exposed to its action, that its restraining influence is rendered nil. Suppose, for example, that we mix with a culture of the anthrax bacillus containing spores an equal quantity of a solution of mercuric chloride of the strength of 1 to 1,000, making the proportion of the salt in the mixture 1 to 2,000: now, if we take one part of this mixture and add it to ten parts of sterilized *bouillon*, we shall have the mercuric chloride present in the proportion of 1 to 20,000. Experiments upon the restraining power of this salt show that anthrax spores will not grow in culture-solutions containing 1 to 300,000, and that their development is retarded by solutions of 1 to 600,000. Failure to develop in this case would therefore be no proof that the growing power of the anthrax spores had been destroyed. This proof is only to be attained by adding sufficient culture-fluid to dilute the mercuric chloride beyond its restraining power. The use of a comparatively large amount of the culture-fluid, and of an extremely small quantity of the material containing the test-organisms, permits us to exclude this source of error, for a few germs serve as well for the test as a large number.

For the reason stated, fluid-culture media are more suitable for experiments of this nature than solids. If we bring a little of our material containing mercuric chloride in the proportion of 1 to 2,000 upon the surface of a cooked potato, or introduce it with a needle into a gelatine-culture medium, the salt will not be diluted, and would exercise its restraining influence upon the germs if they had not already been destroyed by its action. On the other hand, if we add 1 part of the material to 100 parts of *bouillon* and mix thoroughly by shaking, the mercuric chloride will be diluted to 1 to 200,000: this being still within the limits of its restraining action, we may take one part of the mixture and add it to ten parts of the sterile *bouillon*. The mercuric chloride will now be diluted to 1 to 2,000,000, a proportion quite beyond the limits of restraining action. But there will be a sufficient number of anthrax spores in the culture-medium to test the question as to whether the growing power of these particular "germs" is destroyed by mercuric chloride in the proportion named.

It is probable that this source of error has not been kept sufficiently in view in some of the experiments heretofore made. Again: It often happens that no development occurs for a time, but that after several days the germs which have been exposed to the action of a chemical agent commence to grow, and finally produce an abundant and vigorous progeny. In this case mistakes are likely to arise from terminating the experiment too soon. Anthrax spores, for example, develop, in a suitable culture-medium, at a temperature of 80° to 100° F. within twenty-four hours, and give rise to numerous characteristic flocculi, made up of long filaments, which are readily distinguished by the naked eye. But after exposure to a germicide agent in less amount than is necessary to completely destroy their vitality, they may fail to develop under the same circumstances in forty-eight or seventy-two hours, and yet finally produce an abundant crop of filaments.

When development occurs in the little flasks, it is evidence that some of the test-organisms. at least, have escaped destruction, but we have no way of determining whether few or many have escaped the germicide action of the disinfecting agent. From a practical point of view this is a matter of little importance. We wish to know what amount of the disinfectant will destroy *all* pathogenic germs, and in practice we will not fail to keep on the safe side, that is to say, the side of excess. But it is a matter of some scientific interest to ascertain, in a given experiment in which growth has occurred, whether few or many of the test-organisms have escaped the destructive action of the disinfectant. This may be done by the use of a gelatine culture-medium, and is very conveniently accomplished by means of Esmarch's method. In Dr. Bolton's experiments, recorded in the present report, and in my own experiments upon the thermal death-point of micro-organisms, this method has been largely employed. The details for disinfection experiments are as follows:

A pure-culture of the test-organism is made in 5 c.c. of *bouillon*, contained in an ordinary test-tube with a cotton stopper, or in a Miquel flask. To this is added an aqueous solution of the disinfectant in equal amount. The percentage of the disinfecting agent will of course be reduced one half. The mixture is allowed to stand for two hours, and a very small quantity is then introduced into a test-tube containing flesh-peptone-gelatine, which has been liquefied by heat (30° to 35° C.). A closely fitting rubber cap is then placed over the end of the test-tube, the cotton stopper being left *in situ*. The tube is now placed in a shallow vessel containing iced water, and is rotated, with its long axis in a horizontal plane, until the gelatine has become solid. The effect of this procedure is to spread the gelatine out in an even layer over the interior of the test-tube. When now it is placed aside in a room or incubating-oven, maintained at a temperature a little below the melting point of gelatine, each micrococcus, or bacillus, or spore, which has retained its vitality, will form a colony, which after a time will be visible to the naked eye, and the characters of which may be studied under the microscope by the use of a low power objective, *e. g.*, ½ in.

The Esmarch tube is, in fact, a modification of Koch's plate-method, and for experiments of the kind referred to has decided advantages on account of the slight risk of accidental contamination, and of the great saving in time and space effected in using these tubes rather than flat plates of glass, in large glass jars, as in the well known plate-method of Koch.

We have also in our experiments had occasion to use potato-cultures, and have found a modification of the usual method, which has been devised by Dr. Bolton, to be very useful. This consists in cutting the potato into cylindrical pieces of about one inch in diameter, and three inches long; in slicing this obliquely in its long diameter, to make a plane surface upon which to cultivate the micro-organism; in placing these in large test-tubes of proper diameter and length (about six inches long), and stopped in the usual way with cotton plugs; and, finally, in sterilizing these in the steam-sterilizer.

TEMPERATURE EXPERIMENTS.

In my temperature experiments I have taken great pains to ensure the exposure of the test-organisms to a uniform temperature, and have adopted ten minutes as the standard of time of exposure. The method employed throughout has been as follows: From glass tubing having a diameter of about $\frac{3}{16}$ of an inch I draw out in the flame of a Bunsen burner a number of capillary tubes, with an expanded extremity, which serves as an air-chamber. A little material from a pure-culture of the test-organism is drawn into each of these capillary tubes by immersing the open extremity in the culture, after having gently heated the expanded end. (See Figs. 19 and 20.) The end of the tube is then hermetically sealed by heat. These tubes are immersed in a water-bath, maintained at the desired temperature for the standard time. The bath is kept at a uniform temperature by personal supervision. At the bottom of the vessel is a thick glass plate, which prevents the thermometer bulb and capillary tubes, which rest upon it, from being exposed to heat transmitted directly from the bottom of the vessel. To further guard against this, I am in the habit of applying the flame to the sides of the vessel, and a uniform temperature throughout the bath is maintained by frequent stirring with a glass rod. It is impossible to avoid slight variations, but by keeping my eye upon the thermometer throughout the experiment, I have kept these within very narrow limits. A single thermometer, made by Schlay & Borend, of Berlin, and graduated in degrees of the centigrade scale, has been used throughout.

The experiments recorded in this report have been made through the courtesy of Prof. Wm. H. Welch, in the pathological laboratory of Johns Hopkins University.

SECTION I.—HEAT.[1]

The experiments, recorded in the Report of the Committee on Disinfectants for 1885, brought out in a very definite manner the great difference in the resisting power of the spores of bacilli, and of micro-organisms of the same class—micrococci, spirilla, bacilli—in the absence of spores. This difference was so great, both for heat and for chemical disinfectants, as to make it seem necessary to give specific directions separately for the disinfection of "spore-containing infectious material," and "for the destruction of infectious material which owes its infecting power to the presence of micro-organisms not containing spores."

The only objection which can be urged against this classification of means of disinfection, for practical purposes, is that the question of the presence or absence of spores has not been decided in the case of a number of pathogenic bacilli, and that for certain kinds of infectious material —*e. g.*, small-pox, yellow fever, pleuro-pneumonia of cattle—we have no exact knowledge of the nature of the infectious agent. It is evident that in the absence of such exact knowledge it will be safest to employ that group of disinfectants which stands the most difficult test, viz., the destruction of spores. But, on the other hand, there are certain agents in the second list—*e. g.*, carbolic acid, sulphate of copper—which are extremely useful in those cases in which we can be sure that the infectious material to be destroyed does not contain spores. For this reason, and as a matter of general scientific interest, it is desirable that we should ascertain with reference to each of the pathogenic organisms known whether it forms spores, and if so what the resisting power of these spores is to heat and to various chemical agents.

Having ascertained that the spores of several well known species of bacillus require for their destruction a temperature of 100° C. (212° F.), it has been generally assumed that all spores have a resisting power much above that possessed by organisms which do not form spores. This assumption has led the writer to think that the question of the presence or absence of spores might be determined by experiments made to determine the temperature required to destroy vitality. If growth should occur after exposure to a temperature approaching 100° C., there could be no doubt that spores were present in the material, for all experiments are in accord as to the destruction of micro-organisms in the absence of spores at a much lower temperature than this—50°–65° C. But, on the other hand, it does not follow that because no growth occurs after exposure to 60° C. no spores were present. It is not safe to assume, however probable it may appear, that because the spores of various known species of bacillus require a temperature of 100° C. for their destruction, there are no spores which are killed at a lower temperature. As a matter of fact, there are differences in the resisting power of the

[1] The writer's experiments upon the thermal death-point of pathogenic organisms have, in part been published in the "American Journal of the Medical Sciences" of July, 1887. Believing that the interest and value of the present report would be enhanced by publishing these experiments *in extenso*, I have introduced them here with the approval of the Executive Committee of the A. P. H. A.

spores heretofore tested in this regard, and there is no *a priori* reason for denying the possibility that there may be a wide range in the resisting power of these reproductive elements. In the experiments below recorded the writer has demonstrated that a number of species of bacilli which have been said by competent authorities to form spores, exhibit no growth after exposure to a temperature of 60° C. for ten minutes.

This question of spores has been kept in view throughout my experiments, and has seemed to me to be of special importance in the case of the typhoid bacillus. The frequent transmission of this disease by means of infected milk or water, and the importance of destroying the infecting agent in the discharges of the sick, have induced me to give this a prominent place as a test-organism in my own experiments and in those which Dr. Bolton has made under my direction.

It will be understood that all of the experiments included in this report relate to moist heat; that is to say, the test-organisms were in fluid cultures and in a moist condition. The effect of dry heat upon desiccated organisms is quite another question. This has been studied by Koch and Wolffhügel, and their results have been given by Dr. Rohé in his paper on "Dry Heat," in the report of the committee for 1885.

In recording my experiments I shall follow the order in which the test-organisms are described in the introduction to this report (p. 66 to 79).

SPIRILLUM OF ASIATIC CHOLERA

(*comma bacillus* of Koch). My experiments have been made simultaneously upon the cholera spirillum and the two organism which most closely resemble it, viz., the cheese spirillum of Deneke, and the Finkler-Prior spirillum. These experiments are recorded in the following tables, in which the figures represent the temperature to which the test-organism was exposed. The figures in heavy type indicate that growth occurred after exposure to the temperature which they represent; those in light type indicate that no growth occurred; a star after the figures indicates that growth was retarded; Cont. is an abbreviation for control. In every case the control experiment was made with material from the same culture. Unless otherwise stated, the experiment was made by means of an Esmarch tube in the method detailed on page 81.

The cultures in this series of experiments were all made at the room temperature in flesh-peptone gelatine.

TABLE NO. I.

Date.	Organism.	Experiments.
December 30, 1886.	Cholera spirillum.	**42°, 44°, 46°, 48°,* Cont.**
	Cheese spirillum.	**42°, 44°, 46°, 48°,* Cont.**
	Finkler-Prior spirillum.	**42°, 44°, 46°, 48°,* Cont.**

In this first experiment no growth was observed in the Esmarch tubes containing the three organisms, after exposure to 48° for ten minutes, when these tubes were examined after an interval of four or five days, but subsequently a few colonies developed in each tube. This considerable retardation of growth led me to think that a slightly longer exposure would be fatal to all of these spirilla. I accordingly made the following experiment at the same temperature, but varying the time of exposure:

TABLE NO. II.

Date.	Organism.	Temp.	Time of exposure in minutes.
January 7, 1887.	Cholera spirillum.	48° C. = 118.4° F.	2, 4, 6, 8,* 10,* 12.*
	Cheese spirillum.		2, 4, 6, 8,* 10,* 12.*
	Finkler-Prior spirillum.		2, 4, 6, 8,* 10,* 12.*

This was followed by a similar experiment at 50° C.

TABLE NO. III.

Date.	Organism.	Temp.	Time of exposure in minutes.
January 10, 1887.	Cholera spirillum.	50° C. = 122° F.	2, 4, 6, 8,* 10,* Cont.
	Cheese spirillum.		2, 4, 6, 8,* 10,* Cont.
	Finkler-Prior spirillum.		2, 4,* 6, 8, 10, Cont.

In this experiment only a few colonies developed after exposure for eight and ten minutes in the case of the cholera and cheese spirillum, and none at all in the case of the Finkler-Prior spirillum. The following experiment was made at 52° C.:

TABLE NO. IV.

Date.	Organism.	Temp.	Time of exposure in minutes.
January 13, 1887.	Cholera spirillum.	52° C. = 125.6° F.	2,* 4, 6, 8, 10, Cont.
	Cheese spirillum.		2,* 4, 6, 8, 10, Cont.
	Finkler-Prior spirillum.		2, 4, 6, 8, 10, Cont.

This experiment enables us to fix the thermal death-point of these three species of spirillum at 52° C., the time of exposure being four minutes. It will be noticed that identical results were obtained as regards the cholera and cheese spirillum, while the Finkler-Prior spirillum proved to have not quite so much resisting power to heat.

The following experiment gives a result in accord with the above. It was made for the purpose of testing the question whether a difference would be shown in the resisting power of old and new cultures. We may remark here that the cholera spirillum retains its vitality for several months, at least, in cultures which are kept in a moist condition. On the other hand, Koch has shown that it is quickly destroyed by desiccation.

TABLE NO. V.

Date.	Cholera spirillum.	Temp.	Time of exposure in minutes.
January 17, 1887.	Fresh culture.	52° C. = 125.6° F.	**2,*** 4, 6, **Cont.**
	Culture 13 days old.		**2,*** 4, 6, **Cont.**

TABLE NO. VI.

TYPHOID BACILLUS.

(Ten minutes' exposure.)

Date.	Culture medium.	Experiments.	Remarks.
1886. Nov. 10.	Veal broth.	**50°**, 60, 70, **Cont.**	In oven at 38° for 48 hours.
Nov. 15.	Veal broth.	**50°, 52, 54,** 56, 58, 60, **Cont.**	Fluid culture of Nov. 1st.
Nov. 30.	Potato culture.	**50°, 55,** 60, 70, 80, **Cont.**	Culture at room temperature.
Dec. 4.	Potato culture.	60°, **Cont.**	Culture in oven at 38° for 7 days.
Dec. 24.	Potato culture.	60°, 70, 80, **Cont.**	Culture in oven for 10 days, then kept at room temperature for 15 days.
1887. Jan. 15.	Potato culture.	55°, 60, 70, 80, **Cont.**	Culture in oven at 38° for 7 days.
Jan. 20.	Potato culture.	**48°, 50, 52,** 60, **Cont.**	In oven at 38° for 10 days.
Jan. 21.	Potato culture.	**50°**, 60, **Cont.**	Potato in oven for 7 days, then kept at room temperature 7 days.

An inspection of the table shows that no growth occurred in any instance after exposure to 56° C. and above. We may therefore fix the thermal death-point of the typhoid bacillus at 56°, and our experiments show that if spores are formed in potato cultures kept in the incubating oven at 38°, as asserted by Gaffky and others, these spores are also destroyed at this temperature.

BACILLUS ANTHRASIS.

Davaine first made experiments (1873) to determine the temperature required to destroy the vitality of the anthrax bacillus as found in the blood of an animal just dead as the result of an experimental inoculation. Under these circumstances no spores are present. The destruction of vitality was tested by inoculation into susceptible animals. This method is open to the objection that at temperatures approaching that which destroys vitality the development of the bacillus is retarded, and the animal is likely to suffer a non-fatal attack of the disease which may escape observation, and the inference be drawn that the bacillus is killed. This is probably the explanation of the slight difference in the results obtained by Davaine and those of Chauveau made more recently.

ANTHRAX BACILLUS.

TABLE NO. VII.

Authority.	Temperature.	Time of exposure in minutes.	Remarks.
....	55°	5	In blood.
Davaine..........	50°	10	" "
....	48°	15	" "
Chauveau........	50°	20	Cultures.
	54°	10	"

According to Flügge anthrax spores are killed by exposure to 100° C. for two minutes. In a recent experiment by the writer a single colony developed after exposure to this temperature for two minutes, but there was no growth when the time was extended to four minutes. Keeping on the side of safety, we may place the thermal death-point of anthrax spores at 100° C. (= 212° F.), the time of exposure being five minutes. Chauveau has shown that exposure to a temperature slightly below that which completely destroys vitality causes an attenuation of virulence, and that this method may be adopted for procuring a virus suitable for use in protective inoculations. For *premier vaccin* Chauveau uses a culture which has been exposed for fifteen minutes to a temperature of 50° C. A stronger virus for the second inoculation is obtained by exposure to the same temperature for ten minutes.

Bacillus of Glanders. Löffler[1] has recently determined the thermal

1 Arbeiten a. d. Kaiserlichen Gesundheitsamte, Bd. 1, Heft 5.

death-point of the *Rotz* bacillus. He finds it to be 55° C., the time of exposure being ten minutes.

Bacillus of Swine Plague (German, *schweine rothlauf;* French, *rouget*). *Bacillus of Mouse Septicæmia* (Koch). Pasteur's bacillus of *rouget* is, no doubt, identical with the bacillus of *schweine rothlauf* of the German bacteriologists. I have experimented upon cultures from both sources. The bacillus of mouse septicæmia is also supposed by some authors to be identical with the above. According to Eisenberg, the bacillus of mouse septicæmia forms spores. Flügge says of the bacillus of *schweine rothlauf:*

In bouillon cultures which have been kept for three days at the room temperature, or for twenty-four hours at 40°, one notices the formation of small spherical bodies, which probably represent spores, although, on account of their minuteness, the formation and development of these bodies have not, up to the present time, been exactly observed.[1]

My experiments upon the thermal death-point of these organisms are included in the following tables:

TABLE NO. VIII.

CULTURES IN FLESH-PEPTONE-GELATINE.

Date.	Organism.	Temperature to which exposed.
January 20, 1887 . .	Mouse septicæmia.	**50°**, 60, **Cont.**
January 26, 1887 . .	Mouse septicæmia.	**52°, 54, 56,*** 58, **Cont.**
	Schweine rothlauf.	**52°**, 54, 56, **Cont.**
February 7, 1887 . .	Mouse septicæmia.	60°, **Cont.**
	Schweine rothlauf.	60°, **Cont.**
February 8, 1887 . .	Mouse septicæmia.	**54°, 56,*** 58, **Cont.**
	Rouget.	**52°, 54, 56,*** 58, **Cont.**

TABLE NO. IX.

CULTURES IN BOUILLON.

Date.	Organism.	Temperature to which exposed.
March 17, 1887. . .	Rothlauf.	60°, 65, **Cont.**
	Mouse septicæmia.	60°, 65, **Cont.**

These bouillon cultures were kept in the incubating oven at 38° for three days, and afterward at the room temperature for eight days. The bacilli were found to have grown out into slender filaments, which presented the appearance of having vacant places in their protoplasm, which possibly represented spores. As will be seen by reference to the table, no growth occurred after exposure to a temperature of 60 C. for ten min-

[1] Die Mikro-Organismen, p. 246.

utes. We must, therefore, admit either that this bacillus does not form spores under the circumstances stated by Flügge, or that the spores are destroyed at the comparatively low temperature named.

In the following table I include several species of pathogenic and non-pathogenic bacilli in which the question of spore-formation has not been definitely settled. In regard to the first named (Emmerich's bacillus), Eisenberg remarks "spore-formation not yet observed." According to Flügge, *B. sputig. crassus* "appears to form spores at a temperature of 35°." The bacillus of blue milk is said by Eisenberg to form spores in gelatine cultures after the third day. The lactic acid ferment is said by the same author to form spores at the ends of the rods, which appear as spherical, shining, highly refractive bodies. In my own examinations of stained cover-glass preparations from the cultures used in the following experiments, I have in no instance been able to satisfy myself of the presence of spores.

TABLE NO. X.

RECENT CULTURES IN FLESH-PEPTONE-GELATINE.

Organism.	Date.	Temperature to which exposed 10 minutes.
Emmerich's bacillus	January 24.	60°, Cont.
	January 28.	70°, 80, 90, 100, Cont.
	February 1.	60°, 62, 64, Cont.
Brieger's bacillus	January 24.	60°, Cont.
	February 1.	58°*, 60*, 62°, Cont.
Friedländer's bacillus (So called "pneumo-coccus.")	December 24.	50°, 52,* 54,* Cont.
	January 8.	58°, 60, 62, 64, Cont.
	January 11.	54°, 56,* 58, Cont.
	January 20.	56°, 58, Cont.
Bacillus sputig. crassus (Kreibohm.)	January 24.	60° Cont.
	January 28.	50°, Cont.
	January 31.	54°, 56, 58, Cont.
Bacillus pyocyanus (Green pus.)	December 24.	70°, 80, Cont.
	December 31.	46°, 48, 50, Cont.
	January 8.	58°, 60, 62, 64, Cont.
	January 17.	52°, 54*, Cont.
	February 2.	54°, 56, 58, Cont.
Bacillus indicus	January 21.	56°,* 60, Cont.
	January 25.	56°, 58, Cont.
	January 26.	52°,* 54,* 56, Cont.
	February 2.	54°, 56, 58, Cont.
Bacillus prodigiosus (Commonly called micrococcus prodigiosus.)	January 21.	56°, 60, Cont.
	January 25.	56°, 58, Cont.
	January 26.	52°,* 54,* 56,* Cont.
	February 2.	54°,* 56, 58, Cont.
Bacillus cyanogenus (Bacillus of blue milk.)	January 28.	50°, 60, Cont.
	January 51.	54°, 56, 58, Cont.
Bacillus fluorescens	January 28.	50°, 60, Cont.
	January 31.	54°, 56, 58, Cont.
Bacillus acidi lactici	January 24.	60°,* Cont.
	January 26.	52°, 54, 56, Cont.
	February 1.	60°, 62, 64, Cont.
	February 8.	54°, 56, 58, Cont.

TABLE NO. XI.

POTATO CULTURES IN INCUBATING OVEN FOR THREE DAYS AT 38° TO TEST FOR SPORES.

(No spores seen on microscopic examination of stained cover-glass preparations.)

Organism.	Date.	Temperature to which exposed.
Bacillus pyocyanus . .	March 1, 1887.	60°, 65, Cont.
Emmerich's bacillus . .	" "	60°, 65, Cont.
Brieger's bacillus . .	" "	60°, 65, Cont.
Bacillus acidi lactici . .	" "	60°, 65, Cont.

TABLE NO. XII.

OLD CULTURES IN FLESH-PEPTONE-GELATINE TO TEST FOR SPORES.

(March 7, 1887.)

Organism.	Age of culture.	Temperature to which exposed.
Brieger's bacillus . .	36 days.	60°, 65, Cont.
Emmerich's bacillus . .	43 "	60°, 65, Cont.
Bacillus pyocyanus . .	46 "	60°, 65, Cont.
Bacillus fluorescens . .	42 "	60°, 65, Cont.
Bacillus cyanogenus .	33 "	60°, 55, Cont.
Bacillus acidi lactici . .	42 "	60°, 65, Cont.

It will be seen that in all of these experiments the lactic acid ferment is the only one which resisted a temperature of 60° C.; and if the presence of spores could be determined by this test, this is the only organism in the list in which there is any evidence of spore formation. I am not, however, disposed to accept this test, and think it not improbable that some of the bacilli in the list form reproductive spores, which differ from those of the anthrax bacillus and certain other spore-forming bacilli, in the fact that they are destroyed at a comparatively low temperature. The only way to settle this question will be by the method of direct observation. If the refractive spherical bodies, supposed to be spores, which may be seen in potato cultures of the typhoid bacillus, in bouillon cultures of the bacillus of swine plague, etc., are observed to develop into bacilli, they will be demonstrated to be reproductive elements, or spores, notwithstanding the fact that they are destroyed by so low a temperature as 60° C.

The following experiments have been made with pathogenic and non-pathogenic bacilli which are known to form spores:

TABLE NO. XIII.

Organism.	Date.	Temperature to which exposed, ten minutes.
Bacillus alvei (foul brood of bees)	December 8, December 30,	**80°, Cont.** **90°,** 100, **Cont.**
Wurtzel bacillus	January 24, January 28,	**60°, Cont.** **70°, 80,** 90, **Cont.**
Bacillus butrycus	December 28, December 31,	**80°, Cont.** **90°,** 100, **Cont.**

The following experiments have been made upon these spore-forming bacilli at a temperature of 100° C. (212° F.), the time of exposure being varied:

TABLE NO. XIV.

Organism.	Date.	Time of exposure in minutes.
Anthrax bacillus.	February 9,	**2,*** 4, 6, 8, 10, **Cont.** * A single colony.
Bacillus alvei	February 9,	**2,*** 4, 6, 8, 10, **Cont.** * A few colonies.
Bacillus butrycus	February 9,	**2,** 4, 6, 8, 10, **Cont.**
Wurtzel bacillus	March 4,	**2,*** 4, 6, 8, 10, **Cont.** * A single colony.

My experiments upon micrococci are recorded in the following table:

TABLE NO. XV.

RECENT CULTURES OF MICROCOCCI IN FLESH-PEPTONE-GELATINE.

Organism.	Date.	Temperature to which exposed ten minutes.
Micrococcus of osteomyelitis.	December 8, 1886. December 20, February 8, 1887.	**50°, 52, 54,** 56, 58, **Cont.** **52°, 54, 56,* Cont.** **54°, 56,*** 58, **Cont.**
Staphylococcus pyog. aureus.	January 11, 1887.	**54°, 56,*** 58, 60, **Cont.**
Staphylococcus pyog. citreus.	January 8, 1887. January 11, January 20,	**58,° 60,*** 62, 64, **Cont.** **54,° 56, 58,* 60.*** **56,° 58,*** 60, **Cont.**
Staphylococcus pyog. albus .	December 26, 1886. January 11, 1887.	**52°, 54, 56,* Cont.** **54,° 56, 58,* 60.***
Streptococcus erysipelatus .	December 28, 1886. January 20, 1887. January 25,	**48°, 50,** 52, **Cont.** **50°, 52,** 58, **Cont.** 54°, 56, **Cont.**
Micrococcus tetragenus . .	January 25, 1887.	**54°, 56,*** 58, **Cont.**
Micrococcus Pasteuri . . .	March 29, 1887. April 7,	50°, 52, 54, 56, 58, **Cont.** **46°, 48, 50,*** 52, **Cont.**

TABLE NO. XVI.

FRESH CULTURES OF SARCINÆ IN FLESH-PEPTONE-GELATINE.

Organism.	Date.	Temperature to which exposed.
Sarcina aurantiaca	December 24, 1886.	56°, 58,* 60,* Cont.
	January 11, 1887.	54°, 56, 58,* 60.
	January 18,	58°, 60, Cont.
Sarcina lutea	December 29, 1886.	56°, 58,* 60,* Cont.
	January 7, 1887.	58°, 60,* 62,* 64, Cont.
	January 11,	56°, 58, 60,* Cont.
	January 18,	60°,* 62, 64, Cont.

Gonococcus of Neisser. Believing, as I now do, that this organism is the cause of the infectious virulence of gonorrhœal secretions (see *The Medical News* of Feb. 26, 1887), I have made the following experiment with reference to its thermal death-point. Some gonorrhœal pus from a recent case which had not undergone treatment, was collected for me by my friend, Dr. George H. Rohé, in the capillary tubes heretofore described. A microscopical examination of stained cover-glass preparations showed that this pus contained numerous "gonococci" in the interior of the cells. Two of the capillary tubes were placed in a water bath maintained at 60° C. for ten minutes. The pus was then forced out upon two pledgets of sterilized cotton wet with distilled water. Two healthy men had consented to submit to the experiment, and one of these bits of cotton was introduced into the urethra of each, and left *in situ* for half an hour. As anticipated, the result was entirely negative. For obvious reasons no control experiment was made, and no attempt was made to fix the thermal death-point within narrower limits.

In connection with these experiments upon the thermal death-point of known pathogenic organisms, it is of interest to inquire whether the virulence of infectious material, in which it has not yet been demonstrated that this virulence is due to a micro-organism, is destroyed by a correspondently low temperature. Evidently, if this proves to be the case, it will be a strong argument in favor of the view that we have to deal with a micro-organism in these diseases also. We have experimental proof that a large number of pathogenic organisms are killed by exposure for ten minutes to a temperature of from 55° to 60° C. But, so far as I am aware, this low temperature would not be likely to destroy any of the poisonous chemical products which might be supposed to be the cause of infective virulence, leaving aside the fact that such chemical products have no power of self-multiplication, and, therefore, could not be the independent cause of an infectious disease.

Vaccine Virus. Carstens and Coert have experimented upon the temperature required to destroy the potency of vaccine virus. In a paper read at the meeting of the International Medical Congress, in

1879, they report as the result of their experiments that the maximum degree of heat to which fresh vaccine can be exposed without losing its virulence probably varies between 52° and 54° C. Fresh animal vaccine heated to 52° C. for thirty minutes does not lose its virulence. Fresh animal vaccine heated to 54.5° C. for thirty minutes loses its virulence.

Rinderpest. According to Semmer and Raupach,[1] exposure for ten minutes to a temperature of 55° C. destroys the virulence of the infectious material in this disease.

Sheep-pox. The authors last mentioned[2] have also found that the same temperature—55° C. for ten minutes—destroys the virulence of the blood of an animal dead from sheep-pox.

Hydrophobia. Desiring to fix the thermal death-point of the virus of hydrophobia, I obtained, through the kindness of Dr. H. C. Ernst, a rabbit which had been inoculated, by the method of trephining, with material which came originally from Pasteur's laboratory (see Dr. Ernst's paper in the April number of the *Sanitariam*). The rabbit sent me showed the first symptoms of paralytic rabies on the eighth day after inoculation. It died on the eleventh day (March 2, 1887), and I at once proceeded to make the following experiment:

A portion of the medulla was removed, and thoroughly mixed with sterilized water. The milky emulsion was introduced into four capillary tubes, such as had been used in my experiments heretofore recorded. Two of these tubes were then placed for ten minutes in a water bath, the temperature of which was maintained at 60° C. Four rabbits were now inoculated by trephining, two with the material exposed to 60° C. for ten minutes, and two with the same material from the capillary tubes not so exposed. The result was as definite and satisfactory as possible. The two control rabbits were taken sick, one on March 10, and one on the 11th; both died with the characteristic symptoms of paralytic rabies on the third day. The two rabbits inoculated with material exposed to 60° C. remained in perfect health. On the 26th of March one of these rabbits was again inoculated by trephining with material from the medulla of a rabbit just dead from hydrophobia. This rabbit died from paralytic rabies on the 8th of April. Its companion remains in perfect health.

A second experiment was made in the same way on the 14th of March. Two rabbits were inoculated with material exposed for ten minutes to a temperature of 50° C.; two with material exposed for the same time to a temperature of 55° C.; and two control rabbits with material not so exposed. One of the rabbits inoculated with material exposed to 50° C. and one of the control rabbits died on the 25th; the other rabbit inoculated with the material exposed to 50°, the other control, and one inoculated with material exposed to 55°, on the 26th. The second rabbit inoculated with material exposed to 55° died five days later with the characteristic symptoms of the disease.

[1] Deutsche Zeitschrift für Thier med., vii, p. 347.
[2] Ibid.

These experiments show, then, that the virus of hydrophobia is destroyed by a temperature of 60° C., and that 55° C. fails to destroy it, the time of exposure being ten minutes.

Bacillus Tuberculosis. Schill and Fischer (1884), assuming that the tubercle bacillus forms spores, made quite a number of experiments to determine its thermal death-point. Using fresh sputum as the material, and testing the destruction of the vitality of the bacilli contained in this material by inoculations into guinea-pigs, they found that exposure to a temperature of 100° C., in steam, was efficient when the time of exposure was five minutes. When the time was reduced to two minutes a negative result was obtained in two out of three guinea-pigs inoculated, but in one death from tuberculosis occurred.

As this one guinea-pig furnishes the only evidence offered by these experimenters that the tubercle bacillus requires a temperature of 100° for its destruction, I have made a single experiment at lower temperatures. On the 8th of March I obtained, through the courtesy of Dr. Wm. G. Councilman, some perfectly fresh tuberculous sputum from a patient in the Bay View hospital. A cover-glass preparation stained by Ehrlich's method showed an abundance of tubercle bacilli. The sputum, mixed with sterilized bouillon, was drawn into the small glass tubes used in my experiments as heretofore described. Two tubes were prepared for each animal, the contents of one being injected into the cavity of the abdomen, and of the other into the sub-cutaneous connective tissue in the vicinity of the axilla. One guinea-pig was injected with sputum which had been exposed for ten minutes to a temperature of 50° C. (No. 1); one to sputum exposed for the same time to 60° C. (No. 2); one at 70° C. (No. 3); one at 80° C. (No. 4); one at 90° C. (No. 5); and one (No. 6) with material not heated, to serve as a control. The control guinea-pig died of septicaemia a week after the inoculation. No. 3 (70° C.) died on the 5th of April, cause of death uncertain; no evidence of tuberculosis was found upon post-mortem examination. No. 1 (50° C.) died April 24, and was found to be tuberculous. No. 2 (60° C.) and No. 4 (80° C.) remained in good health up to April 26, when they were killed, and no evidence of tuberculosis found. No. 5 (90° C.) died on April 26; it was not tuberculous. In view of these results it is evident that further experiments are required to determine the exact thermal death-point of the tubercle bacillus, which there is reason to believe may be found not to be so high as has been commonly supposed, possibly not higher than that of the typhoid bacillus (56° C. = 132.8° F.).

Having fixed the thermal death-point of various micro-organisms for a standard time of exposure, the question arises as to the influence of this element—time of exposure—in destroying the same organisms at a given temperature. To determine this, I have selected two test organisms,—the bacillus of typhoid fever, and the staphylococcus pyogenes albus. My experiments are recorded in the following table:

TABLE NO. XVII.

Organism.	Date.	Temperature.	Time of exposure in minutes.
	1887.		
Typhoid bacillus	April 23.	50° C.	**60, 80, 100, 120, 140.**
Staph. pyog. albus	April 23.	50° C.	**60, 80, 100, 120, 140.**
Typhoid bacillus	April 27.	52° C.	**20, 30, 40, 50, 60, 70, 80, 90.**
Staph. pyog. albus	April 27.	52° C.	**20, 30, 40, 50, 60, 70, 80, 90.**

My departure for Brazil prevented me from completing the experiment, but the results recorded in the table show that at 52° C. these organisms are not destroyed even at the end of an hour and a half.

In connection with the question of the degree of heat which is fatal to pathogenic bacteria, it is of interest to know whether they are destroyed by freezing. Numerous experiments have been made with reference to this question, and all agree in showing that most bacteria have a very great resisting power to cold. Thus, Cohn found that a temperature of —18° C. was not fatal to certain species of bacteria.

Frisch (1877) by the evaporation of liquefied carbonic acid produced as low a temperature as —87° C., and exposed liquids containing bacteria to this temperature, which failed to destroy the vitality both of micrococci and of bacilli.

Recently Dr. T. M. Prudden,[1] of New York, has made extended experiments upon the influence of repeated freezing upon the vitality of bacteria. According to this author, certain bacteria resist protracted freezing, while others fail to grow when they have been subjected to a freezing temperature for a certain time. Thus *bacillus prodigiosus* was destroyed by being frozen for 51 days; *proteus vulgaris*, in the same time; a *slender fluidifying bacillus* from Croton water, in 7 days. On the other hand, *staphylococcus pyogenes aureus* was not destroyed by exposure to a freezing temperature for 66 days; a "*fluorescent bacillus* from Hudson river ice" survived the freezing temperature for 77 days; the *bacillus of typhoid fever* survived after 103 days. In the case of all of these organisms, however, a diminution in the number of bacilli was noted, corresponding with the length of time during which they were exposed to a freezing temperature. This is shown in the following table, which we copy from Prudden's paper:

[1] The *Medical Record*, New York, March 26 and April 2, 1887.

TABLE NO. VI.

THE BACILLUS OF TYPHOID FEVER.

Time.	Number of bacteria in 1 c. c. of water.
Before freezing	innumerable.
Frozen 11 days	1,019,403
Frozen 27 days	336,457
Frozen 42 days	89,796
Frozen 69 days	24,276
Frozen 77 days	72,930
Frozen 103 days	7,348

Repeated freezing and thawing were found by Prudden to be more fatal to the typhoid bacillus than continuous freezing. This is shown in the following table:

TABLE NO. VII.

RESULT OF ALTERNATE FREEZING AND THAWING ON THE TYPHOID BACILLI—FRESH, ACTIVE CULTURE.

Frozen solid, and remained so.		Frozen solid, but repeatedly thawed and immediately refrozen.	
Time.	Number of bacteria in 1 c. c. of water.	Number of times thawed and refrozen.	Number of bacteria in 1 c. c. of water.
Before freezing	40,896		40,896
Frozen 24 hours	29,780	3	90
Frozen 3 days	1,800	5	0
Frozen 4 days	950	6	0
Frozen 5 days	2,490	6	0

For convenience of reference the results obtained in my own experimental studies, and those of others referred to, are brought together in a single table. Where the determination has not been made by myself, the authority is given in parenthesis after the name of the organism. The time of exposure is ten minutes unless otherwise indicated by figures in parenthesis following those representing the temperature. The table includes those non-pathogenic organisms which have been tested as well as those which are recognized as pathogenic. In this table I have adopted the nomenclature used by Flügge in his recent work, *Die Micro-Organismen:*

TABLE NO. XVIII.

THERMAL DEATH-POINT OF MICRO-ORGANISMS.

Name of Organism.	Centrigrade.	Fahrenheit.
Spirillum choleræ Asiaticæ	52°	125.6° (4 m.)
Spirillum tyrogenum[1]	52	125.6 (4 m.)
Spirillum Finkler-Prior	50	122
Bacillus anthracis (Chauveau)	54	129.2
Bacillus typhi abdominalis	56	138.8
Bacillus mallei[2] (Löffler)	55	131
Bacillus of schweine-rothlauf (rouget of Pasteur)	58	136.4
Bacillus murissepticus	58	136.4
Bacillus Neapolitanus[3]	62	143.6
Bacillus cavicida[4]	62	143.6
Bacillus pneumoniæ[5]	56	132.8
Bacillus crassus sputigenus	54	129.2
Bacillus pyocyanus	56	132.8
Bacillus indicus	58	136.4
Bacillus prodigiosus	58	136.4
Bacillus cyanogenus	54	129.2
Bacillus fluorescens[6]	54	129.2
Bacillus gallinarum (Salmon)[7]	56	132.5
Bacillus acidi lactici[8]	56	132.8
Bacillus alvei; spores	100	212 (4 m.)
Bacillus anthracis; spores	100	212 (4 m.)
Bacillus butrycus; spores	100	212 (4 m.)
Bacillus mycoides; spores	100	212 (4 m.)
Bacillus tuberculosis (Schill and Fischer)	100	212 (4 m.)
Staphylococcus pyogenes aureus	58	136.4
Staphylococcus pyogenes citreus	62	143.6
Styphylococcus pyogenes albus	62	143.6
Streptococcus erysipelatos	54	129.2
Micrococcus tetragenus	58	136.4
Micrococcus Pasteuri	52	125.6
Micrococcus gonorrhœa[9]	60	140
Sarcina lutea	64	147.2
Sarcina aurantiaca	62	143.6
Vaccine virus (Carstens and Coert)	54	129.2
Rinderpest virus (Semmer and Raupach)	55	131
Sheep pox virus (Semmer and Raupach)	55	131
Hydrophobia virus	60	140

By reference to the various tables giving the experimental data in detail, it will be seen that the results are not absolutely uniform for the same organism. Thus, in the experiments upon the typhoid bacillus no

1 Cheese spirillum.
2 Bacillus of glanders.
3 Emmerich's bacillus.
4 Brieger's bacillus.
5 Friedlander's.
6 From water.
7 Pasteur's "microbe du cholera des poules."
8 Old culture in flesh-peptone-gelatine not killed by 60°, probably owing to the presence of spores.
9 A single experiment. A lower temperature would probably be effective.

growth occurred after exposure to 55° in one experiment (January 15), while in another (November 30) colonies of the typhoid bacillus grew out after exposure to this temperature. In this case the thermal death-point is placed at 56°, no growth having occurred after exposure to this temperature. Similar differences, when the temperature approaches that which is uniformly successful in destroying vitality, may be observed with reference to several of the organisms tested. But these differences are within comparatively narrow limits. They are probably due partly to a difference in resisting power depending upon the age of the culture, and partly to unavoidable variations in the temperature during the experiments. By very careful supervision and frequent stirring of the water-bath, variations in the temperature have been kept within narrow limits, but it has been impossible to avoid them entirely. The same thermometer has been used throughout. (Made by Schlag and Berend, Berlin.)

No attempt has been made to fix the thermal death-point within narrower limits than 2° C., and in the above table the lowest temperature is given which has been found, in the experiments made, to destroy all of the organisms in the material subjected to the test. No doubt more extended experiments would result, in some instances, in a reduction of the temperature given as the thermal death-point for a degree or more. But the results as stated are sufficiently accurate for all practical purposes, and permit us to draw some general conclusions:

(*a*) The temperature required to destroy the vitality of pathogenic organisms varies for different organisms.

(*b*) In the absence of spores, the limits of variation are about 10° C. (18° F.).

(*c*) A temperature of 56° C. (132.8° F.) is fatal to the bacillus of anthrax, the bacillus of typhoid fever, the bacillus of glanders, the spirillum of Asiatic cholera, the erysipelas coccus, to the virus of vaccinia, of rinderpest, of sheep-pox, and probably of several other infectious diseases.

(*d*) A temperature of 62° C. (143.6° F.) is fatal to all of the pathogenic and non-pathogenic organisms tested, in the absence of spores (with the single exception of *sarcina lutea*, which, in one experiment, grew after exposure to this temperature).

(*e*) A temperature of 100° C. (212° F.) maintained for five minutes destroys the spores of all pathogenic organisms tested.

(*f*) It is probable that some of the bacilli which are destroyed by a temperature of 60° C. form endogenous spores which are also destroyed at this temperature.[1]

There are micro-organisms of the same class as those included in the above list, which have a far greater resisting power to heat than those which I have tested. Some are even able to develop in culture media kept at a temperature of from 60° to 70° C., and the spores of certain bacilli resist a temperature considerably above that of boiling water; but, in my opinion, it would be exacting too much to require, in our

[1] This question demands further experimental investigation.

practical attempts at disinfection, a temperature capable of destroying the most resistant of these spores, which are found in the earth, and, so far as we know, are in no way concerned with disease processes.

Miquel, in 1881, described a motionless bacillus, found in the waters of the Seine, which grew luxuriantly in *bouillon* at a temperature of from 69° to 70° C. Van Tieghem has also reported the fact that he has cultivated several different species of bacteria at a temperature of from 60° to 70° C. Quite recently, Globig, in a paper published in the *Zeitschrift für Hygiene*, reports that he has been able to cultivate at a temperature of from 50° to 70° C. several different species of bacteria, which are found in the superficial strata of the earth. The same author,[1] in a series of experiments upon the resisting power of spores obtained from this source, found certain ones which resisted a remarkably high temperature. He states that the spores of one species, which he designates the red potato-bacillus, were not killed by exposure for ninety minutes to a solution of 1 to 100 of corrosive sublimate, or by fourteen days' immersion in a five per cent. solution of carbolic acid. From five and a half to six hours was required to destroy these spores in a current of steam at 100°. They survived after exposure for three fourths of an hour in steam under pressure at a temperature of from 109° to 113° C. They were, however, destroyed in twenty-five minutes by exposure in steam at from 113° to 116°, in two minutes at 127°, and instantly at 130° C.

SECTION II.—CHLORIDE OF LIME.

The comparative cheapness of chlorinated lime, and its efficiency as a disinfectant, as shown by extended experiments made under the writer's direction in 1885, induced the Committee on Disinfectants to give to this agent the first place among chemical disinfectants.

In the "Conclusions" given in the report of this committee for 1885, a four per cent. solution is recommended for the destruction of "spore-containing infectious material," and for excreta. In a foot note, the standard of strength in available chlorine is fixed at "at least twenty-five per cent."

In the same report (Reports and Papers, A. P. H. A., vol. xi, p. 202) the writer calls attention to the fact that an oxidizing disinfectant is itself destroyed in the reaction to which its disinfecting power is due, and that therefore it is necessary to use such disinfecting agents "in excess of the organic material to be destroyed, otherwise germs included in masses of material not acted upon would be left intact in a fluid which is no longer of any value for their destruction; and as a few germs may be as potent for mischief as a large number, there would be a complete failure to accomplish the object in view."

Keeping this fact in view, and guided by the experimental data given on pages 199–201 of the report referred to, and by the writer's experiments upon normal feces (p. 269), the committee recommended (p. 278)

[1] Zeitschrift für Hyigene, Bd. iii, Heft. 2, p. 322.

the use of one quart of a standard solution of chloride of lime containing four ounces to the gallon for the disinfection of each discharge in typhoid fever, cholera, etc.

In summing up the results obtained in his experiments for the Committee on Disinfectants, Dr. Duggan says,—

The foregoing experiments show that a solution containing .25 of 1 per cent. (1 part to 400) of chlorine, as hypochlorite, is an effective germicide, even when allowed to act only one or two minutes, while .06 of 1 per cent. (6 parts to 10,000) will kill spores of *B. anthracis* and *B. subtilis* in two hours. A simple calculation will show that all the solutions used were effective when diluted to about this strength, and failed a little below it. No better evidence could be had of the excellent method of Dr. Sternberg for testing agents of this kind. These experiments were all made in duplicate, and they showed a concordance which I am satisfied can be obtained by no other method with which I am acquainted.

Notwithstanding the very satisfactory nature of the experimental evidence above referred to, I have thought best, in view of the great importance of the subject, to have additional experiments made by an independent investigator and by a different method. This seemed the more desirable, as some foreign experimenters have reached results which seem not to be in accord with those above referred to. As, however, the amount of available chlorine in the samples of chloride of lime which these investigators have employed in their experiments has in no case been stated, it is impossible to compare their results with our own, or to attach any great scientific value to them.

In Koch's experiments, published in the first volume of the *Mittheilungen aus dem Kaiserlichen Gesundheitsamte*, the statement is made that a five per cent. solution of chloride of lime (value in available chlorine not given) failed in two days to destroy the vitality of anthrax spores, but was effective in five days.

Van Ermengem, in his work entitled "*Le Microbe du Choléra Asiatique* (1885), says,—

Dry chloride of lime, the mixtures of the hypochlorites known under the name of Labarraque's solution, Javelle water, and the sulphate of iron enjoy a reputation which is not sustained by laboratory experiments. A few tests have convinced me that these substances have only a doubtful efficacy for disinfecting the excreta of cholera patients.

Experiment XXV. I have added a notable quantity of a commercial product known under the name of liquid chloride of lime (hypochlorite of soda) to a culture *bouillon*, before obtaining a complete sterilization of this liquid. Mixtures in the proportion of 1:30 have been required to give sterile products.

Dry chloride of lime is scarcely more active when one adds it to a culture in *bouillon*.

Seitz, in an extended series of experiments upon the bacillus of typhoid fever[1] reports a few experiments with this agent. A five per cent. solution was found to destroy vitality in five minutes (p. 39) when a pure culture was used, but a solution of the same strength failed after three days to disinfect typhoid stools. Unfortunately, this author also fails to state the amount of available chlorine present in his solution.

Chloride of lime must be kept in air-tight receptacles, or it soon loses

[1] "Bakterialogischen Studien zur Typhus—Aetiologie." Munchen, 1886.

its value for disinfecting purposes. But, when properly packed, it keeps perfectly well, and as offered for sale in this country I have usually found it to exceed the standard of strength fixed by the Committee on Disinfectants—25 per cent. A sample bought a few days since at the nearest drug store was found to contain 34.5 per cent. of available chlorine. It was contained in a pasteboard box, lined with rosin (Rozengrantz patent), and bore the label of C. F. Risley & Co., New York. The package contained four ounces, and cost five cents.

Dr. Bolton's experiments have been made with chloride of lime put up for the medical department of the army in twenty-pound jars, which bear the label of Trubner, Whyland & Co., New York.

TABLE NO. XIX.

CHLORIDE OF LIME. RECENT CULTURES IN BOUILLON.[1]

Organism.	Date.	Amount of Chloride of Lime.	
Bacillus of typhoid fever.	Nov. 11.	1 : 100, 1 : 200, **Cont.**	The amount of available chlorine in a solution of 1 : 2000 is 0.015 per cent.
	Nov. 22.	**1 : 5,000, 1 : 10,000, Cont.**	
	Nov. 23.	1 : 2,000, **1 : 5,000, Cont.**	
	Jan. 25.	1 : 500, 1 : 1,000, 1 : 2,000.	
Spirillum of Asiatic Cholera.	1887. Jan. 4.	1 : 50, 1 : 100, 1 : 200, **Cont.**	Colonies in control numberless.
	Jan. 18.	**1 : 2,000, 1 : 5,000, Cont.**	
	Jan. 25.	1 : 500, 1 : 1,000, 1 : 2,000, **Cont.**	
Friedlander's bacillus, so-called pneumococcus.	1886. Dec. 14.	**1 : 1,000, 1 : 2,000, 1 : 5,000, Cont.**	
Bacillus of mouse septicæmia.	1887. Feb. 2.	**1 : 1,000, 1 : 2,000, 1 : 5,000, Cont.**	Available chlorine 30 per cent.
Bacillus of foul brood *with spores*.	March 10.	**1 : 50, 1 : 100, Cont.**	Available chlorine 23.75 per cent.
Anthrax bacillus, *with spores*.	March 10.	1 : 50, 1 : 100, **Cont.** 1 : 50, **1 : 100.**	Available chlorine 23.75 per cent.
	1886. Dec. 12.	1 : 50, 1 : 100, **Cont.**	Available chlorine 30 per cent.
	Dec. 14.	1 : 100, **1 : 200, 1 : 500, Cont.**	Available chlorine 30 per cent.
Bacillus butrycus, *with spores*.	March 10.	1 : 50, 1 : 100, **Cont.** 1 : 50, **1 : 100.**	Available chlorine 23.75 per cent.
Wurzel bacillus, with spores.	March 11.	1 : 50, **1 : 100, Cont.** 1 : 50, **1 : 100.**	Available chlorine 23.75 per cent.

[1] The *bouillon* used in all of Dr. Bolton's experiments was prepared exactly as for Koch's flesh-peptone-gelatine—without the gelatine.

TABLE NO. XX.

CHLORIDE OF LIME (AVAILABLE CHLORINE 30 PER CENT.). RECENT CULTURES IN FLESH-PEPTONE-GELATINE, CONTAINING 10 PER CENT. OF GELATINE.

Organism.	Date.	Amount of Chloride of Lime.	Remarks.
Bacillus of typhoid fever.	1886. Dec. 29.	1 : 50, 1 : 100, 1 : 200.	There is a discrepancy in the results obtained in experiments of January 13, and in those of January 8 and January 19.
	1887. Jan. 8.	1 : 100, 1 : 200, 1 : 500, **Cont.**	
	Jan. 13.	**1 : 500, 1 : 1,000 Cont.**	
	Jan. 19.	1 : 200, 1 : 500, 1 : 1,000, **Cont.**	
Anthrax bacillus.	1886. Dec. 15.	1 : 50, 1 : 100, 1 : 200, 1 : 500, 1 : 1,000, **Cont.**	
Friedlander's bacillus.	Dec. 15.	1 : 50, 1 : 100, **1 : 200,** 1 : 500, **Cont.**	
Staphylococcus pyog. aureus.	Dec. 30.	1 : 50, 1 : 100, 1 : 200, **Cont.**	
Staphylococcus pyog. citreus.	Dec. 30.	1 : 50, **1 : 100, 1 : 200, Cont.**	
Staphylococcus pyog. albus.	Dec. 30.	1 : 50, 1 : 100, 1 : 200, **Cont.**	

TABLE NO. XXI.

CHLORIDE OF LIME (AVAILABLE CHLORINE 30 PER CENT.). CULTURES IN *bouillon* WITH *10 per cent. of egg albumen* ADDED.

Organism.	Date.	
Bacillus of typhoid fever.	Dec. 29, 1886.	1 : 50, 1 : 100, 1 : 200, 1 : 500, **Cont.**
	Jan. 6, 1887.	**1 : 1,000, 1 : 2,000, 1 : 5,000, Cont.**
	April 6.	1 : 50, 1 : 50, 1 : 100, 1 : 100, 1 : 200, **1 : 200, Cont.**

TABLE NO. XXII.

CHLORIDE OF LIME (AVAILABLE CHLORINE 28.5 PER CENT.).

Material Disinfected.	Date.	Amount of Chloride of Lime.	Remarks.
Typhoid feces (liquid) from a patient in the third week of the disease.	Nov., 1886.	1 : 100, 1 : 200, **Cont.**	[1] 20 colonies in Esmarch tube containing 1 : 100, none in 1 : 200.
	Nov.	**1 : 100,**[1] 1 : 200, **Cont.**	[2] Five colonies.
	Nov. 11.	1 : 50, **1 : 100,**[2] **1 : 200.**[3]	[3] Eight colonies.
		1 : 700,[4] **Cont.**	[4] Countless colonies in control.

In the above experiments on typhoid feces, as in all other experiments reported, the amount of material to be disinfected has been made equal to the amount of the solution of the disinfecting agent (5 cc. of each), and the time of exposure has been uniformly two hours. The small number of colonies which developed after the use of a solution of 1 : 100 and 1 : 200 was probably due to the survival of the spores of some common bacillus present in the feces.

In the experiment made Nov. 11th, it was noted that when a solution containing 2 per cent. of chloride of lime was used, the presence of a surplus of available chlorine was shown at the end of two hours by the usual test;[1] when a solution of 1 per cent. was used, there was a slight trace of chlorine at the end of two hours; when the proportion was reduced to 0.5 per cent., there was no trace of chlorine left. The writer made the following experiment on Dec. 4, 1886, by the method used in the experiments made in 1885. At the same time, Dr. Bolton made a similar experiment with Esmarch tubes.

TABLE NO. XXIII.

BROKEN DOWN BEEF INFUSION, OLD STOCK, AND CHLORIDE OF LIME (AVAILABLE CHLORINE 30 PER CENT.).

	Amount of Disinfectant.
Dr. Sternberg's culture tubes.	1 : 50, 1 : 100, **1 : 200**, 1 : 50, **1 : 100**, **1 : 200.**
Esmarch tubes	1 : 50, 1 : 100, **1 : 200**, **Cont.**

The experimental data herein recorded, and the comparative cheapness of this agent, fully justify the recommendations made by the committee in their previous report. But the writer would suggest that *Standard Solution No. 1* be made by adding six ounces of chloride of lime to the gallon of water (about 4 per cent.) instead of four ounces, as heretofore recommended. This would be 40 grams to the litre.

SECTION III.—MERCURIC CHLORIDE.

In the article on mercuric chloride in the report of the Committee on Disinfectants for 1885, the writer arrives at the following conclusion:

> Mercuric chloride, in aqueous solution, in the proportion of 1 : 10,000, is a reliable agent for the destruction of micrococci and bacilli in active growth, not containing spores; and in the proportion of 1 : 1,000 it destroys the spores of bacilli, provided that the micro-organisms to be destroyed are fairly exposed to its action for a sufficient length of time

Evidently, if the organisms to be destroyed are enveloped in masses of material which cannot be penetrated by the disinfecting agent, or if the material to be disinfected contains some substance which neutralizes the action of the disinfectant, the object in view will not be attained. With

[1] See Report of Committee on Disinfectants for 1885, in vol. xi, Reports and Papers A. P. H. A., p. 201.

a view to determining whether such practical difficulties were to be encountered in the use of this agent for disinfecting excreta, the writer made the experiments upon the sterilization of normal feces reported on page 271 of the report of the Committee on Disinfectants.

Van Ermengem gives evidence as to the potency of this agent in the destruction of pathogenic organisms in *bouillon*, but asserts that in the presence of albumen a very much larger proportion of the mercurial salt is required to insure destruction. Thus, when cultures of the cholera spirillum in chicken *bouillon* were exposed for half an hour to the action of this salt in the proportion of 1 : 60,000, the vitality of the spirillum was destroyed; but in cultures of the same organism in blood-serum from 1 : 800 to 1 : 1000 was required to destroy all the bacilli in the same time (op. cit., p. 244).

This author considers carbolic acid preferable to mercuric chloride for the disinfection of cholera excreta, and in this opinion he is sustained by Koch, upon whose recommendation it was given the first place in the directions for disinfection adopted by the International Sanitary Conference of Rome (1885). The writer, who was associated with Dr. Koch on the Committee on Disinfectants of the Conference, urged the claims of chloride of lime, which was placed beside carbolic acid with the following directions:

Carbolic acid and chloride of lime are to be used in aqueous solution:
Weak solutions—Carbolic acid, 2 per cent.; chloride of lime, 1 per cent.
Strong solutions—Carbolic acid, 5 per cent.; chloride of lime, 4 per cent.

There was considerable difference of opinion among the members of the Committee on Disinfectants of the International Sanitary Conference, with reference to the practical value of mercuric chloride for disinfecting excreta, and some hesitation in recommending it for general use on account of the poisonous nature of the salt. For these reasons, and because the two agents named seemed sufficient, no mention was made of mercuric chloride in the recommendations of this committee, which were adopted unanimously by the Conference. Van Ermengem, in discussing the comparative value of mercuric chloride and carbolic acid, says,—"For sublimate it will be necessary to employ a solution containing at least 2 : 1000"

This is exactly the proportion in which the Committee on Disinfectants directed its use for the disinfection of excreta; and in both of the standard solutions recommended, provision is made against accident by adding other salts which give a distinct color to the solution and at the same time add to its efficiency. (See Report for 1885.)

The author quoted says further,—"Practically, sublimate is then not the powerful antiseptic, the germicide *par excellence*, that it is generally believed to be. We should remark, also, that being easily decomposed, it may contract other chemical combinations which enfeeble its action. In dilute solution, for example, it will be rapidly decomposed by sulphurets, by alkalies, and even by organic material; the ammoniacal salts transform it into an inactive body. Now these conditions are found united in a high degree in fecal matters. Carbolic acid, on the other hand, is scarcely modified by these matters, and does not enter into any inert combinations."

Dr. Bolton has made the following experiments with this agent:

TABLE NO. XXIV.

MERCURIC CHLORIDE IN AQUEOUS SOLUTION, WITH CULTURES IN BOUILLON.

Organism.	Date.	Amount of Disinfectant.
Cholera spirillum	Jan. 25, 1887.	1 : 5,000, 1 : 10,000, **1 : 20,000, Cont.**
	Jan. 18, "	1 : 10,000, **1 : 20,000, 1 : 40,000, Cont.**
Typhoid bacillus	Nov. 26, 1886.	1 : 10,000, **1 : 20,000, 1 : 40,000, Cont.**
Bacillus of mouse septicæmia	Feb. 2, 1887.	1 : 5,000, 1 : 10,000, **1 : 20,000, Cont.**

TABLE NO. XXV.

MERCURIC CHLORIDE IN AQUEOUS SOLUTION, WITH AN EQUAL QUANTITY OF A RECENT CULTURE IN *flesh-peptone-gelatine* CONTAINING 10 PER CENT. OF GELATINE.

Organism.	Date.	Amount of Disinfectant.
Bacillus of typhoid fever, .	Jan. 8.	1 : 2,000, 1 : 5,000, 1 : 10,000, **Cont.**
	Jan. 13.	**1 : 10,000, 1 : 20,000, Cont.**
	Jan. 19.	1 : 5,000, 1 : 10,000, **1 : 20,000, Cont.**

TABLE NO. XXVI.

MERCURIC CHLORIDE IN AQUEOUS SOLUTION, WITH AN EQUAL QUANTITY OF A CULTURE IN BOUILLON, TO WHICH *10 per cent. of egg albumen* HAD BEEN ADDED.

Organism.	Date.	Experiments.
Bacillus of typhoid fever . .	April 6, 1887.	1 : 50, 1 : 50, 1 : 100, 1 : 100, **1 : 200, 1 : 200,[1] Cont.**

The results of this experiment are in accord with those of Van Ermengem, and make it evident that for the disinfection of highly albuminous material the amount of mercuric chloride required will exceed that present in the standard solutions (1 : 500) heretofore recommended by the

[1] A single colony.

Committee on Disinfectants for sterilizing excreta. But the liquid discharges of typhoid fever and cholera patients probably do not contain anything like this proportion of albuminous material, and there is good reason to believe that they would be effectually disinfected by the use of standard solution No. II, or of standard solution No. III as recommended in the report for 1885.

We would, however, give the preference to the chloride of lime solution for the disinfection of excreta not only on account of the neutralizing action of albuminous materials, but for the reasons given in the report referred to, viz., "The only advantage which this solution has over the chloride of lime solution consists in the fact that it is odorless, while the odor of chlorine in the sick-room is considered by some persons objectionable. The cost is a little more. It must be remembered that this solution is highly poisonous. It is proper, also, to call attention to the fact that it will injure lead pipes if passed through them in considerable quantities" (op. cit., p. 132).

It has been recently shown that the neutralizing effect of albuminous material is considerably diminished by the addition of an acid to the disinfecting solution of mercuric chloride. Dr. Ernest Laplace, of New Orleans, under the direction of Prof. Robert Koch, has made an interesting series of experiments in the Hygienic Institute in Berlin[1], as a result of which he especially recommends tartaric acid for this purpose. We quote from his experiments as follows:

"Six test tubes, each of which contained 5 c c m. of sublimate solution received the addition of putrefying human blood and pus bacteria in the proportion of $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, and 3 c c m. A considerable deposit occurred in all of the tubes, especially in that containing 1 c c m. To six other tubes, in which each 5 c c m. contained 1 : 1000 sublimate solution, and 5 : 1000 tartaric acid solution was added the same amounts of putrefying blood and pus organisms. No precipitate formed in any of these tubes. At the end of twenty minutes 5 *Platinösen* from each tube in the two series were transferred to gelatine in test tubes which were treated by Esmarch's method. At the end of five days numerous colonies of staphylococcus pyogenus aureus and of the bacillus of green pus had developed in all of the tubes which contained the sublimate alone. On the contrary five of the tubes containing tartaric acid also remained sterile; in the sixth three colonies of the bacillus pyocyanus had developed.

SECTION IV.—CARBOLIC ACID.

Very numerous experiments have been made to determine the exact germicide value of carbolic acid, and in 1885 this seemed to the Committee on Disinfectants to be so definitely established that no additional experimental data were necessary in order that an opinion might be formed as to its utility.

[1] Saure Sublimat-Lösung als desinficirendes Mittel und ihre Verwendung in Verband stoffen. Deutsche Medicinische Wochenschrift No. 40, Oct. 6, 1887.

The principal object in view in making the experiments recorded below has been to determine whether there is a considerable range of resisting power to the same agent among pathogenic organisms, or whether the resisting power of all organisms of this class, in the absence of spores, is included within comparatively narrow limits. The latter supposition seems *a priori* to be the most probable, and it will be seen that it is sustained by the experimental evidence. If it had turned out that certain organisms have a special resisting power for certain chemical agents, and that they have an exceptional susceptibility to the action of others, we would not be able to make any generalizations from the experimental evidence on record, but would have to test each disinfecting agent with reference to its destructive action on every known pathogenic organism before the data would be at hand to guide us in the practical use of disinfectants under all circumstances.

In the case of the oxidizing disinfectants, such as chloride of lime and permanganate of potash, there can be no question of this kind, as these agents act by attacking and decomposing organic matter, whether living or dead, whether in the form of organized cells or devitalized protoplasmic material. In the case of agents which have a toxic action on the living cells, but which, so far as can be recognized, do not destroy their structure, it is not so safe to infer that the toxic action manifested as regards one or more organisms of a class is general for the whole class. Having this question in view, I selected carbolic acid and sulphate ot copper as two agents, of very different chemical composition, which seemed suitable for the experimental determination of the point.

Dr. Bolton, at my request, has made the following experiments:

TABLE NO. XXVII.

CARBOLIC ACID. FRESH CULTURES IN BOUILLON.

Organism.	Date.	Amount of Disinfectant.	Remarks.
Cholera spirillum	1887. Jan. 4.	1 : 50, 1 : 100, 1 : 200, **Cont.**	
	Jan. 18.	**1 : 200, 1 : 500, 1 : 1,000, Cont.**	
	Jan. 25.	1 : 100, **1 : 200. 1 : 500, Cont.**	
Bacillus of typhoid fever.	Jan. 25.	1 : 100, **1 : 200, 1 : 500, Cont.**	
Emmerich's bacillus.	Feb. 23.	1 : 100, 1 : 200, **1 : 500, Cont.** 1 : 100, 1 : 200, **1 : 500.**	
Bacillus of Schweine-róthlauf	Feb. 26.	1 : 100, **1 : 200,[1] 1 : 500,[2] Cont.** 1 : 100, **1 : 200, 1: 500.**	[1] 30 colonies. [2] 60 colonies.
Brieger's bacillus.	Feb. 25.	1 : 100, **1 : 200, 1 : 500, Cont.** 1 : 100, **1 : 200, 1 : 500, Cont.**	
Bacillus pyocyanus (green pus).	Feb. 19.	1 : 100, **1 : 200,[3] 1 ; 500, Cont.** 1 : 100, **1 : 200,[4] 1 : 500.**	[3] 720 colonies. [4] 125 colonies.

TABLE NO. XXVII—*continued.*

Organism.	Date.	Amount of Disinfectant.	Remarks.
Bacillus syncyanum.	March 23.	1:50, 1:100, 1:200, Cont. 1:50, 1:100, 1:200.	
Friedlander's bacillus.	Feb. 11.	1:100, 1:200, 1:500 Cont.	
Bacillus of mouse septicæmia.	Feb. 2.	1:100, 1:200, 1:500, Cont.	
Staphylococcus pyogenes aureus.	Feb. 15.	1:100, 1:200, 1:500, Cont. 1:100, 1:200, 1:500.	
Staphylococcus pyogenes albus.	Feb. 8.	1:100, 1:200,[5] 1:500,[6] Cont. 1:100, 1:200, 1:500.	[5]1,800 colonies. [6]Countless.
Staphylococcus pyogenes citreus.	Feb. 8.	1:100, 1:200,[7] 1:500,[8] Cont. 1:100, 1:200, 1:500.	[7]300 colonies. [8]480 colonies.
Streptococcus erysipelatos.	March 2.	1:100, 1:200,[9] 1:500,[9] Cont. 1:100, 1:200, 1:500.	[9] Very few.

The results obtained by Dr. Bolton accord with those reported by the writer in 1883,[1] as will be seen by the following table, taken from Table III in my paper, in which these results were originally published.

CARBOLIC ACID; CULTURES IN BOUILLON; TEST IN HERMETICALLY SEALED FLASKS.

Organism.	Amount of Disinfectant.
Micrococci from pus of an acute abscess . .	1:100, 1:125, 1:200, 1:200.
M. Pasteuri	1:200, 1:200, 1:400, 1:400.
Bacterium termo, without spores	1:100, 1:200, 1:100, 1:200.

The following experiment was made to determine the influence of 10 per cent. of gelatine in the culture-medium containing organisms to be destroyed.

TABLE NO. XXVIII.

CARBOLIC ACID; RECENT CULTURE OF *typhoid bacillus* IN FLESH-PEPTONE-GELATINE.

Date.	Amount of Disinfectant.
January 8, 1887	1:100, 1:200, 1:500, Cont.
January 13, 1887, ...	1:100, 1:200. Cont.
January 19, 1887	1:100, 1:200, 1:500, Cont.

[1]See paper in "American Journal of the Medical Sciences," April, 1883.

TABLE NO. XXIX.

IN THE FOLLOWING EXPERIMENT *ten per cent. of dried egg albumen* WAS ADDED TO THE CULTURE MEDIUM, *bouillon*.

Organism.	Date.	Experiments.
Bacillus of typhoid fever.	April 6, 1887.	1 : 25, 1 : 25, 1 : 50, 1 : 50, 1 : 100, 1 : 100, **Cont.**

We have here no evidence that the disinfecting action of carbolic acid is influenced by the presence of a large amount of albumen.

TABLE NO. XXX.

CARBOLIC ACID—SPORES.

Organism.	Date.	Experiments.	Remarks.
Bacillus anthrasis.	March 7, 1887.	**1 : 50,**[1] **1 : 100,**[1] **1 : 200,** 1 : 50, 1 : 100, **1 : 200.**	[1] 1 colony only.
Bacillus alvei (foul brood).	March 11.	**1 : 50, 1 : 100, Cont. 1 : 50, 1 : 100.**	
Wurtzel bacillus.	March 23.	**1 : 50, 1 : 100, Cont. 1 : 50, 1 : 100.**	

It will be seen that in the proportion of 2 per cent. there was a failure to destroy spores, except in the case of anthrax. I am not, however, disposed to attach much importance to this single experiment, and think it probable that spores were not present, or that for some reason their vital resistance was very much diminished, for previous experiments are in accord as to the considerable resisting power of spores to this agent. Thus Koch found (1881) that the developing power of anthrax spores immersed in a 5 per cent. solution, was only destroyed at the end of two days, while a 1 per cent. solution destroyed the bacilli, in the absence of spores, in two minutes. In the writer's experiments (1883) a 4 per cent. solution failed to destroy the spores of bacilli present in broken-down beef-tea (old stock).

By reference to Table No. XXVIII, it will be seen that the germicide power of this agent is identical for a considerable number of the test-organisms, and that as a rule 1 per cent. is effective and 0.5 per cent. fails. In a single experiment upon the bacillus of mouse septicæmia 1 per cent. failed, and in the case of Emmerich's bacillus, B. syncyanum, and Friedlander's bacillus, 0.5 per cent. (1 : 200) was effective. This would indicate a certain difference in the resisting power of various organisms, but in a more extended series of experiments it is possible that this apparent difference would be eliminated, for 1 : 200 is near the line of germicide potency, and variations are likely to occur on both sides of this line from various causes, *e. g.*, differences in age of cultures, slight differences in mixing the culture with disinfecting agent, etc. Thus we have in the three experiments upon the cholera spirillum in the proportion of 1 : 200 development in two, and no development in one. The presence of 10 per cent. of gelatine, or of ten per cent. of egg-albumen, in the material to be disinfected, has no marked influence upon the germicide power of this agent, and gives it therefore a decided advantage over mercuric chloride or sulphate of copper for the disinfection of albuminous material.

Recent experiments by Laplace[1] show that the addition of hydrochloric acid to a disinfecting solution containing carbolic acid greatly increases its disinfecting power for spores. Thus, it is stated that "2 per cent. of crude carbolic acid with 1 per cent. of pure hydrochloric acid destroyed anthrax spores in seven days, while 2 per cent. of carbolic acid, or 1 per cent. of hydrochloric acid alone, did not destroy these spores in thirty days. A 4 per cent. solution of crude carbolic acid, with 2 per cent. of hydrochloric acid, destroyed spores in less than one hour; 4 per cent. of carbolic acid solution alone did not destroy them in twelve days."

Finally, we may say that the experiments herein recorded justify the recommendations of the Committee on Disinfectants, for the use of this agent, in their report of 1885, viz., a 2 to 5 per cent. solution "for the destruction of infectious material which owes its infecting power to the presence of micro-organisms *not containing spores*."

Various compounds containing carbolic acid have from time to time been recommended as a substitute for the pure phenol. So far as experiments have been made, none of these possess any special advantage as germicides, and as a rule it may be said that the compounds are less potent than the pure acid. Thus Koch found that a 5 per cent. solution of zinc sulpho-carbolate required five days to destroy the developing power of anthrax spores; a 5 per cent. solution of sodium phenate failed to entirely destroy the growing power of the same spores in ten days, and the same was true of a like solution of sodium sulpho-carbolate. Recently it has been proposed by a Russian physician to combine chloride of lime and phenol for disinfecting purposes. The statement has been made[1] that trichlorphenol is twenty-five times more powerful than carbolic acid.[2] This is to be prepared extemporaneously by mixing one part of a 4 per cent. solution of carbolic acid with five parts of a saturated solution of chlorinated lime. The formula for trichlorphenol is $C_6H_2Cl_3(OH)$.[3]

At my request Dr. Bolton has made some experiments with this agent, prepared as above directed. He found that when freshly prepared the solution contained a considerable quantity of chlorine, either free in solution or as hypochlorite of lime (?). This was shown by the reaction with starch paper. In an experiment made with a freshly prepared

[1] Deutsche Med. Wochenschrift, Oct. 6, 1887, p. 867.
[2] The "Medical Record," New York, Nov. 20, 1886, p. 580.
[3] "Neues Handwörterbuch d. Chemie," von v. Fehling.

solution on the 25th of November the available chlorine was found to be 7 per cent., and naturally this solution showed a germicide power corresponding with this amount of chlorine. But after standing until the solution showed no further chlorine reaction, it failed to destroy the bacteria in broken-down beef tea in the proportion of 50 per cent., and anthrax spores grew after having been immersed in it, at full strength, for two hours.

A second solution, made according to the same formula, destroyed anthrax spores in the proportion of 6.25 per cent. when first made, at which time it had a strong chlorine reaction. I judge from these experiments that whatever germicide value this solution has depends upon the excess of chlorine it contains, and that the chlorine and phenol in combination as trichlorphenol are practically neutralized so far as their germicide power is concerned.

Dr. E. v. Esmarch, assistant in the Hygienic Institute in Berlin, has made an extended research upon a product of coal tar distillation called *creolin*. This is described as a syrupy dark brown fluid, which smells like tar, and forms a milky emulsion with water. This is perhaps the same material which was introduced in this country some years since under the name of "Little's Soluble Phenyle," and which was tested by the Committee on Disinfectants with favorable results.[1]

In a comparative test of the germicide power of creoline and of carbolic acid[2] the former agent had the advantage in the absence of spores. A ½ per cent. solution was fatal to the spirillum of Asiatic cholera in one minute, and a 1 : 1,000 solution in ten minutes, while the same solutions of carbolic acid failed. The typhoid bacillus was somewhat more resistent. A ½ per cent. solution failed after ten minutes' exposure, but sterilization was effected in four days. With the staphylococcus pyogenus aureus as a test organism, 1 per cent. failed after forty-eight hours' exposure, but was effective in four days. These experiments of Esmarch show a decided difference in the resisting power of the test organisms to the agents named, and are not in accord with those of Bolton in this respect.

In an experiment upon anthrax spores, Esmarch found that 5 per cent. of creolin failed at the end of twenty days to destroy vitality, while the same proportion of carbolic acid was effective after twenty days' exposure. These agents were also tested by Esmarch upon putrefying meat infusion, and other infusions containing decomposing organic material, excrement, etc. In this experiment the carbolic acid came out ahead. A solution of ½ per cent. was effective in nine to thirteen days, while creolin in the same proportion failed to sterilize such material in fifty-two days. The general result of these experiments is stated as follows:

"Creolin is decidedly more active for pure-cultures of micro-organisms in the absence of spores; but, on the other hand, carbol is more potent for masses of putrefying material," and retains its disinfecting

[1] See report on "Commercial Disinfectants," Vol. XI, p. 194.
[2] Centralblatt für Bacteriologie, Bd. III, Nos. 10 and 11 (1887).

power longer; it seems as if creolin in contact with putrid matter after some time undergoes changes which neutralize its disinfecting power.

The deodorizing power of creolin was found by Esmarch to be very remarkable. Putrid material, which gave off a very offensive odor, was deodorized almost instantly when shaken up with creolin in the proportion of 1 : 1,000. The addition of a like amount of carbol had no effect, and even 1 : 100 did not notably diminish the offensive odor. But when the material after the addition of these agents was allowed to stand for eight to ten days, a change occurred. In the flasks containing carbol in the proportion of ½ per cent., the putrid odor gradually disappeared and a faint odor of carbol was detected, while in the flasks containing creolin an odor was developed resembling that given off from an old cesspool. Two samples of "creolin powder" were also tested by Esmarch with results corresponding with those above given.

A consideration of the experimental data above given leads the writer to believe that carbolic acid possesses a decided advantage over mercuric chloride or over oxidizing disinfectants, for the disinfection of masses of material to be left *in situ*, *e. g.*, for human excreta in privy vaults. The fact that it is not decomposed or neutralized by putrefying material, and that it will exercise its antiseptic action throughout the mass, even if it does not destroy spores of pathogenic organisms present, gives it a decided advantage. The complete destruction of such masses of material by the use of oxidizing disinfectants, *e. g.*, chloride of lime, or complete sterilization by means of mercuric chloride, appears to be impracticable when we have large masses of material to deal with; and in this case treatment with a 5 per cent. solution of carbolic acid in such quantity as will ensure permeation of the entire mass would seem to be the safest practice.

The prompt deodorizing action of creolin and its decided germicide power make it a suitable agent for the disinfection of excreta in the sick-room, but we would still give the preference to our standard solution of chloride of lime (containing six ounces to the gallon), as this quickly destroys all pathogenic organisms, including the most resistent spores.

SECTION V.—SULPHATE OF COPPER.

Dr. Bolton has made the following experiments with sulphate of copper, by the method heretofore described—equal parts of disinfecting solution and culture of test organism; two hours' exposure; test in Esmarch's tubes.

TABLE NO. XXXI.

RECENT CULTURES IN BOUILLON.

Organism.	Date.	Experiments.
Bacillus of typhoid fever . .	Jan. 25, 1887.	1 : 200, **1 : 500, 1 : 1,000, Cont.**
Spirillum of Asiatic cholera	Jan. 18.	1 : 200, 1 : 500, **1 : 1,000, Cont.**
	Jan. 25.	1 : 200, 1 : 500, 1 : 1,000, **Cont.**
Bacillus of mouse septicæmia.	Feb. 2.	1 : 100, **1 : 200, Cont.**
Bacillus of Schweine-rothlauf	Feb. 26.	1 : 100, 1 : 200, 1 : 500, **Cont.**
Brieger's bacillus	Feb. 25.	1 : 100, 1 : 200, **1 : 500, Cont.** 1 : 100, 1 : 200, **1 : 500.**
Bacillus pyocyanus	Feb. 19.	1 : 100, 1 : 200, **1 : 500, Cont.** 1 : 100, 1 : 200, **1 : 500, Cont.**
Friedlander's bacillus . . .	Feb. 11.	1 : 100, 1 : 200, 1 : 500, **Cont.**
Emmerich's bacillus . . .	Feb. 23.	1 : 100, 1 : 200, **1 : 500, Cont.** 1 : 100, 1 : 200, **1 : 500, Cont.**
Bacillus syscyanum	March 23.	1 : 100, 1 : 200, **Cont.** 1 : 100, 1 : 200.
Bacillus alvei	Feb. 19.	1 : 100, 1 : 200, 1 : 500, **Cont.** 1 : 100, 1 : 200, 1 : 500.
Wurtzel bacillus	Feb. 12.	1 : 100, 1 : 200, 1 : 500, **Cont.** 1 : 100, 1 : 200, 1 : 500.
Staphylococcus pyog. aureus	Feb. 8.	1 : 100, **1 : 200,[1] 1 : 500,[2] Cont.** 1 : 100, **1 : 200,[1] 1 : 500.[2]**
Staphylococcus pyog. citreus .	Feb. 8.	1 : 100, **1 : 200,[2] 1 : 500, Cont.** 1 : 100, **1 : 200,[2] 1 : 500.**
Staphylococcus pyog. albus .	Feb. 15.	1 : 100, 1 : 200, **1 : 500,[2] Cont.** 1 : 100, 1 : 200, **1 : 500.**
Streptococcus erysipelatosus	Feb. 15.	1 : 100, 1 : 200, 1 : 500, **Cont.** 1 : 100, 1 : 200, 1 : 500.

TABLE NO. XXXII.

RECENT CULTURES IN FLESH-PEPTONE-GELATINE, CONTAINING 10 PER CENT. GELATINE.

Organism.	Date.	Experiments.
Bacillus of typhoid fever . .	January 8, 1887.	1 : 100, **1 : 200, 1 : 500, Cont.**
	January 13.	**1 : 100,** 1 : 200, **Cont.**
	January 19.	1 : 100, 1 : 200, **1 : 500, Cont.**

[1]One colony in each tube. [2]A few colonies.

TABLE NO. XXXIII.

RECENT CULTURES IN BOUILLON, WITH 10 PER CENT. OF EGG-ALBUMEN.

Organism.	Date.	Experiments.
Bacillus of typhoid fever . .	April 6, 1887.	1 : 10, 1 : 10, **1 : 20, Cont.**

These results correspond with those previously reported by the writer. Thus in 1881 I found that the virulence of septicæmic blood containing *M. Pasteuri* is destroyed by 1 : 400; and in the report of the Committee on Disinfectants for 1885 I say,—"I have demonstrated by recent experiments that it destroys micrococci in the proportion of .5 per cent. (= 1 : 200)." By reference to table No. XXXI it will be seen that there is some evidence of a difference in resisting power in different organisms, but, as remarked in the case of carbolic acid, it is probable that in a more extended series of experiments these differences would be to a great extent neutralized. Thus we find that in the single experiment upon the bacillus of mouse septicæmia 1 : 200 failed, while in that upon the bacillus of schweine-rothlauf 1 : 500 was successful. Yet these bacilli are thought by many bacteriologists to be identical. It may be that growth in the one case was due to the presence of spores, and failure in the other to their absence.

In the report of the Committee on Disinfectants for 1885 this agent is recommended in a solution of 2 to 5 per cent. for the destruction of infectious material "*not containing spores.*" The experimental data above given show that this is a very liberal allowance, and that the proportion might be reduced to 1 per cent. and still be within the limits of safety, where the conditions resemble those of our experiments. But in the presence of a considerable amount of albumen, this agent, like mercuric chloride, must be used in a much larger proportion to insure disinfection.

Dr. Bolton has made the following experiments upon spores:

TABLE NO. XXXIV.

SULPHATE OF COPPER—SPORES.

Organism.	Date.	Experiments.
Anthrax spores	March 7.	1 : 50, 1 : 100, 1 : 200, **Cont.** 1 : 50, 1 : 100, 1 : 200, **Cont.**
Bacillus alvei spores	March 3.	**1 : 50, 1 : 100, 1 : 200, Cont. 1 : 50, 1 : 100, 1 : 200.**
Wurtzel bacillus spores . . .	March 23.	**1 : 50, 1 : 100, 1 : 200 Cont. 1 : 50, 1 : 100, 1 : 200.**

I judge that there is some mistake about the experiment of March 7 with anthrax. Probably no spores were present in the culture. In my own experiments with this agent I found that even in the proportion of 20 per cent. it failed to kill the spores of anthrax; and as Dr. Bolton's experiment shows that 2 per cent. did not kill the spores of the Wurtzel bacillus or of bacillus alvei, I cannot believe that anthrax spores were killed by 1 : 200.

SECTION VI.—CALCIUM OXIDE.

Recently slacked lime and lime-wash have long enjoyed a reputation as disinfectants, and have been extensively used by sanitarians in their efforts to restrict the extension of infectious diseases. But until recently no exact experiments have been made to determine the precise germicide value of caustic lime. Koch, in 1881, found that lime-water only had a slight restraining influence upon the development of anthrax spores which had been immersed in it for 15 to 20 days. My own experiments upon spores have given results in accord with this. But, inasmuch as we have only in exceptional cases to deal with spores, in our practical measures of disinfection it is well worth while to carry the investigation further, and inquire what value this agent may have for the destruction of pathogenic organisms which do not produce spores. This has recently been done by Dr. Paul Liborius, a medical officer of the Russian navy, whose researches have been made in the *Hygienischen Institut* of Berlin.[1]

In a first series of experiments putrid bouillon was mixed with lime water in the proportion of 2 : 1, 1 : 1, 3 : 5, and 1 : 5. These mixtures were allowed to stand for three weeks, and tests were made at intervals to ascertain whether the micro-organisms present were still capable of development. The result is stated by Liborius as follows:

"Of the various micro-organisms in the putrid bouillon, by far the greater part were destroyed within twenty-four hours, when the proportion of lime at the commencement of the experiment was about 0.09 per cent. The few germs which resisted were restricted in their development, and only multiplied again after a considerable time, when probably the amount of lime in solution was to a considerable extent diminished."

As the result of extended experiments upon the bacillus of typhoid fever and the spirillum of Asiatic cholera, Liborius arrives at the following conclusions:

1. An aqueous solution of calcium oxide of the strength of 0.0074 per cent. in the course of a few hours destroys the typhoid bacillus, and a solution of 0.0246 per cent. destroys cholera bacilli.

2. Bouillon cultures of the cholera bacillus, containing albuminous precipitate (unfiltered bouillon), which offer at least as unfavorable con-

[1] Einige Untersuchungen über die desinficirende Wirkung des Kalkes, Zeitschrift für Hygiene, Bd. II, 1887.

ditions, on account of their physical characters, as natural cholera dejections, are perfectly disinfected in the course of a few hours by a 0.4 per cent. solution of pure caustic lime, = to 2 per cent. of crude burnt lime in fragments.

3. The most energetic action of lime was obtained, under more difficult circumstances, when it was used in the form of pure pulverized caustic lime, or as a milk of lime containing 20 per cent. of the same.

Liborius calculates that 12 grammes of pure caustic lime would suffice to disinfect the alvine discharges during 24 hours in a case of cholera. He says that pure calcium oxide costs from 50 to 70 pfennings per kilogram, or by the quantity from 40 to 50 marks per 100 kilograms (about $5 to $6 per 100 pounds).

"If, upon further researches, it is found necessary to add a certain proportion of magnesium chloride to prevent the development of ammonia, one tenth of the amount of lime will suffice. As the purest magnesium chloride is no dearer than caustic lime, and as the price of crude burnt lime, at the factory, is only 1½ marks per hektolitre, the disinfection of the daily dejections of a cholera patient would cost something less than one pfenning" (=about ¼ cent).

In order to test the conclusions reached by Liborius, I have made the following experiments with calcium oxide obtained from the chemical laboratory of the Johns Hopkins University, *which is quite free from chlorine* (manufactured by Dr. Theo. Schuchardt, of Görlitz, Germany). I have not attempted to determine by chemical tests the exact amount of calcium oxide present in my standard solution of lime water, but have prepared a saturated solution by adding the caustic lime in large excess to distilled water. According to the National Dispensatory, *liquor calcis* contains 0.15 per cent. of hydrate of calcium. The same authority states that calcium oxide is soluble in 750 parts of water at 15° C.

TABLE NO. XXXV.

CULTURES IN FLESH-PEPTONE GELATINE, MIXED WITH AN EQUAL QUANTITY OF LIME WATER. TEST IN ESMARCH'S TUBES.

Organism.	Time of exposure.	Proportion of lime water.		
Typhoid bacillus	Two hours.	50 per cent.,	50 per cent.,	Cont.
Bacillus of Schweine-rothlauf .		50,	50,	Cont.
Bacillus pyocyanus		50,	50,	Cont.
Bacillus acidi lactici . .		50,	50,	Cont.
Finkler-Prior spirillum . .		50,	50,	Cont.
Cheese spirillum		50,	50,	Cont.
Staphylococcus pyog. aureus .		50,	50,	Cont.
Staphylococcus pyog. citreus .		50,	50,	Cont.

TABLE NO. XXXV—*continued.*

Organism.	Time of exposure.	Proportion of lime water.		
Staphylococcus pyog. albus .	Forty-eight hours' exposure.	50,	50,	Cont.
Typhoid bacillus . . .		50,	50.	
Bacillus pyocyanus . . .		50,	50.	
Bacillus acidi lactici . . .		50,	50.	
Finkler-Prior spirillum . .		50,	50.	
Staphylococcus pyog. albus .		50,	50.	
Staphylococcus pyog. aureus .		50,	50.	

TABLE NO. XXXVI.

CULTURES IN BOUILLON, MIXED WITH A SATURATED SOLUTION OF CALCIUM OXIDE.

Organism.	Time of exposure.	Proportion of lime water.
Typhoid bacillus . . .	Two hours.	1 : 1, 1 : 1, 5 : 1. 5 : 1.[1]
Staphylococcus pyog. albus .		1 : 1, 1 : 1, 5 : 1, 5 : 1.
Typhoid bacillus . . .	Three hours.	1 : 1, 1 : 1.
Staphylococcus pyog. albus .		1 : 1, 1 : 1.

TABLE NO. XXXVII.

EXPERIMENTS WITH SPORES.

Spores of	Date.	Time of exposure.	Proportion of calcium oxide.	Result.
Anthrax bacillus.	April 19.	2 hours.	Saturated solution.	Not killed.
Wurtzel bacillus.	"	"	"	"
Bacillus subtilis.	"	"	"	"
Bacillus alvei.	"	"	"	"
Anthrax bacillus.	April 20.	24 hours.	"	"
Wurtzel bacillus.	"	"	"	"
Bacillus subtilis.	"	"	"	"
Bacillus alvei.	"	"	"	"

[1] Development retarded to fourth day.

TABLE NO. XXXVII—*continued.*

Spores of	Date.	Time of exposure.	Proportion of calcium oxide.	Result.
Anthrax bacillus.	April 21.	48 hours.	"	"
Wurtzel bacillus.	"	"	"	"
Bacillus subtilis.	"	"	"	"
Bacillus alvei.	"	"	"	"
Anthrax bacillus.	April 23.	2 hours.	20 per cent. of pure calcium oxide suspended in a saturated solution of the same.	"
Wurtzel bacillus.	"	"		"
Bacillus subtilis.	"	"		"
Bacillus alvei.	"	"		"

TABLE NO. XXXVIII.

CALCIUM OXIDE SUSPENDED IN A SATURATED SOLUTION OF THE SAME (LIME-WASH).

Organism.	Date.	Proportion of calcium oxide by weight.
Typhoid bacillus . .	April 26, 1887.	1 : 40, 1 : 40.
	April 27.	**1 : 80, 1 : 80, 1 : 160, 1 : 160.**
Staphylococcus pyog. albus.	April 20.	**1 : 40,** 1 : 40, **1 : 80, 1 : 80, 1 : 160, 1 : 160.**

The above experiments suffice to demonstrate the fact that pure calcium oxide has no great value for disinfecting purposes, and show that the proposition of Liborius to give it the preference over chloride of lime on account of its comparative cheapness is based upon a misconception of the *practical* value of the two agents for disinfecting purposes. Inasmuch, however, as calcium oxide has considerable germicide power when used in the form of lime-wash, especially after prolonged contact, the general use of lime-wash for sanitary purposes is to be recommended wherever it can be applied to surfaces which are supposed to be infected by disease germs.

The following experiments have been made to determine the antiseptic value of pure calcium oxide in a saturated aqueous solution:

In these experiments bouillon in the proportion indicated was added to lime water, in test tubes, and a drop of a culture containing the test organism was added to this mixture. The test tubes were then set aside, and the time noted when the bouillon became clouded by the multiplication of the organisms with which it had been inoculated.

Mixtures were made in the proportion of 12 of bouillon to 1 of lime water; 8 : 1, 4 : 1, 2 : 1, and 1 : 1. Such mixtures inoculated with the cheese spirillum had all broken down in 24 hours. Inoculated with the typhoid bacillus, 12 : 1 became clouded in 24 hours, 8 : 1 in 48 hours, 4 : 1 in 72 hours, 2 : 1 in 5 days, 1 : 1 in 6 days. With staphylococcus pyogenes albus the result was the same. These experiments show that lime water mixed with an equal quantity of a culture solution exercises a considerable restraining influence upon the development of the typhoid bacillus and upon the micrococcus tested, but that in the end these organisms are able to multiply in a culture solution to which it has been added in this proportion. It is somewhat remarkable that the cheese spirillum was not, apparently, restrained in its development by the same proportion of lime water. The writer's sudden departure for Brazil, to investigate the methods of inoculation against yellow fever practised in that country by Dr. Domingos Freire, has brought these experiments to a more speedy termination than he had intended.

SECTION VII.—VARIOUS DISINFECTING AGENTS.

In the present section we give, for convenience of reference, an abstract of some of the more important recent researches made in the laboratories of Europe.

It must be remembered, in comparing the results reported by different experimenters, that they cannot be expected to correspond unless the conditions under which their experiments have been made were identical. A small amount of material may be sterilized by a given percentage of a certain chemical agent, when the same proportion would fail to sterilize a larger amount. Thus, if we add a drop of material containing any test-organism to a considerable quantity of a disinfecting solution of a given strength, it will be a very different matter from adding the same proportion of the disinfecting agent to a considerable quantity of material containing the same test-organism. A gramme of chloride of lime, or of carbolic acid, is efficient for the sterilization of a certain amount of material containing the typhoid bacillus or the cholera spirillum; and the exact amount will depend both upon the number of germs to be destroyed and upon the character of the material with which they are associated. The quantity of water used in making a solution of the disinfecting agent will, within certain limits, be a matter of no consequence. Thus, one hundred parts of a one per cent. solution of a disinfectant is equal to ten parts of a ten per cent. solution of the same agent. If, therefore, the statement is made that this agent is effective in the proportion of 1 : 100, it is evident that we must know the conditions under which it is effective in order to guide us in our practical measures of disinfection, or to enable us to compare the results of different experimenters. The apparent discrepancies in the results reported below are for the most part due to the different conditions under which the experiments were made.

In the *Revue Scientifique* of Nov. 22, 1884, is a report by Nicati and Rietsch upon the vitality of the spirillum of Asiatic cholera.

In these experiments a small quantity of a culture of the spirillum was added to a considerable quantity of the disinfecting solution:

Sulphurous acid. A saturated aqueous solution, diluted with nine parts of water, destroyed the cholera spirillum in fifteen minutes.

Sulphuric acid (of 66 degrees Baumé), 1 : 400 was effective in forty minutes.

Hydrochloric acid (1 gr.=0.3697 Hcl.), 1 : 2,000 in five minutes.

Acetic acid, 1 : 500 in ten minutes.

Tartaric acid, 1 : 1,000 in one hour.

Carbolic acid, 1 : 200 in ten minutes.

Salicylic acid (saturated solution at 17° C.), 1 : 1,000 in ten minutes.

Sulphate of zinc, 1 : 333 in ten minutes.

Chloride of zinc, 1 : 1,000 in ten minutes.

Sulphate of copper, 1 : 3,000 in ten minutes.

Mercuric chloride, 1 : 300,000 in ten minutes.

Desiccation. Nicati and Rietsch say,—"Our experiments verify one of the assertions of M. Koch, which has perhaps met with the greatest incredulity, that is, that the cholera infection is surely killed by desiccation." Exposure for an hour and a quarter, upon the surface of a glass plate, was found to kill the spirillum. Van Ermengem[1] has also verified this fact, but has found that the time required to effect desiccation and the death of the spirillum depends largely upon the nature of the material containing it, and the humidity of the atmosphere.

When a layer of nutritive gelatine or of agar-agar, having a thickness of to 3 m m. was exposed upon glass plates, in an occupied apartment in which the temperature was about 13° C., and the air tolerably dry, sterilization was not effected in less than two or three days. In a chamber in which the temperature ranged from 5 to 12° C., and which was quite humid, desiccation required a longer time; but after exposure in this chamber for six days, the vitality of the spirilla was destroyed.

Van Ermengem has also made extended experiments upon the disinfecting power of various chemical agents, as tested by the cholera microbe (op. cit.). We give a summary of his results:

Sulphur dioxide. The atmosphere of a chamber was almost saturated with sulphurous vapors. In the corners and under the furniture I placed morsels of a woollen carpet, of fragments of a folded blanket, and of various stuffs rolled in bundles. In the interior of each of these packets was a morsel of blotting paper folded four times, and surrounded by a fragment of sterilized woollen cloth so as to protect the blotting paper, which had been soaked with a liquid culture of the cholera microbe, against all contamination. Even after rumaining for twenty-four hours in the chamber, the paper was never completely sterilized.

Mercuric chloride. In Van Ermengem's experiments the mercuric chloride was mixed with *bouillon* and added to cultures of the cholera spirillum in the proportion of one volume to five. It was found to be effective in the proportion of 1 : 60,000, the time of exposure being half an hour. When one volume of the culture-liquid was added to one hun-

[1] *Le Microbe du Cholera Asiatique*, Paris and Brussels, 1885, p. 219.

dred volumes of the disinfecting solution, sterilization was effected by 1 : 100,000.

Carbolic acid. Solutions containing 1 : 600 to 1 : 700 were found to destroy the spirilla in concentrated chicken *bouillon* in less than half an hour; in blood serum, 1 : 400 was effective in the same time.

Copper Sulphate. Solutions of 1 : 600 were found to kill all of the spirilla in a culture in *bouillon* in less than half an hour. In the proportion of 1 : 1,000 the same culture-liquid was sterilized in from three to four hours; cultures in blood serum required 1 : 200..

Chloride of zinc (chemically pure) produced a complete sterilization in half an hour, in the proportion of 1 : 500.

Zinc sulphate. 1 : 300 failed to sterilize (a single experiment).

Sulphuric acid, 1 : 1,000 effective in half an hour.

Hydrochloric acid, 1 : 2,000 effective in half an hour.

Acetic acid (glacial), 1 : 300 in half an hour.

Citric acid, 1 : 200.

Tartaric acid, 1 : 200.

Sulphate of iron, 1 : 20 in half an hour, probably due to presence of free sulphuric acid in the commercial sulphate of iron. "In several experiments made with a saturated solution of sulphate of iron added to an equal quantity of a culture in fluid blood serum, sterilization was not effected."

Salicylic acid, 1 : 300.

Boric acid, 1 : 300.

Thymol, 1 : 400.

Ramon and Cajal[1] report that the cholera spirillum is destroyed by *hydrochloric acid* in the proportion of 1 : 500, by *sulphuric acid* in 1 : 200, by *carbolic acid* in 1 : 50, by *sulphate of copper* in 1 : 100.

Leitz,[2] in his studies relating to the bacillus of typhoid fever, reports the following results:

The dejections of the typhoid patients, mixed in equal quantity with the disinfecting solution, were sterilized by *carbolic acid* in five per cent. solution in three days; by *sulphuric acid*, in five per cent. solution, in three days.

Pure cultures of the typhoid bacillus, mixed with an equal quantity of the disinfecting solution, were sterilized by *sulphate of iron*, 1 : 20, in three days; *sulphate of zinc*, 1 : 20, in three days; *sulphuric acid* 1 : 50, in fifteen minutes, 1 : 20 in five minutes; *carbolic acid*, 1 : 20 in fifteen minutes, 1 : 10 in ten minutes; *sulphate of copper*, 1 : 20, in ten minutes; *chloride of lime* 1 : 20, in five minutes.

In *Virchow's Archiv* of March 2, 1887, is a paper by Guttmann and Merke, of the City Hospital Moabit, in Berlin, relating to the disinfection of inhabited apartments. In making their experiments, the authors had in view the necessity of effectually destroying infectious disease germs with an agent which should not injure the house or furniture, or

[1] Abst. Rev. d. sci. med. t. xxviii, p. 532.

[2] Bakteriologische Studien zur typhus Aetiologie, München, 1886.

be dangerous to the health of the persons who apply it. The anthrax bacillus attached to silk threads (dried) was taken as a test-organism. The disinfecting solutions were applied directly to walls, ceilings, and floors, or, in the form of spray, to rags, etc. The conclusion is reached that a solution of mercuric chloride of 1 : 1,000, applied as a wash or spray, is the most reliable and the cheapest disinfecting agent for use in inhabited rooms. This corresponds with the recommendations of the Committee on Disinfectants made in their report of 1885.

PTOMAINES.

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A ptomaine is a chemical compound, which is basic in its character, and which is formed during the putrefaction of organic matter. The name was suggested by Selmi, and is derived from the Greek word πτῶμα *(cadaver)*. On account of their basic properties, in which they resemble the vegetable alkaloids, ptomaines may be called putrefactive alkaloids. They have been called animal alkaloids, but this is a misnomer, because some ptomaines are formed by the putrefaction of vegetable matter, as will be shown further on. While some of the ptomaines are highly poisonous, this is not an essential property, for others are wholly inert. Indeed, the greater number of those which have been isolated up to the present time are not poisonous. On the other hand, all poisonous substances formed during putrefaction are not ptomaines. Thus, phenol, some of the amido-acids, and hydrogen sulphide are poisonous products of putrefaction, but are not ptomaines.

All ptomaines contain nitrogen, as an essential part of their basic character. In this, also, they resemble the vegetable alkaloids. Some of them contain oxygen, while others do not. The latter correspond to the volatile vegetable alkaloids, nicotine and conine, and the former correspond to the fixed alkaloids.

Since all putrefaction is due to the action of bacteria, it follows that all ptomaines result from the growth of these micro-organisms. The kind of ptomaine formed will depend upon the individual bacterium engaged in its production, the nature of the material being acted upon by the bacterium, and the conditions under which the putrefaction goes on, such as the temperature, the amount of oxygen present, the electrical conditions existing, and the duration of the process. Only the bacillus of typhoid fever (Eberth's bacillus), so far as is known, at least, can produce the ptomaine typhotoxine, and the special bacterium of tetanus seems to be necessary in order to produce tetanine, a ptomaine which, when injected under the skin of an animal, causes tetanic convulsions.

Brieger found that although the typhoid bacillus grew well in solutions of peptone, it did not produce any ptomaine; while from cultures of the same bacillus in beef tea he obtained a poisonous alkaloid. Fitz found that whilst the bacillus butyricus produces by its action on carbohydrates butyric acid, in glycerin it produces propylic alcohol. Brown has shown that while the mycoderma aceti converts ethylic alcohol into acetic acid, it converts propylic alcohol into propionic acid, and is without effect upon methylic alcohol, primary isobutylic alcohol, and amylic alcohol. Some bacteria will not multiply below a given temperature.

Thus, the bacillus butyricus will not grow at a temperature below 24° C. The lower temperature does not destroy the organism, but it lies dormant until the conditions are more favorable for its growth.

Pasteur divided the bacteria into two classes, the ærobic and the anærobic. As the name implies, the former grow and thrive in the presence of air, while the latter find their conditions of life improved by the exclusion of air. Therefore different ptomaines will be formed in decomposing matter freely exposed to the air, and in that which is buried beneath the soil or from which the air is largely excluded. Even when the same ferment is present the products of the putrefaction will vary within certain limits, according to the extent to which the putrefying material is supplied with air. The kind of ptomaine found in a given putrid substance will depend also upon the stage of the putrefaction. Ptomaines are transition products in the process of putrefaction. They are temporary forms through which matter passes, while it is being transformed, by the activity of bacterial life, from the organic to the inorganic state. Complex organic substances, as muscle and brain, are broken up into less complex molecules; and so the process of chemical division goes on, until the simple and well known final products, carbonic acid gas, ammonia, and water, result. But the variety of combinations into which an individual atom of carbon may enter during this long series of changes is almost unlimited, and with each change in combination there is more or less change in nature. In one combination the atom of carbon may exist as a constituent of a highly poisonous substance, while the next combination into which it enters may be wholly inert.

It was formerly supposed that putrefaction was simply oxidation, but the researches of Pasteur and others have demonstrated the fact that countless myriads of minute organisms are engaged constantly in transforming matter from the organic to the inorganic form.

Historical Sketch. It must have been known to primitive man that the eating of putrid flesh was liable to affect the health more or less seriously; and when he began his endeavors to preserve his food for future use, instances of poisoning from putrefaction must have multiplied. However, the distinguished physiologist, Albert von Haller, seems to have been the first to make any scientific experiments concerning the effects of putrid matter upon animals. He injected aqueous extracts of putrid material into the veins of animals, and found that death resulted. Later, in the eighteenth century, Morand gave an account of the symptoms induced by eating some poisonous meat. In the early part of the present century (1808 to 1814), Gaspard carried on similar experiments. He used as material the putrid flesh of both carnivorous and herbivorous animals. With these he induced marked nervous disturbances, as stiffness of the limbs, opisthotonos, and tetanus. Gaspard concluded from the symptoms that the poisonous effects were not due to carbonic acid gas or hydrogen sulphide, but thought it possible that ammonia might have part in their production. In 1820 Kerner published his first essay on poisonous sausage, which was followed by a second in

1822. At first he thought that the poisonous properties were due to a fatty acid similar to the sebacic of Thénard, and which originated during putrefaction. Later, he modified these views, and believed the poison to be a compound consisting of the sebacic acid and a volatile principle. This may be regarded as the first suggestion as to the probability of the development of a poisonous substance with basic properties in decomposing matter. In 1822 Dupré observed a peculiar disease among the soldiers under his care, who, during the very warm and dry summer of that year, were compelled to drink very foul water. Later, Magendie, induced by the investigations of Gaspard and the observations of Dupré, made many experiments, in which dogs and other animals were confined over vessels containing putrid animal matter, and compelled constantly to breathe the emanations therefrom. The effects varied markedly with the species of animal and the nature of the putrid material, but in some instances symptoms were induced which resembled closely those of typhoid fever in man. Leurent directed his attention to the chemical changes produced in blood by putrefaction, but accomplished nothing of special value. Dupuy injected putrid material into the jugular vein of a horse, and with Trosseau studied alterations produced in the blood by these injections.

In 1850 Prof. Schmidt, of Dorpat, made some investigations on the decomposition products and volatile substances found in cholera stools; and two years later Meyer, of Berlin, injected the blood and stools of cholera patients into lower animals. In 1853 Stich made an important contribution on the effects of acute poisoning with putrid material. He ascertained that when given in sufficient quantity, putrid matter produced an intestinal catarrh with choleraic stools. Nervous symptoms, trembling, unsteady gait, and finally convulsions were also observed. Stich made careful post-mortem examinations, and was unable to find any characteristic or important lesion. Theoretically, he concluded that the putrid material contained a ferment which produced rapid decomposition of the blood.

In 1856 Prof. Panum published a most important contribution to the knowledge of the nature of the poison present in putrid flesh. He first demonstrated positively the chemical character of the poison, inasmuch as he showed that the aqueous extract of the putrid material retained its poisonous properties after treatment which would insure the destruction of all organisms. His conclusions were as follows:

(1) "The putrid poison, contained in the decomposed flesh of the dog, and which is obtained by extraction with distilled water and repeated filtration, is not volatile, but fixed. It does not pass over on distillation, but remains in the retort."

(2) "The putrid poison is not destroyed by boiling, nor by evaporation. It preserves its poisonous properties even after the boiling has been continued for eleven hours, and after the evaporation has been carried to complete desiccation at 100°."

(3) "The putrid poison is insoluble in absolute alcohol, but is soluble

in water, and is contained in the aqueous extract, which is formed by treating with distilled water the putrid material, which has previously been dried by heat and washed with alcohol."

(4) "The albuminoid substances, which frequently are found in putrid fluids, are not in themselves poisonous only so far as they contain the putrid poison fixed and condensed upon their surfaces, from which it can be removed by repeated and careful washing."

(5) "The intensity of the putrid poison is comparable to that of the venom of serpents, of curare, and of certain vegetable alkaloids, inasmuch as .012 gramme of the poison, obtained by extracting with distilled water putrid material, which had been previously boiled for a long time, dried at 100°, and submitted to the action of absolute alcohol, was sufficient to almost kill a small dog."

Panum made intravenous injections with this poison and with ammonium carbonate, ammonium butyrate, ammonium valerianate, tyrosin, and leucin, and found that the symptoms induced by the putrid poison differed from those caused by the other agents. Moreover, he found the symptoms to differ from those of typhoid fever, cholera, pyæmia, anthrax, and sausage poisoning. He was in doubt as to whether the poison acted directly upon the nervous system, or whether it acted as a ferment upon the blood, causing a decomposition, the products of which affected the nerve-centres; but he was sure that it could not correspond to the ordinary ferments, inasmuch as it was not decomposed by prolonged boiling, nor by treatment with absolute alcohol. Certainly the putrid poison could not consist of a living organism.

The symptoms observed by Panum varied greatly with the quantity of the poison used and the strength of the animal. After the intravenous injection of large doses, death followed in a very short time. In these cases there were violent cramps, and involuntary evacuations of the urine and fæces; the respirations were labored; the pallor was marked, sometimes followed by cyanosis; the pulse feeble; the pupils widely dilated, and the eyes projecting. In these cases the autopsy did not reveal any lesion, save that the blood was dark, imperfectly coagulated, and slightly infiltrated through the tissue. Post-mortem putrefaction came on with extraordinary rapidity.

When smaller doses or more vigorous animals were used, the symptoms did not appear before from a quarter of an hour to two hours, and sometimes even later. In these cases the symptoms were less violent, and the animal generally recovered. In all instances, however, the disturbances were more or less marked.

In addition to the "putrid poison," Panum obtained a narcotic substance, the two being separated by the solubility of the narcotic in alcohol. The alcoholic extract was evaporated to dryness, the residue dissolved in water, and inserted into the jugular vein of a dog. The animal fell into a deep sleep, which remained unbroken for twenty-four hours, when he awoke apparently in perfect health.

Weber in 1864, and Hemmer and Schewenninger in 1866, confirmed the results obtained by Panum, and Schwenninger announced that in the various stages of putrefaction different products are formed, and that these vary in their effects upon animals. In 1866, Bence, Jones, and Dupré obtained from the liver a substance which in solutions of dilute sulphuric acid gives the blue fluorescence observed in similar solutions of quinine. To this substance they gave the name "animal chinoidin." Subsequently, the same investigators found this substance in all organs and tissues of the body, but most abundantly in the nerves. Its feebly acid solutions give precipitates with iodine, potassio-mercuric iodide, phosphomolybdic acid, gold chloride, and platinum chloride. From three pounds of sheep's liver they obtained three grams of a solution, in which after slight acidulation with sulphuric acid the intensity of the fluorescence was about the same as that of a similarly acidulated solution of quinine sulphate, which contained 0.2 gram of quinine per liter. Still later, this base was observed by Marino-Zuco.

In 1868 Bergmann and Schmiedeberg separated, first from putrid yeast and subsequently from decomposed blood, in the form of a sulphate, a poisonous substance which they named sepsin. The sulphate of sepsin forms in needle-shaped crystals. Small doses (0.01 gram) of this substance were dissolved in water, and injected into the veins of two dogs. In a short time it produced vomiting, and later diarrhœa, which in one of the animals after a time became bloody. Post-mortem examination showed in the stomach and intestines bloody ecchymoses. It was now believed that the "putrid poison" had been isolated, and that it was identical with sepsin; but further investigations showed that this was not true. There are marked differences in their effects upon animals, and sepsin has not been found to be generally present in putrid material. It is only rarely found in blood, and the closest search has failed to show its presence in pus. Bergmann, following the same method which he had used in extracting this poison from yeast, has been unable to obtain it from other putrid material. Moreover, he has not always been successful in obtaining the poison from yeast. Sepsin was not obtained in quantity sufficient to serve for an ultimate analysis, hence its composition remains unknown.

In 1869, Zeuler and Sonnenschein prepared, from decomposed meat extracts, a nitrogenous base, which in its chemical reactions and physiological effects resembles atropia and hyoscyamia. When injected under the skin of animals, it produced dilatation of the pupils, paralysis of the muscles of the intestines, and acceleration of the heart-beats; but it is uncertain and inconstant in its action. This probably results from rapid decomposition taking place in it, or to variations in its composition at different stages of putrefaction. This substance has also been obtained from the bodies of those who have died from typhoid fever; and it may be possible that the belladonna-like delirium which frequently characterizes the later stages of this disease is due to the ante-mortem generation of this poison within the body.

Since 1870 many chemists have been engaged in making investigations on the products of putrefaction. First of all stands the Italian, Selmi, who suggested the name "ptomaine," and whose researches furnished us with much information of value, and, what is probably of more importance, gave an impetus to the study of the chemistry of putrefaction which has already been productive of much good, and gives promise of much more in the future. Selmi showed that ptomaines could be obtained (1) by extracting acidified solutions of putrid material with ether; (2) by extracting alkaline solutions with ether; (3) by extracting alkaline solutions with chloroform; (4) by extracting alkaline solutions with anylic alcohol; and (5) that there yet remained in the solutions of putrid matter ptomaines which were not extracted by any of the above mentioned reagents. In this way he gave some idea of the great number of alkaloidal bodies which might be formed among the products of putrefaction, and the promising field thus discovered and outlined was soon occupied by a busy host of chemists. In the second place, he demonstrated the fact that many of the ptomaines give reactions similar to those given by the vegetable alkaloids. This led the toxicologist into investigations, the results of some of which we will ascertain further on.

Rörsch and Fassbender, in a case of suspected poisoning, obtained by the Stas-Otto method a liquid, which could be extracted from acid as well as from alkaline solutions by ether, and which gave all the general alkaloidal reactions. They were unable to crystallize either extract by taking it up with alcohol and evaporating. The colorless aqueous solution was not at all bitter to the taste. The precipitate formed with phosphomolybdic acid dissolved on the application of heat, giving a green solution, which became blue on the addition of ammonia. They believed that this substance was derived from the liver, since fresh ox-liver treated in the same manner gave them an alkaloid, which could be extracted with ether from acid as well as from alkaline solutions. Gunning found this same alkaloid in liver sausage from which poisoning had occurred. Rörsch and Fassbender state that while in some of its reactions this substance resembles digitalin, it was distinguished from this vegetable alkaloid by the failure of the ptomaine to give the characteristic bitter taste.

Schwanert, whilst examining the decomposing intestines, liver, and spleen of a child which had died suddenly, perceived a peculiar odor, and obtained by the Stas-Otto method (ether extract from an alkaline solution) small quantities of a base, which was distinguished from nicotine and conine by its greater volatility and by its peculiar odor. He supposed that this substance was produced by decomposition; and in order to ascertain the truth of his supposition he took the organs of a cadaver that had lain for sixteen days at a temperature of 30°, and was well decomposed. These were treated with tartaric acid and alcohol. The acid solution was first extracted with ether, and yielded no result; it was then rendered alkaline, and extracted with ether. The latter extract gave on evaporation the same substance which he had found in the organs of the child. The residue was a yellowish oil, having an odor somewhat similar to propylamine. It was repulsive, but not bitter, to the taste, and alkaline in reaction.

Selmi, in commenting upon the base studied by Rörsch and Fassbender, Schwanert, and himself, believing that all were dealing with the same body, states that it does not contain phosphorus, and that it is separated with extreme difficulty from the vegetable alkaloids.

Liebermann, in examining the somewhat decomposed stomach and intestines in a case of suspected poisoning, found an alkaloidal body, which was unlike that studied by the chemists mentioned above, inasmuch as it was not volatile. The Stas-Otto method was employed. The ether extract from alkaline solution left on evaporation a brownish, resinous mass, which dissolved in water to a turbid solution, the cloudiness increasing on heating. This reaction agrees with conine, but the odor differed from that of the vegetable alkaloid.

This substance is extracted by ether from acid, as well as from alkaline, solutions. The yellow, oily drops obtained after the evaporation of the ether are soluble in alcohol. The taste is slightly burning.

Selmi obtained from both putrefying and fresh intestines a substance which gave the general alkaloidal reactions with potassium iodide, gold chloride, platinum chloride, potassio-mercuric iodide, and phosphomolybdic acid. It has strong reducing power, and when warmed with sulphuric acid gives a violet coloration. These reactions are not due to leucin, tyrosin, kreatin, or kreatinin. This is the substance which, as has been stated, Selmi considered identical with that observed by Rörsch and Fassbender and Schwanert. The minor differences observed by the different chemists may have been due to the different degrees of purity in which the substance was obtained by them.

From human bodies which had been dead from one to ten months Selmi removed many alkaline bases. From an ether solution of a number of these, one was removed by treatment with carbonic acid gas. One base, which was insoluble in ether but readily soluble in amylic alcohol, was found to be a violent poison, producing in rabbits tetanus, marked dilatation of the pupils, paralysis, and death.

Parts of the human body preserved in alcohol were found by Selmi to yield an easily volatile, phosphorous-containing substance, which is soluble in ether and carbon bisulphide, and gives a brown precipitate with silver nitrate. It is not the phosphide of hydrogen. A similar substance is produced by the slow decomposition of the yolks of eggs. With potassium hydrate it gives off ammonia, and yields a substance having an intense conine odor. It is volatile, and reduces phosphomolybdic acid.

Selmi also obtained from decomposing egg-albumen a body whose chloride forms in needles, and which has a curare-like action on frogs. From one arsenical body which had been buried for fourteen days he obtained, by extracting from an alkaline (made alkaline with baryta) solution with ether, a substance which formed in needles, and which gave crystalline salts with acids. This substance did not contain any arsenic, but was highly poisonous. From the stomach of a hog, which had been preserved in a solution of arsenious acid, Selmi separated an arsenical organic base. The fluid was distilled in a current of hydrogen. The distillate, which was found to be strongly alkaline, was neutralized with hydrochloric acid and evaporated to dryness, when cross-shaped crystals, giving an odor similar to that of trimethylamine, were obtained. This substance was found by Cicaccio to be highly poisonous, producing strychnia-like symptoms. From the liquid which remained in the retort a non-volatile arsenical ptomaine was extracted with ether. The physiological action of this substance, as demonstrated on frogs, was unlike that of the arsines, but consisted of torpor and paralysis.

Moriggia and Battistini experimented with alkaloids obtained from decomposing bodies upon Guinea-pigs and frogs, but did not attempt their isolation, because of the rapid decomposition which they undergo when exposed to the air and by which they lose their poisonous properties. These alkaloids they found to be easily soluble in amylic alcohol, less soluble in ether.

In 1871, Lombroso showed that the extract from mouldy corn meal produced tetanic convulsions in animals. This threw some light upon the cases of sporadic illness which had long been known to occur among the peasants of Lombardy, who eat fermented and mouldy corn meal. In 1876, Brugnatelli and Zenoni obtained by the Stas-Otto method from this mouldy meal an alkaloidal substance which was white, non-crystalline, unstable, and insoluble in water, but readily soluble in alcohol and ether. With sulphuric acid and bichromate of potassium it yields a color reaction very similar to that of strychnia.

The action of the ether extracts from decomposed brain resembles that of curare, but is less marked and more transitory. The beats of the frog's heart were decreased in number and strengthened in force; the nerves and muscles lost their irritability, and the animal passed into a condition of complete torpor. The pupils were dilated. Guareschi and Mosso, using the Stas-Otto method, obtained from human brains, which had been allowed to decompose at a temperature of from 10° to 15° for from one to two months, both volatile and non-volatile bases. Among the former only ammonia and trimethylamine were in sufficient quantity for identification. With these, however, were minute traces of ptomaines.

To Prof. L. Brieger, of Berlin, is due the credit of isolating and determining the composition of a number of ptomaines. From putrid flesh he obtained neuridin, $C_5H_{14}N_2$, and neurin, $C_5H_{13}NO$. The former is inert, while the later is poisonous. From decomposed fish he separated a poisonous base, $C_2H_4(NH_2)_2$, which is an isomeride of ethylenediamine, muscarine, $C_5H_{15}NO_3$, and an inert substance, $C_8H_{17}NO_2$, gadanine. Rotten cheese yielded neuridine and trimethylamine. Decomposed glue gave neuridine, dimethylamine, and a muscarine-like base. In the cadaver, he has found in different stages of decomposition choline, neuridine, trimethylamine, cadaverine, $C_5H_{16}N_2$, putrescine, $C_4H_{12}N_2$, and saprine, which is identical with cadaverine in composition, but unlike it in some of its chemical reactions. These are all inert.

After fourteen days of decomposition he found a poisonous substance, mydaleine. From a cadaver which had been kept at from —9° to +5° C. for four months, Brieger obtained mydine, $C_8H_{11}NO$, the poisonous substance mydatoxine, $C_6H_{13}NO_{21}$, also the poison, methyl-guanidine. From poisonous mussel he separated mytilotoxine, $C_6H_{15}NO_2$. From pure cultures of the typhoid bacillus of Koch and Eberth, Brieger obtained a poison, typhotoxine, and from like cultures of the tetanus germ of Rosenbach, tetanine.

Gautier and Étard have also isolated some ptomaines, which will be described later.

In 1885, Vaughan succeeded in isolating the active agent of poisonous cheese, to which he gave the name tyrotoxicon. This discovery has been confirmed by Newton, Wallace, Schæffer, Stanton, Firth, and Wolf.

Nicati, Rietsch, Koch, and others have shown the presence of a ptomaine in cultures of the cholera bacillus. Salmon and Smith have done the same with cultures of the hog cholera germ; Hoffa, with those of the anthrax bacillus; and Brieger with those of the tetanus germ.

FOODS CONTAINING POISONOUS PTOMAINES.

Poisonous Mussels.—Judging from the symptoms produced, there are three different kinds of poisonous mussels. In one class, the symptoms seem to be those of a true gastro-intestinal irritant. Fodere reports the case of a sailor, who, after eating a large dish of mussels, suffered from nausea, vomiting, pain in the stomach, tenesmus, and rapid pulse. After death, which occurred within two days, the stomach and intestines were found inflamed, and filled with a tenacious mucus. Combe and others also report cases of the choleraic form of poisoning from mussel.

However, the symptoms which most frequently manifest themselves after the eating of poisonous mussel are more purely nervous. A sensation of heat and itching appears usually in the eye-lids, and soon involves the whole face and perhaps a large portion of the body. An eruption, usually called nettle rash, though it may be papular or vessicular, covers the parts. The itching is most annoying, and may be accompanied by marked swelling. Then follows a distressing asthmatic breathing, which is relieved by ether. In some cases reported by Mohring, dyspnœa preceded the eruption, the patients became insensible, the face livid, and convulsive movements of the extremities were noticed. Burrow reports similar cases with delirium, convulsions, coma, and death within three days.

In a third class of cases, there may be a kind of intoxication resembling somewhat that of alcohol; then paralysis, coma, and death.

In 1827, Combe observed thirty persons poisoned, two of them fatally, with mussels. He describes the symptoms as follows: "None, so far as I know, complained of anything peculiar in the smell or taste of the animals, and nine suffered immediately after taking them. In general, an hour or two elapsed, sometimes more; and the bad effects consisted rather in uneasy feelings and debility, than in any distress referable to the stomach. Some children suffered from eating only two or three; and it will be remembered that Robertson, a young and healthy man, only took five or six. In two or three hours they complained of a slight tension at the stomach. One or two had cardalgia, nausea, and vomiting; but these were not general or lasting symptoms. They then complained of a prickly feeling in their hands, heat and constriction of the mouth and throat, difficulty of swallowing and speaking freely, numbness about the mouth, gradually extending to the arms, with great debility of the limbs. The degree of muscular debility varied a good deal, but was an invariable symptom. In some it merely prevented them from walking firmly, but in most of them it amounted to perfect inability to stand. While in bed they could move their limbs with tolerable freedom, but on being raised to the perpendicular posture, they felt their limbs sink under them. Some complained of a bad, coppery taste in the mouth, but in general this was in answer to what lawyers call a leading question. There was slight pain of the abdomen, increased on pressure, particularly in the region of the bladder, which organ suffered variously in its functions. In some the secretion of urine was suspended; in others it was free, but passed with pain and great effort. The action of the heart was feeble; the breathing unaffected; the face pale, expressive of much anxiety; the surface rather cold; the mental faculties unimpaired. Unluckily, the two fatal cases were not seen by any medical person, and we are therefore unable to state minutely the train of symptoms. We ascertained that the woman, in whose house were five sufferers, went away as in a gentle sleep, and that a few moments before death she had spoken and swallowed."

The woman died within three hours. The other death was that of a watchman, who was found dead in his box six or seven hours after he had eaten the mussels. Post-mortem examination in these showed no abnormality. The stomach contained some of the food partially digested.

The explorer, Voncouver, reports four cases similar to those observed by Combe. One of the sailors died in five and a half hours after eating the mussels.

In some recent cases reported by Schmidtmann, as quoted by Brieger, the symptoms were as follows: Some dock hands and their families ate of cooked blue mussels, which had been taken near a newly built dock. The symptoms appeared, according to the amount eaten, from soon after eating to several hours later. There was a sensation of constriction in the throat, mouth, and lips; the teeth were set on edge as though sour apples had been eaten. There was dizziness, no headache, a sensation of flying, and an intoxication similar to that produced by alcohol. The pulse was rapid (from eighty to ninety), no elevation of temperature, the pupils dilated and reactionless. Speech was difficult, broken, and jerky. The limbs felt heavy; the hands grasped spasmodically at objects, and missed their aim. The legs were no longer able to support the body, and the knees knocked together. There were nausea, vomiting, no abdominal pain, no diarrhœa. The hands became numb, and the feet cold. The sensation of cold soon extended over the entire body, and in some the perspiration flowed freely. There was a sensation of suffocation, then a restful and dreamless sleep. One person died in an hour and three quarters, another in three and a half hours, and a third in five hours, after eating of the mussels.

In one of these fatal cases, rigor mortis was marked, and remained for twenty-four hours. The vessels of all the organs were distended; only the heart was empty. Virchow concluded from the conditions observed that the blood had absorbed oxygen with great avidity. There was marked hyperæmia and swelling of the mucous membrane of the stomach and intestines, which Virchow pronounced an enteritis. The spleen was enormously enlarged, and the liver showed numerous hæmorrhagic infarctions.

Many theories have been advanced to account for poisonous mussels. It was formerly believed that the effects were due to copper, which the animals obtained from the bottoms of vessels; but as Christison remarks, copper does not produce these symptoms. Moreover, Christison made analysis of the mussels which produced the symptoms observed by Combe, and was unable to detect any copper. Bouchardat found copper in some poisonous mussels; but he does not state the amount, nor the source of the animals.

Edwards advanced the theory that the symptoms were wholly due to idiosyncrasy in the consumer. This may be true in some instances where only one or two of those partaking of the food are affected, but it certainly is not a tenable hypothesis in such instances as those reported by Combe and Schmidtmann, where all those who partook of the food were affected.

Coldstream found the livers of the Leith mussels, as he thought, larger, darker, and more brittle than normal, and to this diseased condition he attributed the ill effects.

Lamoroux, Möhring, De Beune, Chenu, and Du Roxleau have supposed that the poisonous effects were due to a particular species of medusæ, upon which the animals fed. De Beune found in the vomited matter of one person suffering from mussel poisoning some medusæ, and he states that these are most abundant during the summer, when mussels are most frequently found to be poisonous.

The theory of Burrow, that the animal is always poisonous during the period of reproduction, has been received with considerable credit. However, cases of poisoning have occurred at different seasons of the year.

Crumpe, in 1872, suggested that there is a species of mussel which is in and of itself poisonous, and this species is often mixed with the edible variety. Schmidtmann and Virchow formerly supported this idea. They state that the poisonous species has a brighter shell, a sweeter, more penetrating, bouillon-like odor, than the edible kind; also, that the flesh of the former is yellow, and that the water in which they are cooked is bluish.

Lohmeyer also champions this opinion. This theory, however, is opposed by the majority of zoölogists. Möbius states that the peculiarities of the supposed poisonous variety, pointed out by Virchow and Schmidtmann, are really due to the conditions under which the animal lives, the amount of salt in the water, the temperature of the water, whether it is moving or still water, the nature of the bottom, etc. Finally, Möbius states that the sexual glands, which form the greater part of the mantle, are white in the male and yellow in the female. However, it has been shown later by Schmidtmann and Virchow that edible mussels may become poisonous if left in filthy water for fourteen days or longer; and, on the other hand, poisonous ones may become fit for food if kept for four weeks in good water. This, of course, overthrows the theory of the existence of a special poisonous species.

Cats and dogs which have eaten voluntarily of poisonous mussels have suffered from symptoms similar to those observed in man, and rabbits have been poisoned by the administration of the water in which the food has been cooked. A rabbit, which was treated in this manner by Schmidtmann, died within one minute. From these mussels Brieger extracted the ptomaine, mytilotoxin. This poison has a curare-like action. Whether or not those mussels which produce other symptoms also contain ptomaines, remains for future investigations to determine.

Sausage Poisoning. This is also known as *botulismus* and *allantiasis.* While considerable diversity has been observed in symptoms of sausage poisoning, we cannot divide the cases into classes from their symptomatology, as was done in mussel poisoning. The first effects may manifest themselves at any time from one hour to twenty-four hours after eating of the sausage, and cases are recorded in which, it is stated, no symptoms appeared until several days had passed. However, we must remember that trichinosis was frequently, in former times, classed as sausage poisoning, and it is highly probable that these cases of long delay in the appearance of the symptoms were really not due to putrefaction, but to the presence of parasites in the meat. A large majority of the 124 cases more recently reported by Müller sickened within twenty-four hours, and out of the forty-eight of these which were fatal, six died within the first twenty-four hours.

At first, there is dryness of the mouth, constriction of the throat, uneasiness in the stomach, nausea, vomiting, vertigo, indistinctness of vision, dilatation of the pupils, difficulty in swallowing, and usually diarrhœa, though obstinate constipation may exist from the first. There is, as a rule, a sensation of suffocation, and the breathing becomes labored. The pulse is small, thready, and rapid. In some cases the radial pulse may be imperceptible. Marked nervous prostration and muscular debility follow. These symptoms vary greatly in prominence in individual cases. The retching and vomiting, which may be most distressing and persistent in some instances, in others are trivial at the beginning, and soon cease altogether. The same is true of the diarrhœa. As a rule, the functions of the brain proceed normally, but there may be delirium, then coma, and death. In some there are marked convulsive movements, especially of the limbs; in others, paralysis may be an early and marked symptom. The pupils may dilate, then become normal, and again dilate. There is frequently ptosis, and paralysis of the muscles of accommodation is not rare. Complete blindness has followed in a few instances.

The fatality varies greatly in different outbreaks. In 1820 Kerner collected reports of seventy-six cases, of which thirty-seven were fatal. In his second publication (1822) he increased the number to 155 cases, with eighty-four fatal results. This gave a mortality of over fifty per cent.; while in one outbreak reported by Müller the mortality was less than two per cent.

A large proportion of the cases of sausage poisoning have occurred in Würtemberg, and the immediately adjacent portions of Baden. This fact has, without doubt, been correctly ascribed to the methods there practised of preparing and curing the sausage. It is said to be common for the people to use the dried blood of the sheep, ox, and goat in the preparation of this article. Moreover, the blood is kept sometimes for days in wooden boxes and at a high temperature before it is used. In these cases it is altogether likely that putrefaction progresses to the poisonous stage before the process of curing is begun. However, cases of poisoning have occurred from beef and pork sausages as well.

Moreover, the method of curing employed in Würtemberg favors putrefaction. A kind of sausage known as "blunzen" is made by filling the stomachs of hogs with the meat. In curing, the interior of this great mass is not acted upon, and putrefaction sets in. The curing is usually done by hanging the sausage in the chimney. At night, the fire often goes out, and the meat freezes. The alternate freezing and thawing renders decomposition more easy. The interior of the sausage is generally the most poisonous. Indeed, in many instances those who have eaten of the outer portions have been unharmed, while those who have eaten of the interior of the same sausage have been most seriously affected.

Many German writers state that when a poisonous sausage is cut, the putrid portion has a dirty, grayish-green color, and a soft, smeary consistency. A disagreeable odor, resembling that of putrid cheese, is perceptible. The taste is unpleasant, and sometimes there is produced a smarting of the mouth and throat. Post-mortem examination after sausage poisoning shows no characteristic lesion. It is generally stated that putrefaction sets in very tardily; but Müller shows that no reliance can be placed upon this point, and states that out of forty-eight recorded autopsies, it was especially stated in eleven that putrefaction rapidly developed. In some instances there has been noticed hyperæmia of the stomach and intestinal canal, but this is by no means constant. The liver and brain have been reported as congested, but this would result from the failure of the heart, and would by no means be characteristic of poisoning with sausage.

Von Faber, in 1821, observed sixteen persons, who were made sick by eating fresh, unsmoked sausage made from the flesh of a pig which had suffered from an abscess on the neck. Five of the patients died. The symptoms were as follows: There was constriction of the throat, difficulty in swallowing, retching, vomiting, colic-like pains, vertigo, hoarseness, dimness of vision, and headache. Later, and in the severe cases, there was complete exhaustion, and finally paralysis. The eyeballs were retracted; the pupils were sometimes dilated, then contracted; they did not respond to light; there was paralysis of the upper lids. The tonsils were swollen, but not as in tonsillitis. Liquids which were not irritating could be carried as far as the œsophagus, when they were ejected from the mouth and nose with coughing. Solid foods could not be swallowed at all. On the back of the tongue and in the pharynx there was observed a puriform exudate.

Obstinate constipation existed in all, while the sphincter ani was paralyzed. The breathing was easy, but all had a croupous cough. The skin was dry. There was incontinence of urine. There was no delirium, and the mind remained clear to the last.

Post-mortem examinations were held on four. The skin was rough ("goose-flesh"). The abdomen was retracted. The large vessels in the upper part of the stomach were filled with black blood. The contents of the stomach consisted of a reddish-brown, semi-fluid substance, which gave off a repugnant, acid odor. In one case the omentum was found greatly congested. The large intestines were very pale, and the right ventricle of the heart was filled with dark, fluid blood.

Schüz cites thirteen cases of poisoning from liver sausage, in which the symptoms differed from the foregoing in the following respects:

(1) In only one out of the thirteen was there constipation: all the others had numerous, watery, typhoid-like stools.

(2) Symptoms involving the sense of sight were present in only three; in all the pupils were unchanged.

(3) The croupous cough was wholly wanting; though in many there was complete loss of voice. Difficulty of swallowing was complained of by only one.

(4) Delirium was marked in all; and in one the disturbance of the mental faculties was prominent for several weeks.

(5) There were no deaths.

(6) The time between eating the sausage and the appearance of the symptoms varied from eighteen to twenty-four hours, and the duration of the sickness from one to four weeks; though in one case complete recovery did not occur until after two and a half months.

The sausages were not smoked, and all observed a garlic odor, though no garlic had been added to the meat.

Tripe reports sixty-four cases. The symptoms came on from three and a half to thirty-six hours after eating. The stools were frequent, watery, and of offensive odor. In some there was delirium. One died. In the fatal case, the hands and face were cold and swollen. The pulse was rapid and weak. The pupils were contracted, but responded to light. The small intestine was found inflamed.

Hedinger reports the cases of a man and a woman with the usual symptoms, but during recovery the dilatation of the pupils was followed by contraction. Birds ate of this sausage, and were not affected.

Röser reports cases in which there was found after death abscesses of the tonsils, dark, bluish appearance of the mucous membrane of the pharynx, larynx, and bronchial tubes, dark redness of the fundus of the stomach, and circumscribed gray, red, and black spots on the mucous membrane of the intestines. The liver was brittle, and the spleen enlarged.

Many theories concerning the nature of the active principle of poisonous sausage have been advanced. It was once believed to consist of pyroligneous acid, which was supposed to be absorbed by the meat from the smoke used in curing it; but soon it was found that unsmoked sausage might be poisonous also. Emmert believed that the active agent was hydrocyanic acid, and Jäger's theory supposed the presence of picric acid. But these acids are not found in poisonous sausage, and, moreover, their toxicological effects are wholly unlike those observed in sausage poisoning. As we have elsewhere seen, Kerner believed that he had found the poisonous principle in a fatty acid. This theory was supported by Dann, Buchner, and Schuman. Kerner believed the poison to consist of either caseic or sebacic acid, or both, while Buchner named it acidum botulinicum; but the acids of the former proved to be inert, and that of the latter to have no existence. Schlossberger suggested that the poisonous substance is most probably basic in character, and he found an odoriferous, ammoniacal base, which could not be found in good sausage, and which did not correspond to any known amides, imides, or nitric bases. However, this substance has not been obtained by any one else, nor has it been demonstrated to be poisonous.

Liebig, Duflas, Hirsch, and Simon believed in the presence of a poisonous ferment. Van den Corpat described scarcina botulina, which were believed to constitute the active agent. Müller, Hoppe-Seyler, and others have found various micro-organisms, and Virchow, Eichenberg, and others have examined microscopically the blood of persons poisoned with sausage. Recently Ehrlich has attempted to isolate the poisonous substance by employing Brieger's method; but he obtained only inert substances.

In the light of the knowledge of to-day concerning the nature of putrefaction, there can scarcely be a doubt that the active agent of poisonous sausage consists of an easily decomposable base, and we predict its isolation in the very near future.

Poisonous Ham. Under this head we shall not discuss cases of poisoning from trichina or other parasites, but shall refer only to those instances in which the toxic agent has originated in putrefactive changes. A number of such cases have been observed within the past ten years, but only a few of them have been investigated scientifically. The best known of these, as well as the most thoroughly studied, is the Wellbeck poisoning, which Dr. Ballard investigated successfully. In June, 1880, a large number of persons attended a sale of timber and machinery on the estate of the Duke of Portland, at Wellbeck. The sale continued for four days, and lunches were served by the proprietress of a neighboring hotel. The refreshments consisted of cold boiled ham, cold boiled or roasted beef, cold beefsteak pie, mustard and salt, bread and cheese, pickles, and Chutnee sauce. The drinks were bottled and draught beer, spirits, ginger beer, lemonade, and water. Many were poisoned; and Dr. Ballard obtained the particulars of seventy-two cases, among which there were four deaths.

The cause of this illness was traced conclusively to the hams eaten. Klein found in the meat a bacillus, cultures of which were used for inoculating animals. These inoculations were found generally to be followed by pneumonia. No attempt was made to isolate a ptomaine.

Later, Ballard reported fifteen cases, with symptoms similar to the above, and with one death, from eating baked pork. Not all of those who ate of this pork were made sick. This might have been due to inequality in the putrefactive changes in different portions of the meat, or it may have been due to differences in temperature in various portions of the meat during the cooking. In the blood, pericardial fluid, and lungs of the fatal case, Klein observed bacilli similar to those discovered in the Wellbeck inquiry. Pneumonia was produced by inoculating Guinea-pigs and mice with these bacilli.

Poisonous Canned Meats. Cases of poisoning from eating canned meats have become quite frequent. Although it may be possible that in some instances the untoward effects result from metallic poisoning, in the great majority of cases the poisonous principles are formed by putrefactive changes. In many instances, it is probable that decomposition begins after the can is opened by the consumer. In others, the canning is carelessly done, and putrefaction is far advanced before the food reaches the consumer. In still other instances the meat may be taken from diseased animals, or it may have undergone putrefactive changes before the canning. What is true of canned meats is also true of canned fruits and vegetables.

Poisonous Cheese. In 1827, Hünnefeld made some analyses of poisonous cheese, and experimented with extracts upon the lower animals. He accepted the ideas of Kerner in regard to poisonous sausage in a somewhat modified form, and thought the active agents to be sebacic and caseic acids. About the same time, Sertürner, making analyses of poisonous cheese for Westrumb, also traced the poisonous principles, as he supposed, to these fatty acids. We see from this that during the first part of the present century the fatty acid theory, as it may be called, was generally accepted.

In 1848, Christison, after referring to the work of Hünnefeld and Sertürner, made the following statement: "His [Hünnefeld's] experiments, however, are not quite conclusive of the fact that these fatty acids are really the poisonous principles, as he has not extended his experimental researches to the caseic and sebacic acids prepared in the ordinary way. His views will probably be altered and simplified if future experiments should confirm the late inquiries of Braconot, who has stated that Proust's caseic acid is a modification of the acetic acid combined with an acrid oil."

In 1852, Schlossberger made experiments with the pure fatty acids, and demonstrated their freedom from poisonous properties. These experiments have been verified repeatedly, so that now it is well known that all the fatty acids obtainable from cheese are devoid of poisonous properties.

It may be remarked here that there is every probability that the poisonous substance was present in the extracts obtained by the older chemists: indeed, we may say that this is a certainty, since the administration of these extracts to cats was, in some instances at least, followed by fatal results. The great mass of these extracts consisted of fatty acids, and as the chemists could find nothing else present, they very naturally concluded that the fatty acids themselves constituted the poisonous substance.

Since the overthrow of the fatty acid theory, various conjectures have been made, but none of them are worthy of consideration.

We make the following quotations from some of the best authorities, who wrote during the first half of the present decade upon this subject:

Hiller says,—" Nothing definite is known of the nature of cheese poison. Its solubility seems established from an observation of Hussemann, a case in which the poison was transmitted from a nursing mother to her child."

Hussemann wrote as follows: " The older investigations of the chemical nature of cheese poison, which led to the belief of putrefactive cheese acids and other problematic substances, are void of all trustworthiness; and the discovery of the active principle of poisonous cheese may not be looked for in the near future, on account of proper animals for controlling the experiments with the extracts, as dogs can eat large quantities of poisonous cheese without its producing any effect."

Brieger stated in 1885,—"All kinds of conjectures concerning the nature of this poison have been formed, but all are even devoid of historical interest, because they are not based upon experimental investigations. My own experiments towards solving this question have not progressed very far."

In the above quotation, we think that Brieger has hardly done justice to the work of Hünnefeld and Sertürner. Their labors can hardly be said to be wholly devoid of historical interest, and they certainly did employ the experimental method of inquiry. We shall soon see as to the correctness of the prediction of Hussemann, as given above.

In the years 1883 and 1884, there were reported to the Michigan State Board of Health about 300 cases of cheese poisoning. As a rule, the first symptoms appeared within from two to four hours after eating the cheese. In a few the symptoms were delayed from eight to ten hours, and were very slight. The attending physicians reported that the gravity of the symptoms varied with the amount of cheese eaten, but no one who ate of the poisonous cheese wholly escaped. One physician reported the following symptoms: "Every one who ate of the cheese was taken with vomiting, at first of a thin, watery, later a more consistent reddish-colored, substance. At the same time, the patients suffered from diarrhœa with watery stools. Some complained of pain in the region of the stomach. At first, the tongue was white, but later it became red and dry; pulse was feeble and irregular; countenance pale, with marked cyanosis. One small boy, whose condition seemed very critical, was covered all over his body with bluish spots."

Dryness and constriction of the throat were complained of by all. In a few cases the vomiting and diarrhœa were followed by marked nervous prostration, and, in some, dilatation of the pupils was observed.

Notwithstanding the severity of the symptoms in many, there was no fatal termination among these cases, though several deaths from cheese poisoning in other outbreaks have occurred. Many of the physicians at first diagnosed the cases from the symptoms as due to arsenical poisoning, and on this supposition some administered ferric hydrate. Others gave alcohol and other stimulants, and treated upon the expectant plan.

Vaughan, to whom the cheese was sent for analysis, made the following report: "All of these 300 cases were caused by eating of twelve different cheeses. Of these, nine were made at one factory, and one each at three other factories. Of each of the twelve I received smaller or larger pieces. Of each of ten I received only small amounts; of each of the other two I received about eighteen killograms. The cheese was in good condition, and there was nothing in the taste or odor to excite suspicion. However, from a freshly cut surface there exuded numerous drops of a slightly opalescent fluid, which reddened litmus instantly and intensely. Although, as I have stated, I could discern nothing peculiar in the odor, if two samples, one of good and the other of poisonous cheese, were placed before a dog or cat, the animal would invariably select the good cheese. But if only poisonous cheese was offered, and the animal was hungry, it would partake freely. A cat was kept seven days, and furnished only poisonous cheese and water. It ate freely of the cheese, and manifested no untoward symptoms. After the seven days, the animal was etherized, and abdominal section was made. I predicted, however, in one of my first articles on poisonous cheese, that the isolated poison would affect the lower animals. As to the truth of this prediction we will see later.

"My friend Dr. Sternberg, the eminent bacteriologist, found in the opalescent drops above referred to numerous micrococci. But inoculations of rabbits with these failed to produce any results.

"At first, I made an alcoholic extract of the cheese. After the alcohol was evaporated *in vacuo* at a low temperature, a residue consisting mainly of fatty acids remained. I ate a small bit of this residue, and found that it produced dryness of the throat, nausea, vomiting, and diarrhœa. The mass of this extract consisted of fats and fatty acids, and for some weeks I endeavored to extract the poison from these fats, but all attempts were unsuccessful. I then made an aqueous extract of the cheese, filtered this, and, drinking some of it, found that it also was poisonous. But after evaporating the aqueous extract to dryness on the water-bath at 100°, the residue thus obtained was not poisonous. From this I ascertained that the poison was decomposed or volatilized at or below the boiling point of water. I then tried distillation at a low temperature; but by this the poison seemed to be decomposed.

"Finally, I made the clear, filtered aqueous extract, which was highly acid, alkaline with sodium hydrate, agitated this with ether, removed the ether, and allowed it to evaporate spontaneously. The residue was highly poisonous. By resolution in water and extraction with ether, the poison was separated from foreign substances. As the ether took up some water, this residue consisted of an aqueous solution of the poison. After this was allowed to stand for some hours *in vacuo* over sulphuric acid, the poison separated in needle-shaped crystals. From some samples the poison crystallized from the first evaporation of the ether, and without standing *in vacuo*. This happened only when the cheese contained comparatively a large amount of the poison. Ordinarily, the microscope was necessary to detect the crystalline shape. From sixteen kilograms of one cheese I obtained about 0.5 gram of the poison, and in this case the individual crystals were plainly visible to the unaided eye. From the same amount of another cheese I obtained only about 0.1 gram, and the crystals in this case were not so large. I have no idea, however, that by the method used all the poison was separated from the cheese."

To this ptomaine, Vaughan has given the name tyrotoxicon (*turos*, cheese, and *toxikon*, poison).

During 1887, Wallace found tyrotoxicon in two samples of cheese which had caused serious illness. The first of these came from Jeansville, Penn., and the symptoms as reported to Wallace by Dr. Doolittle, who had charge of the cases, were as follows: "There were at least fifty persons poisoned by this cheese. There were also eight others who ate of the cheese, but felt no unpleasant effects: whether this was due to personal idiosyncrasy, or to an uneven distribution of the poison throughout the cheese, I am unable to say.

"The majority, however, comprising fifty or sixty persons, were seized in from two to four hours after eating the cheese with vertigo, nausea, vomiting, and severe rigors, though varying in their order of appearance and in severity in different cases. The vomiting and chills were the most constant and severe symptoms in all the cases, and were soon followed by severe pain in the epigastric region, cramps in the feet and lower limbs, purging and griping pain in the bowels, a sensation of numbness, or pins and needles, especially in the limbs, and, lastly, very marked prostration, amounting almost to collapse in a few cases.

"The vomit at first consisted of the contents of the stomach, and had a strong odor of cheese; afterwards, it consisted of mucus, bile, and in three or four of the severest cases blood was mixed with the mucus in small quantities. Microscopic examination of the same was not made, but to the eye it appeared as such. The vomiting and diarrhœa lasted from two to twelve hours; the rigors and muscular cramps, from one to two hours. The diarrhœa, at first fecal, became later watery and light-colored. No deaths occurred, and for the most part the effects were transient, and all that remained on the following day were the prostration and numbness; the latter occurred in about one half the cases, and disappeared in from one to three days.

"Children, as a rule, seemed to suffer less than adults, and, of course, it was not possible to elicit as definite symptoms from them. The suddenness of the attack was remarked by all, some feeling perfectly well until the moment of attack. Nor did the symptoms seem to be in proportion to the amount of the cheese taken. Some of the severest cases declared they had not eaten more than a cubic inch of it. One of the severest cases was about six and a half months pregnant, but no interference with pregnancy occurred. All the cheese which caused the sickness came from the same piece."

The second sample of cheese examined by Wallace came from Riverton, N. J. This outbreak included a smaller number of persons, all of whom recovered.

Still more recently Wolf has detected tyrotoxicon in cheese which poisoned several persons at Shamokin, Penn. The pores of this cheese were found filled with a grayish-green fungoid growth, though it is not supposed that this fungus was connected in any way with the poisonous nature of the cheese. Tests were made for mineral poisons with negative results, after which tyrotoxicon was recognized both by chemical and physiological tests. "A few drops of the liquid (extract) placed on the tongue of a young kitten produced prompt emesis and numerous watery dejections, with evident depression and malaise of the animal. A larger cat was similarly affected by it, though the depression and malaise were not so marked nor so long continued."

Cheese poisoning caused the death of several children in the neighborhood of Heiligenstadt in 1879, and there were many fatal cases from the same cause in Pyrmont in 1878. Unfortunately, we have not been able to find any detailed account of either the symptoms or the post-mortem appearances in these cases.

Poisonous Milk. In 1885, Vaughan found tyrotoxicon in some milk which had stood in a well stoppered bottle for about six months. It was presumed that this milk was, when first obtained, normal in composition; but since this was not known with certainty, the following experiments were made: Several gallon-bottles were filled with normal milk, tightly closed with glass stoppers, and allowed to stand at the ordinary temperature of the room. From time to time a bottle was opened, and the test for tyrotoxicon was made. These tests were followed by negative results until about three months after the experiment was begun. Then the poison was obtained from one of the bottles. The coagulated milk was filtered through paper. The filtrate, which was colorless and decidedly acid in reaction, was rendered feebly alkaline by the addition of potassium hydrate, and agitated with ether. After separation, the ethereal layer was removed with a pipette, passed through a dry filter paper in order to remove a flocculent, white substance which floated in it, and then allowed to evaporate spontaneously. If necessary, this residue was dissolved in water, and again extracted with ether. As the ether takes up some water, there is usually enough of the latter left, after the spontaneous evaporation of the ether, to hold the poison in solution, and in order to obtain the crystals this aqueous solution must be allowed to stand for some hours *in vacuo* over sulphuric acid.

From a half gallon of the milk there was obtained quite a concentrated aqueous solution of the poison after the spontaneous evaporation of the ether. Ten drops of this solution placed in the mouth of a small dog, three weeks old, caused within a few minutes frothing at the mouth, retching, the vomiting of frothy fluid, muscular spasm over the abdomen, and after some hours watery stools. The next day the dog seemed to have partially recovered, but was unable to retain any food. This condition continuing for two or three days, the animal was killed with chloroform. No examination of the stomach was made.

In 1886, Newton and Wallace obtained tyrotoxicon from milk, and studied the conditions under which it forms. Their report is of so much value that the greater part of it is herewith inserted.

"On August 7th, twenty-four persons at one of the hotels at Long Branch were taken ill soon after supper. At another hotel, on the same evening, nineteen persons were seized with the same form of sickness. From one to four hours elapsed between the meal and the first symptoms. The symptoms noticed were those of gastro-intestinal irritation, similar to poisoning by any irritating material,—that is, nausea, vomiting, cramps, and collapse; a few had diarrhœa. Dryness of the throat and a burning sensation in œsophagus were prominent symptoms.

"While the cause of the sickness was being sought for, and one week after the first series of cases, thirty persons at another hotel were taken ill with precisely the same symptoms as noticed in the first outbreak.

"When the news of the outbreak was published, one of us immediately set to work, under the authority of the state board of health, to ascertain the cause of the illness. The course of the investigation was about as follows:

"The character of the illness indicated, of course, that some article of food was the cause, and the first part of our task was to single out the one substance that seemed at fault. The cooking utensils were also suspected, because unclean copper vessels have often caused irritant poisoning. Articles of food, such as lobsters, crabs, blue fish, and Spanish mackerel, all of which at times, and with some persons very susceptible to gastric irritation, have produced toxic symptoms, were looked for; but it was found that none of these had been eaten at the time of the outbreak. The cooking vessels were examined, and all found clean and bright, and no evidence of corrosion was presented.

"Further inquiry revealed the fact that all who had been taken ill had used milk in greater or less quantities, and that persons who had not partaken of milk escaped entirely. Corroborative of this it was ascertained that those who had used milk to the exclusion of all other food were violently ill. This was prominently noticed in the cases of infants fed from the bottle, when nothing but uncooked milk was used. In one case an adult drank about a quart of the milk, and was almost immediately seized with violent vomiting, followed by diarrhœa, and this by collapse. Suffice it to say that we were able to eliminate all other articles of food, and to decide that the milk was the sole cause of the outbreak.

"Having been able to determine this, the next step was to discover why that article should, in these cases, cause so serious a form of sickness.

"The probable causes which we were to investigate were outlined as follows: (1) Some chemical substance, such as borax, boric acid, salicylic acid, sodium bicarbonate, sodium sulphate, added to preserve the milk or to correct acidity; (2) the use of polluted water, as an adulterant; (3) some poisonous material accidentally present in the milk; (4) the use of milk from diseased cattle; (5) improper feeding of the cattle; (6) the improper care of the milk; (7) the development in the milk of some ferment or ptomaine, such as tyrotoxicon.

"At the time of the first outbreak we were unable, unfortunately, to obtain any of the noxious milk, as that unconsumed had been destroyed; but at the second outbreak a liberal quantity was procured.

"It was soon ascertained that one dealer had supplied all the milk used at the three hotels where the cases of sickness had occurred. His name and address having been obtained, the next step in the investigation was to inspect all the farms, and the cattle thereon, from which the milk was taken. We also learned that two deliveries at the hotels were made daily, one in the morning and one in the evening; that the milk supplied at night was the sole cause of sickness, and that the milk from but one of the farms was at fault. The cows on this farm were found to be in good health, and, besides being at pasture, were well fed with bran, middlings, and corn meal.

"So far, we had been able to eliminate, as causes, diseased cattle and improper feeding, and we were then compelled to consider the other possible sources of the toxic material.

"While the inspection of the farms was being made, the analysis of the milk was in progress. The results of this showed that no chemical substance had been added to the milk; that it was of average composition; that no polluted water had been used as a dilutent; and that no poisonous metals were present. This result left us nothing to consider but two probable causes,—improper care of the milk, and the presence of a ferment.

"As to the former, we soon learned much. The cows were milked at the unusual and abnormal hours of midnight and noon; and the noon's milking—that which alone was followed by illness—was placed while hot in the cans, and then, without any attempt at cooling, carted eight miles during the warmest part of the day in a very hot month.

"This practice seemed to us sufficient to make the milk unpalatable, if not injurious; for it is well known that when fresh milk is closed up in a tight vessel, and then deposited in a warm place, a very disagreeable odor and taste are developed. Old dairymen speak of the animal heat as an entity, the removal of which is necessary, in order that the milk shall keep well and have a pleasant taste. While we do not give this thing a name, we are fully convinced that milk should be thoroughly cured, by proper chilling and aeration, before it is transported any distance, or sold for consumption in towns or cities.

"The results of our inquiry having revealed so much, we next attempted to isolate some substance from the poisonous milk, in order that the proof might be more evident. A quantity of the milk that had caused sickness in the second outbreak was allowed to coagulate, was then thrown on a coarse filter, and the filtrate collected. This latter was highly acid, and was made slightly alkaline by the addition of potassium hydrate. This alkaline filtrate was now agitated with an equal volume of pure, dry ether, and allowed to stand for several hours, when the ethereal layer was drawn off by means of a pipette. Fresh ether was added to the residuum, then agitated, and, when separated, was drawn off, and added to the first ethereal extract. This was now allowed to evaporate spontaneously, and the residue, which seemed to contain a small amount of fat, was treated with distilled water and filtered, the filtrate treated with ether, the ethereal solution drawn off and allowed to evaporate, when we obtained a mass of needle-shaped crystals. This crystalline substance gave a blue color with potassium ferricyanide and ferric chloride, and reduced iodic acid. The crystals, when placed on the tongue, gave a burning sensation. A portion of the crystals was mixed with milk and fed to a cat, when, in the course of half an hour, the animal was seized with retching and vomiting, and was soon in a condition of collapse, from which it recovered in a few hours.

"We are justified in assuming, after weighing well all the facts ascertained in the investigation, that the sickness at Long Branch was caused by poisonous milk, and that the toxic material was tyrotoxicon.

"The production of this substance was no doubt due to the improper management of the milk,—that is, too long a time was allowed to elapse between the milking and the cooling of the milk, the latter not being attended to until the milk was delivered to the hotel; whereas, if the milk had been cooled immediately after it was drawn from the cows, fermentation would not have ensued, and the resulting material, tyrotoxicon, would not have been produced."

In the same year Shearer found the same poison in the milk used by, and in the vomited matter of persons made sick at, a hotel at Corning, Iowa.

In 1887, Firth, an English army surgeon stationed in India, reported an outbreak of milk poisoning among the soldiers of his garrison. From the milk he separated, by Vaughan's method, tyrotoxicon. He also obtained tyrotoxicon from milk which had been kept for some months in stoppered bottles, as had been previously done by Vaughan.

In 1887, Mesic and Vaughan observed four cases of milk poisoning, three of which terminated fatally; and Novy and Vaughan obtained tyrotoxicon from the milk, and from the contents of the intestine in one of the fatal cases. The report of these cases may be found in the first quarterly report of the Michigan State Laboratory of Hygiene, or in the *Medical News* of Dec. 3, 1887.

Poisonous Ice-Cream. In 1886 Vaughan and Novy obtained tyrotoxicon from a cream which had seriously affected many persons at Lawton, Mich. Vanilla had been used for flavoring, and it was supposed that the ill effects were due to the flavoring. This belief was strengthened by the fact that a portion of the custard was flavored with lemon, and the lemon cream did not affect any one unpleasantly. Fortunately some of the vanilla extract remained in the bottle from which the flavoring for the ice-cream had been taken, and this was forwarded to the chemists. Each of the experimenters took at first thirty drops of the vanilla extract, and no ill effects following this, one of them took two teaspoonfuls more, with no results. This proved the non-poisonous nature of the vanilla more satisfactorily than could have been done by a chemical analysis.

Later it was found that that portion of the custard which had been flavored with lemon was frozen immediately, while that portion which was flavored with vanilla, and which proved to be poisonous, was allowed to stand for some hours in a building which is described as follows by a resident of the village:

"The cream was frozen in the back end of an old wooden building on Main street. It is surrounded by shade, has no underpinning, and the sills have settled into the ground. There are no eve-troughs, and all the water falling from the roof runs under the building, the streets on two sides having been raised since the construction of the house. The building had been unoccupied for a number of months, consequently has had no ventilation, and, what is worse, the back end (where the cream was frozen) was last used as a meat-market. The cream which was affected was that portion last frozen; consequently it stood in an atmosphere more like that of a privy vault for upward of an hour and a half or two hours before being frozen."

The symptoms observed in these cases were identical with those produced by poisonous cheese and milk.

The tyrotoxicon obtained from this cream was administered to a kitten about two months old. Within ten minutes the cat began to retch, and soon it vomited. This retching and vomiting continued for two hours, during which the animal was under observation, and the next morning it was observed that the animal had passed several watery stools. After this, although the animal could walk about the room, it was unable to retain any food. Several times it was observed to lap a little milk, but on doing so it would immediately begin to retch and vomit. Even cold water produced this effect. This condition continuing, after three days the animal was placed under ether and its abdominal organs examined. Marked inflammation of the stomach was supposed to be indicated by the symptoms, but the examination revealed the stomach and small intestines filled with a frothy, serous fluid such as had formed a portion of the vomited matter, and the mucous membrane very white and soft. There was not the slightest redness anywhere. The liver and other abdominal organs seemed normal.

A bit of the solid portion of this cream was added to some normal milk, which by the addition of eggs and sugar was made into a custard. The custard was allowed to stand for three hours in a warm room, after which it was kept in an ice-box until submitted to chemical analysis. In this tyrotoxicon was also formed.

Tyrotoxicon has since been formed in some chocolate cream which poisoned persons at Geneva, N. Y., and in lemon cream from Amboy, Ohio.

Shearer reports the finding of tyrotoxicon in both vanilla and lemon ice-cream which made many sick at Corning, Iowa.

Allaben reports poisoning with lemon cream, and makes the following interesting statements concerning it:

"I would first say, July 4, 5, and 6 were very warm. Monday evening, July 5, the custards were cooked, made from Monday morning's cream and Monday night's milk, boiled in a tin pan that had the bright tin worn off. It was noticed that one pan of cream was not sweet, but thinking it would make no difference, it was used; the freezers were thoroughly cleaned and scalded, and the custards put in the same evening while hot; the cream was frozen Tuesday afternoon, having stood in the freezers since the night before, when the weather was very warm."

No analysis of this cream was made, but the symptoms agree with those of tyrotoxicon poisoning.

Wellford observed several cases of poisoning from custard flavored with lemon. These custards were tested for mineral poisons with negative results.

Morrow has put forth the claim that ice-cream poisoning is solely due to vanillin, which is, according to his statement, used instead of vanilla extract, but the facts stated above concerning poisoning with creams in which other flavors had been used contradicts this claim. Moreover, Gibson has shown the utter absurdity of the claim, inasmuch as he calculates, from the amount of flavoring ordinarily used in ice-cream, that in order to produce the toxic symptoms observed, the flavoring must be ten times as poisonous as pure strychnia.

Bartley suggests that poisonous cream sometimes results from the use in its manufacture of poor or putrid gelatine. This is highly probable, and with the gelatine the germs of putrefaction may be added to the milk.

THE PTOMAINES OF CERTAIN DISEASES.

Anthrax. Anthrax has probably been more thoroughly studied than any other infectious disease. Kausch taught that anthrax has its origin in paralysis of the nerves of respiration. Delafond thought that the cause of the disease was to be found in the influence of the chemical condition of the soil affecting the food of animals and leading to abnormal nutrition. The investigations of Gerlach in 1885 demonstrated the contagious nature of the disease, which was emphasized by Heusinger in 1850, and accepted by Virchow in 1855. However, in 1849 Pollender found numerous rod-like micro-organisms in the blood of animals with the disease. This observation was confirmed by Brauell, who produced the disease in healthy animals by inoculation with matter taken from a pustule on a sick horse. Attempts were made to ridicule the idea that these germs might be the cause of the disease, and it was said that the bodies seen were only fine pieces of fibrine, or blood-crystals. But in 1863 Davaine showed that these little bodies must have some casual relation to the disease, inasmuch as his experiments proved that inoculation of healthy animals with the blood of animals sick with anthrax produced the disease only when the blood contained these organisms. He also demonstrated beyond any question that these bodies are bacteria. The conclusions of this investigator were earnestly combated by many. But Pasteur, Koch, Bollinger, DeBarry, and others studied the morphology and life-history of these organisms, and then came the brilliant results of Pasteur and Koch in securing protection against the disease by the vaccination of healthy animals with the modified germ. Now, the bacillus anthracis is known in every bacteriological laboratory, and by inoculation with it the disease is communicated at will to animals. But here the question arose, How do these bacilli produce anthrax?—and in answer to this question various theories were proposed. Recently Hoffa has given us the true answer by obtaining from pure cultures of the bacillus anthracis a ptomaine which, when injected under the skin of animals, produces the symptoms of the disease, followed by death. The anthrax ptomaine causes at first increased respiration and action of the heart, then the respirations become deep, slow, and irregular. The temperature falls below the normal. The pupils are dilated, and a bloody diarrhœa sets in. On section, the heart is found contracted, the blood dark, and ecchymoses were observed on the pericardium and peritonæum.

Cholera. Although the ptomaine of cholera has not been isolated, there are reasons for believing that the comma bacillus of Koch is one of the most active, chemically, of all known pathogenic micro-organisms. In the first place Bitter has shown that this germ produces in meat-peptone cultures a peptonizing ferment, which remains active after the organism has been destroyed. It was shown that this ferment, like similar chemical ferments, would convert an indefinite amount of gelatine or coagulated albumen into peptone. It was also demonstrated that this ferment was more active in alkaline than in acid solutions, thus proving that it resembles pancreatine more than pepsine. This resemblance to pancreatine was further demonstrated by the fact that certain chemicals, such as sodium carbonate and sodium salicylate increased its activity.

That a diastatic ferment is also produced by the growth of this bacillus was indicated by the development of an acid in nutrient solutions containing starch paste. However, all attempts to isolate the diastatic ferment were unsuccessful. A temperature of 60° destroys or greatly decreases the activity of ptyaline, and this seems to be also true of the diastatic ferment produced by the comma bacillus. But the formation of an acid from the starch presupposes that the starch is first converted into a soluble form.

[It is proper to mention here that Sternberg, independently of the experiments of Bitter, has shown that a number of micro-organisms are capable of producing a peptonizing ferment which remains active after destroying the germs by raising the temperature of the culture to 80°. Sternberg experimented with bacillus prodigiosus, b. indicus, b. pyocyanus, and Finkler-Prior's spirillum. It is probable that all germs which liquefy gelatine do so by the production of this ferment.]

In order to investigate the digestive action of bacteria, Rietsch precipitated peptone cultures of the cholera bacillus, typhoid bacillus, bacillus of consumption, and staphylococcus aureus with alcohol, collected, washed, dried, and weighed the precipitates, and tested their action upon coagulated fibrin. The powders thus obtained from cultures of the typhoid and consumption bacillus had no digestive action in either neutral or alkaline fluids. On the other hand, the precipitates obtained from the cultures of the cholera bacillus and the staphylococcus aureus, the latter less energetically than the former, dissolved the fibrine, and the solutions gave reactions for peptones.

Rietsch believes that the destructive changes observed in the intestines in cholera are due to the action of this peptonizing ferment.

Cantani injected sterilized cultures of the comma bacillus into the peritonæl cavities of small dogs, and observed, after from one quarter to one half hour, the following symptoms: great weakness, tremor of the muscles, drooping of the head, prostration, convulsive contractions of the posterior extremities, repeated vomiting, and cold head and extremities. After two hours these symptoms began to abate, and after twenty-four hours the recovery seemed complete. Control experiments with the same amounts of uninfected beef tea were made. These cultures were three days old when sterilized. Older cultures seemed less poisonous, and a high or prolonged heat in sterilization decreased the toxicity of the fluid. From these facts Cantani concludes that the poisonous principle is volatile. The cultures in bouillon containing peptone were more poisonous than those in the simple bouillon.

Klebs has attempted to answer experimentally the question, In what way does the cholera germ prove harmful? Cultures of the bacillus in fish preparations were acidified, filtered, the filtrate evaporated on the water-bath, the residue taken up with alcohol, and precipitated with platinum chloride. The platinum was removed with hydrogen sulphide, and the crystalline residue obtained on evaporation was dissolved in water and intravenously injected into rabbits. Muscular contractions were induced. Death followed in one animal, which in addition to the above treatment received an injection of a non-sterilized culture. In this case there was observed an extensive calcification of the epithelium of the uriniferous tubules. Klebs believes this change in the kidney to be induced by the chemical poison, and from this standpoint he explains the symptoms of cholera as follows: The cycmosis is a consequence of arterial contraction, the first effect of the poison. The muscular contractions also result from the action of the poison. The serous exudate into the intestines follows upon epithelial necrosis. Anuria and the subsequent severe symptoms appear when the formation and absorption of the poison become greatest.

Hueppe states that the severe symptoms of cholera can be explained only on the supposition that the bacilli produce a chemical poison, and that this poison resembles muscarine in its action.

Bujwid found that on the addition of from five to ten per cent. of hydrochloric acid to bouillon cultures of the cholera bacillus, there was developed after a few minutes a rose-violet coloration which increased during the next half hour, and in a bright light showed a brownish shade. The coloration is more marked if the culture is kept at about 37°. In impure cultures this reaction does not occur. The Finkler-Prior comma bacillus cultures give after a longer time a similar, but more of a brownish, coloration. Cultures of many other bacilli were tried, and failed to give the reaction.

Brieger found that this color is due to an indol derivative. In cholera cultures on albumens he obtained indol by distillation with acetic acid.

Tetanus. In 1884, Nicolaier, by inoculating 140 animals with earth taken from different places produced symptoms of tetanus in 69 of them. In the pus which formed at the point of inoculation he found micrococci and bacilli. Among the latter was one which was somewhat longer and slightly thicker than the bacillus of mouse-septicæmia. In the subcutaneous cellular tissue he found this bacillus alone, but could not detect it in the blood, muscles, or nerves. Heating the soil for an hour rendered the inoculation with it harmless. In culture, Nicolaier was unable to separate this bacillus from other germs, but inoculations with mixed cultures produced tetanus. Inthesame year Carle and Ratone induced tetanus in lower animals by inoculations with matter taken from a pustule on a man just dead from tetanus. In 1886 Rosenbach made successful inoculations on animals with matter taken from a man who had died from tetanus consequent upon gangrene from frozen feet. With bits of skin taken from near the line of demarcation he inoculated two Guinea pigs on the thigh. Tetanic symptoms set in within twelve hours, and one animal died within eighteen and the other within twenty-four hours. The symptoms corresponded exactly with those observed in the "earth tetanus" of Nicolaier, and the same bacillus was found. With mixed cultures of this Rosenbach was also able to cause death by tetanus in animals. Beumer had under observation a man who died from lock-jaw following the sticking of a splinter of wood under his finger-nail. Inoculations of mice and rabbits with some of the dirt found on the wood led to tetanus. The same observer saw a boy die from this disease following an injury to the foot from a sharp piece of stone. White mice inoculated with matter from the wound and those inoculated with dirt taken from the boy's play-ground died of tetanus. The bacillus of Nicolaier was again detected. Giordano reports the case of a man who fell and sustained a complicated fracture of the arm. He remained on the ground for some hours, and when assistance came the muscles and skin were found torn and the wounds filled with dirt. On the fifth day he showed symptoms of tetanus, from which he died on the eighth day. Inoculations and examinations for the bacillus were again successful. Terrari also made successful inoculations with the blood taken during life from a woman with tetanus after an ovariotomy. Hocksinger has confirmed the above-mentioned observations by carefully conducted experiments, the material for which was furnished by a case of tetanus arising from a very slight injury to the hand, the wound being filled with dirt. Finally, Shakespeare has succeeded in inducing tetanus in rabbits by inoculating them with matter taken from the medulla of a horse and of a mule, both of which had died from traumatic tetanus. These uniform observations leave no room to doubt that tetanus is, often at least, due to a germ which exists in many places in the soil, and that the disease is transmissible by inoculation.

The question now arises, How do these germs induce tetanus? Brieger has given us an answer, inasmuch as he has obtained in cultures of the germ of Nicolaier and Rosenbach four poisonous substances. The first, tetanine, which rapidly decomposes in acid solutions, but is stable in alkaline solutions, produces tetanus in mice when injected in quantities of only a few milligrams. The second, tetanotoxin, produces first tremor, then paralysis followed by severe convulsions. The third, to which no name has been given, causes tetanus accompanied by free flow of the saliva and tears. The fourth, spasmotoxin, induces heavy clonic and tonic convulsions.

It may be that all these will be found to be modifications or impure forms of the same poison. Brieger states that the exact character and relative amounts of the poisons formed vary with the nutrient in which the germ grows. With this evidence before us we feel justified in saying that the tetanus germ produces its poisonous effects by elaborating one or more ptomaines in the body of the animal into which it has been introduced.

Typhoid Fever. In 1880 Eberth discovered a bacillus, which he believed to be the cause of typhoid fever, and this belief has been confirmed. The fever with its characteristic lesions has been produced in animals by inoculation with the germ. Gaffky was the first to inoculate animals with pure cultures of the bacillus of Eberth, but his results were wholly negative. Fränkel and Simmonds produced fatal results, and observed after death enlargement of the spleen, mesenteric glands and intestinal follicles. Moreover, microscopical examination of the spleen showed the same conditions which are found in the spleens of persons dead of typhoid fever. Seitz, using Koch's cholera method of inoculation, produced with the typhoid bacillus acute enteritis with ulceration and enlargement of the spleen. Vaughan and Novy, using the germ which they had obtained from drinking-water, produced in a cat vomiting, great muscular weakness or prostration, primary depression of temperature four degrees below the normal, and secondary elevation of temperature three degrees above the normal. Section showed ulceration in both the small intestine and ascending colon. Results of this kind leave no doubt that the bacillus first described by Eberth is the true germ of typhoid fever.

In 1885 Brieger obtained from pure cultures of the typhoid bacillus a toxic ptomaine, which produced in Guinea pigs a slight flow of the saliva, frequency of respiration, dilatation of the pupils, profuse diarrhœa, paralysis, and death within from twenty-four to forty-eight hours. Post-mortem examination showed the heart in systole, the lungs hyperæmic, and the intestines contracted and pale. This substance Brieger considers the special poison of typhoid fever, and calls it typhotoxine. However, he obtained with this poison no elevation of temperature.

In 1887 Vaughan and Novy obtained from pure cultures of the typhoid bacillus, found in drinking-water, which had been the supply for many persons who had the disease, an extract which, when injected under the skin of cats, caused an elevation in the temperature of from two to four and one half degrees above the normal.

In one sick of typhoid fever the bacillus grows and multiplies in the intestines and forms the poison, the absorption of which is followed by the rise in temperature and other symptoms of the disease. The lesions in the intestines are probably due to the bacteria themselves, or possibly to the local irritating effect of the ptomaine.

Cholera Infantum. There are many reasons for believing that this disease is sometimes at least due to poisoning by tyrotoxicon. The fact that infants nourished exclusively from the mother's breast are almost wholly exempt from the disease, strengthens this belief. We have already seen how quickly and abundantly this poison appears in milk when the conditions are favorable. Moreover, the symptoms induced by the poison agree with those observed in the disease, and the post-mortem changes are identical. Then cholera infantum is a disease of the summer months, when decomposition in milk goes on most readily. It is most common in cities, and among classes who cannot obtain fresh milk or have not the means necessary to keep it fresh. Moreover, it is often allowed to stand in a foul atmosphere, and all know that milk readily takes up disagreeable odors. Even in the country insufficient attention is given to the care of milk. Cows stand and are milked in filthy barns. The udders are generally not washed before the milking, and the vessels for the milk are frequently not as clean as they should be. There can be no doubt that greater attention to the milk used by infants would result in saving many thousands of lives annually.

HOW TO AVOID BEING POISONED WITH PTOMAINES.

To one who has read the preceding pages, it will be evident that the only way in which poisoning by ptomaines can be avoided consists in preventing their formation. The majority of poisonous ptomaines are not destroyed at the temperature to which food is raised in cooking. The addition of the most powerful disinfectants, such as mercuric chloride, to solutions of ptomaines does not destroy them. Panum boiled his putrid poison for eleven hours without destroying its virulence, and Brieger uses mercuric chloride in the separation of many of his ptomaines. However, the formation of ptomaines may be prevented by the destruction of the germs which produce them, and the methods of accomplishing this have been pointed out in the preceding portions of this report. In exceptional cases, as in milk containing tyrotoxicon, boiling the milk will destroy both the germ and the ptomaine, but boiling does not destroy the active principle of poisonous mussel, nor the poison of typhoid fever.

METHODS OF PRACTICAL DISINFECTION.

By GEORGE H. ROHÉ, M.D.

The scientific determination of the germicide value of various agents used for purposes of disinfection is so recent that practical methods of applying them have not yet been developed to any great degree. Disinfection by means of steam has received most attention during the last two years, and a number of apparatuses have been devised for the efficient and economical application of this agent. As a supplement to the paper by the writer in the last annual report of the Committee on Disinfectants, a description of some of these devices will be given in the following pages.

By referring to the report of the committee for 1886 it will be seen that the most efficient devices for disinfection by heat consist of those in which steam under pressure, or passing through the articles to be disinfected in a free current (strömender Wasserdampf), are the most efficient. The opinion was expressed, based upon practical experience, that steam under pressure, in order to raise its temperature (or possibly to increase its penetrating power), was the best form in which to employ the agent. This opinion was justified by European experience, and especially by the personal observations of Drs. S. H. Durgin and Joseph Holt, members of the committee, to whose reports attention is directed (*vide supra et infra*).

Recent experience abroad seems to indicate, however, that an apparatus in which the steam is not confined under pressure may be equally efficient, more easily managed, and much more economical. The simple disinfecting stove of Gibier (*vide* Report for 1886), as well as the disinfector of Henneberg (*vide infra*), seem to meet all the requirements of an efficient, economical, and safe disinfecting apparatus. During the recent epidemic of sweating sickness in France, Gibier's stove is said to have been used for purposes of disinfecting clothing and bedding with entire success.

For small communities, or for county and township health authorities, either of the two apparatuses above mentioned, or a modification of them, would seem to best subserve the requirements of an efficient apparatus. A disinfecting stove large enough to disinfect the furnishings of an ordinary sized bed should not cost more than one hundred dollars. If made in sections like Gibier's stove, it could be transported in any sort of vehicle, and, if necessary, used in the infected room itself. By a little ingenuity the wagon upon which the apparatus is transported might be made to serve as the disinfecting chamber.

The temperature in the interior of the chamber should be maintained at 100° C. (212° F.), or above for ten to fifteen minutes in order to make sure of the destruction of all infectious material. Every apparatus should be tested for its disinfecting power before being placed in actual service. It would seem that all machines of the same size and pattern should be equally efficient, but practical experience shows that no safe prediction of the "functioning capacity" of any apparatus can be given before a thorough test has been made.

HENNEBERG'S DISINFECTOR.

(Zeitschrift f. Hygiene, Bd. I, Hft. 2.)

This apparatus consists of two superimposed cylinders, of which the upper (Fig. 1, *a*) is intended to receive the articles to be disinfected, while the lower (*g*) is the boiler in which the steam is generated. The upper cylinder has double walls and a cover of tin. The interspace between the outer and inner walls is filled with some non-conducting material. The lower end of the cylinder is open, and rests in a groove which forms the upper end of the boiler. When this groove is filled with water, the joint between the receptacle and boiler is perfectly tight and does not permit the escape of steam. The walls of the boiler are corrugated to increase the heating surface. A perforated iron plate (*i*) forms the lid of the boiler. The fire, heating the upper portion of the iron sides of the boiler, prevents condensation of the steam first disengaged, and at the same time aids in drying the materials to be disinfected, and expelling the air in the upper cylinder before the latter becomes filled with steam. The steam evolved at the surface of the water is also superheated in passing over the heated surfaces of the sides of the boiler.

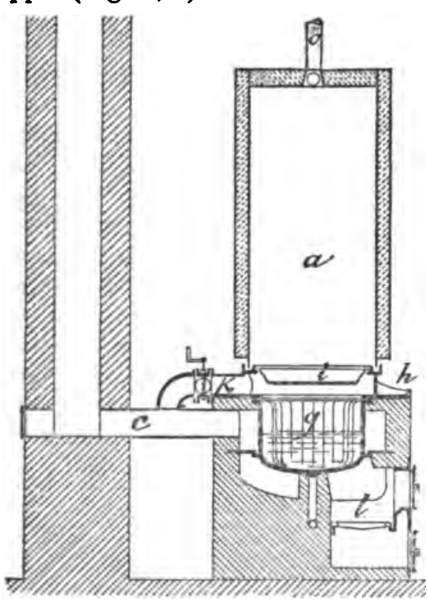


Fig. 1.

The steam is not confined under pressure, but is allowed to escape through the duct (*o*) which may lead directly to the open air or into a chimney. At the lower end of the escape pipe a thermometer is attached which registers the temperature attained in the chamber.

To charge the disinfector, the upper cylinder is raised a short distance by means of an ingenious mechanism, until clear of the groove in which its lower end rests. The cylinder is then turned on its side until it rests almost horizontally. It is fixed in this position until the articles to be disinfected have been placed in it, enclosed in a wire basket. The cylinder is then again turned upright, sunk into its proper groove, and the fire started. After the steam has passsd a sufficient length of time to make sure of thorough disinfection, a valve (*k*) is opened which leads into the chimney. The strong draught not only causes the steam now produced to pass into the chimney, but also draws out that in the cylinder. In a few minutes the contents of the disinfector are entirely dry, and can then be removed by turning the cylinder on its side, as in the process of charging.

The other, non-essential, parts of the apparatus are pipes for filling and emptying the boiler, and for removing the condensed vapor. The estimated expense of running this apparatus, including interest on capital invested, is 8.90 marks (about $2.10) per day for a machine of sufficient size to disinfect 7.35 cubic meters (about 250 cubic feet) of materials.

The disinfecting power of the apparatus has been tested by Dr. E. Esmarch, and found to meet all requirements.

W. Budenberg, a manufacturer of disinfecting apparatus in Dortmund, exhibited a model of a new disinfector at the last meeting of the German Association of Naturalists and Physicians. No description was published, but the following points are of some interest. The steam is under slight pressure. The apparatus is easily transportable, and can be readily connected to any steam generator. After the steam begins to enter the disinfecting chamber, a temperature of 105° C. (221° F.) is secured in five minutes, and after five minutes longer the temperature in the interior of large packages is raised to 102°–103° C. (216°–218° F.). A bacteriological test showed complete destruction of spores. An apparatus 2.25 meters (7 ft. 4 in.) long, nine tenths of a meter (35 inches) broad, and 1.50 meters (4 ft. 11 in.) high, can be made for 400 marks ($100).

COST OF DISINFECTION IN BERLIN.

H. Merke gives in the *Deutsche Vierteljahresschrift für Öffentliche Gesundheitspflege*, Bd. 19, Hft. 2, some interesting details concerning the management and expense of the public disinfecting station in Berlin. The station was opened for the use of the public on November 1, 1886; and in the two months, November and December, 1886, 327 persons made use of the apparatus for purposes of disinfection. The materials to be disinfected occupied a total space of 722.4 cubic metres (25,284 cubic feet). In 298 of the 327 applications, the disease for which disinfection was requested was ascertained. In the remaining 29 cases, either the diagnosis could not be learned, or the materials disinfected consisted of rags, furniture, or trimmings of sleeping-cars, or articles from places suspected of being infected. In these cases the disease to which the articles were supposed to have been exposed was generally cholera.

Disinfection was practised in the 298 cases in which the disease was known,—

After diphtheria in 122 cases,	or 40.93 per cent.
After suspected cholera in 23 cases,	or 7.72 per cent.
After consumption in 47 cases,	or 15.77 per cent.
After scarlet fever in 34 cases,	or 11.40 per cent.
After typhoid fever in 11 cases,	or 3.60 per cent.
After syphilis, scabies, and other skin diseases in 61 cases,	or 20.47 per cent.

Curiously, the larger proportion of those desiring disinfection belonged to the better classes.

Of the applications,	28.6 per cent. were from merchants.
	13.4 per cent. were from mechanics.
	11.4 per cent. were from professional men.
	9.0 per cent. were from officials.
	5.7 per cent. were from manufacturers.
	4.0 per cent. were from rentiers.
	3.0 per cent. were from officers.
	5.7 per cent. were from laborers.
	19.3 per cent. were from restaurateurs, etc.

The charges for disinfection are four marks ($1.00) per cubic meter, including bringing and returning the articles. Where rags are disinfected, the charges are one mark (24 cents) per 100 pounds, exclusive of transportation to and from the disinfecting establishment.

The materials disinfected consisted of 12,935 different articles, classified as follows:

Clothing	1,710 pieces.
Body linen	5,351 pieces.
Feather beds	1,940 pieces.
Mattresses and bolsters	1,084 pieces.
Straw sacks	20 pieces.
Furniture	101 pieces.
Other articles, such as carpets, sacks of rags, curtains, spreads, etc.,	2,729 pieces.

NEW ELECTRICAL REGISTERING THERMOMETER.

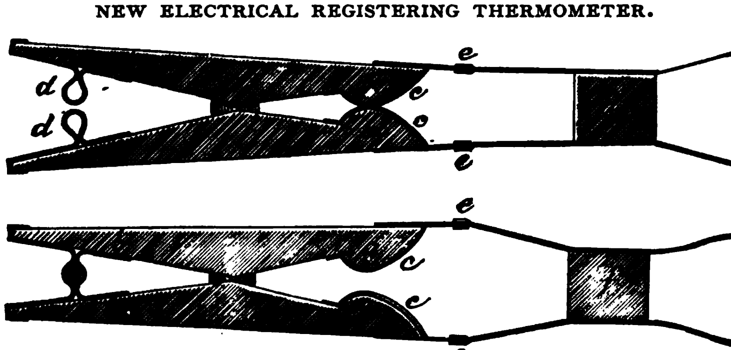


Fig. 2.

Merke has also devised a new electrical contact thermometer for use in determining the temperature of the interior of the disinfecting apparatus. It is constructed as follows: An ordinary wooden spring clamp

(Fig. 2) is faced at the clamping end (*a a*) with metal strips (*c c*). The other end (*b b*) is armed with small strips of metal with two equal-sized openings or rings (*d d*) upon each arm of the clamp. In pressing together this end of the clamp the rings should exactly dovetail into each other. Through the short tube thus formed by the rings, a small rod of fusible metal, made by melting together 8 parts of bismuth, 3 parts of lead, and 3 parts of tin, is inserted. This constitutes the thermometer. To the metal facings of the other end of the clamp conducting wires are attached, which connect it with an electrical alarm bell. The wires are kept from getting entangled in the clamp by a square block of wood (*f*), to which the wires are attached. The whole apparatus is now enclosed in a hollow wooden capsule, with numerous openings in its sides to permit access of steam, and placed in the centre of the package of articles to be disinfected. When the temperature in the centre of the package, or around the thermometer, reaches 100° C. (212° F.), the metal rod melts, the spring comes into play and closes the clamp. The two metal surfaces (*c c*) coming in contact close the circuit, and the electric bell rings to indicate the temperature. This thermometer is cheap, and not liable to get out of order. By placing a number of them in different parts of the disinfecting apparatus, and connecting each one with an electric circuit, the exact time at which the temperature of 100° C. is reached in each portion of the apparatus can be exactly determined.

This contact thermometer can also be used without the electric circuit. If introduced with the articles to be disinfected, and the rods are found to have been melted after exposure, it indicates that the temperature of 100° C. has been reached.

DISINFECTION BY CHEMICAL AGENTS.

In the latest instructions issued by the Berlin health authorities, all disinfectants are discarded except heat and carbolic acid. The latter is used in five per cent. solution for fecal and urinary excreta, expectoration, nasal discharges, etc., and in two per cent. solution for articles of clothing, bedding, and wiping cloths used about the sick-room. These articles are directed to be soaked for twenty-four hours in the two per cent. carbolic acid solution, then boiled for half an hour, and afterward washed in water with half an ounce of soft soap to the gallon. Leather articles (boots, shoes, etc.) are washed in five per cent. solution of carbolic acid. Articles which cannot be washed are sent to the public disinfecting station for disinfection; or, if of little value, are destroyed by burning. To the great surprise of many sanitarians, bichloride of mercury and chloride of lime are not mentioned in the Berlin instructions.

In Boston, mercuric bichloride is generally used as a disinfectant. Dr. S. H. Durgin, a member of the committee on disinfectants and chairman of the board of health of that city, uses a solution of the strength of one part in 3 : 4000 for spraying the streets. A bag of the salt is hung inside of the street watering-carts, and as it dissolves the water is impregnated with the disinfectant. The rapidity of solution of the salt is regulated by the thickness of the wraps placed around it. The capacity of the water-tank and the number of times it is filled during the day, together with the weight of the mercuric bichloride, give the data for finding the strength of the solution.

In Chicago, the solution of the bichloride is freely used in yards, cellars, gutters, etc. Watering-pots with fine sprinklers are used to scatter it over the surfaces where it is required.

Guttmann and Merke have studied the methods of disinfecting apartments after infection by infectious diseases. Many experiments were made, using a five per cent. solution of carbolic acid and a 1 : 1000 solution of mercuric bichloride. The latter was found to be the most efficient, and always trustworthy. The method decided upon as the best is the following: The floor of the room is first saturated with a solution of mercuric bichloride (1 : 1000), and then a spray of the same solution directed against the walls and ceiling until these are thoroughly moistened, which is manifested by the formation of small drops. The floor is then mopped dry, and afterward washed up with clean water. Finally, the walls and ceiling are again sprayed with a one per cent. solution of soda. This causes the formation of oxychloride of mercury, which is brushed off when dry. By this subsequent treatment, all danger of mercurialization of the occupants of the room is removed. The proceeding seems to be rational, cheap, and more efficient than any other hitherto used.

Heræus and Kreibohm experimented with volatilized mercuric bichloride and sulphur in combination (following one fumigation by the other), but failed to secure disinfection of the walls and contents of the room. The method seems to be untrustworthy, and to have nothing in its favor.

The method of disinfecting the bilge of ships has been studied by Koch and Gaffky. A solution of mercuric bichloride was employed, using a sufficient quantity to produce the copper reaction when thoroughly mixed with the bilge water. At the end of eighteen hours the disinfection was complete, as shown by bacteriological tests. The solution is poured into the bilge, and a thorough mixing secured by pumping. No injury results to the ship or her occupants from this treatment. The pump used becomes "infected" with mercury, however, and should not be employed afterward for pumping water for drinking or domestic purposes. This caution, which is given by the authors, seems hardly necessary, as no one would think of drinking bilge water under any circumstances, and the bilge pump is generally a fixture on vessels.

The disinfection of stables is an important part of the prophylaxis of the contagious diseases of animals. Dr. Hugo Plaut, of Leipzig, recommends the following procedure: A wooden structure equally divided into two apartments by a partition is to be built before the main stable door. A door is placed in the partition wall, allowing communication between the two apartments, and one door is to open externally. The outer apartment serves as a receptacle for the clothing worn outside of the stable, while the inner one contains the stable dress. When the attendant enters, he undresses in the outer apartment, then passes through the communicating door into the inner apartment, where he dresses in the stable clothes. When he leaves the stable, he removes his stable dress in the inner apartment, washes his hands and feet, steps through the door into the outer apartment, and resumes his ordinary clothing.

The air of the interior of the stables should be kept saturated with moisture, in order to lessen the mobility of disease germs. When a stable is infected, all animals in it are to be removed, and kept under observation. Before removal they are to be well cleaned, and their hoofs washed in a disinfectant solution.

The stables are then cleaned, and all floors, walls, and partitions scrubbed with water, after which they are to be sprayed with a solution of mercuric bichloride (1 : 500). After several hours' exposure to the action of the bichloride, the excess of this salt may be rendered innocuous by spraying all surfaces with a saturated sulphuretted hydrogen water, diluted with ten parts of water. A simple lime wash would probably answer equally well.

Laplace has found that by adding an acid to a solution of mercuric bichloride or carbolic acid the germicide power of the latter is much increased. A two per cent. solution of carbolic acid, to which one half per cent. of hydrochloric acid has been added, will destroy the spores of anthrax, while without the addition of the hydrochloric acid the carbolic acid is inefficient for the destruction of these spores in five per cent. solution. Tartaric acid acts in a similar manner when added to the disinfectant.

THE QUARANTINE SYSTEM OF LOUISIANA.—METHODS OF DISINFECTION PRACTISED.

BY JOSEPH HOLT, M. D., PRESIDENT BOARD OF HEALTH, STATE OF LOUISIANA.

In describing the methods of disinfection used in the quarantine of Louisiana, it is necessary first to examine the system itself synthetically.

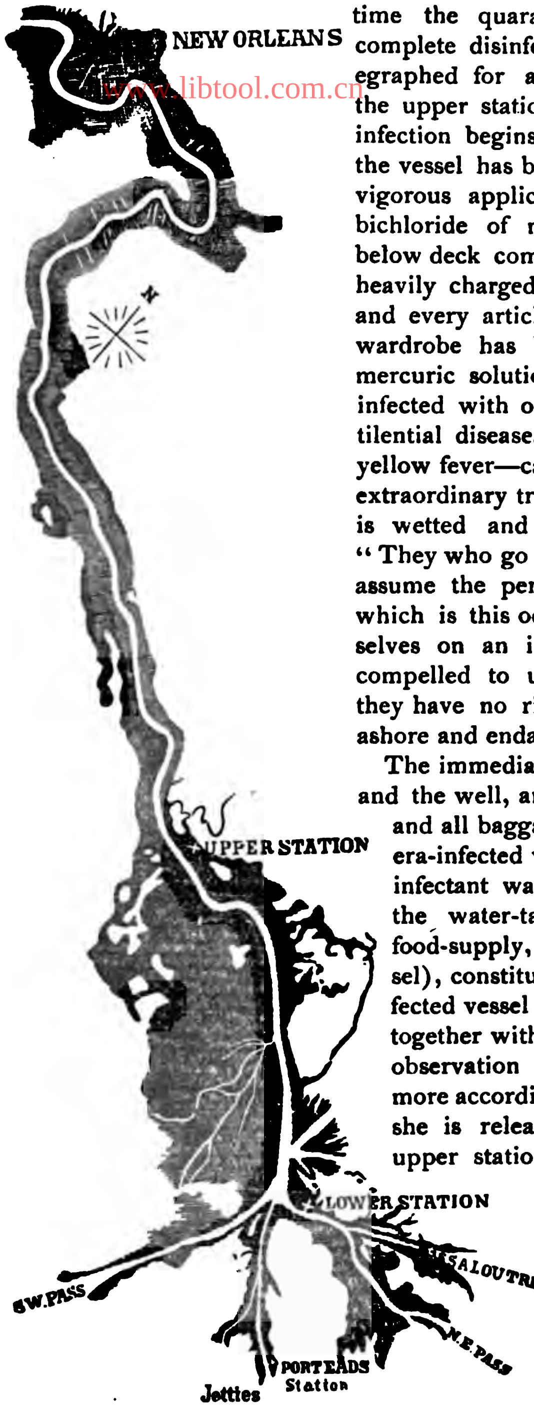
There are three maritime approaches to New Orleans,—the Mississippi river, which is the central and main avenue; the Rigolets, thirty miles to the eastward, a narrow strait connecting Lake Pontchartrain with Lake Borgne and the Gulf of Mexico; and the Atchafalaya river near its debouchment into the bay of that name and Mexican Gulf, eighty-two miles to the westward.

On account of the character of shipping coming through the two lateral approaches, "light in tonnage and mostly from domestic ports," the Rigolets and Atchafalaya are completely closed by a proclamation of forty days' detention against all vessels from quarantined ports, compelling such to seek the Mississippi as the only available route to New Orleans. This is done in order to avoid the immense expense of keeping up three completely equipped stations, and to concentrate at a single point the fight against infection.

The quarantine in the Mississippi is a system composed of three stations, the first of which is an advance guard inspection station, situated at Port Eads, one hundred and ten miles below New Orleans, where the waters of South Pass are jettied into the Gulf.

When an inward bound vessel comes into the offing, she is immediately boarded by a thoroughly skilled medical officer, and a careful inspection is made of her sanitary record and present condition. If from a non-quarantined port, and all is well, she is given pratique and goes on to the city. If from a quarantined port, but presenting a clean health-record of voyage, and no evidence of sickness of a dangerous or doubtful character, she proceeds to the upper quarantine station, situated on the left bank of the river, seventy miles below the city, where she is subjected to a full course of sanitary treatment, and is detained such length of time, not exceeding five days (except in rare instances, wherein further observation may be deemed necessary), as the board of health may provide.

If, upon inspection of a vessel entering the river, she is found to be foul,—that is, showing positive or suspicious evidences of infection, either in a person then ill or in a foul health-record of voyage,—she is at once remanded to the lower station, located on Pass à L'Outre, an unused outlet of the Mississippi, one hundred and three miles below the city. The sick, if any, are at once removed to the hospital, where every provision has been made for them. The vessel, with the well on board, is dropped down-stream a few hundred yards and anchored. In the mean-

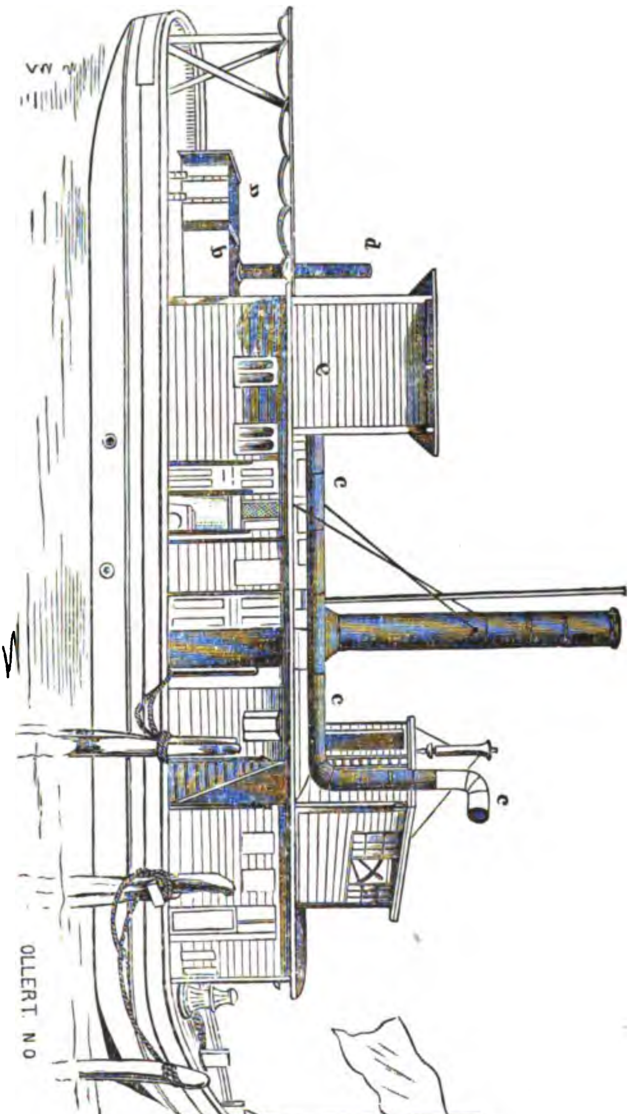


QUARANTINE STATIONS

time the quarantine tug-boat, with its complete disinfecting outfit, has been telegraphed for and speedily arrives from the upper station, when the work of disinfection begins, and does not cease until the vessel has been subjected to the most vigorous application of the solution of bichloride of mercury, her atmosphere below deck completely replaced with one heavily charged with sulphurous oxide, and every article of baggage and ship's wardrobe has been saturated with the mercuric solution. A ship known to be infected with one of the three great pestilential diseases—small-pox, cholera, or yellow fever—can stand and must endure extraordinary treatment, even if clothing is wetted and some articles damaged. "They who go down to the sea in ships" assume the perils of the voyage, among which is this occurrence of finding themselves on an infected vessel and being compelled to undergo a cleansing; for they have no right to bring their perils ashore and endanger others.

The immediate segregation of the sick and the well, and disinfection of the ship and all baggage (in the case of a cholera-infected vessel extended to the disinfectant washing-out and refilling of the water-tanks, destruction of the food-supply, and revictualling the vessel), constitute the treatment of an infected vessel at this station. The ship, together with all on board, is held for observation a period of ten days or more according to circumstances, when she is released and proceeds to the upper station, where the processes of sanitary treatment are repeated, with the addition of the use of moist heat applied to baggage, ship's apparel, etc. (which latter process will be described hereafter), and the vessel is then allowed to proceed to the city.

This course of treatment at the upper station, while probably unnecessary, is enforced purely as an extraordinary precaution. Inasmuch as infected ships are the exceptions, but inasmuch also as the board of health will take no risk in the case of vessels from known infected or suspected ports, regardless of bills of health, the vast majority of vessels are treated at the upper station. Arriving at this station the vessel is brought alongside the wharf. All on board, officers, crew, and passengers, are at once sent ashore, where they find ample accommodation in commodious shelter provided for their entertainment during the time occupied in the sanitary treatment of the ship and all baggage. As soon as this is completed they are permitted to return aboard ship, where they remain under observation during the prescribed period, determined by the remoteness or nearness of the port against which these precautions are taken. The object of this brief detention for observation, after the sanitary treat-



(PLATE I.) TUG-BOAT WITH FUMIGATING APPARATUS.

a. Furnace. *b.* Reservoir for reception of gas. *c.* Discharge pipe conveying gas to ship's hold. *d.* Escape for gas when fan is at rest and sulphur is burning; closed by a valve when fan is in motion. *e.* House protecting from weather the machinery for driving fan and containing accelerating gearing.

ment of the vessel has been completed, is to allow for a probable outbreak of an infectious disease already incubating in the system of any one on board.

As an essential part of the service, there is a tug-boat of sufficient power to move a sailing vessel to or from the wharf. In addition to this requirement, this boat is equipped with a complete outfit for generating and applying germicidal gas for displacement of the entire atmosphere within the ship, transported, perhaps, directly from some infected port. In the hold of this tug is constructed a wooden tank of 2,000 gallons' capacity, to hold the bichloride of mercury solution for the treatment of vessels in the lower quarantine, as described. This tank is furnished with a steam pump (made of iron on account of the greater resistance of that metal to amalgamation) supplied with three-quarter-inch rubber hose. (See plate 1.)

In the sanitary treatment of a vessel in quarantine there are three processes of disinfection currently applied.

APPLICATION OF BICHLORIDE OF MERCURY.

The first is the wetting of all available surfaces of the vessel, excepting cargo, but including bilge, ballast, hold, saloons, forecastle, decks, etc., with a solution of the bichloride of mercury, made soluble by an equal weight of muriate of ammonia, in the proportion of 1 : 1,000 of water.

The idea of using this agent as a disinfectant in "municipal and maritime sanitation" suggested itself to me while reading the chapter on "Wound Disinfection—Antiseptics," in the volume entitled "The Treatment of Wounds," by Lewis S. Pilcher, M. D., containing an account of the experiments of Dr. George M. Sternberg, with a table of chemical agents and their relative germicidal strengths (at the head of which stands the bichloride of mercury), and also a table of the results obtained by Koch in Berlin, 1881, and by Schede and Kümmel in the Hamburg General Hospital in the same year.

The board of health immediately endorsed the idea, and ordered the adoption of the bichloride of mercury, as explained in the following letter:

NEW ORLEANS, July 17, 1884.

Dr. Thomas Y. Aby, Resident Physician Mississippi Quarantine Station:

DEAR SIR: Because of the signal failure of carbolic acid as a disinfectant and prophylactic agent after a trial more fair and extended than has ever been allowed any other; because of its excessively offensive odor and the oppressive and sometimes mischievous effects of its fumes; because of the low order of the commercial acid as a germicide and the considerable expense involved in its use,—you are hereby requested to discontinue its application.

In its stead I have ordered to your station two packages of bichloride of mercury and muriate of ammonia, the latter to act as a solvent.

In its preparation for use, take five and a half ounces of each and dissolve in a half gallon of water; add this to forty gallons of water in a cask. I have sent three large watering-pots, with a fine rose or spray. Your men can quickly wet down a ballast pile and all available surfaces of a ship, and it needs no repetition when once thoroughly applied.

The advantages of this agent are briefly these: The mercuric bichloride stands pre-eminently above all chemicals as a universal germicide. Not only are definite organisms immediately destroyed, but all protoplasms and albuminoids are devitalized by it. It is efficient to accomplish this work when applied in a solution so weak as not to be recognized except by chemical re-agents. It is devoid of color or smell. It does not poison the air by vaporizing, but adheres in an innocuous form to the surfaces upon which originally applied. Its cost is about one eighth of that of carbolic acid.

I feel that this transition is quite as much of a relief to you, my dear doctor, as to the afflicted people on shipboard, who must surely suffer severely from the stifling fumes emanating from carbolic acid applied to surfaces heated by a July sun, as the people of this city can testify to their terrible cost!

The position of persons confined on shipboard under such circumstances, particularly in the instance of women and children as passengers, as related by yourself, must at times be most distressing. The board of health heartily joins with you in the satisfaction and sense of relief afforded by this change, which is an important step in the great work of humanizing our quarantine.

I remain, with great esteem, yours very truly,

(Signed) JOSEPH HOLT, M. D.,

President Board of Health, State of Louisiana.

The bold adoption of this poisonous agent in domestic, municipal, and maritime sanitation at once called forth a flood of most gloomy forebodings of fearful effects upon the human system.

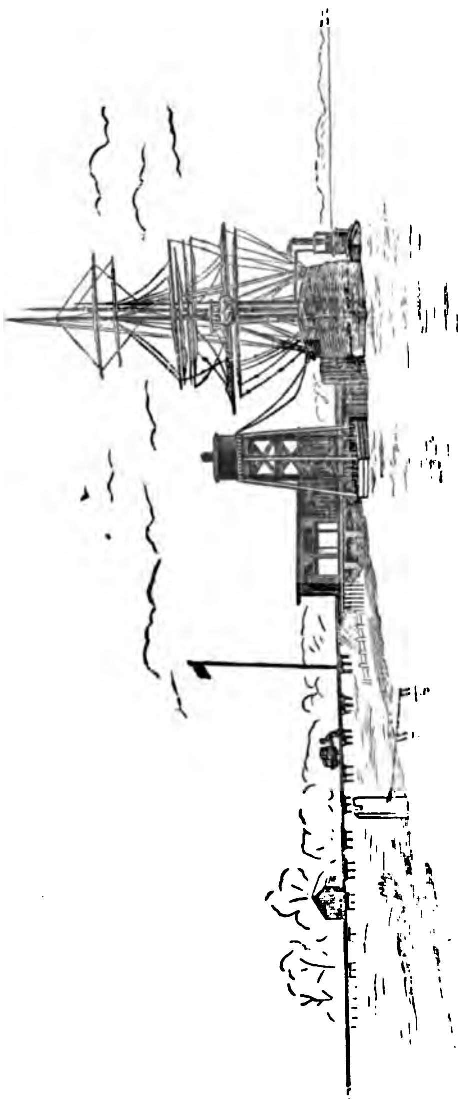
Our declaration at that time is confirmed by an experience of four years' trial on an immense scale, that our standard solution, as used in sanitation, is absolutely harmless to persons unless swallowed, it matters not how extensive or constant the contact. The only objection we have yet discovered is that certain articles, particularly blankets and flannels, treated by the solution, sometimes becomes spotted, and colors liable to "run" when wetted, suffer; but unlike all other chemical agents applied as disinfectants, the textile itself is in nowise injured.

Recapitulating its merits: Being colorless, stainless (except as stated), odorless, not injurious to fabrics, perfectly safe to handle for months at a time, easily applied, and exceedingly cheap, it is impossible to imagine a substance more efficient, and as free from objection in practice. It is indeed the key unlocking difficulties otherwise insurmountable, and rendering practicable in municipal and maritime sanitary work the efficient execution of scientific requirement.

The amalgamating powers of the mercuric salt presented many serious obstacles in the contrivance of an apparatus for its application, all of which have been overcome without sacrificing simplicity, efficiency, or economy.

Immediately adjoining the quarantine wharf and near its water edge is constructed a heavy framework of piles, each twelve inches in diameter. This structure has an ample base, is pyramidal, and forty-five feet in height above mean level of the river. On top of this is a circular wrought iron tank, capable of holding eight thousand gallons of the mercuric solution. (See plate.)

In order to prevent contact of the latter with the iron, the interior of the tank is painted over with three coats of red lead and two of paraffine paint. The top of the tank is closed by a secure cover to prevent access of light to the solution. This, together with the general exterior, is painted black. On the top of this cover is placed centrally a sixty gallon wooden cask, in which is dissolved the mercuric salt, which is then emptied into the tank through a wooden faucet. Seventy pounds are used for one charge.



(PLATE 2.)

View of disinfecting wharf, showing tug fumigating vessel; elevated tank containing 8,000 gallons of bichloride of mercury solution, 3 leads of hose from tank to ship. Gangway leading to building containing super-heating chamber.

In the tank near the lower edge are three heavy galvanized iron faucets, to each of which is screwed a lead of three-quarter-inch, four-ply rubber hose, the farther ends of which lie on the wharf. These are lengthened by additional sections to reach any part of the largest vessel. To the far extremity of each hose is attached a short, wide nozzle, provided with a stop-cock. During disinfection all three are simultaneously used, fore, aft, and amidship. For spraying we use a perforated, heavy black-tin rose, four inches across the face, similar to an ordinary watering-pot spray. These are made with a shank about six inches long, to fit snugly into the open end of the pipe. On a single vessel we averaged fifteen hundred gallons of solution, but often used three thousand. The process requires from thirty minutes to two hours, according to circumstances.

SULPHUROUS OXIDE FUMIGATION.

As soon as the men have completed the work of "bichloriding" below decks, the fumigating pipe is then extended from the quarantine tugboat lying alongside. (See plates 1 and 2.) It is lengthened by sections, being fitted together like stovepipe, and conducted down a convenient hatchway to the bottom of the hole or as near the kelson as possible, preparatory to the fumigation of the entire vessel (and cargo if any) with sulphurous oxide. In the case of a sailing ship, one hatchway gives access of the sulphurous gas to the entire hold; but in large steamers the hold is subdivided by bulkheads into two or more distinct compartments, which must be treated separately.

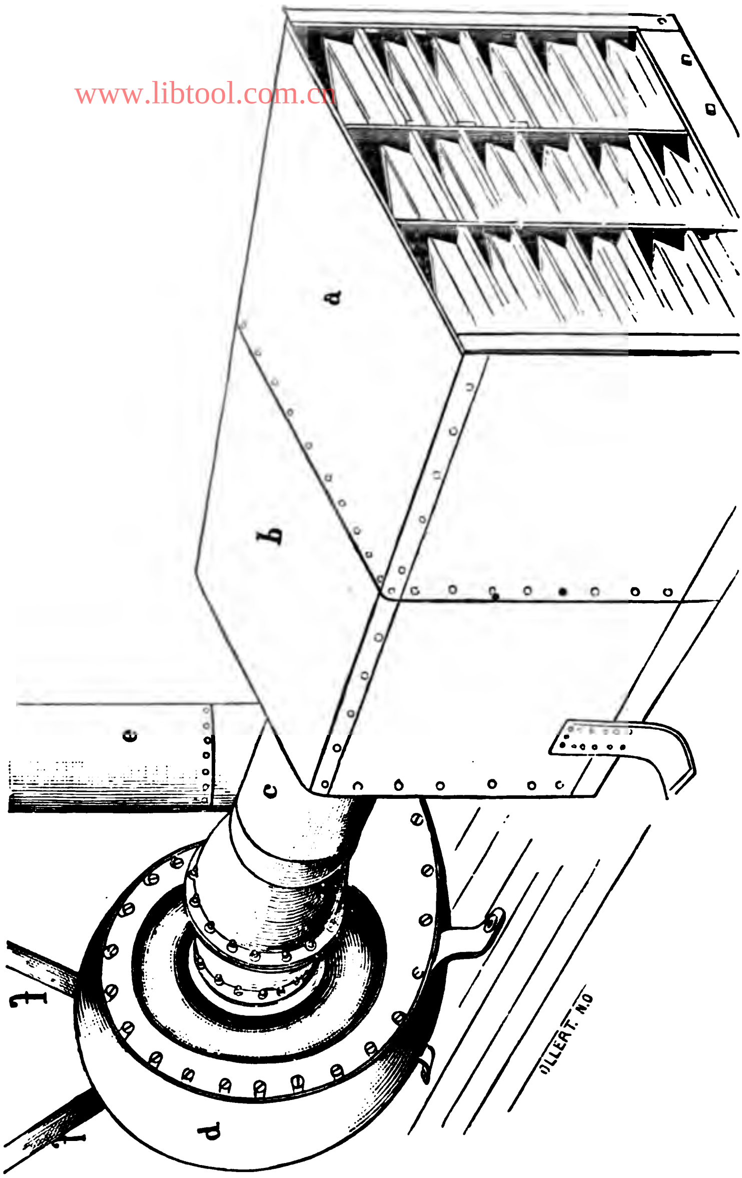
In undergoing treatment the cargo is not disturbed except when the removal of bags of coffee is required to permit the passage of the fumigating pipe, which is twelve inches in diameter, down into the dunnage at the bottom of the cargo.

I have given explicit instructions to coffee importers, whereby the expense of removing bags to make this well or shaft through the cargo may be avoided. It is necessary to have an open, frame-work shaft, allowing a clear inside space of fifteen inches, placed in the centre of the main hatch in a sailing vessel, or in the centre of each hatch in a steamship having bulkhead compartments. The frame-work of this shaft is set before loading, and should be cut flush with the top of the cargo. This simple arrangement avoids all handling and delay.

When the connections are made and the fumigating pipe is arranged, the fan on the tugboat is started and the process of displacing with sulphurous oxide the entire atmosphere within the ship begins. The length of time required to complete the fumigation varies from thirty minutes to three hours, according to size of vessel, number of compartments, etc. The quantity of commercial roll sulphur used varies from one hundred to seven hundred pounds per vessel.

The apparatus invented for rapidly evolving and supplying the germicidal gas consists in a battery of eighteen furnaces, each supplied with a pan to contain the sulphur during combustion. These furnaces open into a common reservoir, to the farther end of which is connected a powerful exhaust fan (Sturtevant's No. 29). (See Plates 3 and 4.)

The gas drawn by the fan is driven into a twelve-inch galvanized iron pipe, through which it is conducted over the side and down the hatchway of the vessel into the bottom of the hold. The gas, as it is driven into the vessel, is quite hot, but would extinguish rather than create fire. The outflow should not impinge directly against bags of coffee or bales of textiles, if it can be avoided, in order to prevent formation of sulphuric acid and some slight injury therefrom at that point. In treating coffee, and for convenience in some other instances, the vertical lead of pipe into the hold is made of abestos cloth, closely and heavily woven for our purpose. Every opening is closely battened during the process, and remains so for at least eight hours after it is discontinued.



(PLATE 3.) FUMIGATING FURNACE, RESERVOIR, AND EXHAUST FAN.

a. Furnace of cast iron, ½ inch thick; 3 feet wide, 3 feet long, 2 feet high. Upper and lower plates grooved for reception of partitions, and sides shouldered for same, as shown in Plate 4.

b. Reservoir, No. 10 iron, same dimensions as furnace.

c. Exhaust pipe connecting reservoir and fan.

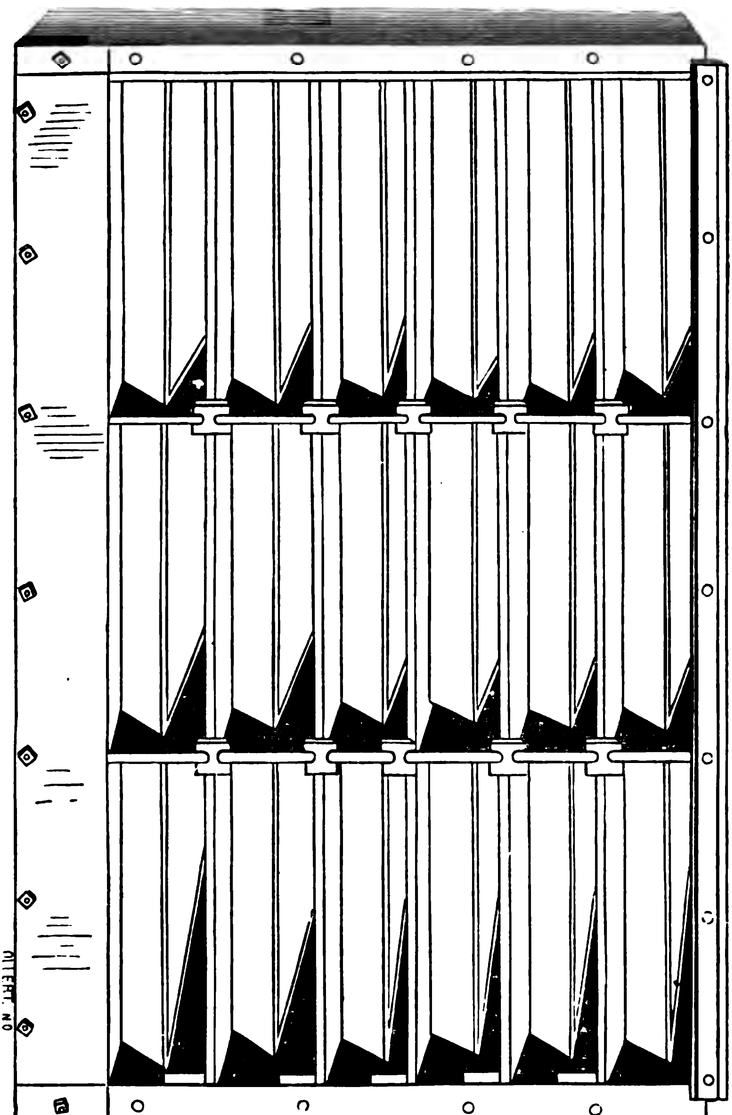
d. Exhaust fan, Sturtevant's No. 29, Medium Planing Mill Exhauster.

e. Discharge pipe from fan, made of No. 20 galvanized iron.

f. Driving belt.

Height of legs supporting furnace and reservoir, 10 inches. On reservoir at letter (*b*) should be shown a 12-inch opening for escape pipe, as indicated (*d*) Plate 1.

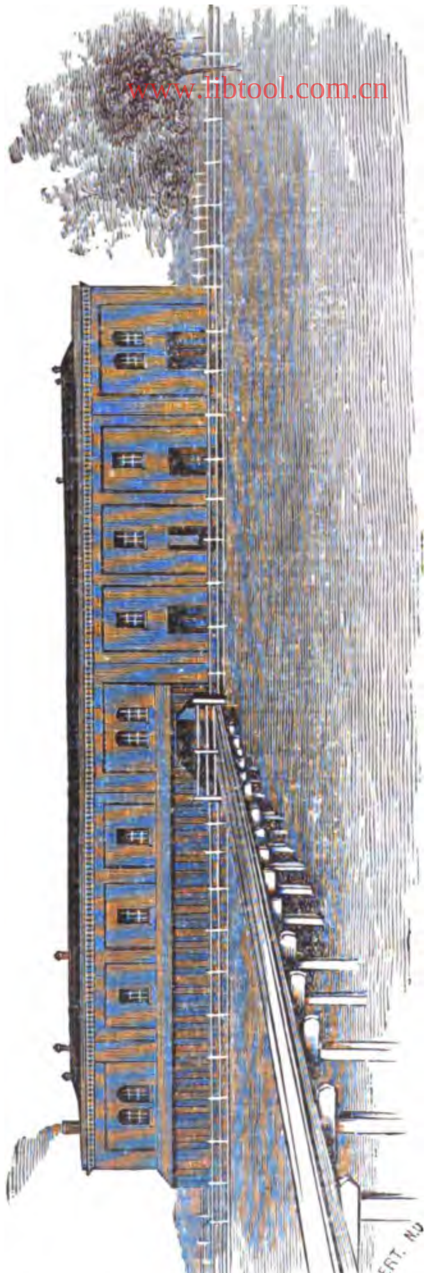
The apparatus throughout is made ample in size and power for rapidity of work and economy in wear and tear, by lessening velocity and friction. The fan is run by a special engine at a slow rate as compared



(PLATE 4.) FRONT VIEW OF FUMIGATING FURNACE.

Dimensions of each compartment, 12 x 3¼ inches. Pans of cast iron 5-16 inch thick; 1½ inches deep, 11 inches wide, and 2 feet 10 inches long, outside measure. Free space above pan about 1¾ inches.

with its capacity, but driving into the ship 180,000 cubic feet per hour of atmosphere surcharged with sulphurous oxide.



(Plate 5.)

Brick building in which is located the superheating chamber; gangway in front connecting with disinfecting wharf.

APPLICATIONS OF DRY AND MOIST HEAT.

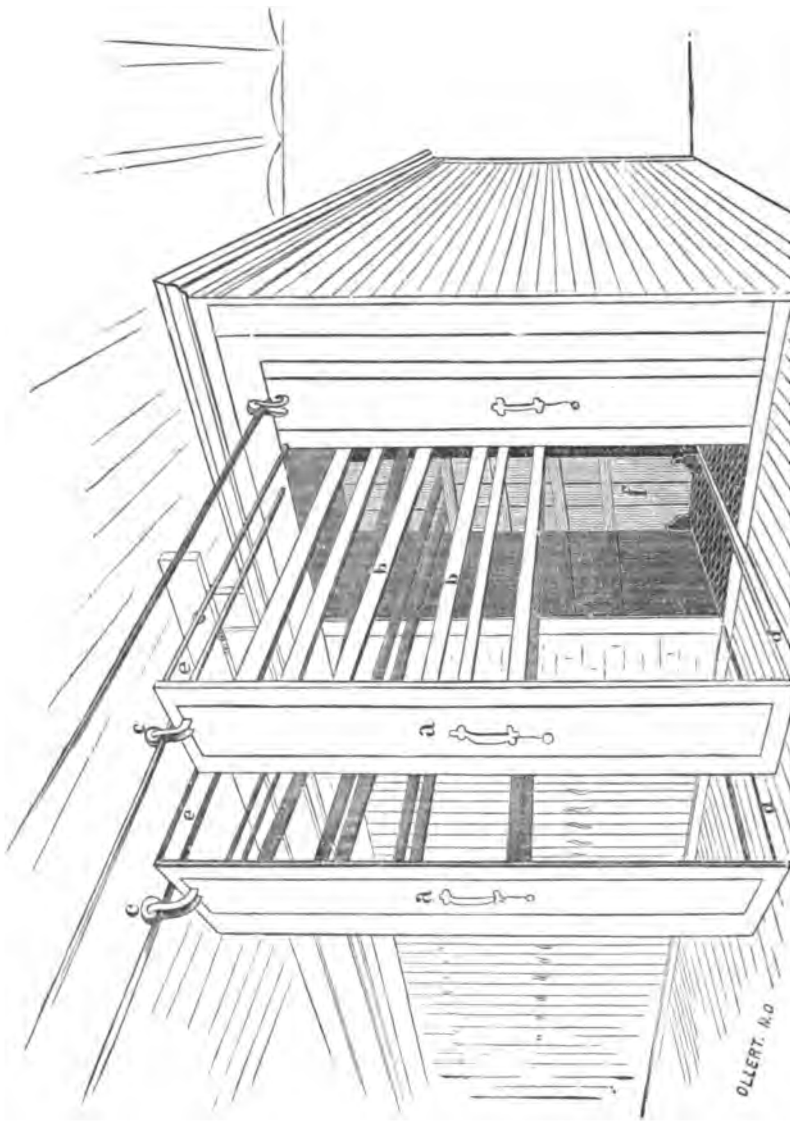
While these two processes of sanitary treatment of the vessel are going on, all bedding, ship's linen, cushions, mattresses, flags, mosquito nets, curtains, carpets, rugs, all personal baggage and wearing apparel of whatever description, are removed from the ship to a commodious building in close proximity (see Plate 5), in which these articles are treated by moist heat at a temperature of not less than 230° Fahrenheit.

The apparatus for this work consists in a steel forty-horse power steam boiler (see Plate 9), for supplying steam to a superheating chamber a few feet distant, and which I will now describe. (See Plates 6, 7, and 8.) The dimensions of this chamber, taken interiorly or inside measure, are 60 feet long, 11 feet wide, and 7 feet high. The framework is composed of 3x3 inch seasoned pine lumber, joined as in the construction of a frame house. Upon the outside of this framework (and corresponding to weatherboarding in the case of a house) is nailed tongued and grooved flooring material three fourths of an inch thick by six inches wide. The inside or interior of the ends, rear, and top of the chamber is ceiled with the same material, and a flooring of the same is also laid. Upon these interior surfaces is tacked heavy "Russian hair-cloth or felting;" and upon this, at intervals of three feet, are nailed parallel strips of wood 1½x2 inches, and, in turn, upon these strips is fastened another sheathing or ceiling of flooring plank, as already described. This secures an air space between the hair-cloth and the inner ceiling. Upon this now smooth interior surface of wood is finally tacked and held in place by very broad-headed

(Plate 6.) Front View of Closed Super-Heating Chamber (60 feet long).
a. Panels. *b.* Rods upon which panels are suspended and travel. *c.* Outer support of rods. *d.* Rollers suspending panels on rods. *e.* Fire hose.

nails, or better, by nails supplied with tin discs or washers, a double layer of "Asbestos Building Felt," well lapped and securely tacked, thus rendering the interior of the chamber fire-proof.

By the foregoing described construction, it will be seen that the walls of the chamber, which are eight inches in thickness, consist of seven non-conducting media: First, the outer layer of planking; second, three inches of air space; third, an inner ceiling of planking; fourth, one inch thickness of "Russian hair-cloth;" fifth, one and a half inch air space; sixth, a third layer of three fourth inch planking; seventh, a double layer, or interior lining, of heavy asbestos felting.



(PLATE 7.) SUPER-HEATING CHAMBER; TWO PANELS DRAWN OPEN.

a. Panels. (Two lower rack bars not shown.) *b.* Rack bars. *c.* Rollers. *d.* Iron bars connecting front and rear panels. *e.* Rods upon which panels are suspended and travel. *f.* Rear panel. Galvanized iron ½ inch mesh screen in bottom of chamber.

The front wall is divided into forty panels, eighteen inches wide each (see Plate 6), which represents that number of racks contained within the chamber. Upon the bars of these racks the clothing, etc., is hung for exposure to disinfection by moist heat. (See Plate 7.) These racks are constructed with a front and rear panel united by horizontal bars, six to each side. Each rack is suspended overhead, on travelling rollers, upon an iron rod which extends from the rear wall of the chamber to a support ten feet in front of the chamber, the rod, therefore, being twenty feet in length. By this arrangement overhead the racks may be drawn out and pushed in with facility, thus avoiding tracks or rods on the floor obstructing the movements of employés. When drawn out the full length of ten feet, the rear panels of the racks securely close the chamber, as do the front panels when the racks are pushed in, thus admitting of the heating of the chamber during the time of hanging the articles of clothing, etc., on the rack-bars preparatory to disinfection.

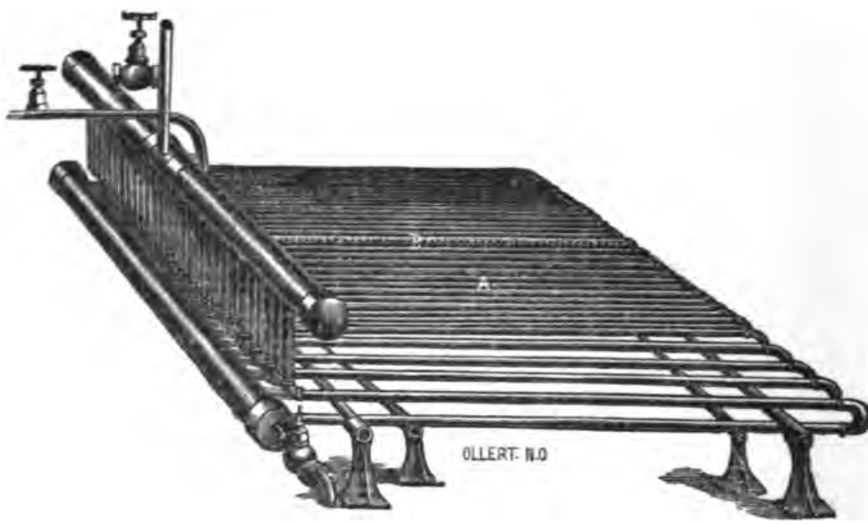
For this admirable device, and, indeed, for the entire skeleton of the superheating chamber, including the dry heat double steam coils, we are indebted to the Troy Laundry Machinery Company, Chicago, Ill. We found the purchase of this apparatus, constructed to include certain of our specifications, to be the most economical and satisfactory we could have desired. The interior surface of each panel is lined with a layer of Russian hair-cloth, over which is applied a double layer of asbestos felting. At intervals of seven and a half feet a bulkhead of one inch tongued and grooved flooring is constructed, subdividing the chamber into eight compartments. These bulkheads or partitions are made fire-proof by a covering of a double layer of asbestos felting. The object of this arrangement is to provide against the spread of fire in the event of its occurrence. In addition to this provision, there is a double lead of one inch fire hose connected with a steam pump near the boiler, and at all times ready, within fifteen seconds' notice, to turn on two streams of water upon any rack on which fire might have originated.

These minute specifications concerning provision against fire are particularly appreciated by ourselves: it cost us two fires and the destruction of a large amount of property to learn a lesson which experience alone could teach. Lacking experience and precedent, these accidents could not have been foreseen, and therefore could not have been provided against. They were the result of an underrating, and failure to appreciate the prodigious force the contrivance invented placed at our will to invoke. Under the present arrangement, including early use of free steam, fire is hardly possible; but if it should occur, we are prepared to draw out instantly the burning panel, to strip it of clothing, and to put out the fire. With reasonable care and watchfulness on the part of the employés, there need be absolutely no danger of loss by fire.

The superheating of this chamber is so provided as to furnish at will dry or moist heat, or both; and by a turn of the hand a temperature of 300° F. can be obtained. Within and at the end of this chamber, next to and connected with the boiler, are two manifolds, one above the other, to which is connected a system of forty-five three quarter inch steam pipes (aggregating 5,509 lineal feet), placed horizontally near the floor of the chamber, running its full length, and supplied with a "bleeder" for conveying off the water of condensation. This double coil furnishes the dry heat. (See Plate 8.) Above and in close proximity to this system of pipes is extended a horizontal screen of galvanized iron, one half inch mesh, to catch and so prevent the coming in contact with the super-heating pipes any article falling from the racks. (See Plate 7.)

The moist heat is supplied by a one inch steam pipe laid centrally in the midst of the above described dry heat pipes, and running the entire length of the chamber, constituting a steam-main, connected with the boiler, and controlled, as the others, by a ball valve on the outside. This pipe is perforated by eighty one-twelfth inch holes, so placed as to furnish steam to each rack.

During the time of hanging the articles of clothing, etc., on the racks, the dry heat is turned on, and the temperature raised to about 190° F.,

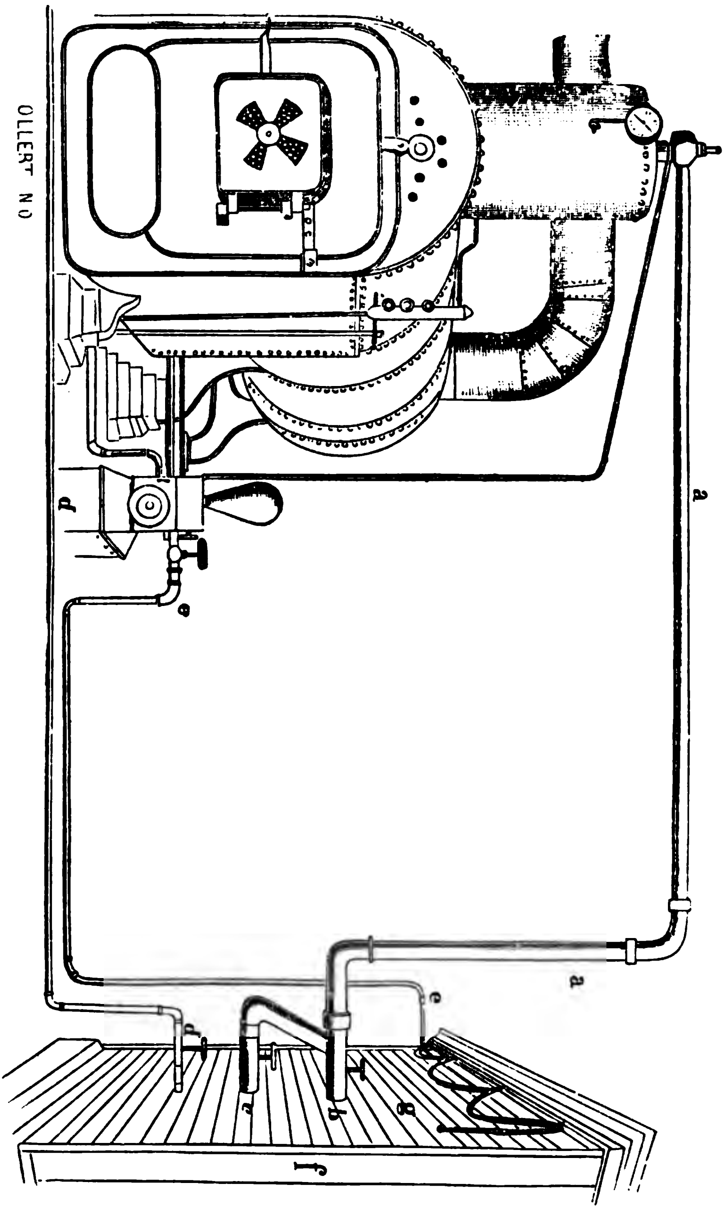


(PLATE 8.)

Super-heating steam coil for dry heat. *b–b*. Perforated steam pipe for moist heat.

made known by a thermometer having a large mercurial column, and suspended near the centre of the chamber, working on a slide or travelling rod in such a manner, when it is desired to make a reading, as to allow of being drawn forward (by a cord extending outside) to a long, narrow pane of glass set in the panel. This thermometer should have a scale of at least 275° F. As each rack is filled it is put back into place. By the time the last of the articles have been hung on the racks, the entire mass of the material within the chamber has attained a temperature between 190° and 200° F., when free steam is turned on; the thermometer speedily rises to a point varying between 230° and 240° F., at which it is maintained for a period of twenty minutes.

The steam pressure in the boiler, at the beginning of this process, registers between 100 and 110 pounds by the steam gauge; at the end of the process of blowing in steam the pressure will have fallen to about sixty pounds. The steam is now entirely cut off from the chamber, the racks are drawn out, and their contents removed. During the process of



(Plate 9.) Boiler and Steam Connection with Super-Heating Chamber.
a. Steam-main from boiler. *b.* Pipe supplying dry heat. *c.* Pipe supplying moist heat. *d.* Bleeder. *e.* Pipe from pump, supplying fire hose. *f.* Front of chamber. *g.* End view of chamber.

steaming, every article is perceived to be saturated and intensely hot, the steam freely permeating to the interior of mattresses, double blankets, etc.; but so great is the heat in the texture of the fabrics as to immediately expel all moisture upon drawing the racks and exposure to the open air. Shirts, collars, etc., instantly assume the crisp dryness they possessed before exposure, losing the musty smell of long packing in a trunk. Silks, laces, and the most delicate woollen goods show no signs of injury whatever from the treatment. Of course, articles of leather, rubber, and whalebone would be injured by the heat, and are therefore disinfected with the mercuric solution, and not permitted to go into the heated chamber. Time required to charge chamber with apparel for disinfection, thirty minutes; time required for moist heat, twenty minutes; for removal of articles, fifteen minutes;—a total of sixty-five minutes. A large steamship, particularly a passenger vessel, may require two or three charges of the chamber. Amount of coal consumed, from two to four barrels per vessel.

In the summer of 1885, we devised and put up a chamber of the above general plan, but wholly inadequate as to size for the requirements of our service. This was replaced by one operating on the same principle, but fifty feet long and supplied with a twenty horse-power boiler, which latter proved too small for rapid work. This apparatus was burned last spring. Our present chamber and supply boiler are of the dimensions given in the appended plates. We prepared the plans of the foregoing described apparatus during the summer of 1884. Obtaining a liberal appropriation of $30,000 from the state legislature for the avowed purpose of establishing a new system of quarantine through the elaborations of purely experimental work, and thoroughly endorsed and sustained in all our efforts by the press of New Orleans and by the merchants, we put the new system into practical operation, and threw open the Mississippi to commerce June 10, 1885. As it stands to-day, we sincerely believe in a nearly perfected state, it is the consummation of experimental effort, through a long and tedious process, beset with difficulties of the most perplexing and often disheartening kind. Without precedent, having to deal with natural forces of prodigious power, repeatedly encountering unexpected difficulties, meeting with accidents, obliged continually to devise improvements upon our several inventions, and continually combating a surly discontent and sometimes violent opposition from those subjected to the sanitary processes, while these were still in an imperfect and unsatisfactory stage of development, the modernizing of quarantine, and bringing it into line with other branches of science and art in the general progress, has been an expensive and difficult task.

We submit to your honorable committee the foregoing plans and specifications of the "System of Quarantine" established by the state of Louisiana, in order to place the results of our experience in the hands of those who, like ourselves, are compelled to resist pestilential invasion by maritime quarantine. We do this, encouraged by the hope that others may find in these results matter worthy of consideration, and beneficial in strengthening their defences against a common enemy.

THE FOLLOWING ARE THE REQUIREMENTS IMPOSED UPON ALL VESSELS ARRIVING AT THE QUARANTINE STATIONS IN THE STATE OF LOUISIANA, DURING THE QUARANTINE PERIOD, BEGINNING ABOUT MAY 1st AND ENDING OCTOBER 31ST.

All vessels arriving at the several quarantine stations in the state, together with their crews, passengers, and their cargoes, shall be subjected to the inspection of the quarantine officers at the said stations. All vessels, together with their cargoes, crews, passengers, and baggage, arriving at the Mississippi Quarantine Station from intertropical American and West Indian ports, shall be subjected to thorough maritime sanitation, according to the following schedule:

First Class—Vessels arriving from non-infected ports.

Second Class—Vessels arriving from suspected ports.

Third Class—Vessels arriving from ports known to be infected.

Fourth Class—Vessels which, without regard to port of departure, are infected; that is to say, vessels which have yellow fever, cholera, or other contagious or infectious diseases on board at time of arrival, or have had same on voyage.

Vessels of the first class to be subjected to necessary maritime sanitation at the Upper Quarantine Station, without detention of either vessels or persons, longer than may be necessary to place such vessels in perfect sanitary condition.

Vessels of the second and third classes to undergo the same conditions, together with detention for observation for a period of five (5) full days from hour of arrival in quarantine.

Vessels of the fourth class to be remanded to the Lower Quarantine Station, there to undergo sanitation and detention of vessels and persons such length of time as the board of health may order.

The five days' detention, as above provided, shall apply to all ports of the Gulf of Mexico and the Caribbean Sea, exception being made in regard to vessels coming from ports south of the Equator, whose period of detention shall be three (3) days.

All vessels arriving from Mediterranean or other ports known or suspected to be infected with cholera, or which may hereafter become infected, shall be subjected to maritime sanitation and such detention as the board of health may determine.

Vessels arriving from the above named ports and places, and belonging to the second, third, or fourth class, as set forth in the foregoing schedule, shall not be allowed to pass the Rigolets or Atchafalaya Quarantine Stations, or other state quarantine stations which may hereafter be established, without having undergone a period of detention of forty (40) days, and thorough cleansing and disinfection.

SPECIAL SUGGESTIONS TO OWNERS, AGENTS, MASTERS OF VESSELS, AND PASSENGERS.

The Louisiana State Board of Health recommends the following suggestions to agents, owners, masters of vessels, and passengers, for the purpose of facilitating the work of quarantine officers, and reducing the period of detention to a minimum:

1. That vessels should be stripped during the quarantine season of all woollen hangings, carpets, curtains, and such like materials, and upholstered furniture, so far as practicable. Hair or moss mattresses to be replaced by wire or wicker beds.

2. That, so far as possible, vessels trading with tropical ports should be manned with acclimated crews.

3. Masters of vessels, ship and consular agents, are earnestly requested to instruct passengers from quarantinable ports to dispense, so far as possible, with baggage which may be injured by wetting, in case of pestilential outbreak on board, while undergoing disinfection. Such passengers are especially warned against bringing silks, laces, velvets, and other fabrics of delicate texture, as they will be compelled to assume all risks of injury.

4. While in ports infected with yellow fever, vessels should be anchored out in the harbor when this is possible, and the crew prohibited from going ashore, especially at night.

5. When practicable, cargoes should be loaded in such a manner as to allow access to the pumps, and also to enable the quarantine officials to pump out and wash the bilge.

6. Special attention should be given to cleanliness of vessels and persons, and provision should be made for all possible ventilation of the entire vessel. The best disinfectants and instructions for using same can be obtained by application to the board of health, or any of its officers.

7. Masters should, before arrival, see that the bilge is thoroughly pumped out and cleansed, and that the entire vessel be put in such good sanitary condition as to permit of the least possible detention. Fruit vessels particularly should be kept thoroughly cleansed, for the purpose of avoiding delay at the Quarantine Station.

8. Vessels observing the above recommendations will receive special consideration at the quarantine station, detention and cost of cleaning, disinfecting, etc., being materially lessened thereby.

CONCLUSIONS.

The experimental evidence recorded in this report seems to justify the following conclusions:

The most useful agents for the destruction of spore-containing infectious material are,—

1. *Fire.* Complete destruction by burning.
2. *Steam under pressure.* 105° C. (221° Fahr.) for ten minutes.
3. *Boiling in water* for half an hour.
4. *Chloride of lime.*[1] A 4 per cent. solution.
5. *Mercuric chloride.* A solution of 1 : 500.

For the destruction of infectious material which owes its infecting power to the presence of micro-organisms not containing spores, the committee recommends,—

1. *Fire.* Complete destruction by burning.
2. *Boiling in water* for ten minutes.
3. *Dry heat.* 110° C. (230° Fahr.) for two hours.
4. *Chloride of lime.* A 2 per cent. solution.
5. *Solution of chlorinated soda.*[2] A 10 per cent. solution.
6. *Mercuric chloride.* A solution of 1 : 2,000.
7. *Carbolic acid.* A 5 per cent. solution.
8. *Sulphate of copper.* A 5 per cent. solution.
9. *Chloride of zinc.* A 10 per cent. solution.
10. *Sulphur dioxide.*[3] Exposure for twelve hours to an atmosphere containing at least 4 volumes per cent. of this gas in presence of moisture.

The committee would make the following recommendations with reference to the practical application of these agents for disinfecting purposes:

FOR EXCRETA.

(*a*) In the sick-room:

1. Chloride of lime in solution, 4 per cent.

In the absence of spores:

2. Carbolic acid in solution, 5 per cent.
3. Sulphate of copper in solution, 5 per cent.

(*b*) In privy vaults:

1. Mercuric chloride in solution, 1 : 500.[4]
2. Carbolic acid in solution, 5 per cent.

[1] Should contain at least 25 per cent. of available chlorine.

[2] Should contain at least 3 per cent. of available chlorine.

[3] This will require the combustion of between 3 and 4 lbs. of sulphur for every 1,000 cubic feet of air space.

[4] The addition of an equal quantity of potassium permanganate as a deodorant, and to give color to the solution, is to be recommended.

(*c*) For the disinfection and deodorization of the surface of masses of organic material in privy vaults, etc.:

Chloride of lime in powder.

FOR CLOTHING, BEDDING, ETC.

(*a*) Soiled underclothing, bed-linen, &c.:

1. Destruction by fire, if of little value.
2. Boiling for at least half an hour.
3. Immersion in a solution of mercuric chloride of the strength of 1 : 2,000 for four hours.
4. Immersion in a 2 per cent. solution of carbolic acid for four hours.

(*b*) Outer garments of wool or silk, and similar articles, which would be injured by immersion in boiling water or in a disinfecting solution:

1. Exposure in a suitable apparatus to a current of steam for ten minutes.
2. Exposure to dry heat at a temperature of 110° C. (230° Fahr.) for two hours.

(*c*) Mattresses and blankets soiled by the discharges of the sick:

1. Destruction by fire.
2. Exposure to super-heated steam, 105° C. (221° Fahr.) for ten minutes.
   (Mattresses to have the cover removed or freely opened.)
3. Immersion in boiling water for half an hour.

FURNITURE AND ARTICLES OF WOOD, LEATHER, AND PORCELAIN.

Washing, several times repeated, with,—

1. Solution of carbolic acid, 2 per cent.

FOR THE PERSON.

The hands and general surface of the body of attendants of the sick, and of convalescents, should be washed with,—

1. Solution of chlorinated soda diluted with nine parts of water, 1 : 10.
2. Carbolic acid, 2 per cent. solution.
3. Mercuric chloride, 1 : 1,000.

FOR THE DEAD.

Envelop the body in a sheet thoroughly saturated with,—

1. Chloride of lime in solution, 4 per cent.
2. Mercuric chloride in solution, 1 : 500.
3. Carbolic acid in solution, 5 per cent.

FOR THE SICK-ROOM AND HOSPITAL WARDS.

(*a*) While occupied, wash all surfaces with,—

1. Mercuric chloride in solution, 1 : 1,000.
2. Carbolic acid in solution, 2 per cent.

(*b*) When vacated, fumigate with sulphur dioxide for twelve hours, burning at least three pounds of sulphur for every 1,000 cubic feet of air-space in the room; then wash all surfaces with one of the above-mentioned disinfecting solutions, and afterward with soap and hot water; finally throw open doors and windows, and ventilate freely.

FOR MERCHANDISE AND THE MAILS.

The disinfection of merchandise and of the mails will only be required under exceptional circumstances; free aeration will usually be sufficient. If disinfection seems necessary, fumigation with sulphur dioxide will be the only practicable method of accomplishing it without injury.

RAGS.

(*a*) Rags which have been used for wiping away infectious discharges should at once be burned.

(*b*) Rags collected for the paper-makers during the prevalence of an epidemic should be disinfected before they are compressed in bales by,—

1. Exposure to super-heated steam of 105° C. (221° Fahr.) for ten minutes.
2. Immersion in boiling water for half an hour.

SHIPS.

(*a*) Infected ships at sea should be washed in every accessible place, and especially the localities occupied by the sick, with,—

1. Solution of mercuric chloride, 1 : 1,000.
2. Solution of carbolic acid, 2 per cent.

The bilge should be disinfected by the liberal use of a strong solution of mercuric chloride.

(*b*) Upon arrival at a quarantine station, an infected ship should at once be fumigated with sulphurous acid gas, using three pounds of sulphur for every 1,000 cubic feet of air-space; the cargo should then be discharged on lighters; a liberal supply of the concentrated solution of mercuric chloride (4 oz. to the gallon) should be thrown into the bilge, and at the end of twenty-four hours the bilge-water should be pumped out and replaced with pure sea-water: this should be repeated. A second fumigation, after the removal of the cargo, is recommended; all accessible surfaces should be washed with one of the disinfecting solutions heretofore recommended, and subsequently with soap and hot water.

FOR RAILWAY CARS.

The directions given for the disinfection of dwellings, hospital wards, and ships, apply as well to infected railway cars. The treatment of excreta with a disinfectant, before they are scattered along the tracks, seems desirable at all times in view of the fact that they may contain infectious germs. During the prevalence of an epidemic of cholera this is imperative. For this purpose the standard solution of chloride of lime is recommended.

At the annual meeting of the Sanitary Council of the Mississippi Valley, held in New Orleans, La., March 10, 11, 1885, the following resolution was adopted:

Resolved, That the secretary request from the chairman of the Committee on Disinfectants, appointed at the last meeting of the American Public Health Association, a plain, practical paper on "Disinfection and Disinfectants," for popular use and distribution, to be furnished to the chairman of the special committee of this council on General Sanitation.

In compliance with this request a Preliminary Report was prepared, which has been quite widely circulated. This report having been made before the experimental researches of the committee were completed, and being a "preliminary report," was only intended to serve a temporary purpose; but it has been thought best to revise it, and to introduce it into this our final report, so that it may be available for distribution in a separate form if sanitary officials find it suitable for popular use.

DISINFECTION AND DISINFECTANTS.

The object of disinfection is to prevent the extension of infectious diseases by destroying the specific infectious material which gives rise to them. This is accomplished by the use of disinfectants.

There can be no partial disinfection of such material: either its infecting power is destroyed, or it is not. In the latter case there is a failure to disinfect. Nor can there be any disinfection in the absence of infectious material.

It has been proved for several kinds of infectious material, that its specific infecting power is due to the presence of living micro-organisms, known in a general way as "disease germs;" and practical sanitation is now based upon the belief that the infecting agents in all kinds of infectious material are of this nature. Disinfection, therefore, consists essentially in the destruction of disease germs.

Popularly, the term disinfection is used in a much broader sense. Any chemical agent which destroys or masks bad odors, or which arrests putrefactive decomposition, is spoken of as a disinfectant. And in the absence of any infectious disease it is common to speak of disinfecting a foul cesspool, or bad smelling stable, or privy vault.

This popular use of the term has led to much misapprehension, and the agents which have been found to destroy bad odors—deodorizers—or to arrest putrefactive decomposition—antiseptics—have been confidently recommended and extensively used for the destruction of disease germs in the excreta of patients with cholera, typhoid fever, etc.

The injurious consequences which are likely to result from such misapprehension and misuse of the word disinfectant will be appreciated when it is known that recent researches have demonstrated that many of the agents which have been found useful as deodorizers, or as antiseptics, are entirely without value for the destruction of disease germs.

This is true, for example, as regards the sulphate of iron or copperas, a salt which has been extensively used with the idea that it is a valuable disinfectant. As a matter of fact, sulphate of iron in saturated solution does not destroy the vitality of disease germs, or the infecting power of material containing them. This salt is, nevertheless, a very valuable antiseptic, and its low price makes it one of the most available agents for the arrest of putrefactive decomposition.

Antiseptic agents, however, exercise a restraining influence upon the development of disease germs, and their use during epidemics is to be recommended when masses of organic material in the vicinity of human habitations cannot be completely destroyed, or removed, or disinfected.

While an antiseptic agent is not necessarily a disinfectant, all disinfectants are antiseptics; for putrefactive decomposition is due to the development of "germs" of the same class as that to which disease germs belong, and the agents which destroy the latter also destroy the bacteria of putrefaction when brought in contact with them in sufficient quantity, or restrain their development when present in smaller amounts. A large number of the proprietary "disinfectants," so-called, which are in the market, are simply deodorizers or antiseptics, of greater or less value, and are entirely untrustworthy for disinfecting purposes.

Antiseptics are to be used at all times when it is impracticable to remove filth from the vicinity of human habitations, but they are a poor substitute for cleanliness. During the prevalence of epidemic diseases, such as yellow fever, typhoid fever, and cholera, it is better to use in privy-vaults, cess-pools, etc., those antiseptics which are also disinfectants, *i. e.*, germicides; and when the contents of such receptacles are known to be infected, this becomes imperative.

Still more important is the destruction at our seaport quarantine stations of infectious material which has its origin outside of the boundaries of the United States, and the destruction, within our boundaries, of infectious material given off from the persons of those attacked with any infectious disease, whether imported or of indigenous origin.

In the sick-room we have disease germs at an advantage, for we know where to find them as well as how to kill them. Having this knowledge, not to apply it would be criminal negligence, for our efforts to restrict the extension of infectious diseases must depend largely upon the proper use of disinfectants in the sick-room.

GENERAL DIRECTIONS.

Disinfection of Excreta, etc.—The infectious character of the dejections of patients suffering from cholera and from typhoid fever is well established; and this is true of mild cases and of the earliest stages of these diseases as well as of severe and fatal cases. It is probable that epidemic dysentery, tuberculosis, and perhaps diphtheria, yellow fever, scarlet fever, and typhus fever, may also be transmitted by means of the alvine discharges of the sick. It is therefore of the first importance that these should be disinfected. In cholera, diphtheria, yellow fever, and scarlet fever, all vomited material should also be looked upon as infectious. And in tuberculosis, diphtheria, scarlet fever, and infectious pneumonia, the sputa of the sick should be disinfected or destroyed by fire. It seems advisable also to treat the urine of patients sick with an infectious disease with one of the disinfecting solutions below recommended.

Chloride of lime, or bleaching powder, is perhaps entitled to the first place for disinfecting excreta, on account of the rapidity of its action. The following standard solution is recommended:

Dissolve chloride of lime of the best quality[1] *in pure water, in the proportion of six ounces to the gallon.*

Use one quart of this solution for the disinfection of each discharge in cholera, typhoid fever, etc.[2] Mix well, and leave in the vessel for at least one hour before throwing into privy vault or water-closet. The same directions apply for the disinfection of vomited matters. Infected sputum should be discharged directly into a cup half full of the solution. A five per cent. solution of carbolic acid may be used instead of the chloride of lime solution, the time of exposure to the action of the disinfectant being four hours.

Disinfection of the person.—The surface of the body of a sick person, or of his attendants, when soiled with infectious discharges, should be at once cleansed with a suitable disinfecting agent. For this purpose solution of chlorinated soda (liquor sodæ chlorinatæ) diluted with nine parts of water, or the standard solution of chloride of lime diluted with three parts of water, may be used. A 2 per cent. solution of carbolic acid is also suitable for this purpose, and under proper medical supervision the use of a solution of corrosive sublimate—1 : 1,000—is to be recommended.

In diseases like small-pox and scarlet fever, in which the infectious agent is given off from the entire surface of the body, occasional ablutions with the above mentioned solution of chlorinated soda are recommended.

In all infectious diseases the body of the dead should be enveloped in a sheet saturated with the standard solution of chloride of lime, or with a 5 per cent. solution of carbolic acid, or a 1 : 500 solution of corrosive sublimate.

Disinfection of clothing.—Boiling for half an hour will destroy the vitality of all known disease germs, and there is no better way of disinfecting clothing or bedding which can be washed than to put it through

[1] Good chloride of lime should contain at least 25 per cent. of available chlorine (page 278, Vol. XI). It may be purchased by the quantity at 3½ cents per pound. The cost of the standard solution recommended is therefore but little more than one cent. a gallon. A clear solution may be obtained by filtration or by decantation, but the insoluble sediment does no harm, and this is an unnecessary refinement.

[2] For a very copious discharge, use a larger quantity.

the ordinary operations of the laundry. No delay should occur, however, between the time of removing soiled clothing from the person or bed of the sick and its immersion in boiling water, or in one of the following solutions until this can be done:

Corrosive sublimate, one drachm to the gallon of water (about 1 : 1,000), or,—

Carbolic acid, pure, one ounce to the gallon of water (1 : 128).

The articles to be disinfected must be thoroughly soaked with the disinfecting solution and left in it for at least two hours, after which they may be wrung out and sent to the wash.

N. B. Solutions of corrosive sublimate should not be placed in metal receptacles, for the salt is decomposed and the mercury precipitated by contact with copper, lead, or tin. A wooden tub or earthen crock is a suitable receptacle for such solutions.

Clothing or bedding which cannot be washed should be disinfected by steam in a properly constructed disinfection chamber. In the absence of a suitable steam disinfecting apparatus, infected clothing and bedding should be burned.

Disinfection of the sick-room. In the sick-room no disinfectant can take the place of free ventilation and cleanliness. It is an axiom in sanitary science that it is impracticable to disinfect an occupied apartment for the reason that disease germs are not destroyed by the presence in the atmosphere of any known disinfectant in respirable quantity. Bad odors may be neutralized, but this does not constitute disinfection in the sense in which the term is here used. These bad odors are, for the most part, an indication of want of cleanliness, or of proper ventilation; and it is better to turn contaminated air out of the window or up the chimney than to attempt to purify it by the use of volatile chemical agents, such as carbolic acid, chlorine, etc., which are all more or less offensive to the sick, and are useless so far as disinfection—properly so called—is concerned.

When an apartment which has been occupied by a person sick with an infectious disease has been vacated, it should be disinfected. The object of disinfection in the sick-room is mainly the destruction of infectious material attached to surfaces, or deposited as dust upon window ledges, in crevices, etc. If the room has been properly cleansed and ventilated while still occupied by the sick person, and especially if it was stripped of carpets and unnecessary furniture at the outset of his attack, the difficulties of disinfection will be greatly reduced.

All surfaces should be thoroughly washed with the standard solution of chloride of lime diluted with three parts of water, or with 1 : 1,000 solution of corrosive sublimate. The walls and ceiling, if plastered, should be subsequently treated with a lime-wash. Especial care must be taken to wash away all dust from window ledges and other places where it may have settled, and thoroughly to cleanse crevices and out-of-the-way places. After this application of the disinfecting solution, and an interval of twenty-four hours or longer for free ventilation, the floors and wood-work should be well scrubbed with soap and hot water, and this should be followed by a second more prolonged exposure to fresh air, admitted through open doors and windows.

As an additional precaution, fumigation with sulphurous acid gas is to be recommended, especially for rooms which have been occupied by patients with small-pox, scarlet fever, diphtheria, typhus fever, and yellow fever. But fumigation with sulphurous acid gas alone, as commonly practised, cannot be relied upon for disinfection of the sick-room and its contents, including bedding, furniture, infected clothing, etc., as is popularly believed.

When fumigation is practised, it should precede the general washing with a disinfecting solution, heretofore recommended. To ensure any results of value, it will be necessary to close the apartment to be disinfected as completely as possible by stopping all apertures through which the gas might escape, and to burn not less than three pounds of sulphur for each thousand cubic feet of air space in the room. To secure complete combustion of the sulphur, it should be placed in powder or in small fragments, in a shallow iron pan, which should be set upon a couple of bricks in a tub partly filled with water, to guard against fire. The sulphur should be thoroughly moistened with alcohol before igniting it.

Disinfection of privy vaults, cesspools, etc.—When the excreta (not previously disinfected) of patients with cholera or typhoid fever have been thrown into a privy vault, this is infected, and disinfection should be resorted to as soon as the fact is discovered, or whenever there is reasonable suspicion that such is the case. It will be advisable to take the same precautions with reference to privy vaults into which the excreta of yellow fever patients have been throw, although we do not definitely know that this is infectious material.

For this purpose the standard solution of chloride of lime may be used in quantity proportioned to the amount of material to be disinfected, but where this is considerable it will scarcely be practicable to sterilize the whole mass. The liberal and repeated use of this solution, or of a 5 per cent. solution of carbolic acid, will, however, disinfect the surface of the mass, and is especially to be recommended during the epidemic prevalence of typhoid fever or of cholera.

All exposed portions of the vault, and the wood-work above it, should be thoroughly washed down with the disinfecting solution. Instead of the disinfecting solutions recommended, chloride of lime in powder may be daily scattered over the contents of the privy vault.

Disinfection of ingesta. It is well established that cholera and typhoid fever are very frequently, and perhaps usually, transmitted through the medium of infected water or articles of food, and especially milk. Fortunately we have a simple means at hand for disinfecting such infected fluids. This consists in the application of heat. The boiling temperature maintained for half an hour kills all known disease germs. So far as the germs of cholera, yellow fever, and diphtheria are concerned, there is good reason to believe that a temperature considerably below the boiling point of water will destroy them. But in order to keep on the safe side, it is best not to trust anything short of the boiling point (212° F.) when the object is to disinfect food or drink which is open to the suspicion of containing the germs of any infectious disease.

During the prevalence of an epidemic of cholera it is well to boil all water for drinking purposes. After boiling, the water may be filtered, if necessary to remove sediment, and then cooled with *pure* ice, if desired.

BIBLIOGRAPHY FROM 1880 TO 1888.

COMPILED BY GEORGE H. ROHÉ, M. D., SECRETARY OF THE COMMITTEE.

The following list of titles supplements and brings up to date the excellent bibliography of the older literature on disinfection and disinfectants given in the third volume of the Index Catalogue of the National Medical Library.

In the preparation of this list, free use has been made of the *Index Medicus*. Indeed, without the aid of that valuable publication the work would not have been undertaken. It is hoped the present compilation will prove useful to those desiring to pursue the study of the subject further than it is carried in this volume.

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XI.

ON SOME FORMS OF TABLES OF VITAL STATISTICS, WITH SPECIAL REFERENCE TO THE NEEDS OF THE HEALTH DEPARTMENT OF A CITY.

BY JOHN S. BILLINGS, M. D., LL. D.,

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As the committee on the preparation of forms of tables for vital statistics, appointed at the last meeting of the Association, has not found it possible to have a meeting during the year, I have prepared a few forms of such tables, which are herewith submitted, thinking that another committee may be appointed whose residences may be sufficiently near each other to permit of occasional meetings during the year, and that these forms may serve as a starting-point for discussion.

The forms presented should be considered in connection with the paper on "Methods of tabulating and publishing records of death" which I presented to the Association in 1885.[1] They relate only to a city, and are intended especially for the information and use of the health department of a city, and to include such data as it seems to me that sanitary officers would find most useful. They do not include all the forms which such officers will need, nor by any means all the forms which a vital statistician would desire;—they are intended to indicate to the sanitary officer the localities in his city in which the death rate is greatest; some of the principal causes or circumstances connected with this increased death rate; and, especially, as to how far it is due to causes or circumstances which may probably be controlled or avoided. Such information is needed by health officials, whether it is to be published or not, and, while its publication is very desirable, both as a means of educating the community to which it relates, and as a contribution to sanitary science for the benefit of other localities, I have not kept in view the precise forms in which it should be published, in the preparation of these tables.

The first two forms which I submit are compilation sheets, No. 1 and No. 2. Compilation sheet No. 1 is intended to show the number of deaths from each cause, in each month, in each ward of the city, occurring in each sex, at certain groups of ages, with the further distinction, where it is required, of color and parentage. As the name indicates, this form is intended for compilation rather than for publication; it is meant to be the current record to which the health officer can at all times resort for any information which he may desire with regard to deaths in his

[1] Public Health Papers and Reports, American Public Health Association, Vol. XI, p. 51.

city. One of these sheets is to be kept constantly checked, as the deaths are reported for each ward during each month. Twelve such sheets would therefore be required for each ward and for the whole city during the year. In those cities in which the proportion of the colored population is five per cent. or more of the whole, I would recommend that separate sheets be made for the white and colored for each ward during each month. In like manner, when the proportion of those of Irish parentage or of German parentage in the city is five per cent. or upwards, I would recommend that separate tables on this form be kept for each of these classes as well as for the whites of American parentage. The names of causes of death given in this sheet, and their classification, are, in the main, those used by the registrar-general of England, in accordance with the last edition of the nomenclature of the Royal College of Physicians in London. I have, however, transferred to the specific diseases all the forms of tubercular disease and tetanus.

Compilation sheet No. 2 is intended to show for the city, and for each ward in the city, the number of births during the year, and the estimated population in the middle of the year, with distinction of parentage, color, age, and sex. The difficulties in filling out this sheet at the present time will be great, and there is probably no city in the United States in which it can be more than very incompletely filled. Nevertheless, it is a matter of great importance to sanitary science that such data should be obtained and noted, and, if proper arrangements are made, as can easily be done when the next United States and state censuses are taken, the foundation can be obtained for such a table; and after such a foundation has been gotten, it can be kept up with sufficient accuracy by simple mathematical computations.

Table No. 1, showing the relative healthfulness of the city and of its several wards for the year, is made up from the compilation sheets above referred to. This table presents to the sanitary officer a bird's-eye view of the healthfulness of different parts of the city and of the different classes of its population, and, if the data in the compilation sheets have been obtained and entered with a reasonable amount of accuracy, it will afford a positive scientific foundation for sanitary recommendations and sanitary work. That the preparation of this table will involve a considerable amount of labor in computation of ratios is true; but by the use of Thatcher's slide rule this labor may be much lessened. Such computations are essential to bring the data into such shape that they can be compared.

For all cities having a population of 200,000 and upwards, and for all states which have a registration of deaths sufficiently complete to make it worth while to compile the statistics, I recommend that the data for each individual death be recorded, as fast as reported, upon cards by punching out holes. Several members of this Association have seen the system of cards, and the machine for counting any desired combination of data from these cards, which has been devised by Mr. Hermann Hollerith, and which is now in Washington. It is comparatively simple, not liable to get out of order, and does its work rapidly and accurately. I have watched with great interest the progress in developing and perfecting this machine, because seven years ago I became satisfied that some such system was possible and desirable, and advised Mr. Hollerith, who was then engaged on census work, to take the matter up and devise such a machine as is needed for counting various combinations of large numbers of data, as in census work or in vital statistics. I think that he has succeeded, and that compilers of demographical data will be glad to know of this system. I append to this paper two specimens of cards used by him, one for a compilation of data for the city of Baltimore, the other for the compilation of certain data for the registrar of the state of New Jersey; also the plan and description of a card furnished by him to show the scope of the system. Upon either of these cards, by punching holes in the proper places, as indicated by the words, letters, and figures on the card, may be indicated the sex, age, color, parentage, marital condition, occupation, ward of residence, and month and cause of death of one person. The precise data and the minuteness of sub-division may vary: thus, the ages may be recorded by single years or by groups of five years, and the number of causes of death specified may be 30 or 300.

When it is desired to classify these data and count them for the purpose of making up tables, these cards are passed directly through a machine which, by a series of counting dials, registers such combinations as are desired. For instance, the machine may be set to count the number of deaths at each age in each ward, or the number of deaths from each cause in each color, etc. As the cards leave the machine they go into an electrical sorting box in such a way that all the cards of each ward, or of each group of ages, or of each parentage, are brought together in one box, and can then be again passed through the machine reädjusted to a new combination of circumstances. It is not my purpose, however, to describe the machine, but only to call attention to it, and to the fact that the existence of such a machine is a strong additional reason for the use of the card system of record for statistical computations. The punched cards cannot, of course, take the place of the written registration records which are required for judicial purposes,—they are an addition, and not a substitution,—but the facilities which they give for statistical work are so great that I advise their use in all cases, no matter whether they are to be counted by machinery or not. Cards of different colors, to indicate sex, etc., will be found desirable.

COMPILATION SHEET NO. 1.

CITY OF WARD NO. RECORDS OF DEATHS EXCLUSIVE OF STILL BIRTHS FOR THE MONTH OF 188 FOR

AGE AND SEX.

Causes of Death.	All ages.		Under 1 month.		1 and under 3 months.		3 and under 6 months.		6 months and under 1 year.		1 and under 2 years.		2 and under 3 years.		3 and under 4 years.		4 and under 5 years.		Total under 5 years.		5 and under 10 years.		10 and under 15 years.		15 and under 20 years.		20 and under 25 years.		25 and under 30 years.		30 and under 35 years.		35 and under 40 years.		40 and under 45 years.		45 and under 50 years.		50 and under 55 years.		55 and under 60 years.		60 and under 65 years.		65 and under 70 years.		70 and under 75 years.		75 and under 80 years.		80 and under 85 years.		85 and under 90 years.		90 and over.	
	Male	Female	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Grand Total																																																							
Unknown causes																																																							
Specific Diseases—total.																																																							
Small-pox																																																							
Measles																																																							
Scarlet fever																																																							
Diphtheria																																																							
Whooping-cough																																																							
Cerebro-spinal fever																																																							
Enteric fever																																																							
Erysipelas																																																							
Septicæmia																																																							
Puerperal septicæmia																																																							
Scrofula and tabes																																																							
Leprosy																																																							
Consumption																																																							
Hydrocephalus (acute)																																																							
Other forms of Tubercular Disease.																																																							
Tetanus and trismus, nascentium																																																							
Other diseases of this class																																																							
Diarrhœal Diseases—total.																																																							
Cholera morbus																																																							
Cholera infantum																																																							
Acute diarrhœa																																																							
Acute dysentery																																																							

Malarial Diseases—total.	
Zoögenous Diseases—total.	
Hydrophobia	
Splenic fever	
Glanders	
Other diseases of this class	
Venereal Diseases—total.	
Parasitic Diseases—total.	
Hydatids	
Other diseases of this class	
Dietic Diseases—total.	
Starvation	
Scurvy	
Intemperance	
Constitutional Diseases—total.	
Acute rheumatic fever	
Gout	
Rickets	
Cancer	
Purpura	
Anæmia and chlorosis	
Leukæmia	
Diabetes mellitus	
Other diseases of this class	
Developmental Diseases—total.	
Premature birth	
Atelectasis	
Cyanosis	
Spina bifida	
Imperforate anus	
Cleft palate, hair-lip	
Other congenital defects	
Old age	
Diseases of the Nervous System—total.	
Inflammation of the brain	
Meningitis	
Apoplexy	
Paralysis	

At least one of these compilation sheets is to be used for each ward each month. If in any ward the number of colored, of Irish, or of Germans is five per cent. or more of the population, it is recommended that a separate sheet be kept for each class as well as one for the whole. At the end of the month the ward sheets should be consolidated on one sheet of the same kind which will form the monthly sheet for the city. At the end of the year the monthly sheets for each ward, and also those for the whole city, should be consolidated on similar sheets, which will be the yearly reports.

COMPILATION SHEET NO. 1.—*Continued.*

CITY OF WARD NO. RECORDS OF DEATHS EXCLUSIVE OF STILL BIRTHS FOR THE MONTH OF 188 FOR

AGE AND SEX.

CAUSES OF DEATH.	All Ages		Under 1 month.		1 and under 3 months.		3 and under 6 months.		6 mos. and under 1 yr.		1 and under 2 yrs.		2 and under 3 yrs.		3 and under 4 yrs.		4 and under 5 yrs.		Total under 5 yrs.		5 and under 10 yrs.		10 and under 15 yrs.		15 and under 20 yrs.		20 and under 25 yrs.		25 and under 30 yrs.		30 and under 35 yrs.		35 and under 40 yrs.		40 and under 45 yrs.		45 and under 50 yrs.		50 and under 55 yrs.		55 and under 60 yrs.		60 and under 65 yrs.		65 and under 70 yrs.		70 and under 75 yrs.		75 and under 80 yrs.		80 and under 85 yrs.		85 and under 90 yrs.		90 and over.	
	Male	Female	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Diseases of Nervous System—Cont.
Epilepsy
Convulsions
Mental diseases
Diseases of the brain
Diseases of the spinal cord
Other diseases of this group
Diseases of the Circulatory System—total.
Angina Pectoris
Aneurism
Diseases of the heart
Other diseases of this group
Diseases of the Respiratory System—total.
Croup
Laryngitis
Bronchitis
Pneumonia
Pleurisy
Asthma
Other diseases of this group
Diseases of the Digestive System—total.
Dentition
Angina
Gastritis
Other diseases of the stomach
Obstruction of the bowels
Hernia
Other diseases of the bowels
Jaundice
Inflammation and abscess of the liver
Other diseases of the liver
Peritonitis
Ascites
Chronic diarrhœa and dysentery
Other diseases of this group

Diseases of the Urinary System and Male Organs of Generation—total.
Bright's disease
Calculus, urinary
Diseases of the kidney
Diseases of the bladder
Other diseases of this group
Diseases of the Female Organs of Generation—total.
Ovarian tumors
Ovarian diseases
Uterine tumors
Uterine diseases
Other diseases of this group
Affections connected with Pregnancy—total.
Abortion
Childbirth (It is desirable to note all deaths of women occurring within one month after childbirth, no matter to what cause they are attributed)
Other diseases of this group
Diseases of the Bones and Joints—total.
Diseases of the spine
Diseases of the bones
Diseases of the hip joint
Other diseases of this group
Diseases of the Skin and Cellular Tissue—total.
Abscess
Carbuncle
Other diseases of this group
Diseases of the Absorbent System—total.
Addison's disease
Disease of the spleen
Other diseases of this group
Accidents and Injuries—total.
Burns and scalds
Drowned
Exposure and neglect
Gunshot wounds
Homicide
Infanticide
Injuries by machinery
Railroad accidents
Suffocation
Suicide by shooting
Suicide by drowning
Suicide by poison
Other suicides
Sunstroke
Surgical operations
Wounds
Other accidents and injuries

COMPILATION SHEET NO. 2:

SHOWING FOR THE CITY OF , BY WARDS, THE BIRTHS AND THE POPULATION, WITH DISTINCTION OF PARENTAGE, COLOR, AGE, AND SEX, ESTIMATED FOR THE MIDDLE OF THE YEAR ENDING

		Stillborn.			Live Births.			All Ages.	AGES. ESTIMATED POPULATION.																		
		Legitimate.	Illegitimate	Total.	Legitimate.	Illegitimate	Total.		Under one year.	1 and under 5.	5 and under 10.	10 and under 15.	15 and under 20.	20 and under 25.	25 and under 30.	30 and under 35.	35 and under 40.	40 and under 45.	45 and under 50.	50 and under 55.	55 and under 60.	60 and under 65.	65 and under 70.	70 and under 75.	75 and under 80.	80 and under 85.	85 and under 90.	90 and over.
THE CITY. Total....	Male....																										
	Female..																										
	Total....																										
Whites of American parentage........	M.																										
	F.																										
	Total....																										
" Irish parentage	M.																										
	F.																										
	Total....																										
" German parentage..........	M.																										
	F.																										
	Total....																										
" all other foreign parentages.	M.																										
	F.																										
	Total ...																										
" Total.......................	M.																										
	F.																										
	Total....																										
Colored..............................	M.																										
	F.																										
	Total....																										
Living in tenement-houses............	M.																										
	F.																										
	Total....																										
WARD 1. Total....	M.																										
	F.																										
	Total....																										
Whites of American parentage	M.																										
	F.																										
	Total....																										

	Whites of Irish parentage	M.
		F.
		Total
	" German parentage	M.
		F.
		Total
	" all other foreign parentages.	M.
		F.
		Total
	" Total	M.
		F.
		Total
	Colored	M.
		F.
		Total
	Living in tenement-houses	M.
		F.
		Total
WARD 2.	Total	M.
		F.
		Total
	Whites of American parentage	M.
		F.
		Total
	" Irish parentage	M.
		F.
		Total
	" German parentage	M.
		F.
		Total
	" all other foreign parentages.	M.
		F.
		Total
	" Total	M.
		F.
		Total
	Colored	M.
		F.
		Total
	Living in tenement-houses	M.
		F.
		Total

TABLE SHOWING FOR THE CITY OF THE NUMBER OF DEATHS FROM CERTAIN SPECIFIED CAUSES, BY WARDS, SEX AND COLOR, AND SEX AND PARENTAGE, PER 1000 OF ALL DEATHS.

Diseases.	WARDS.																				City.	White.		Colored.		Irish parentage		German parentage		Whites of American parentage	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
General Diseases																															
Diseases of the Nervous System																															
Diseases of the Circulatory System																															
Diseases of the Respiratory System																															
Diseases of the Digestive System																															
Diseases of the Urinary System and Male Organs of Generation																															
Diseases of the Female Organs of Generation																															
Affections connected with Pregnancy																															
Diseases of the Bones and Joints																															
Diseases of the Skin and Cellular Tissue																															
Diseases of the Absorbent System																															
Accidents and Injuries																															
Typhoid																															
Diphtheria																															
Cholera Infantum and Infantile Diseases																															
Other Diarrhœal Diseases																															
Consumption																															
Cancer																															
Acute Lung Disease																															
Debility and Marasmus, under one year of age																															
Debility and Marasmus, over 60 years of age																															
Debility and Marasmus, all ages																															
Suicides																															
Accidents																															

	WARDS. 1	2	3	4	5	6	Total for City.
Area in acres							
Number of dwelling-houses							
Miles of streets							
Miles of sewers							
Number of privy vaults							
Number of wells							
Total population							
Total number of deaths, excluding stillbirths							
Death-rate per 1000							
Population under five years of age							
Number of deaths under five years of age, excluding stillbirths							
Death-rate under five years of age							
Proportion of deaths under five years of age to total number of deaths							
Number of births during the year, excluding stillbirths: Legitimate							
Number of births during the year, excluding stillbirths: Illegitimate							
Number of births during the year, excluding stillbirths: Total							
Number of deaths under one year of age							
Rate per 1000 of deaths under one year to number of births							
Number of deaths under one month							
Number of deaths of those born within the year							
Rate per 1000 of deaths of those born within the year to number of births							
Estimated population over sixty years of age							
Number of deaths over sixty years of age							
Rate per 1000 of deaths over sixty years to population over sixty years							
Stillborn, number of: Legitimate							
Stillborn, number of: Illegitimate							
Stillborn, number of: Total							
Number of tenement-houses							
Estimated population of tenement-houses							
Total number of deaths in tenement-houses exclusive of stillborn							
Ratio per 1000 of deaths to population in tenement-houses							
Number of births in tenement-houses exclusive of stillborn: Legitimate							
Number of births in tenement-houses exclusive of stillborn: Illegitimate							
Number of births in tenement-houses exclusive of stillborn: Total							
Number of stillbirths in tenement-houses: Legitimate							
Number of stillbirths in tenement-houses: Illegitimate							
Number of stillbirths in tenement-houses: Total							
Number of deaths under one month in tenement-houses							
Number of deaths under one year, exclusive of stillborn, in tenement-houses							
Ratio per 1000 of deaths under one year to total births in tenement-houses							
Number of deaths under five years in tenement-houses							
Death-rate under five years in tenement-houses							
Proportion of deaths under five years to total number of deaths in tenement-houses							
Number of illegitimate births per 1000 of total births							
Number of cases of specific diseases reported during the year							
Number of deaths from specific diseases reported during the year							
Number of deaths from specific diseases per 1000 of population							
Number of deaths from specific diseases per 1000 of total deaths							
Number of deaths from diarrhœal diseases per 1000 of population							
Number of deaths from diarrhœal diseases per 1000 of total deaths							
Number of deaths from accidents and injuries per 1000 of population							
Number of deaths from accidents and injuries per 1000 of total deaths							

This table is to be made up from Compilation Sheets 1 and 2. In cities of which five per cent. and upwards of the population are Colored, Irish, or German, a separate table of this kind should be made for each of these classes, as well as for the total.

TABLE SHOWING FOR THE CITY OF , FOR EACH WARD, THE POPULATION AND THE NUMBER OF DEATHS, OF EACH SEX, OF EACH COLOR, WITH DISTINCTION OF CERTAIN GROUPS OF AGES.

Wards.			Population.	Deaths	Deaths in 1,000 Population.	AGES AT DEATH.																								
						Under 1.	1 to 2.	2 to 3.	3 to 4.	4 to 5.	5 to 10.	10 to 15.	15 to 20.	20 to 25.	25 to 30.	30 to 35.	35 to 40.	40 to 45.	45 to 50.	50 to 55.	55 to 60.	60 to 65.	65 to 70.	70 to 75.	75 to 80.	80 to 85.	85 to 90.	90 to 95.	95 and over.	Unknown
Ward 1.	White..	M.																												
		F.																												
	Colored	M.																												
		F.																												
	Total...	M.																												
		F.																												
Ward 2.	White.	M.																												
		F.																												
	Colored	M.																												
		F.																												
	Total...	M.																												
		F.																												

TABLE SHOWING FOR THE CITY OF THE DEATHS BY AGE, SEX, MONTH, AND CAUSES OF DEATH DURING THE YEAR 188 .

Sex.	Deaths—No. of.	MONTHS.													Causes of Death.	AGES.											
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Unknown.		Under 5.	5 to 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Unknown.
Males															Deaths from all causes												
Females															" " "												
Females															Abortion												
Males															Abscess												
Females															Abscess												
Males															Abscess, lumbar												
Females															Abscess, lumbar												
Males															Amputation												
Females															Amputation												
Males															Anæmia												
Females															Anæmia												
Males															Aneurism												
Females															Aneurism												

COMPILATION SHEET NO. 1.

CITY OF WARD NO. RECORDS OF DEATHS EXCLUSIVE OF STILL BIRTHS FOR THE MONTH OF 188 FOR

AGE AND SEX.

Causes of Death.	All ages.		Under 1 month.		1 and under 3 months.		3 and under 6 months.		6 months and under 1 year.		1 and under 2 years.		2 and under 3 years.		3 and under 4 years.		4 and under 5 years.		Total under 5 years.		5 and under 10 years.		10 and under 15 years.		15 and under 20 years.		20 and under 25 years.		25 and under 30 years.		30 and under 35 years.		35 and under 40 years.		40 and under 45 years.		45 and under 50 years.		50 and under 55 years.		55 and under 60 years.		60 and under 65 years.		65 and under 70 years.		70 and under 75 years.		75 and under 80 years.		80 and under 85 years.		85 and under 90 years.		90 and over.	
	Male	Female	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Grand Total																																																								
Unknown causes																																																								
Specific Diseases—total.																																																								
Small-pox																																																								
Measles																																																								
Scarlet fever																																																								
Diphtheria																																																								
Whooping-cough																																																								
Cerebro-spinal fever																																																								
Enteric fever																																																								
Erysipelas																																																								
Septicæmia																																																								
Puerperal septicæmia																																																								
Scrofula and tabes																																																								
Leprosy																																																								
Consumption																																																								
Hydrocephalus (acute)																																																								
Other forms of Tubercular Disease.																																																								
Tetanus and trismus, nascentium																																																								
Other diseases of this class																																																								
Diarrhœal Diseases—total.																																																								
Cholera morbus																																																								
Cholera infantum																																																								
Acute diarrhœa																																																								
Acute dysentery																																																								

Malarial Diseases—total.
Zoögenous Diseases—total.
Hydrophobia
Splenic fever
Glanders
Other diseases of this class
Venereal Diseases—total.
Parasitic Diseases—total.
Hydatids
Other diseases of this class
Dietic Diseases—total.
Starvation
Scurvy
Intemperance
Constitutional Diseases—total.
Acute rheumatic fever
Gout
Rickets
Cancer
Purpura
Anæmia and chlorosis
Leukæmia
Diabetes mellitus
Other diseases of this class
Developmental Diseases—total.
Premature birth
Atelectasis
Cyanosis
Spina bifida
Imperforate anus
Cleft palate, hair-lip
Other congenital defects
Old age
Diseases of the Nervous System—total.
Inflammation of the brain
Meningitis
Apoplexy
Paralysis

At least one of these compilation sheets is to be used for each ward each month. If in any ward the number of colored, of Irish, or of Germans is five per cent. or more of the population, it is recommended that a separate sheet be kept for each class as well as one for the whole. At the end of the month the ward sheets should be consolidated on one sheet of the same kind which will form the monthly sheet for the city. At the end of the year the monthly sheets for each ward, and also those for the whole city, should be consolidated on similar sheets, which will be the yearly reports.

COMPLIATION SHEET NO. 1.—*Continued.*

CITY OF WARD NO. RECORDS OF DEATHS EXCLUSIVE OF STILL BIRTHS FOR THE MONTH OF 188 FOR

AGE AND SEX.

Causes of Death.	All Ages		Under 1 month.		1 and under 3 months.		3 and under 6 months.		6 mos. and under 1 yr.		1 and under 2 yrs.		2 and under 3 yrs.		3 and under 4 yrs.		4 and under 5 yrs.		Total under 5 yrs.		5 and under 10 yrs.		10 and under 15 yrs.		15 and under 20 yrs.		20 and under 25 yrs.		25 and under 30 yrs.		30 and under 35 yrs.		35 and under 40 yrs.		40 and under 45 yrs.		45 and under 50 yrs.		50 and under 55 yrs.		55 and under 60 yrs.		60 and under 65 yrs.		65 and under 70 yrs.		70 and under 75 yrs.		75 and under 80 yrs.		80 and under 85 yrs.		85 and under 90 yrs.		90 and over.	
	Male	Female	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Diseases of Nervous System—Cont.																																																								
Epilepsy																																																									
Convulsions																																																									
Mental diseases																																																									
Diseases of the brain																																																									
Diseases of the spinal cord																																																									
Other diseases of this group																																																									
Diseases of the Circulatory System—total.																																																									
Angina Pectoris																																																									
Aneurism																																																									
Diseases of the heart																																																									
Other diseases of this group																																																									
Diseases of the Respiratory System—total.																																																									
Croup																																																									
Laryngitis																																																									
Bronchitis																																																									
Pneumonia																																																									
Pleurisy																																																									
Asthma																																																									
Other diseases of this group																																																									
Diseases of the Digestive System—total.																																																									
Dentition																																																									
Angina																																																									
Gastritis																																																									
Other diseases of the stomach																																																									
Obstruction of the bowels																																																									
Hernia																																																									
Other diseases of the bowels																																																									
Jaundice																																																									
Inflammation and abscess of the liver																																																									
Other diseases of the liver																																																									
Peritonitis																																																									
Ascites																																																									
Chronic diarrhœa and dysentery																																																									
Other diseases of this group																																																									

Diseases of the Urinary System and Male Organs of Generation—total.
Bright's disease....................
Calculus, urinary....................
Diseases of the kidney ....
Diseases of the bladder ....
Other diseases of this group........
Diseases of the Female Organs of Generation—total.
Ovarian tumors....................
Ovarian diseases....................
Uterine tumors....................
Uterine diseases ....
Other diseases of this group........
Affections connected with Pregnancy—total.
Abortion..........................
Childbirth (It is desirable to note all deaths of women occurring within one month after childbirth, no matter to what cause they are attributed)...........
Other diseases of this group........
Diseases of the Bones and Joints—total.
Diseases of the spine...............
Diseases of the bones ....
Diseases of the hip joint............
Other diseases of this group........
Diseases of the Skin and Cellular Tissue—total.
Abscess ....
Carbuncle ....
Other diseases of this group........
Diseases of the Absorbent System—total.
Addison's disease....................
Disease of the spleen...............
Other diseases of this group........
Accidents and Injuries—total.
Burns and scalds ....
Drowned..........................
Exposure and neglect...............
Gunshot wounds ....
Homicide..........................
Infanticide..........................
Injuries by machinery...............
Railroad accidents..................
Suffocation ....
Suicide by shooting..................
Suicide by drowning ....
Suicide by poison..................
Other suicides ....
Sunstroke. ....
Surgical operations..................
Wounds..........................
Other accidents and injuries........

At least one of these compilation sheets is to be used for each ward each month. If in any ward the number of colored, of Irish, or of Germans is five per cent. or more of the population, it is

COMPILATION SHEET NO. 2:

SHOWING FOR THE CITY OF , BY WARDS, THE BIRTHS AND THE POPULATION, WITH DISTINCTION OF PARENTAGE, COLOR, AGE, AND SEX, ESTIMATED FOR THE MIDDLE OF THE YEAR ENDING

		Stillborn.			Live Births.				AGES. ESTIMATED POPULATION.																			
		Legitimate.	Illegitimate	Total.	Legitimate.	Illegitimate	Total.	All Ages.	Under one year.	1 and under 5.	5 and under 10.	10 and under 15.	15 and under 20.	20 and under 25.	25 and under 30.	30 and under 35.	35 and under 40.	40 and under 45.	45 and under 50.	50 and under 55.	55 and under 60.	60 and under 65.	65 and under 70.	70 and under 75.	75 and under 80.	80 and under 85.	85 and under 90.	90 and over.
THE CITY. Total	Male																											
	Female																											
	Total																											
Whites of American parentage	M.																											
	F.																											
	Total																											
" Irish parentage	M.																											
	F.																											
	Total																											
" German parentage	M.																											
	F.																											
	Total																											
" all other foreign parentages	M.																											
	F.																											
	Total																											
" Total	M.																											
	F.																											
	Total																											
Colored	M.																											
	F.																											
	Total																											
Living in tenement-houses	M.																											
	F.																											
	Total																											
WARD 1. Total	M.																											
	F.																											
	Total																											
Whites of American parentage	M.																											
	F.																											
	Total																											

Whites of Irish parentage.............	M.	
	F........	
	Total....	
" German parentage	M.	
	F........	
	Total....	
" all other foreign parentages.	M.	
	F........	
	Total....	
" Total..........................	M.	
	F........	
	Total....	
Colored..............................	M.	
	F........	
	Total....	
Living in tenement-houses............	M.	
	F........	
	Total....	
WARD 2.		
Total....	M.	
	F........	
	Total....	
Whites of American parentage	M.	
	F........	
	Total....	
" Irish parentage	M.	
	F........	
	Total....	
" German parentage..........	M.	
	F........	
	Total....	
" all other foreign parentages.	M.	
	F........	
	Total....	
" Total..........................	M.	
	F........	
	Total....	
Colored..............................	M.	
	F...... .	
	Total....	
Living in tenement-houses............	M.	
	F........	
	Total....	

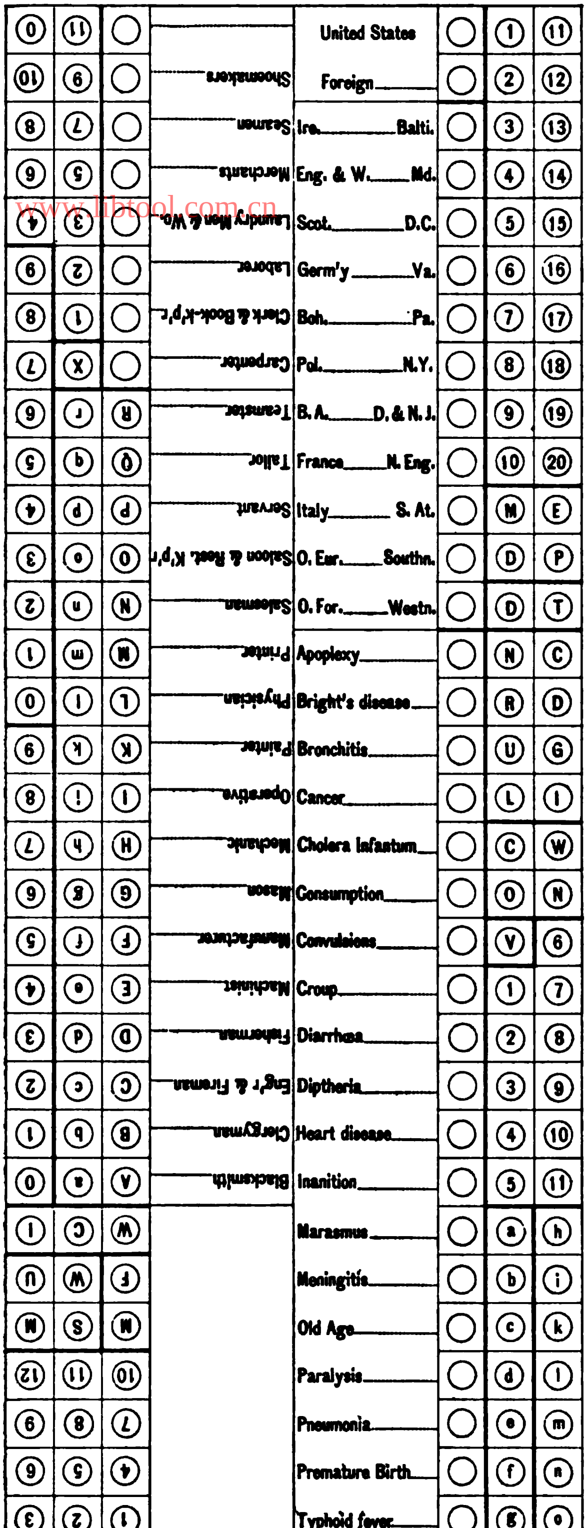


DIAGRAM OF BALTIMORE.

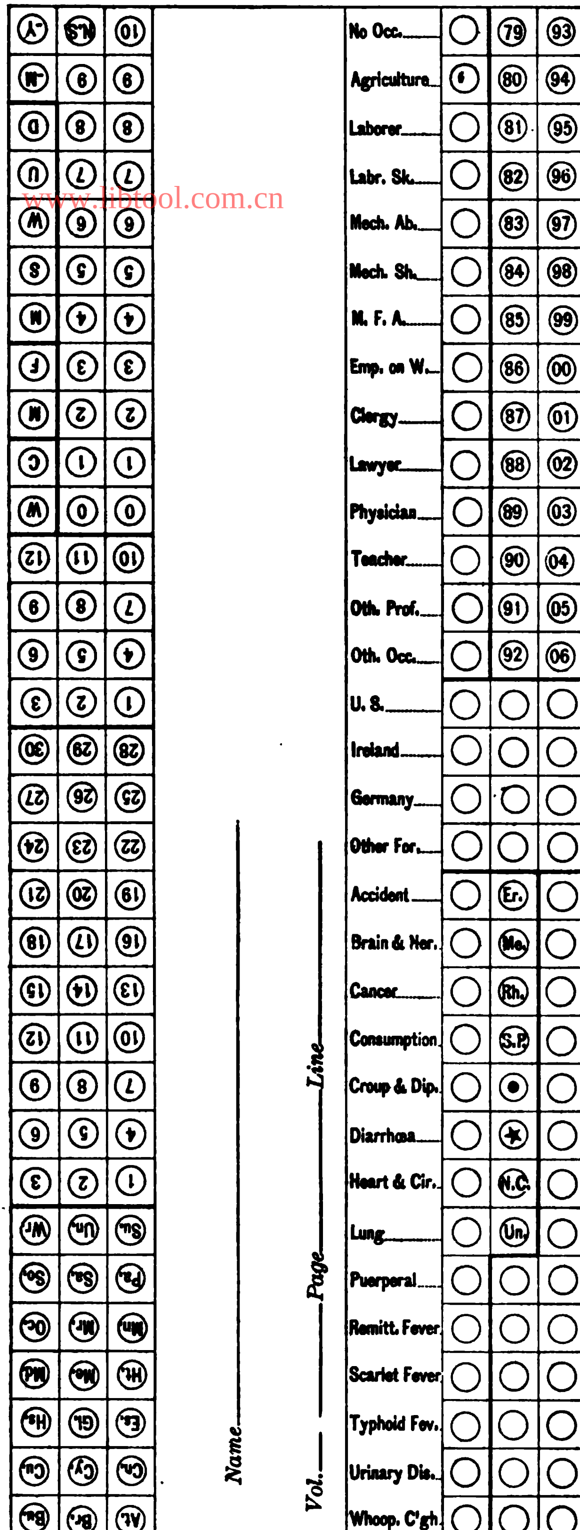


Diagram of New Jersey.

XII.

THE MALARIAL GERM OF LAVERAN.

By W. T. COUNCILMAN, M. D.,
Associate Professor of Anatomy, Johns Hopkins University.

I am led to invite your attention to a consideration of this subject, to-night, from a feeling that it will prove interesting to you, not only in its general scientific bearings, but from the practical result in hygiene which I feel sure the acceptance of the parasitic nature of the malarial virus will lead to. The discovery of Laveran, in 1880, of a peculiar organism in the blood in cases of malarial fever, has opened up a new and unexplored field of research. Koch, in the same year, called attention to the fact, that, in our search for the pathogenic agents of disease, we should not allow ourselves to be limited by the field of bacteria, and adduced one particular evidence in the vegetable kingdom where a parasite was found, which, in a certain stage of its metamorphosis, could not be distinguished from the living cells of its host. The discovery by Laveran of a pathogenic organism, in what constitutes, probably, next to tuberculosis, our most important class of diseases, followed close upon this prediction; and already this has led to the discovery of organisms which apparently belong to the same group as the malarial parasite in several other diseases, one of which is the surra, which affects the horses and mules of India. The protozoa, to which the malarial parasite belongs, are unicellular organisms, larger and more highly organized than the bacteria. Their higher organization is shown principally by the fact that many of them have a differentation of parts of their protoplasm for a particular function, and require for their food highly organized and insoluble material. They are noted for their extreme polymorphism, the changes which they undergo in the various steps of organization being so remarkable that frequently there does not seem to be any connection, certainly no morphological connection, between them. The malarial parasite does not form any exception to this general rule, and it is most interesting to know that certain definite forms of organism are always associated with definite types of the disease.

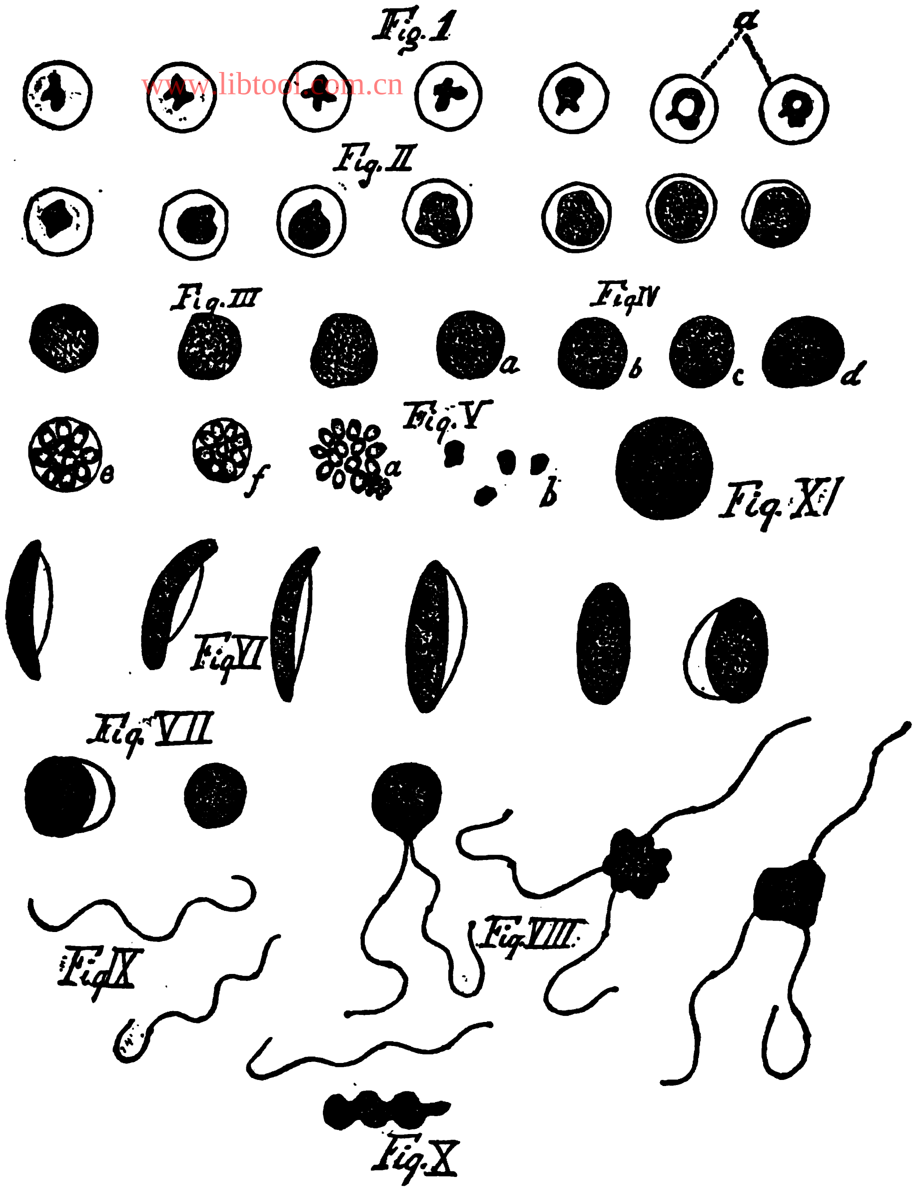
On this chart, which has been rather hastily prepared, the different forms under which this organism is met with have been roughly sketched. There are ten principal forms under which this organism is seen. The first five of the forms shown here (in the upper part of the diagram) are those forms which are found in intermittent fever, and the others belong to certain other types of this disease.

Apparently the first stage in which this organism is found, is in the red corpuscles of the blood, where it is seen as an exceedingly hyaline, very movable, organism. Its changes of form are very rapid—more rapid than the ordinary changes of form one finds in the fresh water amœba. In the first line of drawings here, I have sketched a red blood corpuscle which contains one of these organisms. It is very pale, and its protoplasm is very slightly differentiated from the protoplasm of the red blood corpuscle. The various forms shown here may be seen in the organism in the course of half an hour's observation. The movements that it makes will at once recall to any one the picture of the fresh-water amœba, as it is seen moving over the field of the microscope. The parasite at this stage is always seen inside of the red blood corpuscles. In some of the corpuscles it will be noticed that the organism has more or less of a circular arrangement (*a*, Fig. I). This has led to a good deal of controversy, and the idea has been advanced that this is a form of vacualation in the corpuscle enclosing in the vacuole what, possibly, is an early form of the parasite. But I am inclined to the opinion that what we find here inside of this circular form is a portion of the red blood corpuscle which the organism has separated from the rest, its protoplasm having surrounded it, just as the amœba surrounds any solid particle before assimilating it.

In the next stage we find the same organism, but now marked by a peculiarity which was not seen in the first, and that is the pigmentation (Fig. II). At first we find a small hyaline body that is probably a little larger than the non-pigmented form, and a few granules of pigment appear in it.

Then we have every stage of the pigmentation—sometimes only a few granules, sometimes the whole body is filled with them. Along with the pigmentation, the body increases in size till the entire red corpuscle is filled with it. Then we can see, right around the body, a faint contour which represents the original contour of the red blood corpuscle. The parasite has grown inside of it, and has apparently entirely assimilated it. The pigment it contains has been derived from the hæmoglobin of the corpuscle, and as it increases in amount the corpuscle becomes paler and paler. Finally this remaining rim of the corpuscle disappears, and the parasite becomes free in the blood (Fig. III). At this stage it contains a great many pigment granules in active Brunonian motion; but the body itself has very little of the amaboid motion that was so conspicuous in the first form (Fig. I).

In the next stage a most interesting phenomenon is seen, and that is a segmentation—a multiplication of the parasite. There is first noticed in the body a change in the character of the protoplasm, in that it becomes more granulous. The granules which appear in the protoplasm are larger and paler than the usual granules in cells, the single ones difficult to distinguish, and they merely give the body a more opaque appearance. At the same time this granulation begins, there is some change in the pigment. In the earlier forms it has the shape of very fine rods, and now it becomes larger and nearer round. Then, after a time, we see the



DESCRIPTION OF PLATE.

Fig. 6, 1–5. The intra corpuscular forms of the parasite found in intermittent fever, showing the various stages of its development.

Fig. I. A non-pigmented amœboid body, inside a red corpuscle, found in intermittent fever several hours after the chill. *a*—The ring-like form which this body sometimes assumes.

Fig. II. Pigmented amœboid bodies found inside the red corpuscles at the same time. The pigment increases in these as they grow larger, and the corpuscle becomes correspondingly paler.

Fig. III. Pigmented bodies which, after the destruction of the red corpuscles which formerly contained them, have become free in the blood.

pigment arranged more or less into lines radiating from the centre, as is seen in Fig. IV, *b* and *c*. The pigment gradually collects in the centre of the organism, until we find it collected into a small, solid mass. At this time fine lines can be seen radiating from the centre of the parasite to the periphery. These lines become plainer and more extended, until finally this whole body breaks up into a number of very small bodies (Fig. IV, *e* and *f*) with a mass of pigment in the centre of them. The number of these segments varies greatly. Sometimes there are only six or eight formed, and in one case I counted as many as eighteen. Very often they are arranged in a definite manner, with a certain number forming an inner circle and an outer circle around this. They are usually enclosed in the membrane of the cell. This finally breaks down, and the small bodies become free in the blood, and then, as a rule, we find some free pigment lying near the groups which have resulted from segmentation. This pigment has evidently come from these bodies, and this is the source of the pigment that is formed in the blood, either free or enclosed in white blood corpuscles, and which for a long time has attracted the attention of observers. These small bodies are very faintly amboid. They undergo very slight changes of form, which I have endeavored to depict in Fig. V, *b*.

So far, the changes in this organism seem to form a perfect chain. We can trace a connection between the non-pigmented form to the pigmented form,—first, very small bodies, becoming pigmented; then the granulation commencing; then segmentation, with the formation of groups of small bodies; the escape of these from the envelope surrounding them; and these small bodies are evidently the non-pigmented bodies which we find inside the red corpuscles. On one or two occasions we have apparently seen one of these small bodies in the act of passing into a red blood corpuscle, but our observations on that point have not been sufficiently numerous to speak with certainty. The other forms of the organism that we find differ so much from those I have first shown (Figs. I–V), that one is inclined to think of the possibility of there being something entirely different, and that the type of malarial fever in which these bodies are found, differing as it does from the acute intermittent, is rather an altogether distinct disease.

The next forms (Fig. VI) that we find are crescentic in shape, and

Fig. IV. *a, b, c, d, e, f*,—The various steps leading to complete segmentation which these bodies pass through during the chill period. These changes consist in a gradually increasing granulation, then formation of segments.

Fig. V. The small bodies which have resulted from segmentation. *a*—A group of such bodies lying together with the mass of pigment near them. *b*—Single bodies of like origin which have a slight amœboid motion.

Fig. VI. Crescentic-shaped bodies found free in the blood in cases of malarial cachexia.

Fig. VII. Other forms of these bodies.

Fig. VIII. The flagellated forms of the organism found in the blood in any form of the disease, but found most frequently in blood taken directly from the spleen.

Fig. IX. Free flagellæ found often in the same cases with the flagellated organisms.

Fig. X. A very rapidly moving body found but once, and then in blood taken from the spleen.

Fig. XI. White corpuscle containing pigment granules.

X 800 diameters.

more easily seen than any others. They are found not inside of the red blood corpuscles, but free in the blood. Their size varies somewhat; they are usually about one and a half times as long as the diameter of a red corpuscle, and present some variations from the purely crescentic shape. One of the most curious things about them is a very fine line that runs from one extremity of the crescent to the other. They are very highly refractive, and their outline is so sharp that they appear almost as drops of oil do under the microscope. In fact, one can hardly understand how they should have eluded attention so long, and it is very possible that earlier observers have seen them. Virchow figured, a number of years ago, bodies very similar to these, which he supposed were pigmented endothelial cells which had been washed from the inner lining of the veins of the spleen.

Other bodies, probably of the same nature as the crescents, but which differ from them in shape, are often seen in the same preparation with them; and we may find every variation from the perfect crescent—the round bodies seen in Fig. VII. They are always pigmented. The pigment is contained in the middle of the body, and very often it has more or less of a regular arrangement. These bodies, Figs. VI and VII, are always found in that form of malaria known as malarial cachexia—a condition into which the patient often passes after a more or less severe attack of acute intermittent fever.

One of the most interesting forms of this organism is represented here (Fig. VIII). This is a particularly interesting form, because Laveran described it so fully, and supposed it was the true malarial parasite. Whether he was right or not is a point which, up to the present, cannot be fully determined. These forms are bodies which are not quite (as a rule, about two thirds) as large as blood corpuscles. They always contain pigment, which is not in the shape of the very fine rods seen in Figs. II and III, but in the form of rounder granules, and has a circular arrangement. The most interesting point is, that this body has attached to it long flagellæ, which have a very active, whip-like motion, and lash about the red corpuscles in their vicinity. One often sees in the preparation of blood what appears to be almost a little whirlpool, in which the blood corpuscles are dashed about in all directions, and one then sees a pigmented body in the centre of the whirlpool, and, after a good deal of watching, the rapidly lashing flagellæ come into view. They are very pale, slightly refractive, and are about three or four times the length of the diameter of a red blood corpuscle. Sometimes they are attached to the body at opposite points, but sometimes three and sometimes four of them will be attached to a single point. At other times the body to which they are attached has a more or less elongated shape, and the flagellæ are attached to the small extremity of the body. This is interesting enough in itself, but it is far more interesting to find that the flagellæ very often become detached, or detach themselves from the body and exist free in the blood. They then swim rapidly through the blood, and whenever they come in contact with an obstacle, as, for example, with a blood corpuscle, they do not attempt to pass around it, but continue to push against it. Very often one will see a blood corpuscle struck by one of these free flagellæ: it will be indented, and then the filament remains actively in motion, pushing against the corpuscle. It is very difficult to see these free filaments. They can only be made out by watching the body a certain time. Just how long they can exist in the blood free from this body, is uncertain. I have seen one an hour after the blood was drawn. There is another form I have seen only once in two hundred examinations, and that is a body like this (Fig. X), which has the same index of refraction as the crescentic form. I do n't know how common it is, but in the course of two hundred examinations I only found it once. I omitted to say that, very often, along with this action of the filaments, the periphery of the body to which they are attached has a more or less undulatory motion. The first forms that I have shown here (Figs. I–V) may exist in any form of intermittent fever, whether we have the quartan, the tertian, or the quotidian. With us, in Baltimore, the most cases are the ordinary tertian, but we have, as well, a number of quotidians, and occasionally the quartan form. The segmentation is always associated with a particular phase of the intermittent attack—that is, with the chill. One never finds it taking place except during the chill period, and then it is invariably present. My examinations of the blood in the chill period now cover some eighty-five cases, and in not one of those cases, where the blood was examined during the chill, has this segmented form been missed. The segmentation appears to begin, and one sees the first stages leading up to it, as a rule, about two hours before the chill comes on. Then the bodies in which it is seen gradually increase in number, and it reaches its height at the commencement of the chill. Towards the end of the chill they become fewer, and two hours after the chill, as a rule, one sees none of the segmenting bodies. These crescentic forms (Fig. VI), that are so easily seen, are not found in intermittent fever, but occur in these cases we know as malarial cachexia. They are generally cases that come into the hospital somewhat anæmic, more or less jaundiced, and, as a rule, an enlargement of the spleen and some pain and tenderness of the spleen, and hepatic region as well, can be made out. Generally the patient gives a history of having had chills at some time previous to his entry into the hospital, and very often says the chills have been stopped by doses of quinine. The flagellate forms are not found so often, but they have been found in the blood in cases of intermittent fever and malarial cachexia, along with the other forms which are pathognomonic of their conditions. Figure X was only found once, and that was in a case of very well marked cachexia.

My work this fall was done more to establish, if possible, a connection between the various forms, and as I could not find any connection at all between them in examinations of blood taken from the finger, I undertook a series of examinations of blood drawn directly from the spleen. In all, I have so examined twenty-three cases. In three of these cases there was a failure in getting the splenic blood. In one case the hypodermic needle could not be made to encounter the spleen, and in two cases the syringe did not work properly. There appears to be absolutely no danger in drawing blood in this way from the spleen, if proper precautions are taken. The needle of the syringe was always thoroughly disinfected by boiling it, and then making the puncture with the thoroughly disinfected needle. In one case, to show you how harmless this procedure may be, a year ago I was examining the spleen of an individual who had a severe case of typhoid fever. The syringe happened to be a little imperfect, and in withdrawing it the needle broke short off at its attachment and remained in the spleen. He complained for some days of a slight stitch in his side, but beyond this there were no ill effects at all. What became of the needle is not known. In all of these cases no ill effects followed the puncture. I did not find, in the examinations of splenic blood, the connection between the different forms of the parasite which I hoped to find, but found other interesting results. I found that the flagellated form of organism was very common in the splenic blood. Of the twenty cases examined, eight were cases of intermittent fever. The splenic blood was examined both during the chill and in the period of apyrexia. Twelve were cases of malarial cachexia, and in ten of these cases the flagellated forms were found, and in five out of the eight cases of intermittent fever they were also found. That is exceedingly interesting, because it shows we may have changes going on and certain forms of the parasite developing in the spleen which do not appear in the blood. I attempted some countings, in order to determine just how many of these bodies would be found in a cubic millimeter of blood. I found it impossible to count these first forms, because, under the conditions that were necessary to count them in the blood, they could not be seen. The crescentic forms, however, could be found, and in one or two cases I found these in the blood in the proportion of about one to eighteen hundred red blood corpuscles; and I could only judge from these how numerous the others were, because in both of those cases the crescents were apparently as numerous in the blood as the intra corpuscular forms were found in other cases. It is probable that the blood corpuscles are directly destroyed by these organisms which develop inside the corpuscles; but we do not find enough of them in the blood to account in that way for the very rapidly developing anæmia of malarial fever. So it is extremely probable that we have going on in the spleen, and most probably in the bone marrow as well, certain other processes leading to the destruction of the blood corpuscles that are probably associated with the flagellated or the crescentic forms. We rarely have in Baltimore the type of malarial fever which is known as the pernicious malarial fever. I have seen only seven cases in the last three years. These have all come to the autopsy table, and I show you here a capillary of the brain in one of these cases of pernicious malarial fever, in which the patient died during a distinct congestive chill. We have here in the capillary an immense number of bodies which apparently correspond in all respects with Fig. IV, so that it is probable, in these forms of malaria, that this segmentation is going on all over the body. Still, I found other cases of pernicious malarial fever. Where this segmented form was not found, in the brain capillaries and elsewhere, there were other forms,—some inside of the red blood corpuscles, others free,—which were similar to Figs. II and III. The most easy way of studying these bodies is by staining them. They will stain with any of the analine colors, and are very easy to see after being stained. It was very interesting for me to note the effect of the various anti-malarial remedies on these organisms. I commenced by increasing the dose of quinine, and one could find, after a time, the quantity that would destroy these intracorpuscular forms in every case of intermittent fever. I have found no case of intermittent fever in which, after giving the patient forty-five grains of quinine a day for two days in succession, these forms were not entirely destroyed. With the cessation of these forms in the blood, there was no further return of the chills, and in all these cases the quinine was stopped after two or three days. With regard to the other forms of malaria, particularly in the cachexia, the effect of remedies is not so apparent. One can give extreme doses of quinine and find scarcely any effect on these crescentic bodies. The patient's appetite will improve, and he will express himself as being better in every way, but these bodies will persist. In one case where they were very abundant, and the patient in an exceedingly anæmic condition, I gave him forty-five grains of quinine a day for seven days, then sixty grains daily for four days more, and the bodies still persisted in spite of such doses of quinine, which must be considered a little above the ordinary dose.

Regarding the question whether this organism—because it must be assumed to be an organism, a living body—is the cause of malaria or not, the connecting link is wanting. Up to the present time, the only proof that we have that it is the cause of malaria is, that we find some form of it in all cases of malarial infection, and we do not find it in other diseases. Now, we have abundant analogy for considering an organism that is always found associated with some particular infectious disease, and is found nowhere else, under no other circumstances, in connection with no other disease, as the cause of the disease in question. There is a certain amount of opposing evidence to this. Pfeifer has recently descried in the blood, in cases of scarlet fever, an appearance in the red blood corpuscles that is decidedly similar to the earliest form of these corpuscles; and still more recently an Italian, Mosso, has described wonderful changes in the red blood corpuscles. With regard to Pfeifer's claims, I have not been able to investigate any cases of scarlet fever; but even if a similar organism should be found in cases of scarlet fever, this would argue nothing against the ætiological importance of the organism as found in malaria. It is possible that we may find in scarlet fever, and possibly in other infectious diseases, organisms of the same class as in malaria. With regard to Mosso's experiments, I have repeated some, but with altogether different results. My own examinations embrace more than 225 cases of various forms of malaria, and I have never failed to find some form of this organism. Other observers who have labored in the same field have been equally successful, and the importance of this as a diagnostic point will appeal to every one. It is of special importance, in enabling us to diagnose cases of malarial from typhoid fever in the early stage. I have repeatedly examined cases which were taken into the hospital as typical cases of remittent malarial fever. On examination of the blood, these bodies have not been found, and I have never hesitated, under such circumstances, to say the case, whatever the clinical history might be, was not malarial. And the further history of the case has always confirmed the diagnosis made by the microscope. It is important to be able to say, in the first stages of fevers, whether the cases are typhoid or malaria, because it is between these two fevers that the question of the diagnosis generally rests. As regards the distinct remittent fever as figured by the text-books, I am led to consider those cases as extremely rare, and in the last two years have only found in the hospital in Baltimore one case which could be regarded as at all typical.

XIII.

THE DESTRUCTION OF GARBAGE.

By L. LABERGE, M. D.,
Medical Health Officer, Montreal, Canada.

I fully appreciate the honor conferred upon me by my appointment on the committee chosen to deliberate on the question of the disposal of garbage, a subject which appears upon the programme of this meeting as next in importance to the question of the purity of the supply of one of the most essential elements required for the support of life, namely, water. But had I been present at the time my name was proposed in connection with this committee, I should certainly have declined the nomination; for the limited experience I have had since taking office, and the little time at my disposal, precluded the possibility of my preparing an exhaustive paper upon this important question. Being unable, therefore, to enter upon the treatment of the subject in the manner I should have desired, I felt that it would be wiser to confine myself simply to giving an account of the reasons that induced the authorities of Montreal to initiate the carbonization system, and to giving a description of the works now in operation.

Montreal, in common with most other cities, experienced vast difficulty in getting rid of its fecal matter and house offal. According as the progress of science impressed more and more upon the public mind the danger to be apprehended from accumulations of filth (a teaching which the experience of centuries, often through terrible epidemics, has fully demonstrated) did the anxiety of the authorities to get rid of this danger increase. In our city, as elsewhere, the principal method of disposing of waste matter was by its removal beyond the city limits, where gullies, ravines, marshes, quarry pits, etc., could be had to receive it. But the great inconvenience resulting from this method was constantly felt; and, besides, such a manner of disposal did not effectually rid the city of the filth, for many such places not yet within the city may before long be annexed to it and be built upon, and even if they should not be so annexed, the presence of large deposits of offal so near the city limits exposed its inhabitants to constant danger. As an instance of the evils occasioned by large deposits of garbage, I might cite a case that occurred in Montreal about two years ago. Part of a ravine running through a vacant lot of ground was allowed to be used as a dump for refuse supposed to be free from offensive substances; yet the place became so great a nuisance that further dumping was prohibited, and the deposit covered over with lime and earth. But this did not end the inconvenience, for spontaneous combustion ensued, and a large quantity of smoke was given off, which those residing in the neighborhood had to inhale for weeks, the offal being allowed to smoulder away until the fire exhausted itself, as the efforts of the firemen to extinguish it were fruitless.

Therefore for several years the board of health engaged in an attentive study of the question of dealing with the difficulty, and noted the various attempts made from time to time in foreign cities (especially in those remarkable for their enterprise in sanitary matters) to establish an effectual method of refuse disposal. Incineration, of course, has always been considered the most complete and certain manner of destroying refuse; but the various apparatus hitherto invented for this purpose were generally more or less defective, and in many cases the resulting inconvenience was so considerable as to necessitate their entire abandonment. However, so much progress in this direction had been made, especially in England, that the board of health resolved, in 1885, to make an attempt to secure the incineration of the most objectionable part of the filth of the city, namely, the night soil,—decision in this respect having been hastened by the judgments rendered in the police court and in the court of queen's bench in law-suits brought against the contractor by certain neighboring municipalities; also by the testimony given by scientific men during the trials, and by the decided stand taken by those municipalities to prevent the depositing upon, or even the cartage of this objectionable matter through, their territory.

Ex-Alderman Gray, then chairman of the board, lent his warmest support to this measure, and spared no efforts to secure its adoption. Largely, therefore, as a result of his endeavors, tenders were invited for the carrying out of this work; and that of Mr. William Mann, who had matured a plan for the purpose of incineration, was accepted, he being granted a bonus of $8,000 per annum for the service. The crematory works were then established at Coteau St. Louis, a municipality adjoining the city, and the process of incineration was immediately begun. Upon several occasions after the process had been started, the works were visited by experts under the direction of the board, and the experiment was declared by them to be a success.

During the late epidemic, the attention of the board was directed to another source of danger in addition to the decomposition of organic matter in the house refuse, that is to say, the offal, etc., from houses infected with contagious diseases. It therefore became necessary to institute a special service for the removal and destruction of this matter. But it was clearly evident that such a precaution should not be confined merely to refuse infected with the contagion of small-pox, for equal danger was to be apprehended from that infected with the contagion of diphtheria, scarlet fever, typhoid fever, etc. Here, again, Ex-Alderman Gray exhibited his zeal for the welfare of the city by urging upon the board the absolute necessity for the destruction by fire of the entire collection of offal removed from the city, bearing in mind the possibility of a visitation of cholera, perhaps at no distant day. So tenders were invited for the incineration, as well as for the collection and removal, of house offal. In response to an advertisement, Mr. Mann, who had so successfully initiated the crematory process for the night-soil the preceding year, submitted a tender. After careful examination of the same, the board, having previously possessed themselves of such information as would enable them to judge of the probable efficiency of any method proposed, as well as to form an idea of the probable cost of the same, became convinced that the interests of the city demanded the immediate acceptance of Mr. Mann's tender, and reported to the city council accordingly. The latter body ratified the decision of the board, and granted, in the early part of last year, a contract to Mr. Mann for a period of five years, at the price of $43,000 per annum.

To the enthusiastic support given the measure by the then chairman was due in a great degree its success, and full credit should be given him for the valuable services he thus rendered the city.

Montreal may well be proud of the position she has taken in this matter; and, from the number of inquiries daily received at the health department from all parts of the continent, it is evident that her example will shortly be followed by every leading city in America.

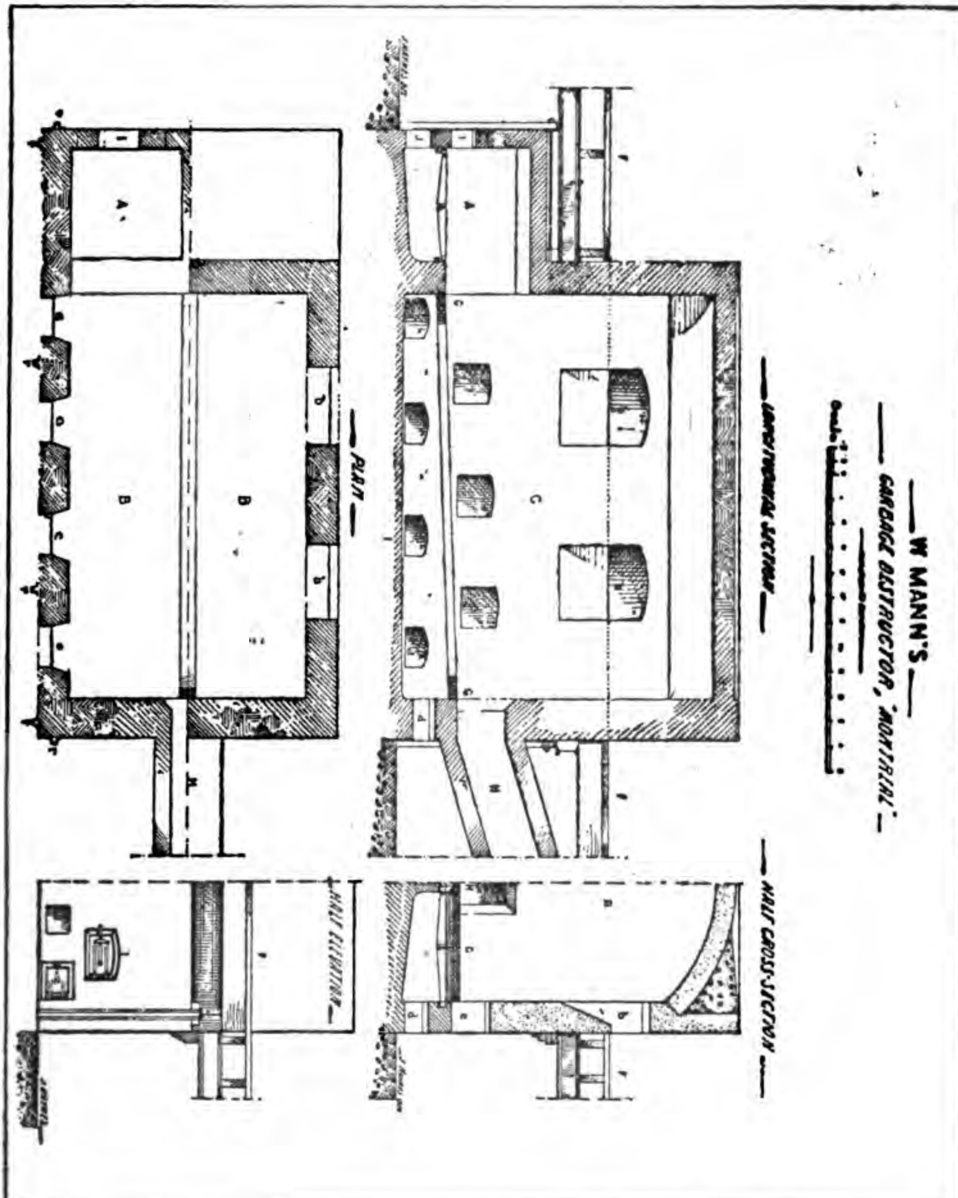
The scavenging work is now performed in the following manner: The city is divided lengthwise into three districts, each of which is visited by the scavengers twice a week, between the hours of seven o'clock P. M., and eight o'clock A. M. Citizens are required to collect the refuse accumulating on their premises and put it out in vessels of a capacity not greater than that of an ordinary flour barrel, either in the streets in front of their houses, or else in the lanes contiguous thereto, when they are large enough to admit the scavenging vehicles. The scavengers are required to conform to the following section of the specification for this work:

SEC. 6. The scavenging work comprises and embraces the removal of all refuse of animal and vegetable food matter excepting human and animal excreta; all decayed fish and fruit; all entrails and cleanings of fish, flesh and fowl, rats; all garbage, ashes, soot, and cinders; all house, store, and yard sweepings; all shavings, sawdust, hair, rags, fur, leather, and tin cuttings; all tailors' cuttings; all oyster, clam, and lobster shells; and all broken crockery, glass, tinware, stove-pipes, paper, garden trimmings, and straw,—which may be placed in boxes, tubs, barrels, or other vessels, and set out in any street, avenue, square, and public or private lanes, by the proprietors, tenants, or householders of all dwellings, hotels, restaurants, offices, shops, factories, warehouses, and all public and private institutions within the limits of the city, as described in the preceding clause; the said barrels, boxes, tubs, or other vessels or receptacles not to exceed in capacity an ordinary flour barrel. The contractor shall also remove from every public or private hospital, within the limits of the city, all such matters as are above enumerated, but he shall not be called upon to remove poultices and other objectionable matter, unless the same be placed in tight-fitting covered vessels, nor shall the contractor be required to remove any portion of human remains or parts of animals which are not the refuse of animal food; and if such is found by the contractor to be mixed with the other matters, he shall report the same to the board of health, who shall relieve him from the necessity of removing the offal from such hospital until convinced that proper precautions have been taken to prevent a repetition of such offence.

The matter thus collected is conveyed to the incinerator, and there destroyed.

A by-law formerly existed requiring the separation of the ashes from the garbage, and an endeavor was made to put it in operation; but when it was found that it would be required to institute prosecutions in order to enforce its provisions, the attempt was abandoned, there being no special reason at the time demanding such separation. Later, when it became necessary to take measures to prevent rag-pickers and others from deranging and overturning the vessels put out for the scavengers, a clause was inserted in the by-law concerning scavenging, to meet this requirement; but, by some mischance, the clause relating to the separation of the ashes from the garbage was altered in such a way as to deprive the board of the power to cause the separation. So that possibly the authorities will find it necessary, sooner or later, to amend the law in question, in order to regain the power lost. Of course the separation of these matters has its advantages and disadvantages. For example: The separation would facilitate the cremation of the garbage, and thus reduce the cost; and the ashes, having been sifted to remove any refuse that might happen to be mixed therewith, could be advantageously used to fill up marshy spots, low lying ground, and the quarry pits that abound on the outskirts of the city. On the other hand, a difficulty might be encountered in forcing poor people to keep two vessels, one of them, that for the garbage and swill, covered; besides, they are so roughly handled by the men employed as scavengers that it is necessary to procure new vessels at frequent intervals. Then, during the heat of summer, the mixture of the ashes with the garbage tends to retard the decomposition of the latter, thus proving, to a certain extent, a disinfectant and an absorbent of a certain value; so that it is very doubtful whether the separation would be in the interests of public health. At certain periods of the year, namely, during the months of April and May, the scavenging work assumes serious proportions, owing to the extensive accumulations formed during the winter season. This is due partly to the negligence of householders, and partly to the blockage of lanes, etc., by snow, which prevent the scavengers from obtaining access to them.

From 1872 to 1875, inclusive, the scavenging service was under the control of the board of health, and the amount expended annually for this work was, for each year respectively, $3,200, $2,000, $3,900, and $2,900. In 1876 the supervision of the work was transferred to the road department, when the expenses increased to a very high figure annually,—namely, $7,000 in 1876, $9,000 in 1877, $10,200 in 1878, and $8,130 in 1879. In 1880 the control of the work was transferred back again to the board of health, when the cost was reduced to the same figure as that paid by the road department the first year they took charge of the service, that is to say, $7,000. But from that time up to the present the expenditure has augmented from year to year, according as the work assumed larger proportions and according as the obligations of the contractor increased. Thus, in 1881 and 1882, the amount paid the contractor was $8,000; and the following year the board, believing that it would be better to change the hours for the performance of the service in order to avoid having the streets and lanes filled in the day-time with all kinds



of unsightly receptacles containing garbage and swill, oftentimes exhaling most offensive odors, decided to have the work carried on at night. This necessitated an increase in the expenditure, the total amounting to

$14,000. In 1884 the cost reached $17,200; in 1885, $25,000; and last year, as has been stated, the contract was given out for five years at the price of $43,000 per annum; but this of course includes the cremation.

The destruction of the garbage is effected by Wm. Mann's Patent Garbage Destructor, of which the following is a description. Referring to the plan, which is drawn to the scale of three fourths of an inch to the foot, we have,—

A The fire-place (2) (4 feet 6 inches long by 4 four feet 3 inches wide, and 3 feet 4 inches high.)

B The combustion chamber (9 feet 4 inches wide by 16 feet 2 inches long, and 10 feet high).

G G' Inclined grate (9 feet 4 inches wide by 16 feet 2 inches long).

H H' Inclined brick flue (18 inches by 22 inches), leading to the boiler-plate stack *S*, 2 feet 4 inches inside diameter, and 90 feet high.

F F' A floor or staging on which the garbage wagons are brought close to the furnace.

N. B.—The destructor is placed in a hollow in order do away with the usual inclined plane, which is a great draw-back, especially in winter.

This staging is made with 3-inch planks, nailed on 3- by 12-inch pin joists; 3 feet centres, supported on 5- by 10-inch rolled beams resting on the destructor proper.

b b' b'', etc., (4) Feeding doors on a level with the top of the floor.

c c' c'', etc., (6) Side doors on a level with the top of the grate, *G G'*.

d d', etc., (8) Side doors on a level with the ground floor.

g Grate-bars to the fire-place.

i (2) Fire doors.

j (4) Ash-pit doors to fire-place.

The whole is substantially built with red brick, lined in the parts exposed to the fire with fire-brick laid in fire clay, and solidly braced with bridge rails (*r*) and wrought-iron tie rods.

Working of the Apparatus.—A fire is built in the fire-place *A*, and when the whole is heated the garbage is dumped in front of the feeding doors, is fed through them with manure forks, and falls in heaps upon the surface of the inclined grate *G*, where it is spread evenly through the side doors *c*. At this stage of the operation the combustion takes place, and the gaseous products make their exit through the brick flue *H* and the stack *S*. When the combustion is completed, the ashes fall through the grate-bars, which are spaced two inches apart, into the ash-pit below, from which they are drawn to the side doors. These ashes are then carted out, and, in accordance with a certain clause of the contract, are placed at the disposal of the road department. The apparatus has, so far, given complete satisfaction in destroying garbage without giving off any offensive gas.

As to the cost of carrying out the process, I may state, in concluding, that Mr. Mann, who, I believe, is present at this meeting, and who is in a better position than I am to furnish information upon the point, will, I have no doubt, be happy to answer any questions relating to the subject that the meeting may put to him.

Further information concerning the cremation of night-soil, as well as household refuse, in Montreal, may be found in the annual report of the medical health officer for 1885, and also in the annexed report of

Ex-Alderman Gray, which is embodied in the annual report for this year, the English edition of which is now ready.

Extract from the Annual Report of the Medical Health Officer of Montreal, for 1886.

Report on the Cremation of Night-Soil and Household Refuse in Montreal, by Alderman Henry R. Gray.

A few years ago the removal and final disposition of the household refuse and night-soil of Montreal became a serious question. It was presented to the citizens in a forcible manner, when the surrounding municipalities not only energetically protested against receiving the city's filth, but passed by-laws to prevent its being carted through.

One municipality (Verdun) took action in the courts against the civic contractor for committing a nuisance, and depositing matter injurious to the public health. The verdict was in favor of the municipality, and the contractor was mulcted in heavy damages.

As the result of this action and of others which were immediately threatened, the board of health was obliged to look for some practical and unobjectionable method for the disposal of the city's refuse within its own limits.

Information was sought from the large cities of England and the United States, and sanitary scientists of world-wide repute were written to, in order to obtain the latest opinions on a subject which has occupied the attention of hygienists for many years.

I had previously arrived at a settled conviction that cremation was the only solution of the problem, and the correspondence received showed conclusively that the vast majority of sanitary scientists are agreed that the manurial value of the solid refuse of large cities must be sunk entirely, and only its total destruction be primarily held in view. Others went further, and gave it as their deliberate opinion that perfection in this matter will not be reached until not only household refuse and human excrement (when the latter cannot be removed with the liquid sewerage), but the bodies of the dead, are cremated.

After much discussion and after various plans had been suggested to the board, I succeeded in getting a motion passed, that the contents of the privy pits should be cremated as a beginning, and that a report be made to the city council for the necessary power to advertise for tenders. The result of this was that a contract for five years was given to Mr. Wm. Mann to build furnaces according to the plans referred to in his tender, and to cremate the night-soil, for the sum of $8,000 per year. The contractor bound himself to take all risks of failure, to employ an engineer to draw out working-plans, and to superintend the building of his furnaces—the whole to be carried out to the satisfaction of the board. In this contract, which was largely experimental, the contractor was not bound to build his furnaces within the city limits, and he succeeded in coming to terms with the authorities of a neighboring municipality, which considerably lessened the expenses which he would have been put to in obtaining land in the city. The cremation of the night-soil was so successfully carried out, and the satisfaction of the citizens of Montreal and the surrounding municipalities was so great, that after having visited the works at all hours, and having assured myself that the burning process produced no nuisance and was thoroughly done, I forthwith began an agitation for the cremation on the same system of the whole of our household refuse, which at that time was being collected twice a week, carted beyond the limits, and dumped on the territory of our immediate neighbors. The stench on some of these dumping-grounds was exceedingly disagreeable, and injurious to the health of the neighborhood, and complaints were being continually laid before the board on the subject.

The small-pox epidemic of 1885 drew the attention of the public to the gross injustice which Montreal was inflicting on its neighbors by carting out its infected refuse and storing it up in the adjoining municipalities. Numerous representations were made to the board complaining of this state of affairs.

After several conferences on the subject with the medical health officer, Dr. Laberge, and the sanitary inspector, Mr. Radford, and knowing that a large number of our most intelligent citizens were in favor of cremating the household refuse, I laid the whole matter before the board, the result being that a report was made to council asking for power to call for tenders for the immediate building of the necessary furnaces, and the cremation of the filth collected by the scavengers. After many delays and no little opposition, with the assistance of the medical health officer and several members of the board of health, I succeeded in having the report sanctioned by the council. Tenders were duly called for, and Mr. Mann, whose knowledge and experience with the furnaces already built by him, under contract with the city, gave him an immense advantage over all competitors, was the sole tenderer. After considerable cutting down of the price tendered, and some changes in the specifications, the contract was eventually given to Mr. Mann at the rate of $28,000 per annum for the furnishing of plant and the bi-weekly collection and cartage of household refuse from every residence within the city; and $15,000 per annum for the cremating of the same, including erection and maintenance of the necessary furnaces, acquisition of the land required *within the city limits*, and the furnishing of all the apparatus; the whole to be at the risk of the contractor, and to the satisfaction of the board of health. The work of cremating the household refuse was commenced early in August, 1886, and has continued regularly ever since, to the great satisfaction of the board, the citizens of Montreal, and the surrounding municipalities.

Both myself and Dr. Laberge have received numerous letters of inquiry with regard to the method employed and the success of our system of cremation, from sanitary scientists, medical health officers, and chairmen of local and state boards of health, from all parts of the continent. Many of them express the opinion that, at the first intimation of cholera having obtained a foothold on United States soil, every city of importance will at once seek cremation as the only practical and safe method of disposing of their household refuse.

The refuse crematories are situated on the Papineau road, within the city limits, in what may be termed the brickyard and stone quarry region of Montreal. The property acquired by the contractor is an old quarry, from which clay had been taken for brickmaking purposes. The night-soil crematories, as previously mentioned, are placed beyond the city limits. When the present contract expires, there will be no reason why the refuse crematories should not be used for this purpose also; an additional furnace being built to accommodate the extra work. Such an arrangement would lessen considerably the expense of cartage, and do away with the necessity of keeping up two establishments.

The heaviest part of the work in connection with the collection of household refuse is done in the spring of the year, and when it so happens that the snow does not disappear from the yards and lanes until near the 1st of May (when a number of families yearly change their residences), the work which the contractor is called upon to perform is enormous, and his ability to perform the work is taxed to its utmost. It is at this period that every effort is put forth by the health department, through its well trained sanitary police, to oblige the citizens to clean their yards and lanes, and put the refuse into convenient receptacles for the scavengers. In this connection it may be stated that the scavengers have removed as many as 9,000 packages in the twenty-four hours; and it must be borne in mind that only one section of the city is scavenged at the same time. The largest number of loads removed in one day was 700, and the smallest, 200,—mean, 450; the load being, Mr. Mann, the contractor, informs me, 30 cubic feet. April and May are the heaviest months in the year.

On the 31st of March, 1886, the medical health officer was requested to find out the number of loads actually taken out of the city, when the officers of the department reported 269 loads, of 15 cwt. each, removed that night.

It only remains for me to add that the contract for cremating the night-soil was given out on the 1st of April, 1885.

The contract for cremating the household refuse was given out on the 1st of July, 1886, and the work began on the 11th of October, 1886.

Both contracts are for a period of five years, and are subject to stringent conditions.

A great responsibility rests on the board of health and its officers, in seeing that these contracts are properly carried out and that every particle of the city's refuse is honestly cremated. The benefits conferred on the community by the immediate and total extinction of its refuse by fire *depends largely on the honesty of the contractor* in faithfully performing his duty, and any laxity in this respect should be at once reported to the board by the head of the department.

The following table, kindly furnished in 1885 by Mr. William Heap, of Owen Sound, manufacturer of Heap's earth closets and agent for the Bee Hive refuse-destructor, will be of some interest, as showing the great expense of cremating only small quantities of refuse in England:

	Size of Cremator.	Daily consumption.	Cost of Cremator.	Working expenses per year for furnaces only.	Population.
Burnley	3 cells	21 loads*	£800 sterling	£250 sterling	70,000
Bradford	12 "	72 "	£8,550 "	£774 "	209,564
Birmingham	Not mentioned	12 "	Not mentioned	3½d per ton	421,210
Blackburn	4 cells	24 "	£10,724 sterling	£26 sterling	110,000
Richmond	2 "	16 "	£450 "	10¾d per load	23,000

* 15 cwt. each.

None of the above towns, at that time, burned all their refuse. Birmingham was then collecting 500 loads per night, and only cremating, experimentally, 12 loads.

By later accounts, the whole of the refuse in many towns, and also in the different parishes of London, is being cremated.

In conclusion, I append the following opinion of a great sanitarian, with reference to the necessity of cremating the filth of a large city:

Extract from "Pall Mall Gazette," July 3d, 1884.

Sir Robert Rawlinson says,—"All that water can remove must be washed away. *All matter liable to become putrid must be consumed by fire.* There must no longer be high heaps of refuse stored and sorted to enable portions to be sold as manure, every £1 sterling obtained from such manure having cost £2 sterling, or upwards, to bring it to any available market. There can be no true economy in retaining refuse liable to become offensive, in the midst of populations, waiting for a market.

"The effectual destruction of the refuse at the least possible expense is the object to be gained."

HENRY R. GRAY,
Chairman Board of Health.

XIV.

CHOLERA AND QUARANTINE.

By JOHN H. RAUCH, M.D.,
Secretary Illinois State Board of Health.

I know of little, if anything, to add to what I have already said and written upon the subject of Quarantine and Asiatic Cholera in this country. In former years, at sessions of the National Conference of State Boards of Health, the American Medical Association, the Illinois State Board of Health, and before this Association, it seems to me that the subject was covered pretty thoroughly, and what I said in 1884, 1885, and 1886 is substantially true at the present time. Recent events, however, make a *resumé* of the subject pertinent on this occasion.

At the National Conference of State Boards of Health, held in the city of St. Louis October 13–15, 1884, I took occasion to offer some "Practical Recommendations on the Exclusion and Prevention of Asiatic Cholera in North America," prompted thereto by the increasing spread of the epidemic in southern Europe. Changing the dates and periods, the summary of the situation presented in the opening paragraphs of that address are as applicable now as at that time.

For the past nine years—ever since the summer of 1878—the country has been free from any serious and widespread epidemic disease. Small-pox, which prevailed from 1880 to 1883, has been successfully combated, and its ravages confined to proportions which are insignificant when compared with many other epidemics. Hundreds of thousands of unprotected immigrants were landed on our shores during those four years; but the Immigrant Inspection Service, inaugurated in the spring of 1882, thenceforth rendered them comparatively harmless, and outbreaks of the disease were promptly suppressed wherever sanitary authority had control, and well defined methods of dealing with the contagion were enforced. On the other hand, while we have fought small-pox and conquered it, we have been spared from any serious conflict with yellow fever. Nor have other diseases prevailed to an unusual extent, as they so often do in the prolonged absence of an epidemic. On the contrary, the average annual death-rate has been low, and until within the past year remarkably so.

This fact was at that time made a warning to the sanitarian. It was then pointed out that a death-rate so long continued below the normal means a survival of a large number of persons who would have been carried off had the non-epidemic diseases maintained their usual severity; that it implies the accumulation of susceptible material ready for the prey of epidemic contagion, whenever such contagion may be introduced under conditions favoring its propagation and spread. "It is one of the most important factors in determining the extent and severity of the next epidemic, whatever that may be and whenever it may visit us."

For a period of six years preceding the date of that address, sanitary effort and sanitary authority had had no unusual demand made upon them, or at least no demand which the public recognized as unusual. During those six years the interest in sanitary matters, which had been aroused by the epidemic of 1878, and which, among other causes, led to the formation of many of the present state boards of health and to the creation of the national board, had gradually diminished as the memory of the epidemic faded away, or was displaced by other and newer topics and occurrences.

This interest was, however, revived to some extent during the summer of 1884, and continued, though gradually diminishing, through the succeeding years. Under its stimulus a great amount of local sanitary work was accomplished by state and municipal health authorities, and it is generally conceded that this was of great value—aside from any consideration of cholera—in reducing sickness and mortality from the entire list of diseases which are caused or favored by filth and other insanitary conditions.

Within the past month there is again a revival of this interest, due to the actual advent of Asiatic cholera to our shores; and it is now our duty as sanitarians to utilize and direct this, primarily and most importantly, to the securing of an adequate quarantine service, which shall, in future, prevent the entrance of cholera and other contagious diseases; and, next, to a continuance of our efforts for the perfection of local sanitary regulations which will enable us to deal efficiently with outbreaks of cholera, should any unfortunately result from the recent importations.

A QUARANTINE OF EXCLUSION ESSENTIAL.

This still seems to me to be the natural and proper sequence of the measures of protection for this country, taking into consideration our geographical position, commercial relations, and the other conditions peculiar to us as a people. For the exotic contagious diseases—those which must be imported in order to appear amongst us as epidemics—a quarantine of exclusion, as perfect as can be made by sanitary supervision at the port of departure and during the voyage, and by inspection on arrival, when, if contagious disease exists or suspicious conditions warrant, prompt segregation, isolation, prophylaxis, and thorough purification of passengers, crew, cargo, and vessel, should be enforced until all danger of landing the contagion on our shores is removed.

As was said in the address already cited, "It may be entirely true that, if all our food-supplies were wholesome, and our water-supplies not only unpolluted but unpollutable; if sewage and refuse disposal were prompt and complete; if our cities, towns, and villages were all models of sanitary perfection, and their inhabitants free from predisposition or susceptibility, acquired or inherited;—in short, if there were no ignorance, nor poverty, nor filth, nor infirmity in the land, we might dispense with precautions against the introduction of disease. But the sanitary millennium is not yet, and we are hardly likely to witness its advent in this generation, no matter how earnestly we may labor for it. So, for the present, at least, as a practical sanitarian accustomed to deal with conditions as they actually exist, I think the wise thing to do in respect to cholera is to resist the first beginnings.

"That cholera *will* come, it is our duty to assume. Mindful of the history of every previous cholera epidemic, we must accept as beyond a doubt, if experience is worth anything, the certainty that the disease will be brought to our shores. It always has come, sooner or later, whenever, since 1832, the contagion has obtained such a foothold in Europe as it now has."

This forecast, made in 1884, has been already fulfilled, and we are to-day threatened with an invasion of the disease, separated from us now by but very slight barriers indeed. It has been said that as long as there was one case of cholera on the continent of Europe this country was menaced. How much more are we now menaced, when, if we have not yet a case, we certainly have islands infected by recent cases in our own country.

CHOLERA PREËMINENTLY A QUARANTINABLE DISEASE.

A grave responsibility rests upon the sanitarian at the present juncture: but there is an equally weighty obligation resting upon the public and upon our legislators. I undertake to say, as a sanitary official of nearly twenty-eight years' experience in the practical administration of sanitary matters in city, state, and nation, and after more than a third of a century of study and observation of the disease, beginning in 1850, that Asiatic cholera may be practically excluded from the United States; that it is preëminently a quarantinable disease; that, with a judicious employment of agencies which have already been tested, Asiatic cholera may be quite as successfully dealt with in this country as small-pox, and probably more so than yellow fever. Unlike the virus of small-pox, unlike the poison of yellow fever, the morbific potency of the cholera germ is sharply limited as to duration in unfavorable surroundings, and thus the disease is made more certainly controllable by modern quarantine methods, such as have been indicated.

It is charged that quarantine is powerless to prevent the extension of epidemic diseases; that, in the language of John Simon, "a quarantine which is ineffective is a mere irrational derangement of commerce;" and that to be effective, it must be of such a nature as to absolutely prevent all intercourse with the infected country. All this may be true of Great Britain, owing to her geographical position, to her extensive commerce and its exigencies, to her dependence on other countries for her food-supply, and to other conditions which do not obtain with us. It may also be true of Europe generally. There, a narrow strait or sea, a river, a mountain-chain, or merely a territorial boundary line, with its custom-houses and passport system, defines the limits to be guarded, and forms the only physical barrier between the quarantiner and the quarantined. Here, the whole width of the Atlantic intervenes between us and the infected country. There, cordons and quarantines mean privation, misery, and suffering, and, ultimately, starvation. Here, the nation is self-supporting, and could exist unaffected in almost all her material interests. There, it may be true, as alleged, that a quarantine of exclusion is impossible of execution, and that the attempt to maintain it does more harm than good, in leading to numberless contraband practices by which the disease may be introduced in unsuspected ways.

None of this is true when applied to the exclusion of Asiatic cholera from this country; while to accept the statements unquestioned would cause vigilance to be relaxed, would invite contagion to our shores unimpeded, and would finally throw upon individual communities the burden and responsibility of fighting the disease at an immense disadvantage, —that is, of fighting it at home and from many quarters, instead of on the outer lines and from only one direction.

With the necessary agencies of an effective quarantine provided in due season, it would not require any very great degree of courage to promise the practical exclusion of the disease. Whether cholera shall be excluded —whether the means and agencies necessary to deal with it shall be supplied—are questions which the public must answer through their representatives in congress, in state legislatures, and in municipal councils.

NATIONAL CONTROL OF MARITIME QUARANTINE.

What congress should do, in my judgment, as the result of prolonged experience and observation, and in the light of the results achieved by the National Board of Health, I have already set forth at some length, and on more than one occasion. But the recent liberation of Italian immigrants from Palermo, a cholera-infected Sicilian town, after a detention of only twenty-four hours in quarantine,—a period entirely too short for the efficient disinfection of baggage,—and the results of my inspection of the sea-coast quarantines from the St. Lawrence to the Rio Grande, of which more hereafter, warrant a further consideration of the subject at the present time. To guard against a possible recurrence of such importations,—which have been often paralleled in my experience with regard to small-pox among immigrants, and through which importations, both of cholera and small-pox, the interior is affected while the port of arrival escapes,—no ordinary system of quarantine, controlled by a state or a municipality alone, will suffice. Prompt and trustworthy information, such as the general government only can obtain, concerning the sanitary history of all emigrants during the existence of cholera in Europe, is obviously necessary to this end.

We must urge congress to organize a national health service, clothed with power, and supplied with means to create and maintain an effective system of modern sanitary maritime quarantine. I would also emphasize a former recommendation, which this experience proves to be well advised. Congress should give the president power to issue a proclamation forbidding immigration into the United States from infected districts of other countries. The necessity of such a measure has been recognized in other quarters, and the mayor of New York has within a few days given a practical endorsement of the suggestion by his letter on the subject. Such a prohibition would be one of the most important measures of protection which could be devised.

In fact, the only alternative for a rigid quarantine of exclusion against the importation of the foreign contagions is the exclusion of the immigrants themselves, through whom alone, in their persons or effects, these diseases find access to this country.

THE PRESENT STATUS OF QUARANTINE.

It will be remembered by some present, that from 1884 to 1886, when our attention was seriously called to these questions by the alarming prevalence of cholera in southern France and Spain, these and similar recommendations as to the duty of congress were made by this and other bodies, but resulted in no improvement in our national quarantine provisions. The federal government failing to take action upon these recommendations, the Illinois State Board of Health authorized me, in July, 1885, to make an inspection of the Atlantic and the Gulf quarantines. Such inspection was designed to supplement the action of the board,—inaugurated on receipt of the first information that Asiatic cholera had again invaded Europe, threatening another pandemic extension,—and which action aimed to secure the best attainable sanitary condition of the territory under its immediate jurisdiction as one of the most important preparations against the spread of the disease within the state, should the contagion be introduced.

The geographical position of Illinois, within from twenty-four to forty-eight hours of all the important ports on the Gulf and Atlantic coasts, its commercial relations, the extent and character of its means of communication, and the fact that fully one half of the immigrants to this country come into or pass through the state, most of them remaining at least long enough to communicate contagion and under conditions favorable to such communication, obviously make the administration of these quarantines, with especial reference to the exclusion of Asiatic cholera, a matter of sufficient importance to warrant the board in securing all accessible information concerning them, the better to enable it to discharge its duty in connection with the protection of the lives and health of the citizens of the state.

In the present epoch of quarantine Illinois has a direct interest, chiefly commercial, in the exclusion of yellow fever from the Mississippi valley; in the exclusion of vaccinally-unprotected immigrants at the North Atlantic ports for the protection of her own territory from small-pox; and in the exclusion of Asiatic cholera generally, whether it threatens by direct importation from Europe, or mediately through the West Indies, Mexico, and South America. In brief, the state is concerned in the condition of the sanitary coast defences from the mouth of the St. Lawrence to the mouth of the Rio Grande.

From 1698 to the present time, the control of quarantine has remained entirely under the jurisdiction of state and local authorities, except during the brief period in which the National Board of Health exercised its limited quarantine powers under the act of 1878, and which expired in 1882. It is this absence of adequate national health authority and legislation, and the fact that, in such absence, the maritime quarantines are controlled and administered by state and local authorities, resulting in diverse, and frequently conflicting, regulations and requirements, and of necessity in a tendency to limit precautions to their own individual interests, commercial as well as sanitary, which throw upon interior states the responsibility of fully informing themselves of the strength or weakness of these outposts, in order to know where to anticipate danger and how to make their own preparations to meet it.

The present status of national sanitary legislation, and of the national sanitary executive, is admittedly defective and unsatisfactory. The history of the attempts to control the disinfection of rags; the complications at the port of New York concerning consular bills of health; the strictures upon the inspection service maintained along the coast, and in the matter of inspections on the Canadian frontier during the last small-pox epidemic; the complaints of various boards of health that they are directed to look to the Associated Press for information and warning concerning threatened danger from abroad to their ports and territory, and many other similar matters, point to the necessity for a well considered and radical revision of existing national sanitary legislation.

Consular bills of health, which are now as a rule almost worthless, might be made of the greatest value; and these, together with the prompt publication of direct and official information concerning the sanitary status of foreign ports—such information to be secured by competent persons—are essential to the prevention of the introduction of foreign contagion. Obviously such measures can be regulated, controlled, and provided only by the national government.

In this connection, while it causes a sense of shame that our own govment has done nothing, it is gratifying to be able to state that the recommendations made in the report of this inspection for improving the quarantine service at Grosse Isle in the St. Lawrence river have been practically carried out, as will be explained later by Dr. Montizambert, the Dominion quarantine officer.

QUARANTINE AT NEW YORK.

Turning from this point to the quarantine station at New York, the following remarks were made in the report of my inspection:

"The *personnel* of the establishment varies with the exigencies of the season. In addition to the health officer, I found only two deputies employed,—one upon the quarantine ship, and one at the quarantine station.

Dr. Smith himself attends to the sick in hospital, and was treating a yellow fever case (convalescent) during my visit.

"Summing up, with reference to the exclusion of cholera and small-pox, the quarantine plant and facilities of the port of New York are unrivalled, the printed regulations judicious, and with proper vigilance the service should suffice to prevent either of these diseases from obtaining access to the country through this avenue. But the entire system is hampered by a vicious financial policy, which is, in effect, a farming-out of the service. At the other important ports, the fees go directly to the municipality or state, and the chief executive officers are paid fixed salaries, and are provided with such employés as may be necessary to the proper and efficient conduct of the quarantine.

"New York *may* exclude cholera under her present system, but more confidence would be reposed in the result if less were demanded of professional ability, personal integrity, and executive firmness in the health officer, and if the system were freed from influences which are most deprecated by those who, without prejudice, best understand them."

With the introduction of cholera into this country on the steamer "Alesia," on September 23, the members of this Association are familiar; but it may be permitted to give the details of my own experience in this connection, as illustrating the anxiety and responsibility thrown upon the sanitary executives of the interior. Upon the receipt of the first information concerning the "Alesia," I telegraphed Dr. Smith, the health officer of the port, asking the status of affairs. He replied as follows on September 26: "No new cases to-day. Eight in hospital. Five hundred and fifty immigrants under observation at Hoffman island. Have no apprehension of disease reaching the city."

To this the following answer was sent: "Thanks for telegram. What is the status to-day? Hope your expectations will be realized. Incur no risk. Allow no passengers or baggage to enter New York until you are perfectly satisfied there is no danger. The quarantine system of the port of New York is now on trial. The season of the year is favorable, and no spread of the disease should occur with the facilities at hand beyond those that have been on the vessel."

On October 10 the following telegram was addressed to Dr. Smith: "What is the cholera status? When will you discharge Italian immigrants? Where are they going? Think it very important that the health authorities of the localities to which they go should keep them under supervision. If any are sent to Illinois, I wish to know it."

To this he replied: "Eight cases of cholera were removed from Alesia. Twenty-six have developed at quarantine of observation. Eight cases now in hospital, seven likely to recover. No new cases during the past two days. Condition of immigrants encouraging. None will be discharged until all danger is past. Full passenger lists will then be published."

An associated press dispatch soon after told of a very satisfactory inspection having been made by the New York city board of health; and, as I was then preparing my quarterly report and desirous of embodying the latest definite information as to the situation, I again telegraphed on October 15, and on the 17th received the following: "Was absent at hospital. No new cases for several days at quarantine. All Alesia passengers convalescent with one exception."

Noting the detention of the Britannia, I sent the following telegram on the 19th: "What is the status to-day? Pleased with work so far. When will Alesia immigrants be discharged? If any should come to Illinois, please inform me. When did last cases occur among immigrants under observation?"

Dr. Smith replied: "But one case since night of 7th among Alesia's passengers. This was closely isolated before symptoms appeared, as several of same family had cholera. Patients in hospital all convalescent."

The unsatisfactory character of this dispatch created some uneasiness, which was increased by the receipt during the session of our board of an associated press dispatch stating that four cases of cholera had appeared on the Britannia, and that she had been ordered down to the lower bay. I promptly telegraphed, asking specifically if this statement was true, to which late at night I received this reply: "Not true. Britannia had three deaths on voyage, declared by surgeon not cholera. Symptoms of all three cases on ship not quite satisfactory. Vessel sent below to observe, clean up, and disinfect."[1]

Had I not received this dispatch, it was my intention to take the action to which attention will be called later. A few days afterwards it was learned that Dr. John C. Peters had made an inspection of Hoffman island, and that he had made some strictures with regard to the sanitary care of those under observation. Then came the information that the passengers of the "Independente" had been relieved from quarantine after only one day's detention. This naturally created an uncomfortable feeling, which was not allayed by the information that the quarantine commissioners had asked the treasury department if vessels from cholera ports could not be turned back. Finally there came the report of the committee appointed by the College of Physicians and Surgeons of Philadelphia, of which the following abstract will suffice:

In its report the committee states that there was not sufficient time at its disposal to warrant the examination of other than the ports mentioned, and that there is no reason to believe, from the published official reports, that any other ports on the Atlantic or Gulf coast had quarantine facilities in any respect superior to those examined. The first part of the report deals with what, in its opinion, is an efficient maritime quarantine against cholera. The second part treats of the provisions the committee found at New York, Philadelphia, and Baltimore. As regards those at Philadelphia and Baltimore, the committee reports that they fail in the

[1] As is now known, the Britannia was actually infected on arrival, the sickness on board being positively identified as Asiatic cholera through the culture experiments made by Dr. Shakespeare of Philadelphia, and others. Being the first diagnosis of cholera by this method for quarantine purposes in any country, it is worthy of note in this connection.

most essential requisites of the necessary number of properly equipped buildings for the isolation and observation of a large number of immigrants.

Concerning New York quarantine, in which we are most interested because of its cholera-infected condition, the committee states that the rooms are not sufficiently divided to permit isolation into small groups; the water-closets are not sufficiently numerous, their flushing arrangements were out of repair, and their soil-pipes reached the sea by tortuous angled turns. The supplementary latrine was condemned. The absence of bedsteads, chairs, tables, and proper eating utensils added to the hardships of the immigrants, and the absence of towels in the lavatory and of paper in the water-closets added to the danger of infection, of which soiled hands and filthy clothing were evidences. It is, perhaps, only necessary to state that the committee believes the infection to exist on Hoffman island by reason of bad management, and that the immunity of the mainland up to the present has been due to good fortune rather than to good management. It recommends the placing of all maritime quarantine in the hands of the general government, and asks authority to issue an address to all medical authorities, urging action looking to that end.

It seems proper to note at this point the prolonged existence of the contagion, and the number of cases after arrival. If only those actually suffering from the disease when the Alesia was boarded off Stapleton had been removed to Swinburne island, and the rest of the passengers had been allowed to land at Castle Garden, there is a strong probability that these would have scattered the cholera contagion widespread throughout the interior.

This question is of great importance, as it deals with affairs at a port which is not local but national in its character, and which, therefore, if for no other reason, should be controlled by national authority.

About two thirds of the total immigration, and more than two thirds of the total foreign imports, into the United States pass through quarantine at the port of New York. Without assuming that these proportions may be taken as a measure of the relative importance of the New York quarantine compared with the quarantines of the rest of the country, its absolute importance cannot be over-estimated. The individuals and their effects, and the cargoes with which it deals, are distributed to every part of the continent; and while from climatic and other conditions the port itself might be protected by given quarantine methods, it would by no means follow that measures adequate for such protection would ensure the safety of remote sections of the country from the disastrous effects of the importation of foreign contagion or infection through and beyond the port.

It having been announced last week that another vessel from cholera ports was on the way, and that one of the quarantine commissioners was going to Washington to confer with representatives of the national government, it was deemed advisable to take the action indicated in the following communications as the only means which I could employ at that time to avert a possible danger. The first of these was addressed to the quarantine commissioners of the port of New York:

ILLINOIS STATE BOARD OF HEALTH,
SPRINGFIELD, November 5, 1887.

Gentlemen: In view of the present cholera situation, I would request that certificates be given to the Italian immigrants now in quarantine at the port of New York, and those arriving from cholera-infected points, when released from quarantine, setting forth that the party is not suffering from cholera or choleraic symptoms, giving length of time under observation, and that clothing, dunnage, and baggage have been thoroughly cleansed and disinfected. It is also requested that when any immigrants leave the quarantine station to come into or pass through the state of Illinois, you will please telegraph this office, and the health commissioner of Chicago, and the health commissioner of St. Louis, according to their destination. This board feels that surveillance should be exercised over this class of immigrants after they arrive in this state, lest they might possibly become the means of spreading the disease. A letter will be addressed to the railroads coming into Illinois from the East, requesting them not to receive or transport these immigrants without the certificates.

I have the honor to be, very respectfully, your obedient servant,

JOHN H. RAUCH, *Secretary.*

The second letter was sent to the presidents of four leading trunk lines, viz., New York Central, Erie, Pennsylvania Central, and Baltimore & Ohio railroads:

SPRINGFIELD, ILL., November 5, 1887.

Dear Sir: I am directed by the Illinois State Board of Health to request of your company that you do not receive, transport, and bring into this state any of the Italian immigrants now in quarantine at the port of New York, or any that may come from cholera-infected ports, without a certificate from the quarantine authorities stating that there is no danger in so doing.

This request is made lest the board might be required to exercise the quarantine power vested in it by law, which would necessarily more or less interfere with the business of roads entering this state from the East.

Hoping for your coöperation in this precautionary measure, I have the honor to be, very respectfully, your obedient servant,

JOHN H. RAUCH, *Secretary.*

[NOTE. Since the adjournment of the Association replies have been received to these communications, and the request for the issue of certificates to the immigrants is being complied with and are being required by the railroad companies.]

The intimation contained in the foregoing letters—to wit, a recourse to the exercise of the quarantine powers of states and municipalities—recalls the only remaining point on which I shall touch in these remarks. I have elsewhere said that I believe Asiatic cholera may be as successfully dealt with in this country as small-pox—notwithstanding that we have no such demonstrated prophylactic for the former as vaccination is for the latter disease; that it may, probably, be more successfully dealt with than yellow fever, notwithstanding that this is limited by climate and temperature, while cholera is independent of the one and only measurably affected by the other. I believe this to be the case, as the result of my own official experience. In the last two epidemics of cholera the disease was controlled, wherever it appeared in the localities under my supervision, by the adoption and enforcement of the simplest measures.

Every community, for itself, may readily provide an adequate mode of dealing with a cholera outbreak successfully. But something more than this is needed in order to perfect the sanitary defence of the whole country. For this we must have coöperation and concert of action. We must devise a plan whereby the limited and individual powers of communities and states may supplement each other, and act harmoniously and efficiently for the common welfare. In the exercise of its police powers—upon which all its sanitary laws and ordinances are founded—the municipality is confined within its own limits, or, for certain purposes, to a short distance beyond. The power of the state is in like manner limited by its own boundary lines.

In the absence of a national health organization, with power to act without reference to state lines and with resources to meet every emergency, the best we can do is to become thoroughly familiar with the degree of protection we may expect from existing quarantines; to bring such pressure to bear for the remedy of defects in these as the exercise of state and municipal quarantines affords; and to secure the best attainable sanitary condition of the territory under our own immediate jurisdiction.

Our experience in the last cholera epidemic affords an illustration of the importance of these three points. In that year, 1873, there were outbreaks of epidemic cholera at Carthage, Ohio, in Kandiyohi county, Minnesota, and at Yankton, Dakota, caused by cholera poison packed up in the household effects of emigrants in Holland, Sweden, and Russia, respectively. These emigrants sailed from healthy ports, in healthy vessels, and were subjected to the usual sanitary requirements of the period. They passed through New York and all the intermediate territory without injury to the public health. But when their infected goods were unpacked in the interior of the continent, they liberated the poison which gave rise to the local outbreaks.

These three instances, which have now become historic, might be supplemented by my own experience as sanitary superintendent of Chicago during the same year. The first cases in that city were in three different families which had received immigrants from Europe direct through the port of New York, in which city, it should be remembered, there was no cholera during the entire year. Members of these three families were attacked by the disease within a short time after the arrival of the immigrants. The fact that the immigrants themselves were not attacked threw the search for the origin of the cases into other directions, and I vainly sought to establish a connection between these outbreaks and the places then infected on the Mississippi river. It was not until such connection was positively disproved, that the right clue was discovered as already intimated, namely, the infected goods of the immigrants, as in the similar outbreaks in Ohio, Minnesota, and Dakota.

Had there been the proper national system of quarantine, these infected goods could not have been shipped—supervision at the port of departure would have prevented that; or, being shipped, and the coast quarantines duly notified by cable, if these latter were properly administered, the goods could not have been landed until after thorough disinfection; inspection on arrival would have revealed their dangerous character while cholera existed in the localities in Europe whence they came. Had there been the proper coöperation and concert of action between state and local health authorities, even with a defective coast quarantine system, the movements of these immigrants would have been duly notified to their various points of destination, where the necessary precautions could have been observed. Had the sanitary condition of these localities been the best attainable, and a well devised system of regulations ready to put in force on the first appearance of the disease, the outbreaks might have been confined to the original cases, and in any event very materially prevented from spreading.

The whole subject is here in a nutshell. First. National authority abroad to prevent, so far as possible, the shipment of foreign contagion, either in persons or their belongings; and to supplement this by prompt notification to threatened ports if such shipments evade the consular supervision, or in the event of suspicion not warranting the withholding of the consular permit which should be required of all intending immigrants to this country.

Second. National control of coast quarantines, enforced by the vessels of the revenue marine, and by sanitary inspectors at the major ports of entry, and by customs officers at other ports, together with the necessary refuge stations for the treatment of infected vessels and their prompt return to commerce, as well as the care of the sick and compromised in accordance with the modern sanitary practice of quarantine.

If this be done, the states and municipalities may be reasonably and confidently expected to care for the rest. They would be relieved of unjust and unnecessary expense; the country would be freed from the frequent dread of epidemics of at least three principal diseases, to wit, small-pox, yellow fever, and Asiatic cholera, none of which is indigenous to this country, but whose ravages have caused an untold amount of suffering, sacrifice of life, and expenditure of money.

It is toward securing this national control and authority that I conceive the American Public Health Association should now devote its efforts.

XV.

REPORT OF THE COMMITTEE ON POLLUTION OF WATER-SUPPLY.

The members of your Committee on the Pollution of Water-Supplies, appointed at Toronto, regret that they have been unable to meet in conference during the past year. This has been due to no lack of inclination on their part, but to certain difficulties which were associated with their distance from each other, the pressure of official business, and their ignorance for a great part of the year of the membership of the committee and the scope of its work. They have, however, all borne in mind the duty to which they were assigned by the Association, and have overlooked no opportunity of investigation bearing on what they conceived to be their special line of work.

Much valuable material collected in Massachusetts, and a series of investigations instituted on the waters of Lake Erie, all of which will be presented hereafter, have given your committee a larger knowledge of the questions at issue. One member has devoted attention to the bacterial growths in water contaminated by factory refuse. Another has given his thought and research to the evils consequent on the use of polluted supplies, and the methods of dealing with sewage that it may cease to be a source of danger. A third spent a month in Minnesota, in a systematized effort to trace the sewage of Minneapolis, St. Paul, and other cities in its progress down the Mississippi to other towns which draw their water-supplies from that river. The vice-president of the Association, Secretary Hewitt of the state board of health, placed not only his laboratory, but his personal assistance therein, at the disposal of the investigator. The committee desires here to thank Dr. Hewitt for the opportunity which he afforded for this investigation, and to express its high appreciation of the earnestness and ability with which he perfected the arrangements and coöperated in the chemical work, thus enabling a great deal to be accomplished in a short time. Water samples were gathered from along the whole length of the Mississippi river in the state of Minnesota, and particularly from above, at and below the points of sewage inflow of certain cities and towns.

One object of this investigation had of course a local reference to Minnesota water-supplies; but so far as this committee was concerned, the object was to find out whether, by a careful estimate of the ammonia, organic and inorganic, and the nitrates, the analyst would be able to follow the nitrification of the former, and account for its diminished quantity by a proportionate increase in the quantity of the latter. This can be done in laboratory experiments on dilute ammoniated and organic solutions kept in bottles and examined from time to time; but it required proof to show that the changes could be followed in a river which contains so much organic matter and receives so many tributary streams, each of different quality, as the Mississippi. This proof was sought in the Minnesota investigation, but it was not found. The details of the analyses of about seventy water samples were published in the issue of *Public Health in Minnesota* for February of this year, so that it is needless here to do more than refer in general terms to the results. The waters of the Mississippi, tested time and again at this city, and at Memphis, New Orleans, and other points, have always shown a large amount of organic matter, chiefly of a carbonaceous or vegetable nature, but usually ascribed in part to the sewage of the many large and increasing cities that are built upon its banks and on those of its tributary streams. But this carbonaceous matter was found in the Minnesota experiments to exist in the river at points where there was practically no sewage; and as the stream was ascended the quantity of this organic matter increased, so that at Aitkin, Brainerd, and St. Cloud the natural water of the Mississippi showed by the permanganate test as much organic matter as that of a Louisiana swamp. The upland waters in Britain and in our Eastern states seldom require more than .4 part of oxygen per 100,000 for the oxidation of their organic matter, and if more is needful the water is conceived to be of doubtful quality and unsuited for a general water-supply: but this water in the upper Mississippi required as much as 1.2 parts. This large quanity of organic matter does not detract from the potability of the water, as it appears to be derived from the pine-covered lands in which the radicles of the stream take their origin; but its influence on the results of the laboratory processes for the detection of variations in the quantity of sewage was very great.

Sewage could readily be detected in the samples taken from opposite St. Paul, and for several miles below that city; but after this it became so diluted by its dispersion in the mass of the flowing stream, and so commingled with the large quantity of vegetable matter natural to the water, as to be no longer susceptible of detection with any degree of certainty. The influence of dilution was perhaps more marked than that of the vegetable organic matter in preventing the detection of the sewage at points distant from its inflow. This dilution was demonstrated by the nitric acid estimations. Many of the elements of sewage, such as urea and other unstable organic compounds, are readily broken up into ammonia during their onward progress with the current, and this ammonia becomes speedily converted into nitric acid. The nitrates are stable salts; they do not disappear from the water of a running stream, as do ammonia and organic nitrogen. Hence their quantity below a point of notable sewage inflow should be greater than their quantity above that point, provided the total quantity of water remains the same. But, as in these Mississippi experiments, the nitrates at Red Wing and Winona were found to exist in no larger proportion than in the waters above Minneapolis, notwithstanding the polluted inflow at that city and St. Paul, the reduction in their proportion must be attributed to dilution. The estimation of the chlorides in the water gave evidence corroborative of this same dilution. Chlorine is a permanent element in water-supplies; but although large quantities are discharged into the river by the sewage of the two great cities, its proportion per gallon diminishes rapidly on the way down to Red Wing and Winona. The enormous dilution which takes place by inflow from the extensive water-shed, and the large quantity of vegetable matter brought down from the head-waters, render futile all efforts for the detection of sewage by known chemical means.

During the same course of experiments, it was several times demonstrated that recent sewage in well-water may be recognized by the continued evolution of ammonia due to the breaking up of urea by boiling. The free ammonia is not removed, as in ordinarily pure waters, in the first two or three measures of the Wanklyn distillate. It continues to be evolved in small quantities, which are the same for each measure if the same length of time be occupied in the distillation of each; and if alkaline permanganate be added, the other conditions remaining the same, the quantity evolved is doubled. A continuous evolution of free ammonia amounting to .01 mgrm. in the measure of 50 c.c. distilled, and a similar evolution of .02 mgrm. of alluminoid ammonia indicate the presence of 1 mgrm. of urea in the 500 c.c. used for the experiment. The urea of urine is a variable quantity, but on the average 1 c.c. of fresh urine in 15 litres of water will give results indicating 1 mgrm. of urea in the 500 c.c. distilled in the Wanklyn experiment.

In the majority of instances, however, the contamination of wells and cisterns by sewage cannot be determined in this manner, as ammoniacal decomposition and subsequent nitrification take place in the sewage during its passage through the soil, so that a probable sewage inflow has to be inferred from an abnormal quantity of free ammonia or nitrates.

In view of these considerations, your committee considers itself warranted in believing that, although the presence of sewage in wells and other underground water reservoirs may generally be indicated by chemical investigations, such investigations will usually fail when the character of a river- or lake-supply is under question. The information as to the wells has a positive value indicating the existence of a polluted inflow which might otherwise have escaped detection, and which may or may not be specifically injurious to the water consumers, according as the sewage is or is not possessed of infectious qualities. That which may be called healthy sewage is, so far as the evidence shows, unproductive of harmful effects in the small quantities which are usually present in a contaminated but probably unsuspected water. On the other hand, an infected sewage, although present in exceedingly minute quantities, may give origin to dangerous epidemics. The drainage area of a well is limited, and, at isolated country dwellings, may remain for years free from such specific infection as that of typhoid fever; but in cities an assured freedom from disease, so far as it may be caused by a well-water supply, can only be attained by the immediate disuse of a sewage-polluted water. The filtration through the soil is capable of destroying the organic constituents of the matter of healthy sewage which may be contained in a water; but this purifying process has, so far as your committee has examined the evidence, no influence on the germs of certain diseases, which enter the well with all their powers for evil undiminished, so that, although the water may show on analysis only those inorganic remains which indicate an antecedent sewage-pollution, it may be as dangerous as though it were rankly tainted with recent sewage.

Bringing these considerations to bear on the sewage-pollution of rivers and other large bodies of fresh water, your committee is inclined to the belief that the failure of the chemical processes to detect minute traces of the contaminating matter is of no practical importance. For protective and preventive purposes the knowledge that sewage entered the water seems all that is required. The sewage, if not infected at one time, may become infected at another, and is therefore an ever-present impending danger to the health and lives of the consumers. But when the constant and extensive prevalence of typhoid fever is taken into consideration with the vast numbers of the contributors to the sewage outflow of a large city, the sewers of that city cannot be safely assumed to be uninfected. Hence, the sewage of a city entering a river above the point suggested as the intake for the water-supply of another community, should suffice to disapprove of all such suggestions, irrespective of chemical analysis or any other considerations. As the well-water may become freed from the ordinary organic matter of sewage during its percolation through the soil, so the running water may have its ordinary sewage matter destroyed by a retroversion of its elements to inorganic forms; but there is evidence to show—the Plymouth epidemic, for example—that this purifying influence cannot be relied upon to protect from specific infection. Nor can reliance be placed on the dilution which takes place in a large stream. Recent experiments on the causative essential of typhoid fever point to matter in a particulate form as the element of danger. Dilution does not dissolve and dissipate it into innocuity, as the typhus miasm is dissipated by ventilation. It is there, and although one tumblerful may not contain it, another may.

The conclusion which arises before your committee on this pathway of inquiry asserts the harmfulness of sewage in waters used as a potable supply, whether these are derived from wells or from larger sources, whether the supply of an isolated dwelling or that of a populous city. Your committee, however, does not purpose at the present time to formulate its conclusions on a matter of such importance.

The measures to be recommended in consonance with the views submitted are hedged with difficulties on account of the relations which one community bears to another; nor will one cast-iron rule suffice for all cases. The abandonment of a sewage-polluted supply may be imperative in one case, while the exclusion of certain dangerous contaminations may guarantee protection to another community. The influence of chemical treatment on the infectious principles of the excreta of disease comes up for consideration, as well as that of the filtrations which are effected not only by irrigation and other modes of consignment to the soil, but by artificial means, conducted on the small scale occasionally by the consumer, and on the large scale by the municipality or the water company. Time is required for the investigation and consideration of these and allied subjects.

Your committee has submitted the present paper merely as suggestive of the tendencies of the work of its members during the past year, and to avail itself of the opportunity which is here presented of requesting a continuance of its existence during the coming year.

CHARLES SMART,
S. W. ABBOTT,
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EDWARD PLAYTER,
Committee.

XVI.

WATER POLLUTION IN MASSACHUSETTS.

BY S. W. ABBOTT, M.D.,

Secretary of the State Board of Health of Massachusetts.

In the present paper I shall present a brief review of the past action of the state of Massachusetts with reference to this important subject, together with a more extended *résumé* of the recent legislation in the same direction.

LEGISLATION FROM 1843 TO 1886.

Prior to the year 1878, the only law which existed in the statute-books of Massachusetts having any bearing upon the question of water pollution was the following Act of 1843:

Whoever wilfully or maliciously defiles, corrupts, or makes impure any spring or other source of water, or reservoir, or destroys or injures any pipe, conductor of water, or other property pertaining to an aqueduct, or aids or abets in any such trespass, shall be punished by fine not exceeding one thousand dollars, or by imprisonment in the jail not exceeding one year.—*General Statutes of Massachusetts* 166, § 6.

This act was deprived of its usefulness by the introduction of the words "wilfully or maliciously," a measure which has unfortunately shorn many a sanitary act of the efficiency which had been anticipated by its framers. In fact, I cannot find that any actions were ever brought under this law during the thirty-five years in which it was the only existing act having reference to water pollution in the state.

The state board of health was established in 1869, and during the earliest years of its history, judging from its published reports, the subject of water pollution appears to have been viewed as a matter of secondary importance. The first, second, and third volumes have little reference to the subject, beyond an inquiry as to the quality of the waters of one of the sources of the Boston water-supply, suggested by a member of this Association.

In 1872 the legislature, having become convinced of the necessity of at least a preliminary investigation relative to the subject of water pollution, adopted an order requesting the state board of health, among other questions, to consider "the sanitary effect of draining sewage into the waters of the commonwealth," and also "the increasing joint use of water-courses for sewers, and as sources of supply for domestic use, by the people of the commonwealth."

In compliance with this order, a report was presented in the following year by Prof. W. R. Nichols and Dr. Geo. Derby, men of acknowledged ability, honesty of purpose, and rare devotion to scientific pursuits. The conclusions which were arrived at in that inquiry may be briefly stated as follows:

"It would appear that, for the present, the rivers of Massachusetts are not polluted to such an extent as to cause alarm; and yet neither the Blackstone, nor the Merrimack below Lowell, would be recommended as a source of supply for a city."—Report of State Board of Health, vol. iv, page 91, 1873.

This inquiry was continued in the following year, and the conclusions are more decidedly stated. (Report of 1874, vol. v, pp. 103–106.)

One important negative conclusion arrived at in the latter report, and corroborated by more recent inquiry, is, that chemical analysis alone is not sufficient to determine the purity or impurity of a given supply. Examinations of the water of certain rivers, especially of the Merrimack, the Blackstone, and the Charles, were then made, which formed a valuable basis for comparison in later years.

These reports prepared the way for the more extended and valuable inquiry, to be found in the Seventh Annual Report of the State Board (1876), prepared by Messrs. Kirkwood and Nichols, and Drs. Folsom and Winsor. The former portion of this report dealt with the pollution of the streams, both qualitatively and quantitatively, showing the character of the manufactures located upon the different rivers, and the amount of damage inflicted by them upon the waters of such streams. Dr. Winsor had charge of the direct correspondence with cities and towns, and Dr. Folsom reviewed the subject of sewage disposal, which was greatly aided by his recent valuable observations in other countries.

By these different inquiries, the serious danger to which the inland waters of the state were being subjected, was clearly shown, and in one instance, at least,—that of the Blackstone river,—measures were suggested for the relief of the evil.

As a result of these various inquiries, to which reference has been made, the following law was proposed and enacted in 1878:

No sewage, drainage, or refuse, or polluting matter, of such kind and amount as either by itself or in connection with other matter will corrupt or impair the quality of the water of any pond or stream hereinafter referred to, for domestic use, or render it injurious to health, and no human excrement, shall be discharged into any pond used as a source of water-supply by a city or town, or upon whose banks any filter basin so used is situated, or into any stream so used, or upon whose banks such filter basin is situated, within twenty miles above the point where such supply is taken, or into any feeders of such pond or stream within such twenty miles.

The preceding section shall not be construed to destroy or impair rights acquired by legislative grant prior to the first day of July in the year eighteen hundred and seventy-eight, or to destroy or impair prescriptive rights of drainage or discharge, to the extent to which they lawfully existed on that date; and nothing therein contained shall be construed to authorize the pollution of any waters in this commonwealth, in any manner contrary to law; nor shall it be applicable to the Merrimack and Connecticut rivers, or to so much of the Concord river as lies within the limits of the city of Lowell. The supreme judicial or superior court, in term time or vacation, upon the application of the mayor of a city or the selectmen of a town interested, may grant an injunction against any violation of the provisions of section ninety-six of chapter eighty of the Public Statutes.

Certain features of this act are worthy of notice:

First. The distance within which it is forbidden to discharge sewage into a stream used as a water-supply is limited to twenty miles above the source.

Second. Two rivers of considerable size, and a portion of a third, are exempted from the operation of the law.

Third. The supervision of such waters was, by the same act, entrusted to the state board of health, and also the authority to investigate alleged cases of pollution, and also the power to issue orders for the prevention of such pollution.

By a later act of 1884, this authority was removed from the state board of health, since it was alleged that this method of procedure lacked the efficiency of an action at court.[1]

The efficiency of this law, as it now stands, has been tested by the trial of several cases, especially in connection with the water-sources of the Boston supply. In some cases, existing pollution has been removed by amicable adjustment between interested parties, efficient measures being employed for the prevention of existing evils.

An act of much less real importance and value was that of the following year, which provided for triennial returns of water companies and commissioners to the state board,—these returns comprising certain statistics of little actual value, except as furnishing material for the public printer, together with certain useful information for contractors, pump manufacturers, and others.

In 1881 two important resolves were enacted, the intent of which was to devise measures for the relief of those portions of the state already referred to—the densely populated river valleys in the immediate neighborhood of Boston, and also of that portion of the valley of the Blackstone river, lying below the city of Worcester.

The two commissions, appointed under these resolves, reported in the following year,—in the former case, recommending a metropolitan drainage system, to include all the territory draining into Boston harbor. In the latter case—that of the upper Blackstone valley—a plan involving the disposal of the sewage of Worcester by intermittent downward filtration was proposed. A tract of land, west of the river and a mile or more below the city, was advised for the purpose.

This brings us to the year 1884. The previous inquiries had prepared the way for a more thorough and general work, and in this year the Massachusetts Drainage Commission was appointed, with authority to report "a general system of drainage for the relief of the Mystic, Blackstone, and Charles River valleys, and for the protection of the public water-supplies of the cities and towns situated within the basins of these rivers. They were also empowered to report upon the various methods of sewage disposal, and also as to the needs of any other portions of the state."

The report of this commission, presented in 1886, not only forms a

[1] The act above quoted is as it was amended in 1884.

valuable contribution to the subject of sewerage, but is also a thorough report on the necessities of the districts requiring relief.

Out of all these fifteen years or more of inquiry, and of consequent legislation, was evolved the following act. The immediate causes and train of reasoning which led to its final passage are clearly presented in the following language of its authors:

We think it would be well for the legislature to designate some one or more persons to look after the public interests in this direction, these persons to be given *advisory power only*. Let the guardians of inland waters be charged to acquaint themselves with the actual condition of all waters within the state as respects their pollution or purity, and to inform themselves particularly as to the relation which that condition bears to the health and well-being of any part of the people of the commonwealth. Let them do away as far as possible with all remediable pollution, and use every means in their power to prevent further vitiation. Let them make it their business to advise and assist cities or towns desiring a supply of water or a system of sewerage. They shall put themselves at the disposal of manufactories, and others using rivers, streams, or ponds, or in any way misusing them, to suggest the best means of minimizing the amount of dirt in their effluent, and to experiment upon methods of reducing or avoiding pollution. They shall warn the persistent violator of all reasonable regulation in the management of water, of the consequences of his acts. In a word, it shall be their especial function to guard the public interest and the public health in its relation with water, whether pure or defiled, with the ultimate hope, which must never be abandoned, that, sooner or later, ways may be found to redeem and preserve all the waters of the state. We propose to clothe the board with no other power than the power to examine, advise, and report, except in cases of violation of the statutes. Such cases, if persisted in after notice, are to be referred to the attorney-general for action. Other than this its decisions must look for their sanction to their own intrinsic sense and soundness. Its last protest against wilful and obstinate defilement will be to the general court. To that tribunal it shall report all the facts, leaving to its supreme discretion the final disposition of such offenders. If such a board be able to commend itself by its conduct to the approval of the great court of public opinion, it will have no difficulty, we think, in materially reducing the disorders and abuses which are threatening to give great trouble in the future if not speedily checked. If, however, we err in this expectation, and more drastic measures prove indispensable, the mandate of the state can always be invoked to reënforce its advice.

The legislature of 1886, after duly considering the report of the drainage commission, enacted the following law, which is essentially the same as that devised by the commission, the state board of health being designated as the proper body to execute its provisions:

ACTS OF 1886. [CHAP. 274.]

AN ACT TO PROTECT THE PURITY OF INLAND WATERS.

Be it enacted, etc., as follows:

SECTION 1. The state board of health shall have the general oversight and care of all inland waters, and shall be furnished with maps, plans, and documents suitable for this purpose; and records of all its doings in relation thereto shall be kept. It may employ such engineers and clerks and other assistants as it may deem necessary: *Provided*, that no contracts or other acts, which involve the payment of money from the treasury of the commonwealth, shall be made or done without an appropriation expressly made therefor by the general court. It shall annually, on or before the tenth day of January, report to the general court its doings in the preceding year, and at the same time submit estimates of the sums required to meet the expenses of said board in relation to the care and oversight of inland waters for the ensuing year; and it shall also recommend legislation and suitable plans for such systems of main sewers as it may deem necessary for the preservation of the public health and for the purification and prevention of pollution of the ponds, streams, and inland waters of the commonwealth.

SECT. 2. Said board shall, from time to time as it may deem expedient, cause examinations of the said waters to be made for the purpose of ascertaining whether the same are adapted for use as sources of domestic water-supplies, or are in a condition likely to impair the interests of the public or persons lawfully using the same, or imperil the public health. It shall recommend measures for prevention of the pollution of such waters, and for removal of substances and causes of every kind which may be liable to cause pollution thereof, in order to protect and develop the rights and property of the commonwealth therein, and to protect the public health. It shall have authority to conduct experiments to determine the best practicable methods of purification of drainage or disposal of refuse arising from manufacturing and other industrial establishments. For the purposes aforesaid it may employ such expert assistance as may be necessary.

SECT. 3. It shall, from time to time, consult with and advise the authorities of cities and towns, or with corporations, firms, or individuals, either already having or intending to introduce systems of water-supply or sewerage, as to the most appropriate source of supply, the best practicable method of assuring the purity thereof, or of disposing of their sewage, having regard to the present and prospective needs and interests of other cities, towns, corporations, firms, or individuals which may be affected thereby. It shall also from time to time consult with and advise persons or corporations engaged or intending to engage in any manufacturing or other business, drainage, or refuse from which may tend to cause the pollution of any inland water, as to the best practicable method of preventing such pollution by the interception, disposal, or purification of such drainage or refuse: *Provided,* that no person shall be compelled to bear the expense of such consultation or advice, or of experiments made for the purposes of this act. All such authorities, corporations, firms, and individuals are hereby required to give notice to said board of their intentions in the premises, and to submit for its advice outlines of their proposed plans or schemes in relation to water-supply and disposal of drainage or refuse. Said board shall bring to the notice of the attorney-general all instances which may come to its knowledge of omission to comply with existing laws respecting the pollution of water-supplies and inland waters, and shall annually report to the legislature any specific cases not covered by the provisions of existing laws, which in its opinion call for further legislation.[1]

Approved June 9, 1886.

In order that the board might be as fully equipped as possible for the work provided for in this act, an additional resolve was enacted providing for the transfer of all maps, plans, and other property in the possession of the drainage commission to the custody of the state board of health. Whether this legislation was or was not the most efficient for the purposes for which it was devised, remains to be shown. It is hardly time, in the year or more which has elapsed since its passage, to judge of its results.

The act is certainly broad and comprehensive. It includes, in its provisions, the supervision of all the inland waters of the state, and requires the executive authority to advise and consult not only with cities and towns, but also with corporations and individuals. It includes within its scope the whole system of water distribution from its source or fountain-head, through the intermediate stages of public and domestic use, to its final conversion into sewage, and its disposal in some form or other.

[1] This act was amended by the legislature of 1888 by a provision in the third clause of the third section, that all applications to the legislature for authority to introduce any system of water-supply or sewerage should be accompanied with the approval of the state board of health.

All parties having such matters in charge are required to submit their plans to the supervision of the board before their final adoption.

An important element in this act is the protection which it offers to one community against the selfish action of another, through the intervention of a central board. Previous legislation had failed to remedy this evil, until, through the intolerant action or inaction of municipalities situated on the banks of water-courses, the interests of their neighbors lower down upon the stream have been materially damaged and the public health imperilled.

By the terms of the act, the execution of the duties prescribed therein was entrusted to the state board of health.

Soon after the passage of the act, the board entered upon the performance of the duties prescribed. It was deemed essential, at first, to secure the services of experts in such lines of work as were necessitated by the law. In the first place an engineering department was organized; and later on a corps of chemists and biologists was appointed for such analytical and microscopic work as was deemed to be necessary for the examination of waters and of sewage.

So soon as it became generally known that the board was ready "to consult with and to advise the authorities of cities and towns," applications began to be received for such counsel as was contemplated by the act. Such applications have, up to this date (November, 1887), been received from twenty-nine cities and towns,—about two thirds of the number having reference to questions of sewerage and sewage disposal, and the remainder to water-supplies.

In several of these instances hearings have been given by the board, at which interested parties were present, and offered such evidence as they could present, either in favor of or in opposition to the proposed plans.

The number of corporations, either public or private, supplying water to the inhabitants of the different cities and towns of the state is at present about one hundred and twenty, and it was deemed to be advisable for the interests of the consumers that examinations of the supplies should be made during the first year as often as once each month. The board would thus have a collection of data relative to the condition of the water-supplies, which would enable it to give a tolerably correct opinion as to their character.

As will be readily seen, this plan involved a very great amount of chemical work, and the laboratory has presented the appearance of a busy work-shop. Since the beginning of laboratory work in June last, about 1,100 samples have been submitted to chemical analysis in this department of work.

We are not unmindful of the fact that too much dependence must not be placed in chemical analysis alone as a basis for judgment, and therefore the board has taken measures for ascertaining everything in relation to the different water-supplies which may have an injurious influence upon the water.

The services of the biological expert are also called to the aid of the chemist in special cases of doubt, and also for the regular examination of the larger supplies.

Already have the benefits of this plan of work made themselves manifest, and the board has been enabled to convey such information to the different water companies as would aid them in improving the condition of their water-supplies.

The condition of the larger rivers and streams has also received special attention, and careful examinations have been made for the purpose of determining the quality of their waters under different conditions,—of wet and dry seasons, summer and winter flow, etc. These have been made with special reference to the question of using such streams as domestic water-supplies for the cities located upon them, and such examinations have been extended, in some instances, beyond the limits of the state.

With reference to investigations in regard to sewerage and sewage disposal, the act of 1886 authorizes the board to conduct such experiments as it shall deem necessary, and for this purpose a series of such experiments has just been inaugurated at Lawrence, on the banks of the Merrimack river, under the direction of a member of the board.

This series of experiments is to be conducted for the purpose of determining the capacity of different sorts of soils for sewage-filtration; coarse and fine sand, gravel, river silt, peat, and other materials being used for the experiments, which are to be carried out in a series of tanks constructed for the purpose.[1]

The examination of these soils before the admission of sewage, the examination of the sewage and also of the effluents from the different soils, the measurement of the effluents as compared with the flow of sewage at different seasons of the year,—these observations to be made with the help of chemical analysis and of biological observation,—will undoubtedly render much assistance in solving some of the difficult problems which are constantly being presented to the board from the different cities and towns.

The field of observation in this line of inquiry, under the peculiar conditions of our climate, has not been a large one, and the opportunities for carrying on such experiments under careful observations have been limited, and if we shall be enabled to add anything to the common stock of knowledge in this direction, we shall have accomplished a double purpose.

In addition to the work rendered necessary by the enactment of the act of 1886 (chap. 274), a special resolve was passed by the legislature of the present year, recommitting to this board the question of the drainage of the two valleys of the Mystic and Charles rivers, and providing for a report upon the subject a year hence. The district referred to in this resolve is one of more rapid growth than other parts of the state; the four counties included in the provisions of the act having more than

[1] An account of the work of the board in this direction may be found in the 18th and 19th Annua Reports of the State Board of Health for 1886 and 1887.

half the population of the state and a density of 580 inhabitants to the square mile, while the drainage basins of the rivers themselves are more densely populated.

Measures for the relief of these districts cannot be longer deferred. The board has already entered upon the work by the appointment of engineers, who are now busily engaged, and will occupy the coming season, in work upon the district in question.

XVII.

RIVER POLLUTION IN CONNECTICUT.

PROF. S. W. WILLISTON, M. D.,

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Following closely in the wake of improved sanitation and rational sewage disposal comes the evil of increased river pollution,—an evil rapidly assuming in not a few places much importance. The question of the removal of refuse and excrementitious matters from house and premises has found a practical and definite solution in the water-carriage systems of sewerage, wherever such are practicable. What shall be done with the sewage is, however, a problem arising therefrom that is now only a little less urgent, and one that often does not admit of as simple a solution. The problem is, moreover, one more dependent upon local conditions,—a problem of preëminent importance to manufacturing communities. In agricultural regions there is less segregation upon water-courses than occurs in the former; the population is more evenly distributed, and sewage is much less in quantity. It will be many years before the question of sewage disposal in the Southern, Western, and Middle States attains the same degree of importance that it has already acquired in the scarcely more densely settled New England states.

The conditions are here the most favorable for undue pollution. The moderate sized, rapidly flowing streams call into existence the very factors of their own contamination, and are, at the same time, the sustenance and the sewers of the population along their banks. Nor can we escape from the conviction that in many of these manufacturing communities a period has arrived when the pollution will increase much more rapidly than the population; that we have arrived at a sewerage density of population, if I may use this expression, that will speedily and largely augment the sewage pollution. In Massachusetts, the subject of river pollution was prominently forced upon public attention by the discharge of the city of Worcester's sewage into the Blackstone river. The evil would have slumbered much longer had that city deferred her sanitary improvements. So, too, in Connecticut, upon the completion of an excellent system of sewerage in the inland city of New Britain, we found an important stream turned into an open, fetid sewer; and the subject of river pollution in Connecticut commanded attention.

Under the auspices of the state board of health, by special instructions of the state legislature investigations of the rivers have been undertaken, and already the results show that a number of other streams in the state are in immediate danger of undue pollution. With the exception of certain sea-board cities and of Hartford upon the Connecticut river, there is but one city in the state with any adequate sewerage; that city is New Britain, already spoken of. On the other hand, no less than eight cities and boroughs, varying in population from ten to thirty thousand, are projecting or laying down sewers to discharge into streams of moderate or small size; furthermore, the general demand for the more modern sanitary improvements will in a very few years require sewerage in several other towns. What shall be done in these cases it is very difficult to decide. The state is unprepared for summary action, and the towns themselves resent imputations upon their right to sewer into natural water-courses.

Examinations, more or less complete, have been made of four of the contaminated streams in the state during the past year or two, and some of the results at present attained are of more than local interest.

The Naugatuck river, flowing from north to south in the western part of the state, and discharging into the Housatonic at tide-water, is nearly forty miles in length, with a drainage area of about three hundred square miles. At its mouth, the flowage during the past summer was a little in excess of twenty million cubic feet (about 150,000,000 gallons) per diem. This, however, does not represent the minimum dry weather flowage, which must be fully twenty-five per cent. less, or say fifteen million cubic feet. The entire population of the valley was given in the census of 1880 at about 50,000, but the increase since then has been marked, so that the number now will probably reach 70,000. This population is located chiefly in a half dozen towns and cities on its banks, whose existence depends almost exclusively upon the extensive manufacturing industries for which the river is noted, especially the brass manufactories, which constitute the centre of the brass industries of America. The valley of the river is in general narrow; its tributaries numerous, but small; the bed of the stream is largely rocky, and its current rapid. It will thus be seen that the conditions are favorable for contamination. The water-power is most excellent, and its access as a manufacturing region easy. Reports from the manufactories give me a total of over thirteen thousand operatives employed in the different mills—about a fifth of the entire population of the valley. Aside from the fact that most of these operatives discharge their excrementitious matters into the stream directly, it is plainly seen that the population must be collected at centres in immediate proximity to the banks of the river. The chief centre is, at present, Waterbury, a city of 32,000 population, whose increase in size has been fully fifty per cent. in the last seven years. This place has reached sewering density, and sewers are now being laid down rapidly. Most of the other towns are fast approaching that condition when sewering will be unavoidable, and two are at the present time projecting sewering plans. This river will thus exemplify my preceding remarks. At the present time the entire sewage thrown into the Naugatuck river, outside of the factories, does not exceed that from eight thousand people. Ten years from now, with the present ratio of population increase, if preventive measures are not instituted, forty thousand people will be sewering into the stream.

The Naugatuck is not an isolated example;—nearly every stream adapted to manufacturing requirements in the state is contaminated—some more, others less, than the Naugatuck. Connecticut has reached a point when the problem of sewage disposal has become pressing. That she has not reached that point sooner has been partly due to the fact that most of her manufactures are of metal goods, which in themselves contaminate less than most others, and still more to the fact that, either from neglect of proper sewage sanitation, or the lack of the required sewage density, public sewering has been neglected.

At present, the sewered population of the Naugatuck valley exceeds only slightly sixteen thousand in number. More than two thirds of this population are in Waterbury, where the stream is but little more than half the size of what it is at the mouth. Its sewage pollution, it is seen, has not reached an alarming degree. Complaint is, however, justly made of its contamination by the towns below Waterbury, and the fact is indisputable that the river in its larger portion has long since reached that stage when it is impossible for fish to live in it. The contamination is, however, chiefly of a chemical nature, whose sanitary bearings are less evident. As has been said, the manufactories upon the stream are chiefly brass and copper ones, employing more than nine thousand operatives; and in addition there are six paper mills, five woollen mills, and a few iron and other mills. The organic refuse from the factories is very small in quantity,—smaller, perhaps, than in any other equally large manufacturing region in the country,—and consists chiefly of dyestuffs and oils. It has been frequently claimed by those conversant with the local conditions of this river and other rivers of the state, that the antiseptic, or, rather, the disinfectant, character of the mill-refuse is, and would be, sufficient to counteract the organic refuse cast into the streams. Influenced in part by this claim, statistics of the mill-refuse have been sought for, and obtained with a completeness that leaves little to be desired. Of the more than eighty manufactories upon the Naugatuck river, more or less full reports have been received from all but one, and the conclusions reached have been such as to utterly refute all disinfectant arguments. The quantity is, however, enormous, and will be of interest aside from what sanitary bearings it may have.

It may be stated, by way of explanation, that the processes employed in the working of brass and copper, as well as iron, require the use of large quantities of acids, chiefly sulphuric, in giving a clean surface to the metal. This acid, bearing with it bases extracted from the metals, nearly all reaches the stream. My reports give me for the annual sum total of the acids for the river 2,910,000 pounds, of which 610,000 pounds are nitric and 70,000 muriatic. In addition to the acids, there are nearly 340,000 pounds of the alkalies and alkaline earths, 10,000 of metallic salts as such (copperas, blue vitriol, and tin salyts), 150,000 of soap, and about 50,000 gallons of oils, making a total of the chemical refuse of the stream of over 2,000 tons per annum. Analyses of the acid wastes show that at least fifty per cent. is saturated with the metals, nine tenths of which must be copper and zinc. This would make over a thousand tons of the nitrate and sulphate of copper and zinc, or, say, add five hundred tons to the sum total, making between seven and eight tons per diem as the entire amount of chemical refuse for each working day of the year. More than three fourths, or at least four tons daily, are turned in at Waterbury, the chief town on the river.

Another fact of importance, that adds to the possible dangers to the public health, is, that at the various towns the water of the stream is diverted from its natural course into canals and flumes, leaving the river-bed at intervals exposed. That the general pollution has been prejudicial to health hitherto has not been proved, but there can be little question that a moderate amount of additional pollution would ensure such a result.

Among the other contaminated streams of the state, the most important as well as by far the most polluted of them all is the one which receives the sewage of New Britain. New Britain, whose chief importance is derived from its iron manufactories, is a city of at present about twenty thousand inhabitants. Its growth within the past few years has been rapid, and it has adopted an excellent system of sewers, which has only been completed within a very few years. A small stream passing through the city, known as Piper's brook, was utilized for this purpose, the stream being diverted into the trunk sewer within the city limits. Measurements of this brook as it enters the sewer gave a flowage of nine hundred thousand gallons daily; at the outlet of the sewer the flowage is increased to twenty-nine hundred thousand gallons, the added two million gallons being sewage, manufactory refuse, and under-ground drainage. In this stream of about three million gallons there is the sewage of nine thousand people, and the daily amount of nearly one ton of chemical refuse from the factories. This refuse consists almost wholly of sulphuric acid, more or less saturated with iron, there being, it is estimated, more than half a ton daily of copperas. This brook, carrying its pollution, runs to the Connecticut river, a distance of nine miles, to and through the town of Newington and the city of Hartford, the state capital. At the village of Newington, three miles away, the stream has increased to eleven million gallons daily. Just before entering the city of Hartford, it empties into a larger stream, Park river, having perhaps thirty million gallons of daily flowage. This river passes through the whole width of Hartford, a city of about fifty thousand inhabitants, winding around the capitol grounds, and receives in its course four fifths of the sewage of that city, before discharging into the Connecticut. In addition to the above, Park river receives the surface wash of two smaller villages; it is, in fact, a sewer for a population of seventy-five thousand inhabitants. Piper's brook, two miles after leaving New Britain, may be virtually considered an open sewer, and is very offensive to the people who live in its vicinity; even at Newington human fæces may be distinguished by their physical properties.

The stream, though perhaps inferior in its pollution to the Blackstone below Worcester, is probably one whose condition is to be most deprecated of any in New England, chiefly from the fact that so few miles intervene between its polluting source and the important city of Hartford, through which it passes.

Here, if anywhere, the disinfecting properties of the metal mills refuse should be shown; and the city of New Britain, in replying to the proposed prohibitory measures on the part of the state legislature, take the ground that the sewage is virtually disinfected by the one ton of disinfecting material turned into it daily. With the view of testing the value of this claim, which, however, hardly needs serious refutation, numerous experiments were made at different times to ascertain the number of bacteria actually present in the water. At the mouth of the sewer, not less than five thousand germs were found per cubic centimeter, and in most cases from fourteen to twenty-one thousand were found. Two miles below New Britain and before the stream receives tributary water, examinations gave four and five thousand germs; at Newington, from eleven hundred to five thousand.

Notwithstanding the great pollution of this stream in its course below New Britain, direct evidences of a deleterious influence upon the health of those living in its vicinity are questions of dispute among them, though the odor arising from it at Newington is frequently great, and although it is said that cattle will not drink its waters. The magnitude of the evil of such extreme river pollution, however, is not easily demonstrated; but we cannot escape the certain conviction that such polluted streams are the possible carriers of disease, and are a standing menace to public health, and sooner or later must be abated.

There can scarcely be said to be a river in the state whose waters may be called potable. The Hockanum, emptying into the Connecticut below Hartford, receives large quantities of sewage and organic manufactory refuse. Still river, a small stream, receives the sewage of the city of Danbury, and over a ton daily of dyestuffs from hat factories. Farmington river, Willimantic river, and the Thames all are polluted by sewage and manufactories; and Meriden now sends a large part of her sewage, and wants to send all from its twenty thousand inhabitants, down in the Quinnipiac river through Wallingford and New Haven to Long Island sound.

Fortunately, the water-supply of Connecticnt, as of New England in general, is not dependent upon its rivers. The large and numerous ponds offer an inexhaustible supply of uncontaminated water. Were the problem different, Connecticut would long since have been driven to the direst extremities. As it is, the problem is, How far may a stream be polluted, and not carry disease and death in its course? It is my belief that the state is fast approaching that limit in numerous cases.

XVIII.

NOTES ON THE POLLUTION OF STREAMS.

By RUDOLPH HERING, C. E.,

New York.

The proposition of permanently discharging the sewage of Chicago into the Desplaines and Illinois rivers recently gave me an occasion to inquire somewhat closely into the existing facts concerning the supposed self-purification of polluted streams. Owing to circumstances, this inquiry is not completed, and may not be for the present. While I therefore regret that I cannot give you a paper on the subject, I believe that a few data and some inferences may perhaps interest you at this time, and perhaps be of some value, in view of the importance the subject is gaining in many parts of our country. The Ohio River valley will soon require serious attention. Its numerous cities, some of them quite populous, discharge their sewage into the same river from which they take their water-supply. Typhoid fever is unusually prevalent in the valley. Likewise, the Schuylkill river furnishes a number of small cities, and finally Philadelphia, with water, after receiving above the latter city the water-closet drainage from 27,000 persons, and the wash-water drainage from 85,000 persons.[1] Here also the death-rate from typhoid fever is high. And a large number of other streams are beginning to cause trouble from similar conditions, though perhaps of less magnitude than those mentioned.

Evidently, it is becoming a pressing question to know with greater certainty just how far we may safely carry this system of pollution, or whether we must entirely abandon it. Much work will yet have to be done, and many investigations will have to be made, before the subject is cleared up in a way that will allow of a treatment which is just to both those who must have drainage, and to those who, residing farther down on the same stream, must have potable water.

In discussing the question of water pollution, of setting up a standard of purity, of a minimum proportion of sewage, or perhaps of the necessity for its entire exclusion, a distinction must be drawn at the outset. The problem must be viewed very differently when the sewage-polluted water is to be used for potable purposes, or when, as often occurs, it is simply to be inoffensive, not destructive to fish, nor objectionable to manufacturing interests and to the residents along its course.

With reference to the first case, we have a large number of observations, data, and opinions, yet withal they are insufficient to give a posi-

[1] See Report Philadelphia Water Department, 1888.

tive guide to the selection of a water-supply in every case. The engineer who is employed to advise on the selection, is sometimes confronted with great difficulties, from the want of reliable evidence regarding the real danger from pollution. Is he to reject a palatable water, and perhaps by far the most economical source of supply, because 50 or 100 miles above, another community discharges some sewage into it? Is he to be governed at all by the degree of dilution it has received, and by the number of days or weeks since the polluted water has had a chance, during its flow, to convert the sewage matter into organic compounds? And is he to consider the aeration of a stream as effecting the gradual destruction of disease germs in the same measure as it effects the destruction of the dead organic matter?

Before engineers can receive definite answers to these and other questions, from the medical and allied professions, they must, in order to help their clients, continue to say as follows: We know, as for instance in the case of Plymouth, Pa., that clear and tasteless water from a mountain brook may cause an epidemic of typhoid fever, by being used for drinking purposes within a few miles of the point where the dejecta of a single patient entered the stream. We do not know the conditions under which the dangerous germs may be deprived of their vitality in a living stream. We therefore assume, for want of further evidence, that in water previously polluted, but through dilution or other cause containing a minimum quantity of organic matter and a maximum of dissolved oxygen, the danger from the pathogenic germ gradually vanishes. And to be reasonably safe, we further assume that potable water must not only be of good quality, chemically speaking, but that before being used it must have run in the stream for a considerable distance, depending upon circumstances, after it has been even slightly polluted by sewage matter, whether detectable by chemical analysis or not.

In an investigation of the projects for a new water-supply for the city of Philadelphia, which was undertaken a few years ago, the chemical work was supplemented by a survey of 450 square miles of water-shed, showing the location of every farm-house, building, manufactory, or other possible sources of pollution in their relation to the water-courses. In this way the actual and possible pollution could be readily determined, as well as the practical ways of preventing it, in each case. Such surveys, which in a smaller way have often been undertaken, I consider invaluable to the discussion of water-supplies likely to suffer from sewage discharge, and the results should naturally have a far greater weight than those of the chemical analysis of the water at the foot of the drainage area.

The present researches in bacteriology will no doubt soon throw an abundance of light on this question; and the engineer is anxiously awaiting the results, in order that he may solve the practical problems in the selection of a water-supply, if possible with a degree of certainty and safety approaching that which he secures when dealing solely with the laws of mechanics.

The second case I referred to, concerns polluted water *not* to be used for potable purposes, perhaps because it is altogether impracticable to preserve a high standard of purity, or because better sources for a domestic supply are available. The Desplaines and Illinois rivers, for instance, receive the sewage of Chicago and other towns, and no drinking-water is obtained from the same, except some at Peoria, 160 miles below the main sources of pollution. The Blackstone river in Massachusetts also serves as a sewer, and will probably always continue to do so; and the Schuylkill river in Pennsylvania will, I believe, likewise have to be entirely abandoned to drain the cities and manufactories of the valley.

There are a number of other streams in our country which will have to perform this duty, and if there are other and better sources for a city's supply, this use of a river cannot reasonably be objected to on economical grounds.

The question then arises, How much sewage should be permitted in such a case? In other words, what is the proper standard of purity to satisfy the various interests? This is the subject on which I endeavored to get some light in the Chicago investigations, but, as I said, the data are not complete.

The first point to settle is a proper measure for the permissible pollution. This is best assumed as being the quantity of water which can safely receive the drainage from a unit of population; in other words, the least number of cubic feet of water per minute which should flow down the stream for say every 1,000 persons draining into the same.

By using this measure we eliminate the difficulties arising from a varying quantity of water consumption and dilution of sewage before reaching the stream. In England, the quantity of sewage ranges from 30 to 60 gallons per head; in America, from 50 to 150 gallons per head. But the quantity of refuse per inhabitant does not vary much. Where factories discharge considerable waste matter of a particular kind, or where large slaughtering establishments drain into the rivers, some additional allowance for them may be required, but otherwise the amount of waste matter per inhabitant will be pretty constant, and therefore convenient as a measure.

The problem then is, How much running water must we have to dilute the sewage from every 1,000 persons in order to make it inoffensive, not objectionable to manufacturing interests, nor destructive to fish?

The standard for inoffensiveness must of necessity be one of personal judgment, and can only be approximate. The admissible sewage pollution of water used for manufacturing purposes depends on the particular industry, some mills requiring a much higher standard than others; and, unless in any particular case the nature of the industry is a governing element, we are again obliged to resort to personal judgment as to what is a fairly clean water for average cases. A standard of pollution which, thirdly, will prevent the destruction of fish depends upon the particlar species which it is desired to retain. Yet, as we find fish living in sewage-polluted water which is sufficiently diluted to answer the first and second requirements, we can usually ignore this one, except in occasional instances, where it assumes special importance, and where special experiments will become necessary.

There are three ways in which we may get a solution of the problem from this point of view. In the first place, we can obtain a sample of the average sewage per inhabitant from a sewer, and mix it with enough water to make it what is believed would be unobjectionable, and thus determine the dilution. This method can be applied in small towns,—not so well in large cities where the sewage varies in different sections, owing to different classes of population and manufactories.

In the second place, we can observe the gradual increasing pollution of a water-course, caused by the successive discharge of a number of sewers, and, after determining the point at which we find the condition of the river to have become objectionable, either to the senses or for use, we can measure the flow, and find the population which has drained into it at this point.

It is usually difficult to get a satisfactory answer in this way, owing to the imperfect mixture of the sewage with the river water until they have run a long distance. It was intended, however, to make some observations on this point in Chicago, where the river serves as the main outfall sewer for the city, with the hope of fair results, notwithstanding the additional difficulties there encountered, due to the frequent but irregular stirring up of the sludge by the tugs and vessels. But, owing to want of funds, this, as well as other inquiries, has not been undertaken.

The third way in which we can throw light on the question is to observe the gradual so-called self-purification of polluted streams. On this subject, taking a little broader view than required for the above special purpose, I have the following notes to present:

It has been asserted in England by Drs. Miller, Odling, and Letheby, that organic matter of sewage is rapidly oxidized during the flow of a river into which it is discharged, and that if the dilution is at least twenty times, the sewage[1] will not only be made inoffensive, but be utterly destroyed within a "dozen miles or so." But the Rivers Pollution Commission of Great Britain, in 1878,[2] after a careful direct investigation, prove that this assumption is altogether wrong so far as the rapidity of oxidation is concerned, and state that there is no river in England long enough to allow of a complete disappearance of sewage-matter discharged into it.

The main causes of the apparent disappearance of such matter are *dilution*, *subsidence*, and *oxidation*. Let us consider them for a moment.

When sewage is discharged into a comparatively large volume of water, it becomes dispersed throughout the mass, and lost to sight and even to chemical tests if the dilution is great enough.[3]

[1] English sewage is from 2 to 3 times less dilute than American sewage.

[2] Sixth Report, 1879.

[3] According to Dr. Konig ("Pollution of Water-Courses." Berlin, 1887) the minimum quantity of organic matter which can be detected by chemical means is 1 milligram in a dilution of 1 : 1,000,000; of ammonia 0.05 milligram in a dilution of 1 : 20,000,000. Chlorine can be detected as 0.1 milligram in a dilution of 1 : 10,000,000.

The measure of relative dilution can usually be ascertained by the mineral salts in solution, and, particularly, by the chlorine in common salt conveyed to the streams by the sewage, because they are not liable to undergo any change which would cause their disappearance.

Subsidence of the heavier organic and mineral matters of sewage has a marked influence in clarifying a polluted river. It is observed immediately below outfall sewers, and is caused by a reduction in the velocity of the sewage after emerging from them, which permits the suspended particles to deposit. This deposit or sludge continues to undergo decomposition until the matter is reduced to its inorganic components. During floods the increased velocity of the water stirs it up, mingles it with the earthy matter generally suspended in flood-waters, and allows it to be again deposited at another place lower down the river, usually in a less objectionable condition than before. Factory refuse often contains chemical agents, such as lime, alum, and metallic salts, which precipitate much of the sewage matter, and thus tend to increase the amount of deposits. Metallic oxides unite with the sulphuretted hydrogen of decomposing sewage, and form insoluble compounds and harmless deposits.

Oxidation and total destruction of sewage matter by decomposition was for a long time thought to be the main cause for the clarification of polluted rivers. To-day it is known to be but a minor cause, compared with dilution and subsidence; and if the sewage is discharged in a fresh condition into a stream of water, its destruction is in part due to fish and other aquatic animals. Some of the refuse from stockyards is disposed of, no doubt, in this way. Most of the sewage, however, is decomposed or oxidized, as it is usually termed, by the myriads of microscopic plants, microbes, or bacteria contained in both air and water, which at once seize upon the dead organic matter. It is true that chemical changes, not caused by life, assist in converting the organic matter into simpler compounds, but their effect is comparatively insignificant.

The English River Pollution Commissioners[1] state that sewage oxidation is more active in sunshine than in shade, and is almost arrested at night, and when the thermometer approaches the freezing point, showing its dependence on the condition favorable to the lower orders of life. Since then it has been quite conclusively proven that the question of sewage oxidation in a polluted stream, or even in the soil of sewage farms, is practically one of a sufficiency of micro-organisms and of air and other conditions that sustain their life.

Dr. Dupré[2] sterilized sewage, and kept it for weeks without the slightest change. By adding a little non-sterilized sewage, decomposition at once began. Mr. Warrington has found similar evidence. Dr. Emmich[3] has shown that sterilized sewage, continuously aerated by sterilized air, did not oxidize perceptibly, nor purify itself at all.

[1] Sixth Report, 1879, p. 176.
[2] Proc. Inst. C. E., vol. 88, p. 215.
[3] Chem. Central Blatt, 1885, p. 333.

If the aeration of rivers can be kept up to the highest practicable point, it would on a summer day offer the most favorable conditions for a disappearance of the organic matter.

Applying these facts, we can say that for purifying the sewage discharged into a river, oxidation can be depended upon only to a limited extent, because of the comparative slowness with which it takes place. Subsidence of the heavier matter tends to clarify it before it flows many miles; dilution with a sufficient quantity of clean water prevents an offensiveness almost at once; but oxidation requires many days under continuous aeration of the river.

Therefore, by examining the actual purification of polluted streams, and realizing that oxidation is a comparatively small factor, we are furnished with some evidence as to the proper dilution of sewage in the case under consideration, which cannot be far wrong, and may serve a useful purpose until more information is obtained.

The data which are now available are not many, because opportunities to establish the same on a large scale, which alone is of practical value, have seldom offered.

In our country instances are the Desplaines and Illinois rivers, receiving the sewage of Chicago; the Blackstone river in Massachusetts, with the sewage of Worcester; and the Merrimack river in Massachusetts, with the sewage of Lowell and Lawrence. In Europe the most instructive case is the river Seine below Paris, at the time when it received all the sewage from that city. Other rivers are the Irwell, Mersey, and Darwen in England, and the Oder, Isar, and Elbe in Germany.

It would be tedious to describe to you in detail the changes taking place in each case, and I will confine myself to some general remarks. Profiles were platted of some of these streams, showing their general descent, to indicate their relative facilities for oxidation, also the average dry weather flow at all points, gradually augmented by the affluents. The results of the chemical analyses were platted at the respective points.

It was clearly shown how the increased dilution lowered the percentages of albuminoid and free ammonia almost in exact proportion to the increase of dilution, and that the apparent purification, which was often supposed to be due to oxidation, was due mostly to greater dilution.

The sewage of Chicago, mixed in a proportion of about one of sewage to four of lake water, or of 60 cubic feet per minute per 1,000 persons, is pumped into a canal, and flows, without further increased dilution, for nearly thirty miles in about as many hours, and its condition, which is quite offensive, is not changed very much. Then it descends over several dams, mingles with the water of the Desplaines river, and within a few miles it is visibly improved. When, forty-five miles below Chicago, it unites with the water of the Kankakee and forms the Illinois river, the water causes a dilution twice as great as that in the canal, and the river loses its offensiveness during the greater part of the year. At Peoria, 158 miles below Chicago, the sewage has a dilution of nearly three times that in the canal, and, except when ice has covered the stream for some time, no odor can be detected, and the water is even partly used for the city's supply. Here there is a flow of 170 cubic feet per minute for every 1,000 persons draining into it.

Owing to the fact that the velocity in the canal is greater than that in the rivers at its two ends, deposits are formed in the Chicago river before entering the canal, and again in the Desplaines river after leaving it.

I will say that the analyses upon which these deductions are based were made under the direction of Dr. John Rauch, secretary of the State Board of Health of Illinois, and that the conclusion that in winter 180 cubic feet of water per minute per 1,000 persons draining at Chicago would be sufficient to prevent objectionable conditions all along the river is originally his.

The Blackstone river, in Massachusetts, which is quite foul below Worcester, and receives much additional sewage on its way, becomes unobjectionable at ordinary times for all but potable purposes about 15 miles below the city,[1] with a dilution at the rate of 140 cubic feet per 1,000 persons draining into it, together with considerable manufacturing refuse, and after there has been a chance for complete subsidence and some oxidation due to a large number of dams.

In Paris the sewage of nearly 2,000,000 people was turned into the River Seine before the irrigation fields were put in operation. The organic matter in this sewage per inhabitant is, from the analysis, hardly one half that of our sewage, because excrementitious matter was almost wholly excluded from the sewers. The dilution which rendered the polluted river entirely inoffensive in summer was 60 cubic feet per 1,000 people after a flow of 14 miles and after subsidence of the suspended matter had taken place.

If we reduce the recommendations of Dr. Miller and others, for England, as mentioned above, to our measures, we find that they believe a dilution of say 120 cubic feet of water per minute for 1,000 persons to be sufficient to guard against offensiveness. But this recommendation probably applies to small cities not devoted to manufacturing.

By comparing these results, and also those of the other rivers mentioned, we can observe much similarity and consistency, and, for the present, we may draw the following inference: Rivers not to be used for water-supplies, but to be inoffensive to communities residing a few miles below, to remain fit for ordinary manufacturing purposes, and to sustain the life of fish, may receive the sewage from 1,000 persons for at least every 150 to 200 cubic feet of minimum flow per minute, supposing that natural subsidence of the heavier matter takes place immediately below the town discharging the sewage.

Where, for some reasons, it is necessary to dilute it at once so that it is quite inoffensive *before* subsidence, which cases are rare, a somewhat greater dilution may be required. Inasmuch as the flow governing the minimum dilution occurs in summer, no attention need usually be paid

[1] Seventh Annual Report of the Massachusetts State Board of Health.

to the larger dilutions required in winter, because the natural flow of the water is much greater at such time.

Beyond the above limit it appears to be advisable, when arranging for a sewage disposal, to resort to its purification at once by land or other filtration, or by chemical precipitation, in order to prevent the river water from becoming objectionable to others.

It is to be hoped that more investigations will be made on this subject, so that the limits, which sometimes may be very important from an engineering and financial point of view, can be more closely drawn. While the above figures may be a useful guide in many instances, yet they are but empirical formulæ, to be used only by those who thoroughly understand the subject, and to be applied only in cases similar to those from which they were deduced.

XIX.

PRIME REQUISITES AND SUGGESTED IMPROVEMENTS IN THE CONSTRUCTION AND METHOD OF LAYING SEWERS AND DRAINS FOR HOUSE DRAINAGE.

By Dr. L. A. FALLIGANT,
Savannah, Ga.

So much is already known concerning the operation of the closet-flush and its necessary volume and force, that I will confine myself in this paper to a few suggestions concerning what I may properly designate as the central lane or street pipe, into which the house drains directly enter, and which are the connecting links between the primary house drains and the sewers.

First, the necessary fall in the grade of these central drains is determined by two principles—the amount of the flow and the power and force of the flush current. The longer the pipe and the less the fall, the greater is the requisite pressure in the flush. As an economical question, a long straight pipe is less expensive than a short one, and in it a single flush current can be made to serve a large territory.

Second, the central pipes should be so laid in the ground that the openings for the connecting house-drain pipes shall be on the upper surface of such central pipes,—thus doing away with the obstructing influence of eddies in the flush current, such as are constant in the central drains having lateral openings for the connecting house-drain pipes.

Third, the lower side or surface of the connecting house drain should slant downwards and forwards at the point of entrance into the central drain, so as to present a slanting inner and upper slope at such point of entrance, thus relieving in all possible degree such obstruction to the flush current as might be caused by a sharp angle at the point of entrance of the house drain.

In making the above suggestions, I may say that the placing of the openings on the top or upper surface of the central drains is so perfectly in harmony with the laws of gravitation that I need not enlarge on that part of my subject in this paper.

The important result of getting rid of the lateral openings into the central drains is the point on which I wish most to dwell. The theory in regard to lateral openings is, that the flush current runs through and out of the central drain in the same coincident flow as out of a river and its tributary streams,—that is, that the flow from the tributary and main streams runs in the same direction and at the same time.

The very contrary takes place in a system—indeed, in the best systems—of house drainage; the general truth being that, unless the flush of the central drain is constant, there is little or no joint flow. And in cases where the openings into the central drains are lateral, there is an eddy or backing out of the current into these lateral openings at every point of lateral opening, with a consequent obstructive effect upon the smooth and cleansing flow of the flush current in direct ratio to the number of these lateral openings.

NOTE. Dr. F. illustrated the above suggestions by a series of maps showing the con struction, position, and distances apart of the top openings in central pipes for house-drain connections by his plans,—these openings being moulded into the pipe originally before it is put into the ground, and not having to be cut or broken jaggedly into it afterwards.

PROCEEDINGS AND DISCUSSIONS OF THE FIFTEENTH ANNUAL MEETING,

HELD AT

MEMPHIS, TENNESSEE, NOVEMBER 8–11, 1887.

TUESDAY, November 8, 1887.

The Fifteenth Annual Session of the American Public Health Association was called to order by the President, Dr. George M. Sternberg, of Baltimore, at ten o'clock A. M., Tuesday, November 8, 1887, at Memphis, Tennessee, being the time and place agreed upon by the Association at its last meeting.

The PRESIDENT.—Gentlemen, Rev. Dr. Daniel will open our session this morning by prayer.

Dr. Daniel offered the following prayer:

Almighty God, Thou art our Creator; Thou hast given us immortal souls; Thou hast bestowed upon us these bodies, in which we live and move and have our being. We adore Thee that Thou dost keep us in life, and that every moment we can look to Thee as our preserver as well as our Creator. We thank Thee that Thou hast made it our privilege to look up through nature to nature's God, and to believe that Thou rulest in heaven above and amongst the armies of the earth beneath. Wilt Thou enable us always to adore Thee; acknowledge Thee always as the King of kings and Lord of lords, asking for Thy blessing upon us in all our right ways. We beseech Thee that as this body has met together this morning for the transaction of important business, Thou wilt give to them the spirit of wisdom and of grace, that in all things they may devise that which is best for humanity, and which will most promote the glory of our God. We thank Thee that Thou hast in Thy providence called men into this work; and as all of us are the beneficiaries of it, and in our own persons and in our families have been called upon to experience the blessed effects of it, we beseech Thee that Thou wilt give to us the spirit of appreciation, and that we may all earnestly pray that through it greater good may be done to the world in the future than has ever been done in the past. Wilt Thou prosper true science everywhere, and grant that all the means that are being used for the discovery of truth, and for the elevation and amelioration of the condition of the human race, may be blessed. Almighty God, prosper these physicians in their studies, and in all their practical experiments and scientific investigation. Keep them from error. Guide them in the way of all truth, and grant that through them the world may be blessed, the bodies of our fellow-men be relieved from suffering, and society may be prospered in everything that is noble and good. We ask Thee that Thou wilt bless him who presides over this body, and upon every member of every committee do thou send Thy blessing. Let this meeting be exceedingly prosperous; let it enlist the interest of the community; let it redound to the good of this city, and to the good of the whole country, and to the glory of God. We ask in Christ's name. Amen.

The PRESIDENT.—The first business before us this morning is the announcement of the Committee of Arrangements.

Dr. THORNTON (Chairman of the Committee of Arrangements).—Gentlemen, during your stay in Memphis I wish to state to you, here's an invitation from the Memphis Cotton Exchange, and they'll be pleased to see you there any time. Your badges will carry you in. Here is a like invitation from the Merchants' Exchange, to which your badges will also admit you. Both exchanges are located in one building, just two squares east of this, down this street, which is Madison, on the corner of Madison and Second streets, and the secretaries will be very glad to show you through the Exchanges, or give you any information connected with them, while here. I have two other invitations of a social character—one from the Tenessee Club; you are invited there at any time, day or night. The club is not closed until twelve o'clock at night. It's a social club made up of the business men of the city. These gentlemen will be pleased to see you, and you can just introduce yourselves to the secretary, Mr. Walker, who will take pleasure in extending the courtesies of that club to you. Another invitation is from a similar club, the Chickasaw. This is not closed until twelve o'clock at night. The secretary will be pleased to show you that club. The Tennessee Club is on this street, Madison, between Main and Second, very near the Cotton Exchange. The Chickasaw Club is on Second street, just below Union. Any of the citizens of Memphis can give you the exact location of either club. There will be a reception arranged by the Committee of Entertainment, of which Dr. Robert Mitchell is chairman, given to-morrow evening at nine o'clock at the Gayoso House. The ladies and gentlemen of Memphis will meet you there informally, and the ladies visiting the town with you, and spend the evening in that way. It is proposed to give you a two hours excursion on the river, Thursday possibly; that's not definitely fixed, as it will be on the Kate Adams, a very fine boat. It will leave the wharf at ten o'clock Thursday morning, and be back at the wharf at one o'clock. I wish to state that that is not positive, as this is the busy season, and the boats can't always be exactly on time; but if it's possible, that short excursion will be given you, and we want you to take that as it gives you a full view of our river front. We suppose that many of you come here not only to attend the Association, but to study Memphis, and see it somewhat from the standpoint of the sanitarian. We have to take a boat that is now in commission, and so we can't be positive about getting it. During your stay, the Tower from which you get a splendid view of the city and the river—you can go to it any hour during your sessions here in this building. Anything else that may come up will be announced from time to time. The Committee of Arrangements will be glad to show you any courtesy. A list of its members will be supplied, and you can call on any of them.

The Secretary read a list of gentlemen recommended for membership by the Executive Committee. On motion of Dr. Brodie, of Michigan, they were elected members of the Association.

The report of the Treasurer, Dr. J. Berrien Lindsley, was read, and referred to an Auditing Committee composed of Drs. Johnson, Holt, and Wyman.

The President.—The first paper on the programme is entitled "The Necessity of Burial Permits and Inspection of the Bodies of Deceased Persons," by Carl H. Horsch, of Dover, N. H., to be read by Dr. Rohé, of Baltimore, who is not here. I shall therefore call on Dr. Ezra M. Hunt, of New Jersey, to read his paper,—"The Origin of Some Diseases," and the "Prevention of Microphytic Diseases by Individual Prophylaxis." (See page 50.)

Dr. Hunt, of New Jersey.—I had proposed to have this second paper read only by title, but, as it was allied to the other paper, the committee requested that it be read with it. (Dr. Hunt then proceeded with the reading of his paper.)

The President.—The paper, gentlemen, is now before you for discussion.

Dr. Falligant, of Savannah.—Some years ago I commenced a series of experiments, striking out from everything in the ordinary method of treatment of diphtheria and the destruction of the growth in the throat, and found such success from it that I intended to prepare a paper on the subject, but it struck me at the time it might not come under sanitation. Those experiments originated in part from an accident. One of my nephews was taken sick in my house on one occasion with a condition of throat that looked so much like diphtheria, that I ordered him to remain at home. His mother was taking music scholars at the time, and was afraid it might interfere with her class. I came back in the evening, took another look at it, and the whole thing was almost gone ; the next morning, had disappeared in the throat. I asked his mother about it, and she replied,—"I can beat you, doctor, every time ; I took a good big swab, and rubbed it with turpentine." It was a revelation ! I took case after case of diphtheria where the deposits were so thick they looked like buckskin,—I have seen where those deposits were just as thick as buckskin,—and you could n't possibly get them off. I have seen them sloughing off so you could see patches of mucous membrane in twenty-four hours again and again. I have seen them disappear in a week or ten days. I pursued that treatment in a number of cases, with the same results almost invariably, and the great proportion of the cases got well, and the exception was when they died. This was something that had not been brought out before, and the doctor's reference to corrosive sublimate made me think of it. I prepared a preparation of pure corrosive sublimate of one tenth strength, so as not to be dangerously strong, in a glass of water, giving that internally; and with that turpentine on the throat, I have seen again and again the membranes cleared in forty-eight hours, so that, instead of having a house full of cases following, I just cleaned the whole thing up in that way. The same results I had seen follow in the membranes, too, in several cases in succession. I found that hardly one out of five died, even after they had gotten down to a condition of suffocation. I went to New Orleans some time since, and one of our medical gentlemen had just delivered a lecture on the treatment of diphtheria by germicides. I had a country friend there with a good deal of experience and a good deal of humor, a broad cracker dialect, and when this gentleman got through, that friend of mine from the country got up and made a remark about the amount of science that they did n't have up in his part of the country; and said that some of them had science, and a great many of their cases died; that the others just wrapped their cases in turpentine, and nearly all of those cases got well. There was a confirmation coming from a man of no science and very little education. It is such a discovery that it occurred to me it had almost reached a point of sanitary value, independent of its value in the treatment of diseases of that type.

Dr. Burrows.—I do n't know that this comes exactly within the line of the discussion of the paper, and I've been thinking, while listening to the reading of the paper, that the acoustic properties of the room were not quite perfect, and that it would be well for the committee to consider the advisability, at subsequent meetings, of having the papers printed and laid before the members in a shape we could, at least, partially digest before hearing them read. In relation to the use of turpentine in diphtheria, I may say—

The President.—I think I must restrict the discussion to the subject of the paper: it is getting rather into a medical line, and I would like you to confine your remarks strictly to the subject of the paper. The previous speaker certainly led off in that direction, and I simply wish to check it now.

Dr. Burrows.—I will merely say that we can hardly realize the full importance, in the full sense, of a paper read before the meeting, where the acoustic properties of the room are poor; and I do n't know that I can rationally discuss that paper, and I doubt if any member can, read in that way. I hope in future meetings that they will be printed.

Dr. Richardson.—I think I can speak of one or two facts that bear on this paper. During the summer of 1886 we had an epidemic of whooping cough, and a number of cases died; and, having heard of the use of arsenic as a prophylactic in some malarial troubles, I thought perhaps it might be used in those cases. I used it in at least a dozen cases, and ten out of that dozen were exposed and did n't contract the disease. One of the cases was a child, newly born, in which the mother had the whooping cough. The child escaped without contracting the disease, and was well until it was about a year old, when it was subjected to the malarial poison of the country, and took arsenic for about a month, and escaped that malarial season.

The President.—Dr. Burrows, if you were about to speak of the prophylactic use of turpentine, it was quite in order.

Dr. Burrows.—I was going to say that I had for some time—I should say some years—used turpentine by atomizing. I have used it, and frequently do to this day, with my own family, on my own child, who is very subject to croupous attacks. I find there in nothing I ever tried that equals it. I've used it sometimes alone, sometimes with iodine, and can endorse the opinion of the previous speaker as to the use of turpentine as a destructive agent. I know of nothing more efficient.

Prof. Brewer.—I will say but a word, and that is as regards the first paper. A considerable portion of it being speculative, cannot be discussed. It seemed to me, however, that in the direction in which the speakers have spoken, we have the only philosophical explanation that has yet offered of the varying intensity of epidemic diseases. An epidemic of a contagious disease is sometimes very severe, and sometimes mild; and in this paper we have a philosophical explanation for and of that fact. There is one point in the paper where, I think, the doctor's statements are misleading: that is as regards the fertility of hybrids in plants. While there is no question whatever but what a large number are fertile, I got the impression that hybrids were as fertile as the "straight species"—we'll call them that. I think that all of the experiments that have ever been made point in the opposite direction—that there is a diminished fertility. The experiments of Gethna, carried on for a great number of years in every case, while in some cases he managed to continue hybrids for fifteen years, there was a diminished fertility in every case; and I do not know of a single course of experiments continued for a number of years, which does not show a diminished fertility and vigor on the part of the hybrids in the higher order. When it comes to the lower order, while it is probable they may show more vigor, there is certainly a diminution of vigor and of fertility, if we can follow out the whole line of experiments.

Dr. Brodie, of Michigan.—This paper,—that is, the first part of it,—read by my friend, Dr. Hunt, has very much interested me. Its interest lies in the fact of the want of knowledge of the causation of disease. If we could understand the cause of disease, I think what might follow in reference to its prophylactics and treatment would be very easy. It is very difficult, when scarlet fever or small-pox breaks out in the community, to know where it comes from, and its causes. I've always held the doctrine that there was always a first cause, of course; but I can conceive where scarlet fever or diphtheria may break out in a community without necessarily being carried by contact. I've always believed strongly in the influence of atmosphere, accompanied by local and other conditions, in the production of disease, and I believe that circumstances may occur under which scarlet fever can arise in a community without contagion with any other town, place, or individual. I cannot explain to you how I arrive at that conclusion, or give the facts that make me think so; but yet on observation, not only of my own, but of other gentlemen, distinguished gentlemen, in years gone by, I have held that to be the case. This paper points to very much the same conclusion, and rather pleased me, because it conveys the idea that I just stated about the origin of diseases. We may have, for instance, typhoid fever. . . Now in Michigan, my friend, Dr. Baker, and many others disagree with me, and put down a certain class of diseases as typhoid fever. I have not seen any typhoid fever in Michigan for the last ten or fifteen years—what I call typhoid fever. The disease there called typhoid fever lacks a great many of the conditions of that disease as described by Bartlett and Louis, and, according to my own observation, yet contains and retains several of the same conditions. Hence I think it is a misnomer when a disease is called by the name of the original disease, and I think it misleads the people, and has a bad effect in sanitation to so consider it. We have a fever—remittent fever, if you please—brought about without any known causes. That fever passes along with certain conditions of sanitation which prolong that disease. We begin to have irregular remissions and intermissions, and hence we pass it along and call it, after awhile, typhoid fever, because the patient lies in bed perhaps thirty days, and is emaciated before he recovers. In that way I think the paper of Dr. Hunt has thrown out some good ideas in reference to the causation of disease, and I am sorry I had not thought about this subject sooner. If I had heard the doctor's paper yesterday, and thought it over, perhaps I might have been better able to explain myself at this time. I do like the idea of having the discussion of a paper confined to the subject the author writes about. These side issues take away the interest, and we lose sight of the fact of what the author wishes to convey to his hearers.

Dr. BELL.—I have but few words to say in regard to Dr. Hunt's first paper—the supposed hybridism of yellow fever. I am satisfied that the earliest history of it we receive as credible corresponds to the latest description we can get of it, whether in Africa or the West Indies. A good while ago, I may call it almost thirty years ago, I had opportunities of seeing yellow fever myself as it occurred in the Gulf, and as it occurred in Africa not long thereafter. It appears to be the same disease,—what I think accords with other observers; and all the history I have ever read of it, from what I regard the best authorities—the English on the coast of Africa—is perfectly consistent with the earliest introduction we have of it in the West Indies, and, from its continuous similarity, I may say its exact conditions, according to all the descriptions we have been able to get, I am unable to see any ground-work whatever for the supposition that it is a hybrid in any sense. If there is any disease we encounter that has pathognomonic symptoms by which we can certainly distinguish and characterize it after having once become familiar with it, it is yellow fever. It is as free from any evidence of hybridism with any other disease as any I have encountered.

I would say in regard to the second paper: Some twenty-five or thirty years ago, when I was in service in some of the worst climates in the world, some of these very ones to which I have alluded,—on the Spanish Main and on the coast of Africa, where I had a great deal to do with the worst forms of malarial and pernicious fevers,—I tried to my satisfaction the possible preventive effects of quinine. I then concluded that to give quinine to well persons was a very easy way of making them sick, and that the best preventive was regularity of life and abstinence from stimulants. They resisted much better than those to whom I administered quinine and arsenic. Only about one month ago I met the surgeon-in-chief of the Panama Canal Company, Dr. Charles Williamson, formerly of the United States navy, an exceedingly prominent practitioner and a keen observer. I entered into conversation with him about the mortality among the operatives. He said it was caused by quinine and whiskey. I said, Can you separate the two? He said there were some persons who did not take whiskey, but the great mortality was due to the fact that they had inculcated in them, before going there, that they must take quinine and whiskey. He attributed the great mortality to that treatment, before they had any malarial disease. I asked him, in his own person, during three years' residence in one of the most deadly places in the tropics, if he ever took quinine or anything else. He said, Never; that he had not been ill during his three years residence there, and that other persons who had lived as he had lived, *i. e.*, who had taken no prophylactics except to take good care of themselves, were the healthy people in that climate. My own observations in the tropics for six or seven years, and among different peoples in Africa and America, I felt were fully confirmed by his statements, inasmuch as my observations ante-dated his in that particular. I have not heard anything through Dr. Hunt's paper or the authorities quoted that leads me to change my opinion of the mischievous effects of well people taking medicine under any circumstances.

Dr. Ames.—I remember some years ago it was then the fashion with our former Executive Committee to send out to the old ex-presidents of the Association, asking their advice as to the subjects to be discussed; and, addressing a note of that character to old Dr. Snow, asking his opinion as to the desirable topics for the next meeting, he replied,—"I think we had better take one year to unteach the fallacies we have taught." In listening to the very definite propositions of my friend, Dr. Hunt, in his first paper, as to the overthrow of the theory of the sterility of hybrids, I thought that perhaps we had arrived at that year, and that Dr. Snow's suggestion was finding its fulfilment. I am thankful to Prof. Brewer for having at least put the interrogation point in regard to that subject. I confess a paucity of knowledge myself upon it—my personal information being confined to the small experiments I made some years ago in my own conservatory in hybridization of plants: but I must admit that I am not ready to so definitely state that the idea of greater sterility in hybrids has been disproved. I think we may be grateful for the broad range of the suggestion he throws out, as for an outlining in somewhat definite form of what perhaps might be termed an inquiry into the philosophical bases of disease; and for that I am certainly grateful, as I am for any light on any line, even which I am not ready to accept. Still, I think it would hardly be wise for us to allow a paper to go upon record in such a way as to put this Association in the position of absolutely agreeing with that paper, to the overthrow of a theory upon which so much is based. For my own part, I can but believe that any philosophical basis of disease must rest upon a very thorough law; and if it is a law, I should be slow to believe that what certainly has little effect and strength in the animal kingdom can be sure of the same workings in even the lower forms of plant life. While I am free to admit that there is a greater fertility of hybrids in the lower forms of plant life than there can be in the higher forms of the vegetable and animal kingdom, I should be slow to adopt the idea that the greater sterility of hybrids, as a theory, was completely overthrown.

Dr. Hewitt, of Minnesota.—I, for one, should be very happy, as the executive officer of a state board which had a great deal to do with dealing with this matter, if I could believe that we had got far enough along yet to suggest a specific prophylaxis for disease. My office is full of suggestions of that sort. We have several remedies in which the basis is turpentine, which bring in a large income to their venders. Our arrangements are such that all reports (and there is hardly a report in which they do n't constantly complain of the belief that there is such a thing as taking medicine while you are well to keep from getting sick) have proved a bar to our progress—the belief that you can take a little dose beforehand and need n't take the disease at all. I remember a few years ago, when we had the largest outbreak of small-pox in Stearns county. It was a thinly settled county, and no physicians practising there. They believed in specifics that had something in them that prevented the occurrence of the trouble; and therefore they did n't any of them think they had small small-pox until over a hundred cases had occurred. When I got there I found ten or fifteen townships permeated with the poison; and all the intelligent men believed that a one millionth solution touched to the tongue of a visitor was sufficient to prevent the spread of the disease. One of the strongest bars, I tell you,—and I speak from an experience of twenty years as the health officer of our state,—one of the strongest bars we have to meet is the belief that we or somebody else can provide them with a specific which does away with all necessity for cleanliness, or anything in the shape of common-sense. It is one of the strongest bars that stands in my way as a practical officer. I do not wish to be understood that I do not yearn, just as heartily as my friend Dr. Hunt and all other executive officers do, for something that would enable us to deal with this disease in that way; but we must be very careful indeed, especially with respect to that damnable disorder, diphtheria. It is this disease of all diseases that is dealt with by specifics—that can be prevented by something in contact with the visible sign of it. It is the disease of all diseases that can't be dealt with in any such way! [Applause.] We have two works to do, and we must distinctly differentiate the two. The first of those works is the ideal,—the hope, the anticipation, the expectation of the future. That is what sustains us. If we did not have the expectation that we should do better and be better hereafter, there would be a good deal of despair; but it is just such anticipation that encourages and sustains us in our every-day work. But we must not carry the one too far into the territory of the other. I believe as heartily in the pursuit of the one as I do in the practice of the other. And when the pursuit of the one shall put into our hands a tangible means for use in the other, I say God be thanked, and let us try again!

Dr. BAKER, of Michigan.—I wish to endorse what Dr. Hewitt has said, very strongly. I think we are all indebted to Dr. Hunt for his able paper, and the hypotheses are very interesting; but I cannot go the length of my friend, Dr. Brodie, in making that a working hypothesis. I think we must draw the line there. It is following that hypothesis of the *de novo* origin of disease that has given us a thousand deaths from typhoid fever in our state in a year. That is the sort of thing we get from acting on that as a working hypothesis. We ought not to work on that line at all. I think we want to do the reverse of that—find where the disease came from, find where it is likely to come from, and teach the people how to prevent it; and in that way we think we are doing some work in Michigan, as they are in Minnesota, in preventing diphtheria and scarlet fever and typhoid fever. I can understand why they do not have typhoid fever in Detroit, where Dr. Brodie comes from—they have a good water-supply; and we can get a good supply if we will not teach the *de novo* origin of typhoid fever, but teach that it is usually traced to bad water. The working hypothesis he have now is a useful one, and the hypotheses given to us by our friends here may be useful some time in the future; but I think we should not take it up and work on it to-day: it is what we have been doing in the past. When people think that a disease like typhoid fever and diphtheria comes to them from an unknown source, they do nothing; but when we teach them they can isolate their cases, and disinfect and save hundreds of lives a year, I think we ought to continue in the same line.

Dr. OTTERSON, of Brooklyn.—In view of the drift this argument has taken, I wish to say, here is a pamphlet the health department of Brooklyn issues to persons or houses found infected with contagious disease, in the way of popular education in the management of these cases, and the sanitary conditions by which they should be surrounded. In this list of the disinfectants, their manner of application, both to the patient and to the room after the patient has recovered or died, are embodied. This pamphlet is published in English and German, and left at the houses of all patients throughout the city. These instructions are made very plain. The articles of disinfectant, which I will simply read, are,—Fire; boiling water; chloride of lime, either dry or in a solution; standard solution, No. 1; solution of chloride of soda; sulphur; and bi-chloride of mercury. The walls of the patient's room, the clothing, the bedding, the dejections—everything in and about the patient is subjected to one or the other of these means of disinfection. As a means of preventing the further spreading of this disease, of course, where these things are enjoined upon the people, the owners of houses and agents are notified, after due inspection of these places, in relation to any defects that may be found in drainage, or plumbing, or water-supply, or anything of that kind. While I am up I will say, in relation to this condition of typhoid fever, that, while we have more or less of that, we consider it typhoid fever in Brooklyn, especially after as hot a summer as we have just passed through. Yet there are no cases,—or seldom any case occurs,—where all the phenomena of the disease are found in any individual case. That, of course, is the experience of every practitioner in the cases of these fevers; but we have abdominal complications, etc., is which there is quite a large mortality. I simply submit this pamphlet for the examination of the Executive Committee.

Dr. Bailey, of Louisville, Ky.—There is so much of this subject I know so little about, I will not speak very long. First, in regard to the fertility of hybrids. This may be so,—what Dr. Hunt states,—in regard to the lower forms of animal and vegetable life; but if it is so in full, then I shall go home and advise my neighbors to raise colts from their mules, which they have not been able to do heretofore. [Laughter.] I want to say that I admire exceedingly the tendency of the paper. It is seeking after what we want where frequently we are unable to determine intelligently, and, reasoning by analogy, even from this inferior order of fertility, hoping to gain a specific organism by development that will account for diseases not heretofore accounted for, and also for the influence of environment in cases *de novo*. I think Dr. Bell can tell us something of the influence of environment. But I want to say that I think Dr. Hunt possibly may have gone beyond really his own convictions seeking after something he hopes may be true, and in that way eventually good may come out of it. I am pleased with the paper.

Dr. Brodie.—Speaking of prophylactics and bi-chloride of mercury, it carries my mind back to the time when the use of mercurials was the general practice in this country; and I am inclined to the idea that the long continued use of mercurials at that time prevented the formation of these bacteria we now find since mercury ceased to be used as a remedial agent. I am very glad to think that the profession is coming back to the use of mercury in treating disease, and I cannot but see it is the most direct way. These parasites can be destroyed in the treatment of the disease by the use of calomel or bi-chloride of mercury. I think if the profession would look into that a little more, it would be the means of changing the character of disease very much. You all know—at least a great many of you know—what is called the calomel treatment. In Detroit we have had a good deal of diphtheria, and some of the profession have treated it entirely by the use of calomel, and claim that by giving three doses they scarcely lose a patient. I have found that those gentlemen who treat under the calomel system have had very good success—as good as with any other treatment. Others treat with the chloride of iron treatment, which is as efficient as the other. I do not know except its purely tonic properties: the effect of mercury upon the system is altogether purely tonic. Dr. Baker speaks of our water. I think we have the best water of any city in the Union, and if any board of health, in giving advice to their constituents throughout the state as to the prevention of disease, would call their attention more particularly to looking after their water-supply, and see that that is changed, I think they would have less to do. It is having plenty of water: I have seen the effects of that on shipboard and in other places. If you have an insufficient water-supply, or it is diseased, you are pretty sure to have disease; and hence I think that more attention should be paid to the water-supply than it receives at present.

Dr. HUNT, of New Jersey.—I should have been disappointed if this paper had not called out some discussion; and I thought, in proposing the subject of the paper, I was very careful not to commit myself to any theory. I entertain a hypothesis a great while before I convert it into a theory. As to the first paper, one point has been entirely overlooked, —that of the suggestion of the change that takes place in disease by *evolution*, and of the possibility of accounting for new types and forms of disease in this way. The whole attention seems to have fastened upon the question of the fertility of hybrids. I was quite aware that, because there are mules, and multitudes of physicians and men that know more about mules than they do about the infinitesimal botany of disease, that proposition would be disputed.

When preparing this paper, I first spent a day with Dr. Mc Closkey, the professor of botany at Princeton, and got his opinions. I also consulted Professor Apgar, the instructor in the same branch in the State Normal School of New Jersey. I then wrote to Mr. Meehan, the able florist of Germantown, Penn., and editor of the *Gardeners' Monthly*. As what I have said is fully confirmed by all of these, I shall not yet doubt their correctness, or the judgment expressed. I knew it would bring out a difference of view. In looking to my manuscript, I see that I say,—"But so numerous are the exceptions, and so abundant have been the results of new cultivation, that the view that most *hybrids* are sterile is fully disproved." That is true. That does not mean to say that all hybrids are fertile, but it does mean to say that fertility among hybrids—the non-fertility among hybrids is the exception—fertility among hybrids is the rule. I inquired definitely into the fixity of the fertility, and find that many of the hybrids do come to be fixed in their fertility.

Next, as to the danger of the doctrine of the *de novo* origin of disease: Now, sir, it is always dangerous to fasten too much upon one idea. There are two parallel bars on which the progress of sanitation runs, as much as the rear car on a railroad. One is isolation. If I ever should say anything in a paper that would lead to a want of caution, as to this, I should be sorry; but I should also be sorry if I were not teaching that filthy surroundings—the condition of the person—may propagate disease; and sometimes there is a possibility that they may be related to the origin of diseases. I know, after thirty years of practice, some things about diphtheria and scarlet fever, and about typhoid fever, that make me not ashamed to agree with Murchison, and with Sir James Paget and others, that new diseases do occur. I entertain, as a working hypothesis, that there is a sense in which evolution and hybridism may come to explain the thing, and therefore let it be understood only as a hypothesis; but it is my business to set myself to thinking, and my brethren to thinking, in right directions. That is all I have attempted to do. I have not accepted a theory, nor do I want you to accept it; but I do want these propositions to elicit your kind attention.

As to the other point—prophylaxis. Is there any disagreement that we do not want men and women and children running up and down the country with all sorts of nostrums as antidotes for disease? But does that prove, when I am going into a malarial district, it is bad for me to take small doses of quinine as a preventive? For three years the government of Great Britain has kept Dr. Cash at work, and the experiments made show the beneficial effects of prophylactic treatment. And shall we not accept such pieces of proof, even if they are little pieces? shall they not put us on the *qui vive* to be after these things, not accepting them as proven, but as possible facts that are well worthy our attention? That is all I have to say.

Dr. Reeves.—I can never listen to any remark on the subject of typhoid fever that I am not at once greatly interested in the subject. When I started out in the practice of medicine over thirty-six years ago, I stepped into one of the most fatal and wide-spread epidemics of typhoid fever I have ever witnessed up to this time.

The President.—Did you hear the doctor's paper? The subject is prophylaxis. I only want to make the remark, as I checked another gentleman before.

Dr. Reeves.—I heard a part of it. I propose to speak on that subject. . . . I soon learned that typhoid fever was as specific in its character, and as certainly contagious, as scarlet fever or measles, or any of that class of diseases. I busied myself in 1860 tracing the history of typhoid fever in Barber county, in West Virginia, and the history may briefly be told in these words:—That in 1837 a case of sickness came into that county from a neighborhood which was then scourged with a disease called "slow nervous fever." That patient came into Barber county, and from his centre the disease spread into various neighborhoods,—a disease never before known in that community,—and from that centre the disease spread over eight or ten counties. Now I believe no more in the *de novo* origin of typhoid fever than I can believe in the *de novo* origin of small-pox, and if we are to rest ourselves on the labors of bacteriologists, and especially if we are to regard the investigations and experiments by our very learned and distinguished president, we understand we must believe in a specific microbe in typhoid fever which may be cultivated outside of the body, and which may be administered in water or in food, and sent broadcast over a community, large or small. Bad water, no doubt, is the vehicle; but bad water without the specific germ will not produce typhoid fever any more than it will produce small-pox. Old Dr. Watson, in his Practice of Medicine, teaches us an admirable lesson we should never forget in the study of this question, and that is, that epidemics and contagious diseases come around in uncertain circles. They come mysteriously, and disappear mysteriously; but he accounts for it in this way,—that there is in every community a certain amount of contagious matter pent up, only waiting the proper atmospheric causes for its lighting up and spread. The only way to prevent typhoid fever, in my judgment, is simply to treat it as you would treat small-pox—disinfect the discharges, prevent the visiting of the sick, treat it, in a word, as you would treat scarlatina or small-pox.

The PRESIDENT.—I omitted to ask you to permit me to make one remark,—although it is contrary to custom,—and that is with reference to this question of the sterility of hybrids. I really do not see how this applies to the pathogenic bacteria; they multiply by the division of spores. Where you have conjugation of spores, I do not quite see how the question as to the sterility of hybrids can come in, in the case of the bacteria.

Dr. THORNTON, chairman of the local committee of arrangements, read a letter from the Western Union Telegraph Company relating to special rates to members of the convention.

The PRESIDENT.—Next is a paper on "The Necessity of Burial Permits, and Inspection of the Bodies of Deceased Persons," by Carl H. Horsch, M. D., of Dover, N. H. Paper read. (See page 45.)

The PRESIDENT.—Gentlemen, this paper is now open for discussion. [After a pause.] No remarks on this paper? Well, proceed to the next, "Some Forms of Tables of Vital Statistics, with Special Reference to the Needs of the Health Department of a City," by John S. Billings, M. D., surgeon U. S. army, to be read by Dr. H. P. Walcott, of Cambridge, Mass.

Dr. WALCOTT.—This paper is submitted by Dr. Billings, not as a representation of the views of the committee. The paper is illustrated by various diagrams, and it will be almost impossible for me to do justice to it—I can simply read it.

Paper read. (See page 203.)

Dr. DUFFIELD, of Michigan.—I wish simply to ask one question of the reader of the paper: How would such a card be received judicially, in court? Would it require an absolute calculation by the health officer on there, or would he adopt the calculation of the machine, and swear to that judicially?

Dr. ————.—Mr. Chairman, I can hardly conceive of any circumstances under which the ordinary statistical work of the state would become a matter for judicial investigation. As Dr. Billings very properly observes, the state register must contain the name and various facts which our records now contain, for judicial purposes. The card is simply one step in the machinery, but not the final step, as I understand it. In my own state, the card is not produced in court.

Dr. BAKER, of Michigan.—As one of the committee, I can say that Dr. Billings is correct in that the health officers have not helped him very much. I think we should thank him for his contribution. I think it will be of great assistance to the health officers of cities. In regard to that machine, I am very strongly impressed with it, both as regards the saving of labor and the question of accuracy. My impression is, that the certificate of accuracy could be much more readily given to the results of the machine work than to the results obtained by the ordinary method. That is my impression. Dr. Hunt, of New Jersey, has had some practical experience with the machine. They have had their statistics compiled by that method.

Dr. HUNT, of New Jersey.—I want to say we have not perfected our work, but it strikes us favorably. We have had a gentleman at work on the machine in our office, and it will greatly aid the compilations; and it is in contemplation with us whether, instead of copying them, we shall not substitute the punch as our recorder, with a large part of the work. If so, it will diminish the quantity of clerical work; but the great value is in having the cards. They are just as easy of reference as the writing would be, and will be immensely valuable in the whole subject of vital statistics in enabling us to make combinations and numbers of combinations that most of our officers could not make under the appropriations. We are taking a city like Newark, which has 120,000 inhabitants, and about twenty counties which are thinly settled; and this operator is doing those for three years. He gives us the record for three years of the deaths and causes, and it will cost us only about $200. The machine costs about $3,500, but what he proposes to do is to have the work done for us. He sends a man to make the punchings, and as soon as that is done, he takes the cards and gives us the results, without the machine being bought. That is his method. It has been under the examination of Dr. Billings, and I was so well satisfied with it, I was sure we needed some work done with it; and I presume that next year, when we come to the decennial combinations, we shall do some further work with it.

Dr. ROHÉ, of Baltimore.—The Committee on Disinfectants presents to-day one portion of its third annual report. The package of manuscript I hold in my hand contains the detailed report of the experimental work performed by the chairman of the Committee on Disinfectants, Dr. Sternberg, during the past year. I do n't think the Association wants me to read this report. There is a portion of the report to be furnished by Dr. Horn. I will go back a little. Dr. Sternberg has, in the laboratory, tested various organisms, which I shall mention presently a little more in detail. Dr. Vaughan was instructed by the committee, at a meeting held in Toronto last year, to undertake certain investigations into the effects and the rendering innocuous of ptomaines. Dr. Durgin, of Boston, a member of the committee, was instructed to carry out a certain portion of the work; Dr. Holt, of New Orleans, a certain portion, of which he will present a report later on in the meeting, I believe; and the secretary was instructed also to furnish certain abstracts. All these papers will be part of the report of the committee, and will be furnished. I have been requested by the chairman to submit to the Association for their determination, whether it would not be proper, after this report is received, to discharge the committee. The committee believes that with its present report it can say that the instructions which were given to it three years ago in Saint Louis have been carried out; that the disinfectants which are in use have been tested carefully; that their applications have been formulated, and that at present there is no work for the committee to do which they can do with satisfaction; that there is undoubtedly a great deal more work to be done, but at present, and with the resources at their command, they cannot do that work. They ask that you accept what they have done, and give them a leave of absence, at least, if not a final discharge. I have prepared an abstract of the report of the chairman, and shall, with your permission, read it.

Paper read.

Dr. FALLIGANT.—I would like to ask as to the possibility of the reabsorption of the bacilli of typhoid fever by the patient himself after the decline of the fever. I have seen a number of cases where the secondary fever had run about three weeks, and a very curious condition led me to suspect one of these causes; and it occurred to me that on the cessation of the diarrhœa, and if these bacilli had not entirely passed away, possibly there might have been a retention of some of the bacilli in the system, and that secondary fever might have been brought about in that way. When I saw this lump formation, I concluded I would work that lump out; and it raised that question in my mind whether those bacilli could be reabsorbed.

The PRESIDENT.—I do n't know whether I could throw any light upon that question. I think it is quite possible.

Dr. BELL.—Probably it is with a sense of pride—it is certainly with a sense of great gratification—that in 1864, in the Transactions of the Medical Society of the state of New York, I published a summary of my experiments, limited chiefly to yellow fever, in the use of moist heat; that is to say, experiments actually tried with regard to the fever, and where there was no subsequent development of the disease. I deduced the conclusion at that time that a temperature of 145 degrees Fahrenheit, applied for two hours, was amply sufficient to destroy all the causes of contagious diseases of which we had any knowledge. That is among my conclusions deduced in the year 1864, summarizing and covering a period of actual dealing with yellow fever in particular and with some other diseases experimentally, covering a period of sixteen years,—that is to say, covering the time when I first used steam as a disinfectant in 1845, and various experiments on board ship during that period of sixteen years. During these subsequent twenty-three years, I have on various occasions defended the use of steam under such circumstances. I have very recently been interested in getting its exact application in quarantine, which it will be proper for me to relate to-morrow morning. I have occupied your attention quite long enough to express my gratification that, after twenty-three years' experiment in the laboratory and by the most expert biologists, they have proven by actual experiment a conclusion which I adopted, based upon dealing with the disease itself.

Dr. ———.—Mr. President, I would just like to ask, Are the solutions all made in water, and will the ordinary drinking-water answer?

The PRESIDENT.—The solutions are all made in water.

Dr. ———.—Will the ordinary drinking-water answer the purpose?

The PRESIDENT.—Yes, sir; in making these tests we use distilled water, but in practice ordinary drinking-water will answer.

Dr. BAKER, of Michigan.—I wish to ask, Is it in order to offer the resolution bearing on the subject of the work of the Committee on Disinfectants? I have n't it written out, but it is to this effect: That the Executive Committee be requested to consider the desirability of publishing in complete form the entire work of the Committee on Disinfectants. I understand that there are plates of the part already published, so that the expense would not be so great as it would to set up the whole matter; and I understand further, that there is a fund set apart for that work, which, if the committee are discharged as they request, would be available for that purpose; and I make the motion that the Executive Committee consider the advisability of publishing in complete form the entire work of the Committee on Disinfectants.

Dr. BELL seconded the motion.

Motion carried.

On motion of Dr. Hunt, the Association then adjourned till 8 P. M., Nov. 8, 1887.

EVENING SESSION—8 O'CLOCK P. M.

Dr. THORNTON presided.

Chairman THORNTON.—Gentlemen of the American Public Health Association, I have the honor to introduce to you—excuse me, we will open the meeting with prayer by Rev. Dr. Daniel.

Dr. DANIEL.—Almighty and ever blessed Lord our God, in the morning of creation, when darkness covered the earth, Thou didst speak and say, "Let there be light;" and we adore Thee as the God of all light, who hast sent forth by Thy Spirit into this world the light of the knowledge of the truth as it is in Jesus Christ our Lord. We worship Thee as the king eternal, immortal, invisible, the only wise and true and living God. We adore Thee as Thou dwellest in light inaccessible and full of glory, Whom no man hath seen, nor can see and live. Our spirits are bowed before Thine, the great Spirit of all; and this night we come to Thee, almighty God, for Thy blessing. We thank Thee that Thou hast manifested Thy love toward us, and that in the midst of the suffering which we have here upon this earth, Thou hast provided means for our temporal and spiritual relief. We rejoice that Thou hast put it in the hearts of men to consecrate themselves to the work of ameliorating the condition of humanity; and we ask Thee this night that Thou wilt bless those who are met together before Thee for the purpose of ascertaining the truth that is needful, in order that they may prosecute this great work with success. Give to them the spirit of wisdom, and grant that in all their discussions they may be guided in the ways of truth and of permanent usefulness. We pray Thee that Thou wilt accept our thanksgiving for all the good done through those who have consecrated their lives to this work in this city and throughout the world—in this city in those days never to be forgotten by us, when all was darkness and gloom, and these men stood faithfully in their places, ministering to the suffering and alleviating the distresses of those who were in the deepest sorrow. And, almighty God, may they all be blessed of Thee in their persons and in their work. Grant unto them, we beseech Thee, the march of intellect, advancing always in the paths of truth to the good of humanity and to the glory of God. Almighty Father, we pray Thee to spread the light of knowledge all over the earth; banish ignorance; bless all means that are being used for the dissemination and the propagation of the truth; and let Thy saving health be known among all nations,—the saving health of the body and of the soul; and Thy kingdom come, and Thy will be done in earth as it is in heaven, to the praise and the glory of Thy goodness and Thy grace, forever. Amen.

Dr. THORNTON.—Gentlemen of the American Public Health Association, on behalf of the local Committee of Arrangements, I have the honor to introduce to you the Hon. W. L. Clapp, who will now deliver you an address of welcome on the part of the citizens of Memphis. [Applause.]

The Hon. J. W. Clapp then delivered his speech. (See page 25.)

Dr. THORNTON.—I now have the honor of introducing to you His Excellency the Hon. Robert L. Taylor, governor of Tennessee, who will deliver to you an address of welcome on the part of the state. [Applause.]

Gov. Taylor then delivered his address. (See page 22.)

Dr. THORNTON.—Gentlemen, I now have the honor to introduce to you Dr. Geo. M. Sternberg, the president of this Association, who will deliver the annual address.

Dr. STERNBERG.—I am under very great obligations to the eloquent speakers who have preceded me for having placed you in a good humor. You will now be prepared to take the sort of medicine I have to give you, and I am sorry to say I am afraid it is not sugar-coated with any humor, but is a very plain sort of address.

Dr. Sternberg then read his address. (See page 1.)

Dr. THORNTON.—Gentlemen, as chairman of the local Committee of Arrangements, I have been repeatedly asked by parties if ladies would be admitted to these meetings; and I take occasion to say that they will be most cordially welcomed, and [turning to the ladies] we hope you will grace the meetings by your presence; be very happy to see you at any time. [Applause.] I will remark further, that the meetings will be continued every day, and a programme published: it will be in the morning papers and in slip, indicating the essays which will be read each day. And I will go a little further, and state that to-morrow evening it has been decided that there will be a paper, or rather a lecture, on the Quarantine Defence of the Mississippi Valley, by Dr. Joseph Holt, the president of the Louisiana State Board of Health; and I urge especially that the business men of Memphis come and hear that lecture of Dr. Holt's, in which he proposes to demonstrate, by diagram and otherwise, his methods of disinfecting ships and protecting the Mississippi valley from the approach of yellow fever during the yellow fever period; and this subject is one that we in Memphis are as vitally interested in as New Orleans. As after the advent of warm weather I am approached so frequently and asked about what is being done in New Orleans, we urge especially the business men of Memphis, the merchants, to come to-morrow night and hear Dr. Holt, at half-past seven o'clock. The meeting will be held to-morrow morning at ten o'clock—the morning session.

Dr. Jas. E. Reeves, of Wheeling, W. Va.—Permit me to say, that I deem this a very appropriate occasion to call out the sympathy of our hearts for our fellow-workman, our beloved friend and member of this Association, Dr. Thos. F. Wood, of North Carolina, who cannot be with us to-night on account of a fatal illness from which he is confined to his house; and I think it will be very becoming in this Association to send him a word of sympathy. I therefore move that the president and secretary be instructed to send a message of sympathy to Dr. Thos. F. Wood, of North Carolina.

Motion carried.

Adjourned.

SECOND DAY.

Wednesday, November 9, 1887.

MORNING SESSION—10 O'CLOCK A. M.

President Sternberg called the Association to order, and called for the report of the Executive Committee.

The Secretary.—I am directed by the Committee of Arrangements to announce that there will be a reception at the Gayoso hotel this evening at 9 o'clock, and that all the members of the Association, with their ladies and friends, are invited to be present.

The Executive Committee recommend the following persons for membership. List read.

The President.—Gentlemen, you have heard the list of names recommended by the Executive Committee for membership. What is your pleasure?

Dr. Hunt, of New Jersey, moved that the applicants be elected members of the Association.

Motion carried.

The President called for announcements from the Committee on State Boards of Health.

Dr. Hunt, of New Jersey, read the committee's report, and moved that it be referred to the Executive Committee.

Motion carried.

Dr. Johnson, of Chicago, read the report of the Auditing Committee, which was adopted.

Dr. Walcott, of Massachusetts, moved that the recommendations of the Committee as to the Presidential Office be referred to the Advisory Council.

Motion carried.

Dr. Rohé, of Baltimore.—I have a resolution which I would request to have referred also to the Advisory Council.

Resolution read and referred.

Dr. Otterson.—By request I offer the following:

Resolved, That this Association urges its membership to recommend to the representatives in congress to further by all means in their power additional appropriations for the maintenance and equipment of the U. S. quarantine stations at Delaware, Breakwater, Cape Charles, and the Gulf of Mexico, and that legislation providing a penalty for the violation of the U. S. quarantine law is in our opinion an urgent necessity.

Be it resolved further, That the surgeon-general of the marine hospital service be requested to cause the detail of an additional officer to serve in the bureau to act as register of vital statistics, and that such statistics be made part of the weekly abstracts.

The President.—Under the rules that goes to the Executive Committee.

The President.—I will announce the names of the members of the Advisory Council appointed for this meeting to take the place of absent members. Dr. Cochran, of Alabama, being absent, Dr. Dozier, of Alabama, to represent that state; Dr. Falligant for Dr. W. H. Elliott, of Georgia; Dr. Rauch for Dr. Oscar C. DeWolf, of Illinois; Dr. Councilman for Dr. W. C. Van Bibber, of Maryland; Dr. Holt for Dr. S. H. Durgin, of Massachusetts; Dr. Duffield for Dr. J. H. Kellogg, of Michigan; Dr. S. S. Kilvington for Dr. D. W. Hand, of Minnesota; Dr. Mead for Dr. Wirt Johnson, of Mississippi; Dr. Fulton for Dr. E. A. Nelson, of Missouri; Dr. Hunt for Dr. William K. Newton, of New Jersey; Dr. Otterson for Dr. A. Mercer, of New York; Dr. Probst for Dr. R. Harvey Read, of Ohio; Dr. Horlbeck for Dr. H. D. Fraser, of South Carolina; Dr. R. Mitchell for J. D. Plunkett of Tennessee; Dr. Rutherford for Dr. R. M. Swearingen, of Texas; Dr. Reeves for Dr. C. T. Richardson, of West Virginia; Prof. W. H. Daniels for Dr. J. T. Reeve, of Wisconsin; Dr. Wyman for Dr. C. W. Covernton, of the Dominion of Canada; Dr. Leberge for Dr. F. N. Boxer, of the Province of Quebec.

The President.—It will be understood that any of the members of the Advisory Council who make their appearance are entitled to take their places. These appointments are simply for this meeting, in the absence of the regular members of the Advisory Council. Is there any one from the state of Pennsylvania present, or from the state of Virginia?

Mr. TAYLOR, of Indiana.—I merely wish to inquire if Indiana is represented on the board.

The PRESIDENT.—No, sir. I am very glad that you mentioned your presence. Dr. Taylor, of Indiana, for Dr. J. D. Gatch, absent.

The PRESIDENT.—Is there any one here from Colorado, from Delaware, or from Florida?

No response.

The PRESIDENT.—The first paper on the programme this morning is a paper on "The Necessity of Inspection of Animals Required for Food," by Carl H. Horsch, M. D., of Dover, N. H., to be read by Dr: Rohé.

Paper read. No discussion. (See page 34.)

The PRESIDENT.—The next paper to be read is entitled "The Meat Food-Supply of the Nation, and its Future," by Azel Ames, Jr., of Chicago, Ill.

Paper read. (See page 37.)

The PRESIDENT.—Gentlemen, this interesting paper is now open for discussion.

No discussion.

The PRESIDENT.—The next paper on the programme is a paper on "Cholera and Quarantine," by John H. Rauch, M. D., secretary State Board of Health of Illinois.

Paper read. (See page 242.)

Dr. RAUCH.—There is nothing new which I can say on this subject, and so, Mr. Chairman, I would suggest in this connection that Dr. Montizambert be requested to tell us something about Canada.

Dr. F. MONTIZAMBERT.—I am called upon to give a statement of the year's quarantines, and more especially with regard to the St. Lawrence. It is a pleasure to me to be able to say that our year's history is one of advance and progress in almost every direction. It will be within your memory that at the meeting at Toronto I had the honor to submit to this Association copies of the supplementary regulations then recently issued. The experience of another year's work caused my government to add to those regulations certain clauses greatly increasing their stringency and efficiency. These were issued in the month of August last, and are now being carefully and thoroughly enforced. No vessel from outside of Canada can now enter at the custom-house at Quebec or Montreal without first exhibiting a quarantine clearance given by a quarantine officer who is directly responsible to the government and to the country. The endeavor that the government made to secure the construction upon the passenger steamships of isolated and ventilated hospitals has met with success: the differential regulations allowing those vessels so provided, and on board of which three or four cases of minor diseases had occurred, when they gave proof that those hospitals had been intelligently used, the regulation was that the health officers were to be satisfied with the landing of those cases, and the disinfection of the hospital cabin alone. If these hospitals were not used, the occurrence of a single case of even the lighter forms of disease would be held to cause the quarantine officer to consider the whole vessel infected, and lead to the disembarkation of the passengers and the fumigation of the whole vessel. This has had the desired effect. The importance of this, not only in limiting the extent of an outbreak of infectious disease among the steerage passengers themselves, but in giving facilities for the immediate handling of cases of cholera, and for the great protection it gives to cabin passengers on vessels on which infectious diseases occur, will be at once evident to you all. Recognizing the different interpretations that may be put upon the expression vaccinal protection, and the varying usage obtaining among ships' servants and quarantine officers in regard to it, my government thought it better to fix a term during which the occurrence of vaccination itself could alone be taken as a sufficient protection. The period was fixed at seven years. No steerage passenger can land without satisfying the quarantine officer that he has either suffered from small-pox itself or been vaccinated within seven years. The consequence is, that the great majority of immigrants landing on our shores have been vaccinated over by the ship's surgeon during the voyage, or by the quarantine officers at the stations. I said at the beginning of my remarks that our year's history was marked by progress in almost every direction. I must now refer to that point upon which my government has made a retrograde movement. Those of you who were present last year, and remembered the discussion as to the vaccinal protection of cabin passengers that followed the resolution in its favor introduced by Dr. Rauch, will have it in mind that that resolution was objected to by some of the quarantine officers of American ports. They spoke of the great difficulties that existed where the cabin passengers were confronted with the necessity of exhibiting their arms. They knew nothing of the quarantine officials, had no confidence in them or in the purity of the vaccine virus they intended to use; and I was asked whether I gravely and really proposed to extend those difficulties to the cabin passengers of every steamship arriving. The position I took and maintain is, that if that law was made general that opposition would be entirely done away with. Once it was made known that all cabin passengers arriving would be required to give evidence of revaccination within seven years, cabin passengers would readily provide themselves with vaccination certificates from their own private physicians just as they do with tickets and passports. Passengers being provided with those certificates, the ship surgeon would check them by the passenger list on the way out, could make the affidavit under oath, and so, even where small-pox actually had occurred on the voyage, the passengers would be spared the trouble that now awaits them in such cases. In your most interesting address last evening, Mr. President, you referred to the principle that the expense of quarantine protection should be borne by the people so protected. I may state that that is the rule that obtains in Canada. There the government bears the whole expense of quarantine. All the quarantine officials are salaried officers of the government; there is no fee charged vessels either for inspection or for disinfection, nor for the landing, or maintenance, or care of the sick. All those expenses are borne by the government; and in reference to what you spoke of last night and Dr. Rauch has urged this morning, the importance of having a central authority on quarantine matters, it may be of interest to this Association to know that that rule has been found to work well in Canada. There quarantine is under the control of the government of the dominion of Canada. From it regulations are issued to all our nine principal ports, and to all the minor ports where these customs officers act as quarantine officials when necessary. In this manner uniformity of action is secured at all outposts throughout the Atlantic and Pacific seaboards, while matters of local health, and the handling of indemic and indigenous disease, are left entirely to the provincial, local, and municipal authorities of health. The protection of the country at large from the introduction from abroad of exotic and epidemic disease is considered a matter of national importance, and kept within the control of the national authorities. [Applause.]

Dr. A. N. Bell.—I have an excuse, though I require no apology to this association for appearing here with what ought to have been, and could it have been a month later would have been, the substance of a carefully written paper. During the last month, ending at about three o'clock on Friday, November 4th, the day before I left home, I have spent a considerable portion of my time at the New York quarantine, assisting the health officer in the destruction of cholera there. Permit me to state, however, at the outset [addressing the president], in reference to your own sentiment yesterday that the quarantine expenses should be paid by the people protected, that I decidedly dissent; and I will give you a reason, with an example, before I get through with my remarks, for my dissension. For the rest, it seems almost unnecessary for me to remark, in reply to the last speaker, that the quarantine establishment of the St. Lawrence, the facility with which it can be controlled, and the success of its efforts, as compared with the quarantine establishment of New York, when we consider the relative commerce and the relative danger of importing disease into this country, are scarcely comparable. But this is not a new question to me; it was my experience before another association (the American Medical) as long ago as 1866, when in the face of cholera, to be engaged in an effort, begun seven years before, to establish a national quarantine, to take exception to a plan submitted by Dr. Marsden, of Quebec, which he wished the association to adopt. I regarded it as unnecessarily obstructive to commerce for the port of New York, and was, perhaps, instrumental in rejecting it by the medical association.

I fully agree with Dr. Rauch in that a quarantine not properly equipped is worse than none at all, whether in New York or elsewhere; that a properly equipped quarantine will prevent cholera as effectually as yellow fever. Moreover, I believe that the New York quarantine, in its conception, arrangement, and contemplated equipment, under the spur only by which sanitarians can make progress, when epidemics strike the community, is in its design one of the most complete establishments in the world. But it has never been equipped; and we should make the present occasion a means of appealing not only to the national government, but to every state government, for effective quarantines at every seaport of the country. The New York quarantine establishment, as it now exists, was begun under the spur of a limited epidemic of yellow fever along Bay Ridge and at Fort Hamilton, first by the destruction of the worse than useless quarantine which previously existed at New York; and had it been completed as designed, and kept in condition, there would have been no such embarrassments as those which now obtain.

The New York quarantine, virtually, consists of four parts. There are two artificial islands in the lower bay, about two miles distant from the shore on either side, and about one mile apart. One is called Swinburne Hospital island, on account of the hospitals that were erected there during Dr. Swinburne's administration as health officer in 1866–'70, and the other one Hoffman island, in honor of the governor by that name, a refuge station for the well from infected vessels during the period of incubation, and to admit of the cleansing of vessels as soon as possible in the promotion of commerce. The health officer's residence is on Staten Island, at a point where he can overlook the establishment, and opposite his residence, in the Narrows, is the upper boarding station. The fourth part is a floating hospital ship, anchored in the lower bay during the summer below Hospital island, used also to facilitate commerce by the prompt boarding of all infected ships before permitting them to go further up.

The PRESIDENT.—Was that ship in the lower bay this summer?

Dr. BELL.—You will hear about it presently. The pilots have instructions from the health officer that when any ship has an infectious disease on board, she must come to anchor in the lower bay. But there was no hospital ship in the lower bay this year; she lies rotting on a mud flat at Red Hook, Brooklyn. That ship I superintended the fitting of fifteen years ago, during her last repairs; she will no longer float.

Now, of other conditions: The Swinburne hospital was at about the same time, fifteen years ago, equipped in every particular. And I do not think I was ever so much abused for anything I had a hand in (I was commissioner of quarantine at the time) as I was for insisting upon the equipment of that hospital, particularly for having provided a condenser for making ten thousand gallons of fresh water daily. The hospital is now, and has ever since been, kept in good condition. Among other things was a steaming apparatus for disinfecting the soiled clothing and bedding of all the sick of the hospitals.

I went out of office as quarantine commissioner about six months after Dr. Vanderpoel was made health officer, in 1873. We acted in concert with regard to the requirements of Hoffman island, but by this time that epidemic spur and a succeeding one of cholera, under which the buildings were begun and had been thus far constructed, had subsided. The people and the legislature had become lukewarm, and further appropriation for finishing the work was refused.

On Hoffman island three buildings had been erected—two large ones for detaining passengers, and one administrative building. They had been furnished with a good heating apparatus, a cooking galley sufficient for one thousand people, and a steam-pump connected with the heating apparatus. A little plumbing was subsequently added, alike despicable in its arrangement and construction.

The islands are constructed of what is called crib-work. Swinburne Hospital island was begun in seven feet of water; Hoffman island, in eleven feet. This, the larger one of the two, comprises a little less than three acres. The outer area, all around, consists of broken stone, and on the inner side of this a beton wall four feet thick. And next to the beton wall a circle of flooring beams twenty feet wide, covered with two-inch plank, was laid. This, bear in mind, was done fifteen years ago. And those who thought they knew more about such matters than the health officer and quarantine commissioners concluded enough had been done.

Seven years ago the present officials were appointed under a different executive administration from that which now exists in the state. They are "hold-overs" under the privilege of the state senate to withhold confirmation of the governer's nominations for substitutes. The health officer, however, is in immediate connection with the other health authorities of the state. That is to say, he is *ex-officio* member of the state board of health, and *ex-officio* member of the health department of the city of New York; and, besides, he consults the health commissioner of Brooklyn before sending up such ships as the Alesia. He has, therefore, the benefit of counsel with the health authorities of the state and of New York and Brooklyn, though he is not subject to it. In 1884 the health officer, realizing the danger of cholera and the decayed condition of the wood-work, to which reference has been made, the beams and planking being reduced to a mere mass of rotten wood mingled with the sand filling, invited a special meeting of the state board of health and of the city health authorities with the quarantine officers, to consider and to urge upon the legislature needful appropriations for repairs. Appropriations were provided for in the supply bill and passed by the legislature, but the measure was vetoed by the executive for reasons, doubtless, satisfactory from his point of view; but this action is urged by the quarantine authorities in excuse for the present disgraceful condition which exists.

The health officer, I know, has been exceedingly solicitous with regard to this inefficient condition, and, up to the time of the arrival of the

Alesia with the cholera, he was certainly uneasy as to the possibility of using the means at hand successfully in the event of such an arrival.

The Alesia arrived on the 23d day of September. The boarding officer reported that she was filthy in the extreme. Six deaths had occurred on the voyage, four of which were unquestionably of cholera, and eight passengers were sick with that disease at the time of her arrival. The sick were immediately transferred to the hospital, and the well were sent to Hoffman island. A police of twelve persons was chosen by the health officer from among them who could speak English, and under my own observation they appeared to be very vigilant in their duties. One of the first acts of the health officer was to have the water pumped out of the cistern most distant from the quarters of the immigrants, and the cistern thoroughly scoured. (Both of these islands are provided with large cisterns for catching rain-water from the roofs of the buildings.) He then had the cleansed cistern kept filled with the Croton from New York, and placed a policeman over it all the time for dealing out drinking-water, and for preventing the immigrants from dipping their cups into it. Plumbers were ordered there to make repairs as rapidly as possible, and to put new water-closets in the place of the old and worthless ones. A number of bath-tubs were extemporized by cutting hogsheads in two and using them as such. Meanwhile the Alesia was being disinfected by means of burning sulphur and the free use of mercuric bichloride. No disinfecting apparatus of any kind was or ever had been in the Hoffman Island buildings up to this time. The health officer ordered two large "boxes," twenty feet long, twelve feet wide, and twelve feet high, erected in one of the buildings as disinfecting chambers, by sulphur fumigation. His purpose was to have all clothing and baggage placed in these boxes and exposed to the fumes of burning sulphur, three pounds to every one thousand cubic feet of space. It hardly need be said that this process could be gone through with but once daily, on account of the persistence of the fumes preventing renewal; and, moreover, the vapor so escaped as to make the buildings wellnigh untenantable. Realizing the slowness of this process, he next had the steaming-tub, that was made for disinfecting clothing at the hospital, removed to Hoffman island, connected with the boiler of the engine there, and put into use. This tub is oval-shape, only five by four feet, and four feet deep—so small that with the utmost use the clothing of five hundred immigrants could not be passed through it in less than a week. Meanwhile, cases of cholera continued to occur among the inmates every few days. Under these circumstances Dr. Smith invited my assistance. I suggested at once,—"You will never get through with these people until every one of them susceptible to the disease takes it, unless you disinfect everything in one day." He entrusted the effort to me to procure the means by which this could be done. After a week's effort, I procured a box ready made for steam purposes, six feet in length and five feet each of the other dimensions, with a door of the whole dimensions of one end. I was told it would stand twenty-five pounds pressure. It was ordered to be sent to quarantine; but on the same day I received a communication from Dr. Smith, suggesting that it first be sent to the Britannia. I replied,—"Certainly not; steam the clothing of the Britannia and the ship in position; make a receptacle of her own steerage; put all the clothing and baggage of all on board into the steerage, and steam the steerage with her own engine." She had had three cases of cholera since her arrival three or four days before, and with a so-called medical officer, who said there had been only one death on board during the voyage, and that was a case of perforation of the intestines by *lumbricoides*. That report was sufficient to send the Britannia to the lower bay. The vessel and clothing were disinfected by means of steam, in the manner suggested; and the next day all the passengers were required to change their clothing, put on that which had been steamed, and that which they removed from their persons was put through the steaming process—subsequent to which time there was not a case of cholera on board, or among her passengers after they were removed. Meanwhile, the steam box was in process of fitting for the Alesia's passengers on the island, and I had opportunity to observe the necessity for the utmost vigilance of the watchmen with regard to the use and cleansing of the water-closets,—the floors of which were kept constantly wet, and the closets frequently flushed with the mercuric bichloride solution,—and the filthy habits of many, despite the vigilance of the watchmen, in making their alvine deposits round about. The feeling among these people was evidently the same as it is said to have been among the Italians at home during the prevalence of cholera among them—afraid of the doctors, and, consequently, using every means in their power to avoid them by concealing the evidences of the disease. I stood myself day after day with Dr. Smith, having these people pass between us, and carefully examining every one. Notwithstanding, cases of children escaped us, because they could not be detected until they were on the verge of collapse—their mothers concealing the premonitory symptoms, and secreting the diapers among the clothing to prevent discovery.

The steam-box being ready, from previous practical knowledge of the use of steam as a disinfectant I deduced the conclusion that steam under seven and a half pounds pressure would sustain the desired temperature of 230° F. for rapid disinfection, provided it be introduced under high pressure. An escape-valve, at seven and a half pounds pressure, was provided at the top of the box. The box was then filled with baggage on wooden gratings, avoiding contact of the clothing with the sides; a registering thermometer was put in, the door closed, and steam turned on from a boiler under sixty pounds pressure. The escape-valve was sprung in less than one minute. At the end of fifteen minutes steam was shut off and the door opened: the thermometer registered 230°. The same process was gone through with under my own supervision several times with the same result—230° to 232° every time. The apparatus was then, by Dr. Smith's order, transferred to an intelligent engineer, with directions to extend the time to twenty minutes each charge, with the same directions with regard to initial temperature under sixty pounds' pressure. In less than twelve hours all the baggage of all the immigrants was passed through this process. On the next day they were all required to change their clothing, wash themselves thoroughly, and put on clothing that had been steamed the day before. There had not been, up to the time of my leaving home, during an interval of three weeks, a case of cholera among them since.

Two days after this steaming I attended a conference of the joint boards of health of New York and Brooklyn, with Dr. Smith, and expressed my opinion that those people and their baggage could be discharged without danger to anybody.

Commissioner Bryant, of the board of health of New York, after asking me the question,—" Considering what you have described to be the condition of Hoffman island,—the accumulation of rotten wood mixed with the sand, and its befoulment, despite the watching,—considering all the circumstances, would you be willing that your family should risk going to Hoffman island, supposing there was some occasion for it?" I replied, "Yes;" for, admitting that there were alvine deposits on that island, so thoroughly exposed as it is to the sun, and knowing as I do that the water has been perfectly protected, I should not deem it dangerous in the least. He said,—" Nevertheless, I object to those people coming to New York until some intermediate place, long enough to cover the period of incubation, be provided for them." I assented,—" Very well, it is right that you should protect the public health to the utmost limit." The decision was quickly acted upon, and, on my suggestion, measures were at once taken by the quarantine authorities to obtain a ship suitable for the purpose, to be anchored in the lower bay; and within two days one was obtained. I saw all those people on board on the day before I left home. Immediately on their transfer from Hoffman island, all of the immigrants on board the Britannia took their place for detention, and for the same measures of baggage disinfection again, notwithstanding that which had been applied in the steerage, though there had not been a single case of cholera among them since.

A very singular thing, however, occurred: Scarcely had the disinfecting process been gotten through with when an epidemic of measles broke out among the Britannia's passengers. I saw fifteen cases in the hospital the morning I was among them,—the day before I left home,—some of whom, I think, will die. The rumor that these cases were cholera, falsely reported, I know to be absolutely untrue.

I have before remarked that contrasts in quarantine service are profitable lessons. The Alesia, on arrival, was abominably filthy, and doubtless had been so during the voyage. The heavy expense incurred by her owners for her treatment, and of her passengers in quarantine, is a just penalty for their disregard of properly qualified sanitary officers, and for receiving immigrants for transportation without regard to whence they came, or the condition of their effects, and their total disregard of the danger of introducing cholera into this country by such means.

Meanwhile, another emigrant ship, the Independente, arrived from the same port. On board of her there was an intelligent medical and sanitary officer. He had, from the time he left Naples, paid due attention to the cleanliness of the ship, and had, doubtless, also to the emigrants on their reception. All the clothing and bedding was aerated daily during the voyage. The ship arrived in admirable condition—everybody on board well, and without having had any sickness on the voyage. There being no reason for detaining such a ship, or any person belonging to her, she was, after careful inspection, promptly admitted to pratique, and her passengers, after the disinfection of their baggage, were permitted to proceed. Yet the health officer's action in this case has been severely criticised by persons not acquainted with the facts.

From my recent intercourse with the health officer of New York, I am satisfied he feels that, with the extemporized means now at his disposal, he is confident in his ability to deal successfully with any possible recurrence, such as that of the Alesia, from Naples or elsewhere. But he fully concurs with me in the opinion that the means which have thus been extemporized are anything but mere temporary makeshifts, the best that could be supplied in the time under existing circumstances.

I have already spoken longer than I intended, and taken up too much time, but permit me to say, in conclusion, I am no apologist for the disgraceful condition of the New York quarantine establishment long before and at the time of the arrival of the Alesia. I have endeavored to describe it as it is, and I sincerely hope for the full strength of this Association, as well as any other assistance that can be had, to promote its thorough repair and equipment.

Dr. Rutherford.—I want to ask Dr. Bell a question, if his remarks are not to be published. If they are, I will not ask it.

The President.—They will be published.

Dr. Oldright.—I appear here as a delegate from the Board of Health of Ontario, and I was charged by that board with a certain duty which will appear on reading these resolutions. I am not myself a member of the board, my term of office having expired last spring, but having attended the convention last year, I was appointed a delegate to this meeting. [Reads the resolutions.] I may say, as I have said before, I am not a member of the board, and to me it would seem more appropriate that, instead of making inquiries, we should come to some understanding as to the future. The necessity for coöperation and mutual confidence must be fully obvious to all the members of this Association without my dwelling upon them; and I would like to know whether the resolution and agreement which was arrived at by the Convention of State Boards of Health, and subsequently reported to this Association at Toronto last year,—this Association having enforced that resolution, carried it,—whether that has been carried out fully in the case of the city of New York. The coöperation of the boards, and these inquiries that are made, instead of being taken in an antagonistic spirit by any board, ought to be received in a friendly way, inasmuch as they will strengthen the hands of the health authorities at the point interrogated. As an example of that, I may refer to our own country last year, when inquiries were made with regard to the quarantine of the St. Lawrence river. Dr. Montizambert is here, and has explained what has been done there, and we have never had the slightest complaint as to any inquiries or suggestions made by your inland boards. I think he has felt that any inquiries that were made have been, or might be, of service to him in strengthening his hands in the demands he might find necessary from time to time to make of his government. In the same way I think the Province of Quebec, when it was afflicted with small-pox, at first seemed suspicious of our board's taking action, but after a time the people of Montreal were glad we had sent those men there, because by our taking that action, and our health officers being there to see that every precaution was taken, the people of our own province were willing to receive goods from Montreal: in certain cases goods had been rejected. Merchants wrote to the Montreal houses, "We can't take your goods." We wrote to them and told them that every precaution was being taken, and we were glad to receive the goods. I merely use that as an illustration. During that same epidemic we were threatened from New York with quarantine, and, in fact, they were enforcing it. Our friend Dr. Baker, of Michigan, was a little suspicious of us for a time, but by this mutual coöperation and confidence, finding that we were telling him everything that was taking place, he was quite willing to receive our assurances. And in Buffalo also the same thing took place. I merely use these illustrations for the purpose of showing that instead of the quarantine officers of New York taking our inquiries amiss, they ought to extend to us that confidence which we are willing to extend to them, and in that way create a harmonious coöperation for preventing this scourge passing into our country. If that course is not taken, we must still continue to have our suspicions, and adopt, with regard to New York, the same measures they would adopt with regard to us if some disease broke out in our midst.

With regard to the state of the quarantine at the port of New York, it has been a revelation to me: the state of things which has been described by Dr. Bell. Surely in a port like New York there ought to be—wherever the money comes from—there ought to be some means by which infected vessels could get a dose of Dr. Holt's remedy when they come in; such a dose as would be given them by my friend Dr. Montizambert at the mouth of the St. Lawrence. The port of New York ought to have facilities for dealing as rapidly and as effectively with shipping as they have at the mouths of the St. Lawrence and Mississippi rivers. [Applause.] Dr. Bell also spoke of water-closets, and I want to ask him, if he has an opportunity to reply, whether there is any method of disinfecting these closets, because it seems to me that it is an omission if the excreta from these immigrants are allowed to pass into the waters of the harbor and then again be thrown up with the tide; and this continual oozing of excreta, perhaps infected with the germs of cholera, be thrown up and down upon the shores of those islands. With regard to this whole matter, I am merely here asking, as Rosegardle did, for information, rather than bringing any charge, and I fancy that the attitude of many of the members of the Association: we merely want to know what is being done, and invite from New York that confidence which will be given in return. And I will say, if, after all the talk we have had year after year, cholera takes a hold in this country as it has done before, that the American Public Health Association and the health authorities may well hang their heads for shame.

Finally, there is another matter which I think this a most opportune time to present. I will read the resolution, and say two or three words in relation to it. It is moved by myself, and seconded by Dr. Rohé, that this Association should press upon the attention of railroads, national, state, provincial, and local health authorities, the absolute necessity of abolishing the present system of scattering excreta along the railroad tracks, and of substituting therefor some method whereby the excreta can be completely and frequently moved from the trains and tracks and safely and properly disposed of on sanitary principles. I would just say, in regard to that, we had a strong example yesterday. We were side-tracked on the train, and there were the excreta from the closets of the sleeping-car lying in a very dirty looking heap; and supposing that train had been a train with immigrants on board—perhaps only one or two might have managed to escape through the quarantine—there would be their cholera-infected stools. Or take the example of typhoid fever: Suppose a person having typhoid fever is travelling on the train, and the excreta is left on the track, and with such a dust as we had blowing yesterday I think we would have stood a good chance of inhaling some of it. I do n't think I need say anything further in support of the resolution. I think there ought to be some method on the trains for disposing of this excreta,—for example, by a pail containing some disinfectant; the excreta could be passed into that, and when the car was cleaned up these pails could be taken off and disposed of.

Dr. Brodie.—This seems to be new matter. In reference to this railroad matter I should have something to say.

The President.—That 's not under discussion.

Dr. Brodie.—The doctors pretty well discussed it on one side.

Dr. Rauch.—I should like to ask Dr. Bell a question with regard to the cholera in New York.

Dr. Oldright.—My reason for bringing this matter up now is, although it is not pertinent to maritime quarantine, still, if the cholera should break through—

Dr. Rauch.—I would like for Dr. Bell to state to the Association what action the New York State Board of Health has taken, if any, with regard to cholera in the state of New York.

Dr. Bell.—You all heard the question? None that I'm aware of. I have told you that the state board of health became interested in the New York quarantine in 1884, and I suppose has continued its interest ever since. In 1884 they united with the quarantine authorities to try to get the appropriation needful to put this station in proper condition.

Dr. ———.—Is not the health officer of the quarantine station an *ex-officio* member of the New York State Board of Health?

Dr. BELL.—He is.

Dr. ———.—Has the New York State Board of Health held a meeting in regard to quarantine?

Dr. BELL.—They held a meeting in 1884 [laughter], and adopted resolutions [great laughter] asking the governor to approve the appropriation. As to whether they have adopted any resolution since that time, asking it again, I don't know. The other questions I will answer. If I know a case of measles when I see it,—and I ought to,—those cases are measles that came from the Britannia after her three cases of cholera in the port of New York, and after one case on the passage suspected to have died of cholera. The water-closets are deluged constantly with bi-chlorate of mercury, and watchmen are placed there all the time.

Dr. MCCORMICK, of Kentucky.—I want to answer Dr. Oldright's question in regard to inter-state notification. I believe that it has been faithfully carried out by every state board of health in the Union with the exception of the state of New York, not only in regard to cases of actual disease, but suspicious cases, such as have occurred several times in New Orleans. I am sure that, as the executive officer of the State Board of Health of Kentucky, I have never received any notice from the State Board of Health of New York in regard to cases of cholera, or cases suspected to be cholera, in New York, and if others received any such notices, I've heard nothing of them. With the exception of New York, I believe the spirit of the resolution has been faithfully carried out.

Dr. SALOMON, of New Orleans.—I am glad to have heard the remarks of Dr. Bell. The condition of the quarantine at New York has interested me very much, and it has been a surprise that a port like that should have been found in the disgraceful condition described at the time of the arrival of that vessel with cholera. We have been looking for cholera to come to this country for several years; and that a so-called quarantine should have been in such a condition as to have to resort to makeshifts is most astounding, particularly a port like New York. Another remark which Dr. Bell made in attempted defence of the Independente passing through without disinfection, is in direct contradiction to his own remarks. We at the mouth of the Mississippi river have taken these matters into consideration. We have been on the watch, and not a single vessel has come from any Mediterranean port or Buenos Ayres, where cholera has been in existence, no matter how clean has been her health record, but that every ship's carpet has been taken up, every piece of baggage, and *every thing*, submitted to the steaming process; the vessel is steamed and bi-chlorided from one end to the other, and thoroughly disinfected with sulphurous acid gas. That has been done with every ship that came from or touched at any port where cholera was known or even suspected to prevail. We have had a great deal of trouble with vessels from Marseilles, where there was a suspicion of cholera only. I can hardly believe that in a small box five feet by six feet any efficacious treatment of cholera could be given to a mass of clothing put into that box. I will take that small box and contrast it with the heating chamber at the Louisiana quarantine. You will see what a vast difference there is, not only in the method, but in the efficiency of that method, between the New York and the Louisiana quarantines. Our box is sixty feet long, twelve feet high, and seven feet wide. It is supplied by a steam boiler, which we work under a pressure of 110 pounds, and if we chose to do so, we could run our temperature up to 300°—have done that experimentally. I would like to ask Dr. Bell a question. He has stated that it is not expected that the quarantine officers of the port of New York shall supply any apparatus or put up any buildings for quarantine purposes. In almost the same breath he said the quarantine revenues derived from fees imposed on vessels were for the purpose of maintaining the quarantine. I would like to ask, What is maintaining the quarantine, if not providing the necessary apparatus and buildings for the proper carrying out of an effective quarantine? The same condition is maintained, pretty much, in the state of Louisiana in regard to quarantine fees. There is a quarantine inspection fee imposed upon vessels, and we also charge vessels for cleansing and disinfecting; but jealous of any use that may be made of the money by our successors, we went before the state legislature last year and had an act passed, which act provided that all revenues derived from quarantine fees, with the exception of salaries paid to officers and employés, should be used exclusively for quarantine purposes. The moneys derived from quarantine fees and disinfection fees cannot be used for anything else but quarantine purposes; consequently, no one can become the beneficiary from quarantine fees derived from the mouth of the Mississippi river. I do n't want to enter any further into this discussion, Mr. President. The methods in use with us will be more fully described by Dr. Holt. I simply wish to mention a little incident in connection with the question of the introduction of cholera and the passengers of the Independente,—how difficult a matter it is, after such emigrants have been liberated from the ship and allowed to spread themselves over the country,—how difficult a matter it is to trace them. We were informed by Surgeon-General Hamilton that two of these passengers from the Independente had left New York for New Orleans. We used the detective force of New Orleans; went to every tenement-house, and even to the houses of more prominent and well-to-do Italians connected with emigration; and although we felt morally certain that one or two of these emigrants had arrived, it was impossible to find them. There is one man elected a member of the city council by the Italian contingent of New Orleans. He sent our officers to eight or ten places in search of these emigrants; they would go to one place, and then he would send them to another, and so on. That shows how difficult it is to find these people, and thus protect not only their friends and relatives, but the community at large.

Dr. BELL. I'll answer the questions which have been put to me as briefly as possible. I perfectly agree with Dr. Salomon as to the inefficiency of that box; it was simply the best we could do. I think there ought to be one at New York twice as large as he had in New Orleans. The gentleman laughed at me for answering a question by the way it was put. When I went back to the state board of health, they all seemed to want me to speak in regard to the city boards of health. The city boards of health of New York and Brooklyn were in daily communication with the quarantine, and urging every measure in their power. The difference between New York and New Orleans is in regard to the fees and their application by the state boards. There are quarantine commissioners paid salaries as conservators of the state property—that means the quarantine establishments; they pay for all of its building. its fitting, its repairs, out of the funds appropriated by the state of New York. The health officer, by a law more than fifty years old, charges so much visiting fee,—seven dollars for visiting every foreign ship; from one to three dollars during certain seasons of the year for all domestic ships depending on their tonnage. These are his fees. Out of those he is obliged to pay his deputies, his police, his laborers, his watchmen, his boats, for all of his coal and everything in connection therewith; he charges for disinfection, for burial. I believe the charge is yet—I know it used to be fixed at—a dollar a day for taking care of the sick in the hospital; but that was brought under the provision of the state, and the funds went back to the commissioners of quarantine, if there was any surplus after paying the expenses of the establishment for taking care of the sick. Now the expenses that the health officer must incur certainly make a large reduction in the amount of his fees, and still there will be a large income left. I do n't pretend to theorize on which would be the better plan. Another inference doing injustice to the establishment is in regard to the deputies. I have already said, that, when fully equipped and in good condition, one of the deputies, a boarding officer, usually was in the lower bay on board of the hospital ship. Since the arrival of this infected ship the health officers, I believe, have had two deputies, and I do n't believe ever more. They are both boarding up at the Narrows, at the health officer's residence. When a ship is found to be infected she's immediately sent down. The deputy in the lower bay, kept there for disinfecting ships, usually attended the persons sick. Since the health officer had his deputies boarding with him he has attended the sick himself. He is blamed for not having a deputy do what he has been doing. I think that is an injustice; however, I'm here to describe, not to defend the conditions.

Dr. ROHÉ, of Baltimore.—I do n't think it's the proper spirit to consider this question, to claim that there is so much difference in size between the quarantine station of New York or the port of New York and its business, and the size or business of ports elsewhere. Dr. Bell said it was hardly proper to compare the port of New York—he did n't say with the little port of Quebec, but that 's what he meant. I say the port of New York is no more dangerous to this country than any port where a single passenger from a possibly infected place arrives. I say that the proper quarantine of every port is just as important to this country as the proper quarantine of the port of New York. That 's important enough, and it has been sufficiently neglected, but we are here to deal with the whole question of quarantine protection, not to consider it merely with reference to one or another port, but to urge that there should be a uniform system of quarantine. There are shortcomings at every port. I am quite sure that the judgment of the committee of the College of Physicians in Philadelphia, expressed upon the quarantine establishments of Philadelphia and Baltimore, is perfectly just. So far as I know, the quarantine in Baltimore amounts to nothing. It is worse than nothing, because it attempts to create a confidence in a thing which does not exist. I think we ought to look at the matter more broadly. I certainly would n't like to endorse anything that 's been done at the quarantine in New York. It seems to me utterly inefficient. Dr. Bell stated that every rag should be disinfected, and then admitted that when these passengers of the Independente came up to New York they were allowed to go through the country, and created a great deal of alarm wherever they went. The question is, every port at which a passenger enters into this country is a point of danger, and should be guarded. The case at New York is a flagrant one—but that is n't the question at all; we ought to have a uniform system of quarantine.

Dr. Hewitt, of Minnesota.—The question before this Association at this moment is not how we shall get a system and a method. We 've been talking about that for the last twenty years. As one of the original members of this Association, the first thing I heard when I came into it in 1873 was, "How shall we manage to coördinate our various forces?" and it 's been that ever since. One committee reports on one side of the question, and another committee reports on the other side of the question. The question is not, What is the method and system in New York, but What shall we do with the possible danger confronting us? You know, those of you that are active sanitarians as I 've been for so long, that the idea of securing from the national government of the United States such an authority as shall take the control of its quarantine away from the port of New York is the most preposterous thing ever put before us. It ought to be done, but it can't be done. The commercial interests of New York run the government, and when you attempt to take the control of the New York harbor away from the state of New York, you 've got a bull-fight on your hands, sure. We can't wait for it to be settled. We 've tried to have some understanding about it over and over again. Since the national board of health deceased we 've tried other methods; you know with what success. The question before us to-day as an Association, who are not to meet till after the battle has come, if it 's coming next year, is, What can we do, dealing with it as a practical living question? We can put the screws to New York through the transportation lines from New York. [Applause.] And Dr. Rauch has hit the right nail on the head, as when a fight comes he almost always does if he does n't make a mistake in hitting. That 's exactly what we propose to do in Minnesota. The legislature has given our state board absolutely executive power. We can put it to the railroads, and we have succeeded in putting it to the railroads. There 's nothing or nobody in this world that responds with such submissive subordination as the harbor of New York. I hope there 's nobody so green in sanitary work as to suppose that any resolution of this body has any influence down there. This is a body of great national influence, etc., and those of us who have come here with a sense of the responsibility which practical, everyday work has taught us, get worried and anxious when the Association fiddles while Rome burns. The only thing I can see that 's practical ahead of us is to put it to the railroads. Any defence or any discusssion of the—I was going to say damnable—condition of New York harbor is out of place; it 's discussing an axiom, a settled fact. The idea that a health officer, an executive officer, standing at the entry port of the great nation, in the presence of a great pest, knowing that that has been threatening for consecutive years, could put his hands in his breeches pocket and say, "I 've got the funds, but they ar' n't to be used in any such way; I'm not going to do a thing till the emergency shall arise which demands that it be done; I know that the iron and machinery and kettles are rusty, but I'm not going to do a thing till the cholera is here!"

Another point Dr. Rauch makes. We have a right to demand, through the railroads, from the health officer of New York, the name and destination of every emigrant he sends out from there. [Applause.] We may have the utmost confidence, and we have a right to have, in the capacity of our friend, Dr. Bell, who has had long executive experience in this matter, to diagnose the case. But change places; put us there, and Dr. Bell, having the same confidence in us as we in him, would say, "My dear doctor, we want the papers;"—and those two things give us the solution of the question for the present. If, in addition to this, we can compel New York to put her quarantine in condition the next year, we 've accomplished the next best thing. Their proper treatment of the baggage, etc., we can get through the influence of the railroads. Nobody has proved what a glorious pæan for sanitary science a railroad is, as Dr. Rauch did when he played on a lot of them, just as this chap does on the keys of this machine.

Dr. Johnson, of Chicago.—Dr. Bell, with a good deal of detail, has given us a very interesting picture of what has transpired in the harbor of New York. I know something of the location there, and I 've listened with a good deal of interest to Dr. Bell's remarks. I believe that at all of our seaports it is possible to institute a system of inspection of, and of destruction of, morbific matters that will protect the interior of the country from the invasion of a pestilence from without. I believe that in most of our seaports such a state of things will occasionally be found to obtain, but I do not believe that under the existing state of things a persistent, continuous, well established system of quarantine at any of our seaports, will be maintained for the reason that the effort is spasmodic; it is modified more or less by local interests, by commercial interests; and Dr. Hewitt has well characterized the influence of the commerce of New York in modifying the precautions taken there. When between two and three hundred millions of dollars are invested in steamships entering the port of New York alone, we may well understand there will be some obstacles to the enforcement of any regulations embarrassing the commerce of which those steamships are the agents: such is always the case. What shall then be done? I listened to the remarks of Dr. Hewitt with some degree of dissent. I generally agree with him, because he's almost always right, I think, but when he says it's folly to expect to secure from the national government—

Dr. Hewitt.—I mean in time to deal with the present danger: I mean within a year, two years.

Dr. Johnson.—But I do think we ought not to relax our efforts to secure from the general government some general supervision of maritime quarantine by which the interior of our country shall be as thoroughly protected as any seaport. It is possible for New Orleans and New York to protect their own citizens, to protect the people in their immediate vicinity, and at the same time to neglect entirely the interests of Illinois, and Minnesota, and Tennessee. Such facts have obtained in the past. It is not always in the history of maritime quarantine that at the sea-ports we have men of the same degree of vigilance and the same degree of integrity as now characterize the health officers of New Orleans. [Applause.] It is in the memory of some of us when the statements of health officers were received with a good deal of doubt as to the accuracy of those statements. We do not feel that hesitation now when Dr. Holt tells us what transpires in New Orleans. We ought to have the same confidence and protection everywhere that we now have at New Orleans. This can only be accomplished by the supervision of maritime quarantine by the general government. As to how it shall be done sanitarians are perhaps not the best judges. They ought to demand that the thing shall be done, but leave it to politicians to say how it shall be done. But do it anyway. "Get there all the same." We have the same interest in sanitary matters at Memphis as at New Orleans, but you can't make the citizens of those cities understand that St. Paul and Chicago are interested in the results of their work to the same extent that they are. The general government manages to levy its tax upon every foreign product except yellow fever and cholera and small-pox. I would have the general government tax and restrict the importation of these contagious and infectious diseases just as certainly as it does woollen goods, cotton goods, or any other product of foreign manufactures. They can do it very well because they can put in operation machinery as efficient as that of our treasury department. The old organizations have been tried. They have not met the wants of politicians and the country generally, and we must have something new. . . I'm not prepared to say what or how it should be, but I think the fact that these diseases from foreign ports are now knocking at our doors and gaining a foothold on our soil should be the occasion of making a new demand on the general government for some measure by which it should take control of maritime quarantine. Let us educate the public up to these ideas, and convince senators and representatives that their constituents want such a measure. I know there are differences of opinion as to whether the marine service should have charge of it, or a health bureau; and some maintain that the old national board of health should be revived. I say, as a former member of that board, that whatever is done, the rules and regulations, appliances and machinery, of that board will continue to be in the main the methods which any power that may be created will be compelled to use, because I think the test of experience has proved they were in the main wise. The board did an excellent work, and as one of its members I am satisfied to go into history with our reports. We have commenced a wise work in the history of our country and its sanitary legislation and work. I do not desire to see it perpetuated in its present form, because I do not think it is the best form in which sanitary authority should exist, but it is a good beginning. I wanted to say, that in looking at our seaports and in looking at the maritime quarantines, we ought not to forget that they are powerless beyond their borders. They exist as police regulations for the port where they are created. They cannot extend in most cases beyond the immediate port, and in New York they cannot extend beyond the lines of the state itself. The general government should apply to each river and harbor the same attention in sanitary matters they now give them in making up the river and harbor appropriation bill. Let us have every inlet in which a cholera patient could swim made subject to the sanitary supervision of the general government.

Dr. ———.—Mr. President, I happened to be on the executive committee in Richmond, and it was my vote which determined them to organize the national board of health. It was distinctly understood that its power should be the external quarantine of the nation. That has always been the belief that sustained me in the work.

Dr. Brodie.—Mr. President, how many of the states have quarantine powers?

The President.—I am not able to inform you, Dr. Brodie; perhaps Dr. Rauch can.

Dr. Rauch.—All the states have quarantine powers. You mean boards of health?

Dr. Brodie.—Yes.

Dr. Rauch.—Not many. Some boards have no quarantine power. The Wisconsin board has no authority to quarantine.

Dr. ———.—The Mississippi board has power; the Louisiana board has quarantine power; Texas has, through its state quarantine officers; Arkansas I think has; the Missouri board also has, but they are not in a condition to do anything; never have been; those states have made appropriations; the Kentucky board has quarantine power; the Tennessee board has, the Alabama board has, and South Carolina has.

Dr. Brodie (?).—It seems to me, then, Mr. President, in reference to this matter in which all these states are so much interested, in this quarantine business,—I do not know how we can expect the state of New York is going to furnish all the information for nothing that the rest of the states require. It seems to me that each state is as much interested in this quarantine business as they are in New York, and if the United States will not take hold of the matter, every state should have its agent in the harbor of New York, and know all about what comes there, and inform their proper authorities at home. New York, of course, is quarantining for the state of New York, not for the United States. There is no obligation we can put upon them to do it. There is a difference of opinion. A health officer sees a ship come into the harbor. He is satisfied it is all healthy, and he does not fumigate it. Somebody must have some judgment. If every steamboat that comes into the port has to be fumigated you will have a good deal of trouble. Think of the number of hundreds of thousands of our best citizens that have been coming from Europe through the season. If they have to be detained there a week or ten days, you will find there is a great deal of trouble.

The President.—Permit me to interrupt you one moment, Dr. The Advisory Council are requested to meet at 3 o'clock in the room at the hotel which was used by the Tri-State Medical Society, if that is at our disposal, and if not, in one of the parlors in the neighborhood; the meeting is to be held to-day, at 3 o'clock, in the Gayoso hotel.

Secretary Watson read a telegram from Mr. Jno. D. Adams, addressed to Capt. Tobin, stating that it would not be possible for the steamer Kate Adams to take the Association on the contemplated river excursion.

Secretary Watson.—Mr. Ross, the city engineer, will be at the Gayoso hotel this afternoon, at 4 o'clock, and will be pleased to show the city sewers to any gentleman interested in them.

The President.—The Advisory Committee has some important business to attend to. The Executive Committee meets at 4 o'clock. The Advisory Council will meet at 5 o'clock instead of at 3, as first announced. Those members who are present will please notify the absent members.

Adjourned till Nov. 9, 1887, 7:30 P. M.

EVENING SESSION.

Dr. C. A. Lindsley, second vice-president, called the convention to order, and announced that the first paper on the programme was entitled "The Malarial Germ of Laveran," by William G. Councilman, M. D., of Baltimore, Md.

Paper read. (See page 224.)

Dr. MITCHELL, of Nashville.—I would like to ask the doctor if I understood him correctly, that in an ordinary case of quotidian there was only one red blood corpuscle affected in about eighteen hundred.

Dr. COUNCILMAN.—That was what I said.

Dr. MITCHELL.—Then you would have to make several examinations to satisfy yourself thoroughly in any particular case—would not be satisfied with one?

Dr. COUNCILMAN.—Oh! if there is one to fifteen hundred in every field of the microscope there will be one or two bodies present, because one rapidly runs over fifteen hundred corpuscles at a glance.

Dr. HOLT (?).—I would like to ask whether he ever finds these in the white corpuscles, or are they confined to the red blood corpuscles.

Dr. COUNCILMAN.—So far as my observations go they have always been found in the red. In Philadelphia they are said to have been found in the white corpuscles, but I have never found them. The only other medicine I have ever tried has been arsenic, and that in cases where the crescents were present, and I have not observed any direct results on the parasite from the arsenic.

Dr. ———.—I would like to ask if you have noticed this form in anything else.

Dr. COUNCILMAN.—Yes, sir. One always finds in any form of malarial infection some form of organism that we have been describing.

The president next called for the reading of a paper on the "Quarantine Defence of the Mississippi Valley," by Joseph M. Holt, M. D., of Louisiana. Applause followed the announcement. Dr. Holt prefaced the reading of his paper with the following remarks:

Dr. HOLT.—I will not encroach upon your patience by attempting to explain, in minute detail, the technique of the working of the quarantine system of Louisiana, because it would be interesting to but very few of you, and to the others would simply be intolerably tiresome; and therefore, if you will permit me, as fulfilling that which is promised in the caption just read by your president, to present you the pamphlets wherein is explicitly detailed all that you would wish to know, perhaps, in regard to this, I will endeavor to command your attention for a few minutes by indulging in a few generalizations connected with this question, as we see it who belong—especially, I say, we see it—who are here of the Mississippi valley; not that this quarantine question is one which interests only the citizens of the Mississippi valley, but a few generalizations as we who are of the states of the Mississippi valley are compelled particularly to see it, and will beg your patience for a few minutes. (See page 161.)

Dr. HOLT continues: Here is exhibited the lower Mississippi, beginning here at New Orleans, and passing on down to this point, and then from there [pointing to top of right-hand map], because this map is simply a continuation of this one; it is just as if this one [on the left] was placed above this one [pointing to the one on the right]. Starting from New Orleans, and passing through these numerous curves of the river, you reach a point here on the left bank of the river, as you go down, and there is established what is called the "upper quarantine," for the careful inspection and treatment of all vessels from what we call quarantinable ports, or ports that are suspicioned or known to be infected, but the vessels themselves not infected. Whether a vessel is infected or not is determined at an advance-guard station right here at the jetties. Here [P] are Eads's celebrated jetties. Here [P] is old town. A ship coming from the sea, when she goes into the offing, is at once boarded by a skilled medical officer, and the most thorough scrutiny made of every one and every thing on board. If there is any taint or suspicion on that vessel as regards cholera, small-pox, or yellow fever, she is ordered to this outlet of the Mississippi in Pass à L'Outre to the lower station for infected vessels only, and there that vessel is held until she is known to be no longer a menace. Now, as to vessels coming from the Mediterranean, or any ports whatsoever in which we know or even have any reason to suspect there may be cholera: for instance, such vessel, no matter how perfectly clean her bill of health may be, cannot pass that station until everything on her has gone through the most rigid treatment. A vessel comes with 300 Italian emigrants; has had a perfectly healthy trip; comes from Italian cities which we have reason to believe are not infected with cholera; but we are going to take no chances, and everything on that vessel, from a shoe-string to an overcoat, has to undergo the most rigid treatment before it can pass. [Applause.] We take it for granted that every vessel coming from a port known or suspected to be infected is a dangerous vessel, and we do not even notice the bill of health given by consuls. We have an obstinate way down there with vessels, and issue our own bills of health, and then let them pass on. Gentlemen of Memphis, you talk about fighting for your town! There is the strategic point, and there is where the fight must prevail. [Applause.]

I wish to do myself the honor of presenting to the Memphis Board of Health, through its worthy President, Dr. Thornton, this pair of charts. They are of the United States Coast Survey. They are most elaborate in every point, giving only a narrow strip of country on each side of the Mississippi river, but in everything they furnish the most absolute information concerning the depth of water, character of soil, and everything that could be desired. On these I have had most carefully placed our quarantine system; and I beg the Memphis Board of Health to receive this pair of charts. [Applause.]

Dr. Falligant (?).—According to the account of New York quarantine as given by Dr. Bell, and the account of New Orleans quarantine as given by our friend Dr. Holt, I think that the New Orleans quarantine is about as far superior, in all the elements that constitute intelligent management of ships and warding off disease, as heaven is above the conditions of the earth, where we find the diseases originating.

Dr. Thornton.—I am not willing for the occasion to pass without saying a few words commendatory of the present quarantine system in

New Orleans under the operations of the Louisiana State Board of Health. I have had the privilege of visiting New Orleans, and going through these different quarantines that Dr. Holt has so graphically described—going first to the upper station seventy-five miles below the city, seeing his methods there for treating infected goods or supposed infected goods, and then going to the lower quarantine station at Pass à L'Outre, and from thence to his outpost on the station at the jetties, at Eads's port. I was one of a party, sir, of health officials who were invited there just after the completion of this system of quarantine, and witnessed the process of disinfection. After seeing it, and having it demonstrated to me in the way that it was, and as he has described it to a limited extent, it was impossible for Dr. Holt or any one else, in a brief essay of this sort, to do justice to the methods that he there practises. I must say, sir, that after being a skeptic, and at one time having published a report to my state board of health,—a report of criticism, as it were,—I visited this quarantine after Dr. Holt had perfected it, and then it was that I became a convert to his theory; and I believe that he has the means there of preventing the introduction of yellow fever into this valley, if human effort can do it. I, wish, also, to state, it having been my duty for some years past to watch with a very jealous eye everything pertaining to the public health of New Orleans during periods of danger after the advent of warm weather here, that I have the utmost confidence now in the health service of the state of Louisiana. I believe that there will be nothing suppressed,—that the health officials of Louisiana will make known even the suspicion of disease,—and I have as much confidence in a telegraphic statement from the health officials of New Orleans as to the true condition of things there as if I were there to see for myself. [Applause.] I am very glad, sir, to have this opportunity to bear testimony, and I do it after the most critical observation that I could possibly keep that point under.

Before taking my seat, in the name of the Board of Health of Memphis, and, I will also state, of the Tennessee State Board of Health, I must thank the Louisiana State Board of Health for the valuable present as made in those diagrams. [Applause.]

The PRESIDENT.—Any further remarks upon the paper of Dr. Holt? If not, our programme for the evening is concluded, and a motion to adjourn will be in order.

Adjourned.

THIRD DAY.

THURSDAY, NOVEMBER 10, 1887.

MORNING SESSION—10 O'CLOCK.

The PRESIDENT.—The Association will please come to order.

Dr. THORNTON.—There are no new announcements to make this morning. I regret very much to state that to-day we are disappointed in getting the Kate Adams steamboat. A telegram was received saying she will be so behind time she will not be able to give you the two hours. It is a source of deep regret, but it is simply one of those things we cannot avoid. This season the steamboats are so occupied—stopping at every landing, heavily laden with cotton, that every minute of their time is occupied. The reception will be tendered to-night, as announced already, by the Chickasaw Club, and we would be very happy to see any of you there. The Tennessee Club is open to you likewise day and night until 12 o'clock, and we would be happy for any of you to go in there.

The SECRETARY.—The following resolution offered by Dr. Rohé is recommended by the Executive Committee for adoption:

Resolved, That a committee of five, of which the present president of the Association shall be chairman, be appointed to study experimentally the methods and effects of protective inoculations against infectious diseases.

On motion, the resolution was adopted.

It was moved and carried that the president appoint the committee.

The SECRETARY.—The resolution offered yesterday by Dr. Oldright, and seconded by Dr. Rohé, of Baltimore, is reported to the Association in a new draft by the Executive Committee, and they recommend its adoption by the Association:

Resolved, That this Association would press upon the attention of railroad officials, and upon national, state, provincial, and local health authorities, the absolute necessity of abolishing the present system of scattering excreta along the railroad tracks, and of substituting therefor some method whereby the excreta can be immediately and completely disinfected before removal. For the disinfection of excreta the Association recommends the use of chloride of lime, six ounces to the gallon of water.

The PRESIDENT.—Gentlemen, you have heard the resolution which is recommended for your adoption by the Executive Committee. What is your pleasure?

On motion, the resolution was adopted.

The SECRETARY.—The resolution offered by Dr. Baker is reported back to the Association, with the recommendation that it be adopted:

WHEREAS, An accurate knowledge of the resources of the nation, especially of its sources of food-supply, is of great importance to all its interests, and must be attained to enable and determine the action of the general government, the states, and the people of the United States, in many important directions; and

WHEREAS, The eleventh decennial census of the United States will, by law, be taken in the year 1890, now near at hand, and legislation regarding it will be enacted by the present, the 50th congress;—therefore,—

Resolved, That the American Public Health Association urges upon the congress of the United States the wisdom and desirability of making adequate provision in its legislation providing for the conduct of the census of 1890, for a full and complete enumeration and classification of the food animals of the country, and the tabulation of their products, natural and manufactured.

On motion, the resolution was adopted.

The SECRETARY.—The Executive Committee also recommend the adoption of the resolution offered by Dr. Hunt (endorsing the Miller-Carey bill).

Dr. Rohé read the resolutions.

Dr. HUNT.—In offering that resolution I did it by request, and was myself very much in doubt whether we ought so fully to endorse a bill with which we were unfamiliar, and I should prefer, unless the committee have examined the bill, to say "some comprehensive legislation" instead of "such comprehensive legislation."

The PRESIDENT.—The bill was not examined.

Dr. HUNT.—The reading of the resolution is, that this body recommend a comprehensive bill, such as the Miller-Carey bill. Dr. Rohé, will you be kind enough to read again that portion of the resolution relating to the legislation?

Dr. Rohé read the portion of the resolution referred to.

Dr. HUNT.—If Dr. Ames were here I should ask him to explain the bill. Unless the body knows more about the Miller-Cary bill than I do, I should be unwilling to recommend a particular bill, and I think we should say "some comprehensive legislation," leaving out the name of the bill.

On motion, the resolution was adopted, with the amendment suggested by Dr. Hunt, as follows:

WHEREAS, The food-supply of the nation is its chief concern, and demands every possible protection and fostering care in the interest of the whole people; and

WHEREAS, The neat herds of the United States which furnish the greater portion of our flesh food have already suffered severely from, and are still exposed to, destruction by the existence of contagious pleuro-pneumonia;—therefore,—

Resolved, That the American Public Health Association, convened in its sixteenth annual session in the city of Memphis, Tennessee, respectfully but earnestly urges upon the 50th Congress of the United States the wisdom and necessity of enacting at an early stage of its approaching session some comprehensive legislation for the effectual suppression and prevention of contagious pleuro-pneumonia among the cattle of the country.

Dr. THORNTON.—Since making the announcement this morning, an invitation has been extended to the Association through Judge Hammond, from Miss Clara Conway, of the Clara Conway Institute, giving a cordial invitation to you, gentlemen, to visit her institute this afternoon at 3 o'clock, as many of you as can go; and I will say that the yellow car, Poplar street car, will carry you directly to her institute—female institute. We have one or two institutes here, and this lady is very anxious for you, gentlemen, who take interest in school hygiene, to see her new building, and I shall be much pleased if some of you can make it convenient to go out. Judge Hammond will take pleasure in going with you or meeting you there; and I will take this occasion to say that we are indebted to him for the courtesy of the free use of this court-room.

Judge HAMMOND.—So far as indebtedness to me for the use of this room is concerned it is not worth mentioning; but in behalf of Miss Clara Conway I wish to say she specially delegated me this morning to come here and extend to you a cordial invitation to come to her school some time this afternoon. She has a very large school for girls, of which she is very proud, and of which this community is proud, and she desires this Association to come in a body, or, if they cannot do that, to have any of the gentlemen who will, go out and visit her. I will, in my chambers on the floor below, meet them and go there, and she requested me specially to ask Dr. Walcott to be good enough to manage this affair for her in such a way that as many of you gentlemen as can do so will come out this afternoon. I hope I shall have the pleasure of conducting a good many of you, gentlemen.

Dr. Rohé.—I have a telegram which I am requested to read:

ROCHESTER, N. Y., Nov. 9, 1887.

Dr. IRVING A. WATSON, *Secretary American Public Health Association:*

If Association approves I will offer one prize,—five hundred dollars, one two hundred dollars,—on following subject: Practical Sanitary and Economic Cooking Adapted for Persons of Moderate and Small Means. If letter mailed to-day does not reach you in time, use telegram.

H. LOMB.

Dr. JOHNSON, of Chicago.—The presentation to us of an additional evidence of the interest taken by non-professional people in our work, brought to us by this telegram, I am sure must be gratifying to all. I rise, sir, to move that this Association do approve of this purpose, and to recommend that the telegram be referred to the Executive Committee for the purpose of arranging the details for carrying into execution the purpose of Mr. Lomb. [Motion seconded.] It is well known to the Association that this is only a continuation of the generous action of Mr. Lomb in the interest of sanitation, and especially in the interest of sanitation looking to the benefit of the middle and laboring classes of our country. I have heard, some time within the last year, a little criticism of the work of this Association in this respect—"Pretty large number of pamphlets; people who wanted to write something perhaps, and get their names before the public, sending them about under the auspices of this Association for an advertisement." The fact is, these essays are sought for largely by men seeking for information, and the publication and distribution have only been such as has met the demands for their use practically by those who are studying the questions involved. More than 100,000 of these essays in pamphlet form have been printed and distributed upon the request of individuals who need them. Several of these essays have been translated into other languages. The essay, for instance, of Prof. Vaughan, has been published in English and German to the extent of 5,000 copies, and the same is true of the essay of President Sternberg. They have also been translated into other languages, and 3,000 copies are bound in book form. In moving this acceptance and approval of the proposition of Mr. Lomb, I am sure I only carry out the thought and feeling of this Association, and of all well-wishers to public sanitation.

Dr. ———.—I rise to ask whether it is intended this shall be acted upon by the present, or by the future, Executive Committee.

The PRESIDENT.—The present Executive Committee would certainly act upon it under the rules of the Association.

Dr. ———.—Well, I would add as an amendment that it be referred to the committee for the ensuing year.

Dr. ———.—If I understand correctly the relations of this Executive Committee, it is a committee that never dies, and is made up of the perpetual elements in the persons of the past presidents. The Executive Committee itself is made up of the persons elected for two years, and they go out of office gradually. That committee is not renewed every two years, even as to the elective members. Only a portion of them are changed, and I do not see any special reason therefore for referring the matter to the committee for the ensuing year.

Dr. ———.—I understand that the Executive Committee are made up of the ex-presidents and such others as the Advisory Committee may elect.

The PRESIDENT.—Under our constitution they cannot do so; only three members are elected each year.

Dr. HUNT.—If it were so, our experience with the last three prizes shows we are certainly able this year to manage one prize. Last year there were three prizes, and the secretary managed the whole thing very satisfactorily with regard to the three, and we certainly can get this matter before the public this year as well as by a year's delay.

Dr. ———.—My amendment is not for the purpose of delay. I understand the Executive Committee are authorized to act, and if I am wrong I stand corrected. I withdraw the amendment.

Dr. Johnson's motion to refer the matter to the Executive Committee was then put and carried.

Dr. Rohé read a list of applicants for membership. On motion, the applicants were elected members of the Association.

Dr. BELL.—If it is in order, I should like to submit a proposition for an amendment to the constitution, subject to the rules, of course, to lie over for another year, "to strike out of article 9, referring to members of the Executive Committee, the words, 'and of the ex-presidents of the Association,' and add to article 10, entitled 'Advisory Council,' after the words 'as a nominating committee of officers for the ensuing year,' by adding, 'none of whom shall be members of its own body;' thus providing that no member of the Advisory Council can be nominated for office."

Amendment laid over under the rules.

Dr. McCormack offered the following resolution, which was read and referred:

WHEREAS, This Association has heard, with surprise and alarm, that after four years of warning Asiatic cholera found the authorities of the port of New York totally unprepared to deal with it; and whereas the administratioh of the quarantine regulations at all ports, and especially at the port of New York, at this time is of the highest importance,—

Be it resolved, That this Association urges upon the authorities of the state and port of New York such a revision and modernization of their methods as will ensure protection from exotic plagues.

Dr. Bell offered the following resolution, which was also referred:

Resolved, That a committee of three be appointed to consider and report upon such sanitary and medical services on board emigrant passenger vessels as may be subject to congress.

The president called for the reading of a paper on the Disposal of Garbage, by Dr. L. Laberge, of Montreal, Canada.

Dr. Laberge.—Mr. Mann had promised to be present. I must state this, that I cannot be answerable for any cost because we have got a contract. Whether he makes money by the contract of $45,000 or not I cannot say. I may say, in concluding, Mr. Mann, who is present in this meeting—he promised to be here—will be able to answer any questions.

Dr. Laberge then proceeded with the reading of the paper. (See page 233.)

Dr. Oldright.—What are the length and breadth of the grate bars, and also the chamber above?

Dr. Laberge.—Including grate, 9 feet 4 inches by 16 feet 2 inches long.

Dr. Falligant.—I desire to ask, with regard to the breadth of the opening in the grating below, where the garbage is placed. Did I understand you that those are the iron bars placed at two inches apart, the opening between the two bars where you throw it in the chamber?

Dr. Laberge.—Those bars are two inches apart.

Dr. ———.—Is that found to retain even the smaller portions of filth, or anything of the kind?

Dr. Laberge.—All I can say about the work of the affair is that Mr. Mann is destroying the garbage according to the laws of the board of health. As to the details I do not know, but as far as I have seen the destruction is complete.

Prof. Brewer.—I did not quite catch the point relating to the cost.

Dr. Laberge.—The contractor builds the whole furnace.

Prof. Brewer.—And he manages the whole collection of garbage?

Dr. Laberge.—Yes, and the cost is $45,000 per year. He had begun to ask $46,000 and $48,000, but we made an average.

Prof. Brewer.—How far does the garbage collection extend in the suburbs?

Dr. Laberge.—Only the limit of the city.

Prof. Brewer.—How large is the population?

Dr. Laberge.—190,000. I must say we have got more than this.

Dr. ———.—With a population of 25,000, how much would this cost?

Dr. Laberge.—Well, I am always in the same position; that is the reason I regret Mr. Mann is not here. We asked for tenders. He made a tender for the carrying out and the destruction of the garbage for $45,000. Whether he makes money or not I cannot say.

Dr. ———.—What I want to find out is, to destroy the garbage of a city of that kind—I would like to know what the cost of apparatus would be.

Dr. Laberge.—I cannot tell that.

Dr. ———.—Can this apparatus be bought by a corporation independent of the man that owns it—of the manufacturer?

Dr. Laberge.—The contractor of Montreal had the contract; then he began to build a furnace for the night-soil. There is little difference between a furnace for night-soil and this one, the description of which is given in my annual report of last year, and he has a patent for this. I cannot give you much information about the cost of the destruction of the garbage.

Dr. ———, of Milwaukee.—I would like to inform the gentleman that Mr. Mann, whom I saw last Friday, had made an offer to our city to furnish this same crematory for a royalty of $1,000.

Dr. Hunt.—I have had considerable correspondence with Mr. Mann, and I think he prefers to put it in by a royalty. I had not supposed he asked so much as that, but he stated in a letter to me that the original cost was somewhere between $2,500 and $4,000. That was not very definite. I believe we ought to look forward to this method of disposing of garbage with the greatest interest. It is not at all new. There are over thirty-five of these in England, and they are so successful that they are being enlarged. The one at Birmingham, Frier's, has been followed by others, and there has been an improvement made in the Jones destructor. We have the statements of Mr. Tider and Mr. Newsom, both authorities in England, as to its great success. The great trouble has been with the fumes: they now attach the fume-crematory, and we have the testimony of several gentlemen who have visited it that it prevents the complaints from this source. You will find a full, detailed account of the working of various destructors in England in the Sanitary Record, and especially this Jones destructor, that serves a population of 22,000 inhabitants, and the night-soil is entirely consumed for a population of 19,000. If these facts are as they are stated,—and we have them on the best authority, and we also have the details which fully accord with those given by Mr. Mann himself,—I am sure the time has come when we shall be able to avail ourselves of this method of thoroughly consuming the garbage and caring for the night-soil of a city.

Dr. Brodie.—My attendance on this meeting of this Association is in the interest of the destruction of garbage in cities. It is becoming now one of the greatest questions, to take care of that material in our now fast growing cities. In Detroit, we have been taking care of our garbage by carrying it down the river three miles, and filling up a bayou with the garbage; but that is becoming a nuisance on account sometimes of the change of wind, and the oozing out of this material in the river interferes with the character of the water of the towns below on the river, and we have got to find another way to take care of this garbage, and the common council now have the subject under consideration as to how they can take care of it without defiling the water. It has not come actually before the board of health yet, but I am here to obtain all the information I can get in reference to the matter, and we are of the opinion that this material must be destroyed in some way by fire, and the only way, in my opinion, that we can take care of this garbage is by burning it; and I wanted to find out from these gentlemen here as to the cost of these instruments for the destruction of garbage, and to know what the opinion of this Association was as to the proper way of getting rid of the garbage, both as regards the safety to the public health, and likewise regarding the cost. These things have to be considered. Cities look after prices of instruments of this character just as a person would look at the cost of putting a furnace in his own house; and I am very glad there is a gentlemen here from Pittsburgh, for I have heard a good deal about that Pittsburgh furnace. If he can explain that furnace so we can comprehend it, I am very favorably impressed with the value of that instrument.

Dr. ———.—This one is within the bounds of the city, and is only for the garbage. For the night service we have got about the same apparatus, except there is a flue on it above, in order that the liquid may be evaporated. It is about two miles from the city.

Dr. ———.—It appears to me the city of Montreal is paying a pretty large price without knowing what money is being made by the contractor, or how much he invested.

Dr. Duffield.—I have experimented on the burning of garbage, and I am satisfied it is not so much the form of the apparatus as it is the heat you generate before the garbage enters the furnace. I have investigated several forms, and I find they have to reach a certain temperature, so that as soon as the garbage falls into this flame on what has already been heated to a very high temperature—not less than 1,500°—so that these gases are almost instantly consumed, you have a garbage consumer; but if you fail in your temperature, no matter how the furnace is arranged, you will have the odors escaping.

Mr. Smith, of Pittsburgh.—I do not know of any city in the United States that has required a garbage furnace, or a system of furnaces, more than Pittsburgh has since the government constructed a dam in the Ohio river. Theretofore the garbage of Pittsburgh had been thrown into the Ohio river and floated down into the gulf; but by the construction of the dam all the garbage we have thrown into the Ohio has simply remained in the city. That, in connection with the introduction of our new fuel, natural gas, has rendered the destruction of garbage a necessity. After a careful consideration of all devices, they adopted the one I am going to show you to-day, and which we expected Health Officer Garr would be here to tell you about himself; but owing to a change taking place in our city government in January, he found it impossible to leave, and deputized me. They have put up the Rider Garbage Furnace. The contractor who put that furnace up agreed that the furnace should have the capacity of destroying thirty tons of all kinds or any kind of animal or vegetable garbage, or thirty tons of butchers' offal, or thirty tons of night-soil matter, in the space of twenty-four hours. The furnace has been in operation since last Monday—just merely finished and put in operation. It has demonstrated so far a capacity of over fifty tons a day instead of thirty, and that, too, at a very trifling cost. The principle is this: It is constructed in such a manner that, after once being heated up to its proper temperature,—which, as the gentleman just said, is a very important element in the destruction of garbage,—the garbage itself furnishes the only fuel necessary to keep up its intense heat. That fact alone demonstrates its perfection in the destruction of gases arising from garbage. It has another advantage which can be availed of if necessity requires, and that is, that the waste heat can be used under a system of motors and steam-power generators sufficient to drive all the dynamos of a corporation. In addition, it is so constructed that, by the proper, systematic laying out of the sewers of a city, by connection with the sewers in sections and the location of furnaces in different parts of the city, all the sewer gases can be drawn up and passed through the furnace, and any disease germs will be destroyed by the intense heat of the furnace. In addition to that, the residuum, having no other element in it except the ashes of the garbage itself, forms a fertilizer that the farmers in our locality are glad to get hold of, so that our city expects to make the furnaces possibly a source of profit besides securing cleanliness and health. The furnace is a very simple device, divided into two parts—the fuel and combustion chamber—where all the garbage is fed from the top by teams driven over the top. In the fuel chamber, all that has got to be burned up—night-soil, butchers' offal, anything—is discharged into the fuel chamber. The intense heat of the fuel chamber dries up and renders to an ash anything in the combustion chamber; and from time to time, by an agitation of the grate bars, everything in the fuel chamber can be removed, leaving all perfectly clean for the demonstration of the working of the furnace.

Dr. ———.—What is the cost of this furnace?

Mr. Smith.—About $5,000. That [pointing] is a device of the artist to show that in case the supply of garbage should run out, the deficiency may be supplied by gas.

Dr. ———.—Describe the process of the first firing till you get the furnace in regular operation.

Mr. Smith.—About fifty bushels of coal or coke—or refuse from anthracite mines, which they were using when I left—is put in there, and that heats to a temperature of about 2,000°, and then the garbage is put in from time to time to maintain that heat. You do not have to make any addition of fuel as long as the supply of garbage lasts.

Dr. ———.—How does it operate on the fluid excreta?

Mr. Smith.—The company claim they will burn up anything containing as high as 70 per cent. of water.

Dr. ———.—Where do you put that fuel?

Mr. Smith.—Right in here, in the front chamber.

Dr. ———.—What goes in the back chamber?

Mr. Smith.—Anything that can be burned up or dried up thoroughly, such as street sweepings, ashes, &c.

Dr. ———.—How high is the chimney?

Mr. Smith.—Eighty feet.

Dr. ———.—Any offensive odors ever been perceived?

Mr. Smith.—No, sir.

Dr. ———.—What is the look of the cinder?

Mr. Smith.—A kind of an alkali ash, such as would collect from the burning up of bones and vegetable matter, and woody matters that are in among the garbage more or less.

Dr. ———.—What is the proportion of cinder to the material?

Mr. Smith.—That depends on the amount of broken crockery in the garbage.

Dr. ———.—What is done with it?

Mr. Smith.—It is separated, and sold to people who take it away.

Dr. ———.—How long has it been running?

Mr. Smith.—Since last Monday.

Dr. ———.—Has there been any experiment made with the same furnace anywhere else?

Mr. Smith.—Only in large tanneries around the city.

Dr. ———.—It seems to me this would be a very important matter, and it would be a very proper matter, to refer to a special committee to see where exists the best system of garbage destruction. I am not here to advocate any particular kind.

The President.—We have a special committee on that subject, and if he will present any additional matter upon that subject to that committee, they will be glad to receive it.

Dr. ———.—Are the night-soil and garbage introduced in the same chamber?

Mr. Smith.—Yes, sir, separately or together.

Dr. Lindsley.—Is the garbage dried previously?

Mr. Smith.—No, sir, no preparation at all.

Dr. ———.—Is there no offence from the smoke and vapor, or is it all consumed?

Mr. Smith.—I never noticed any offensive odor.

Dr. Brodie.—I will state in reference to this furnace, that the agent called upon me before I left Detroit, in reference to this instrument, or, rather, about three weeks ago, and I gave him the name of Dr. Reeves, chairman of that committee, and I suggested to him he had better see Dr. Reeves about this matter so the doctor could help make out a report for this meeting. I do not know whether he managed to get down there or not. He wanted me to go. It has been spoken of very highly, and it seemed to me the committee that has this matter in charge should at once proceed to inform themselves in reference to all these different forms of furnaces, and the members of this Association should receive a printed copy of the results of their investigations. Time is very valuable. This Association's opinions may not be promulgated for a year after this, and it is a great deal of time.

In reference to the amount of garbage accumulating in our large cities, what is wanted is some instrument that will do this thing safely and quickly, and at the least cost. Corporations look after money as well as individuals, and we may recommend an instrument that may be very fine, but the cost too high; and I hope the committee to whom this matter is going will be able to examine into it, and report in some way, so we can learn what is best to do in these matters. We are very anxious about it in our city. As I say, we have got to defile the water to get rid of the garbage—and that we must not do; but if we have no way of destroying the garbage without doing so, the city itself is going to get its garbage away, even if the smaller towns have to suffer.

Prof. BREWER.—Our time is flying by, and there is one other person that has a plan here. I wish he could be heard, and at the same time, time utilized as much as possible. Where a furnace has been started such a short time as this Pittsburgh furnace, I do not see that any amount of talk—when the person is going to elaborate how successful it is going to be—will be profitable.

Dr. ———.—Is it or is it not a fact, that last Tuesday, after quite a number of bushels of coke had been put on this furnace, in the presence of some Chicago parties, a yard of night-soil put the fire out?

Mr. SMITH.—No, sir, it is not. In one hour, 2,450 pounds of night-soil matter, pure and alone, was rendered to a complete ash in that furnace. I have got Health Officer Gray's statement to that effect, though I cannot now find the letter.

Dr. BELL.—May I not suggest it would facilitate our work for all of these plans to be submitted to the committee on the subject.

The PRESIDENT.—The committee have already submitted the report, and the subject is now being discussed.

Mr. SMITH.—In this letter of Mr. Graves to Dr. Reeves, he says, during a partial test with night-soil, and under still more unfavorable circumstances, the furnace destroyed 2,450 pounds of night-soil in about one hour.

Dr. KENNEDY.—I would like to know how much it costs to burn every cubic foot.

The PRESIDENT.—It is too soon to answer that question, perhaps. I think you would better get the information from Mr. Smith, privately.

Dr. ———.—This is called the Angle crematory, and has been on trial in Des Moines for some time. Over two years ago one was put into our state-house for the cremation of night-soil. It was put in by our state board of health. It has been there since. That was in our old building. The state board have moved their quarters into the new building, and we have no occasion to use it; but it was used there over a year, with perfect satisfaction, for the cremation of night-soil. It was for the water-closet of the capitol building, and was very successful. I have a small plate illustrating the kind put in private houses. This one is supposed to be for the use of cities. Teams come on across this way, it being covered with a heavy iron plank floor, and arched with fire-brick underneath. They drive there, and simply dump it into these places. I have a report here of the Chicago health commission that went there to examine it. It will only take, perhaps, three minutes to read it. Their description will give their opinion in regard to it. There is a damper leading into this chimney. That damper is opened, and the fire is first built here next to the chimney. This flue is open. . . . . There is no connection with the garbage put in here at present. After it gets to burning real well, fire is put at this point, this damper is closed, and the heat, smoke, steam, and everything passes over and through this fire. I should have stated first that immediately beneath the garbage is a heavy iron grating resting on fire-proof brick, the slats being about an inch and a half apart. Beyond that and the floor there is a another one that is solid; a solid iron plating that runs the whole length beneath that, for catching any small particles of the garbage that may be partially consumed. After this is shut up, the fire passes in front here, and underneath here, and down here, and up the chimney;—the theory is, that the passage of all this heat, smoke, steam, etc., on through the fire that is here, will destroy all the noxious odors, and practically it has done so in all the experiments that have been made; there have been quite a number now. There have been delegations there from Toronto and Chicago, and from some other points, and, as far as I have heard of their reports, they speak very favorably of it. I will state that we are not using it in Des Moines, for the simple fact that Des Moines, like some other Western cities, in the extension of its sewers and gas and water mains, and everything of that kind, has exceeded a statutory limitation, and an injunction is against the city, so that though the state board of health and our local health authorities have adopted it and urged it, yet they are powerless to use it, except experimentally.

Dr. OTTERSON.—This is a statement taken from the *Chicago Times*. The commission, on their return from Des Moines, were interviewed by the press of Chicago, and this is the report. He says, regarding the Des Moines furnace,—Mr. Thompson said,—"The furnace is 18 feet long by 4 feet 6 inches wide. This is one on a much larger scale. The trial furnace at Des Moines might be represented in that way; this one (18 feel long, 4 feet 6 inches wide) has a capacity of fifty yards of garbage," etc. [Reading from report of interview.] When the doctor reached that portion of the interview referring to the time occupied in consuming the garbage in the furnace, he said,—"That, I think, is a mistake of the reporter or of the compositor. I was present at that trial myself, and saw Mr. Thompson there, and it took two hours and a half in the consumption of that matter, but I do not think that Mr. Thompson intended to make a statement of that kind. Sometimes reporters get things wrong, and it was evidently a mistake in regard to that. He says, 'this was consumed in one hour, with no offensive smell,' etc." [Reading of the extract concluded.]

I have nothing further to say. I just simply wanted to illustrate the plan, and say it is in operation there. I understand from Dr. Barton, of Milwaukee, that they have put one up there, and he does not speak well of its operation. I understand that one is to be put up in Topeka, or some other place in Kansas, in the very near future; and Minneapolis is also looking at our plan with a view to its adoption. I have no interest whatever in any way, except that I knew this question would be presented. This one that was put up at Des Moines, including the building there, which is a substantial frame building—the cost of the building and furnace and all, with only one dumping place, was about $1,700. That was the estimate that was given by the parties to Mr. Thompson.

Dr. ———.—I understand that Dr. Rauch was to have some information from Chicago, this morning, with reference to something that took place in reference to this furnace.

Dr. Oldright.—With regard to furnaces: I had at the hotel, and I intended to bring, a diagram of the bee-hive furnace. I will merely say that in cremating furnaces there seems to be one principle that does not obtain in these furnaces which is found in the bee-hive furnace—that is, some method by which the heat that is wasted at the top of the furnace, and the same with this other furnace, that that heat could be utilized in drying the garbage, so the combustion would take place more rapidly and with less expenditure of fuel. With the bee-hive furnace the garbage does not go directly into the fire, but there is a long passage through which it must go before it reaches the fire, and it is thus dried on its way. The bee-hive destructor originated in Burnley, Yorkshire, and the circulars are printed and distributed largely. Another point is, that the same principle adopted here, in burning the refuse, is adopted there in a different way. There is a series of flues through which the smoke may be made to pass from one up to the next, but if it is found the draft is not sufficient—as in starting the furnace—the dampers of these connecting flues can be shut off, and the draft goes directly into the main flue. There is another point in connection with the destruction of garbage—that is, the economic aspect. I was very much struck with an article I saw in a Glasgow paper, the other day, describing the whole matter of disposing of the refuse, and if the gentlemen would like to hear it, I could describe it. In Glasgow, besides the sewerage system, they have to dispose of their garbage, their stable manure, and their night-soil. They have a three-story building for the purpose. The stable manure is driven in. It does not need to be disposed of. It is taken right away at once, driven into the top story, and taken off at once to the country. The garbage is driven in on the same floor, passes through a double screen which is inclined in two directions—an outer and inner screen. It revolves, and the garbage at first passes into the outer screen. That contains an inch-and-a-half mesh, and the stuff here, the garbage, passes through that screen. Anything less than an inch and a half passes through and on to a travelling stage. The outer screen would run in this direction, everything passing on to a travelling stage, and is there picked over by women who sort the material, taking off old brass, old iron, boots, and pieces of horn,—they use those for obtaining ammonia,—and so on with the various articles of refuse. They are sold. Any wet stuff, such as pieces of turnip, and so on, is thrown down into the dump. Particles of manure, and so on, are thrown down into a dump to be used for manure. The other screen runs in the opposite direction. Both are on the same shaft. The cinders and ash are separated; the ash is thrown out, and the cinders go on down to the furnace and are used for fuel. They use nothing but the fuel which is obtained from the garbage—not a particle of coal or coke. Then the mode of disposing of the night-soil is this: they use the pail system there, and the pails are emptied on to a grating. From this grating the liquid portions pass into tanks,—the whole of it, in fact, passes into the tanks,—which act as strainers. Whilst that process is going on, the ashes pass down a shoot and are mixed with the night-soil in certain proportions, and, along with that, sulphuric acid is added and forms an artificial manure, and goes to the country as an artificial manure. Dr. Brodie has been talking much of the economic aspect. By this method the amount of garbage destroyed has been much lessened. It is not necessary to mention the various ways in which these articles are utilized, but they are utilized, and diminish very much the cost of the destruction of the garbage.

Dr. ———.—Dr. Kennedy evidently misunderstood me when he said I did not favor this crematory. We have a working one. It was tested, and was very successful. The one, however, we have been using for the past month—it will be a month to-morrow since we commenced—I am not pleased with, because the odors are very offensive. They are burning the garbage to a fine ash, and they promise to be burning the odors by the time I return.

Dr. ———.—I would like to ask Dr. Kennedy the question in regard to the fuel——

Dr. Kennedy.—In this trial that was made, there was not to exceed ten bushels of our Iowa coal,—that is a soft coal, differing somewhat from the Pittsburgh bituminous coal,—not to exceed ten bushels. They claim for this the same as for the Rider—that after the heat is once generated you can put in the material just as rapidly as you please, and the garbage itself furnishes all the fuel necessary to run it. We have not had an opportunity of testing that, but I believe it would be a fact in regard to this as well as the other.

The president next called for discussions on the following topics:

"What are the views of members of state boards of health as to whether state systems of quarantine should be replaced by a national system?"

"What are the privileges and experiences of state officers as to the investigation of epidemics at points in other states or provinces threatening to them?"

"What diseases should be subject to interstate notification, and should there be uniformity in method?"

Dr. Walter Wyman, of the U. S. Marine Hospital Service.—The recent experiences at the New York quarantine have made prominent three facts, viz., its state of non-preparation, the apparent division of responsibility therefor, and the great interest and dependence of the whole country upon the New York quarantine. Division of responsibility or authority in the presence of sudden danger is disastrous. Should cholera be communicated from Swinburne Island to the adjacent shores, the health officers who would be concerned in its suppression, viz., town, county, city, state, and even national authorities, might, by their very number, cause confusion of action, and prevent as prompt a suppression as might be had if there were but one powerful authority to whom all the rest might look for direction at the start. A national supervision of quarantine would be more equitable even toward the state of New York itself, for it is hardly fair that this state should alone stand the expense and responsibility of preventing immigrated disease. Why should New York be held responsible for infected baggage that is opened in Chicago? Strictly speaking, she need only care for baggage that may be opened within her own borders. Any change, however, in the quarantine administration of New York could only be brought about by the New York state authorities themselves. Sanitarians are almost unanimous in the opinion that the national government should manage maritime quarantines. The recent report of the committee of the College of Physicians of Philadelphia, after reciting the inadequacy of the quarantines at New York, Baltimore, and Philadelphia, recommends "putting quarantine in the hands of the national government." This is no new idea, for as early as 1799, and subsequently in 1878, 1879, 1882, and 1883, congress passed laws directing national assistance, and permitting, in some cases, national control of quarantine. So strong were the appeals for national supervision, that in 1879 a national board of health was established, which, however, was allowed to expire by the limiting clause in the act, after four years' existence. It should be remembered, however, that the national board of health, which was an unsuccessful experiment, was engaged in other work than quarantine defence. Its members proposed to make it a general health authority, absorbing other regular and old branches of service, and if, by attempting too wide a scope, or for whatever other cause, it failed, the inference is not to be made that national supervision of quarantine is a failure. Whether the United States should establish a bureau of public health, is a question that cannot be answered at the present time. Whether any work to be done by such a bureau excepting quarantine may not as well be done by the respective states, is a question not yet settled. National control of the health interests of the several states is a question in the same ill-defined state of solution as the question whether the government should own and operate the telegraph and railroad lines of the country. But on the one question of maritime quarantine there is no longer a doubt as to the advisability of national control, save in rare instances. Absolute national control of all quarantines without consent of the state is subject to constitutional objection, but national aid and control of previously weak and imperfect quarantines is not only a desideratum, but is an accomplished fact.

The national quarantines are administered by the marine hospital service at points where local means are inadequate, or where several states may be guarded by a single quarantine. Thus, quarantines are regularly operated at Cape Charles, the Delaware Breakwater, Sapelo Sound, and Ship Island. On account of the present alarm about cholera there has been intimated a project for establishing a bureau of public health. Whatever plan is proposed, the executive character of quarantine work should be borne in mind, and its administration should be divorced from all matters which have no direct connection with it. If congress chooses to establish huge laboratories, and examine the food and drink for the whole nation, that is one thing; but to establish a national quarantine service is another thing,—and any movement is faulty that looks to a combination of these two distinct classes of labor. Still, a quarantine service, dissociated from any other service, may, by long continued disuse, become rusty, so that when needed suddenly, as is generally the case, it is found unprepared. It is fortunate if it can find some natural association which will permit it to lie dormant when not required, yet spring into immediate efficiency at a moment's notice. It is such an association of the present national quarantine system with the marine hospital service that has made its administration natural, easy, and effective; and before making a labored effort to establish a great national health centre, a complex bureau of health and sanitation, congress would do well to inquire into the establishments and facilities which the country already possesses.

The marine hospital service, which administers national quarantine, seems not completely understood by all. It is a bureau of the treasury department, established in 1798 and reorganized in 1871, and has for its primary object the health interests of sailors; and as sailors in time of epidemic play so important a part both in carrying disease and as its victims, it seems but a natural part of the work of this service to undertake quarantine labor. The service has physicians in every large and many of the smaller parts of the country—about 150 in all. Its regular officers, appointed after examination, about forty in number, are ordered from place to place as circumstances demand. They form a well disciplined body, accustomed to the transaction of public business and familiar with public health matters, and particularly with maritime laws. It should be remembered that this service, being under control of the secretary of the treasury, can summon at once as quarantine aids the collectors of customs who have by law the power of search and detention of vessels, and who may be relied upon for accurate home information. By department usage, also, the secretary of the treasury is immediately furnished with copies of all health despatches received at Washington by the state department from its foreign consuls and ministers, and thus reliable information from abroad is secured. Moreover, the secretary has a powerful aid in the revenue cutter service, as a naval force to patrol the coast, and as a maritime police to assist in quarantine. This service is under his direct control, as are also two other factors, viz., the coast survey and light-house establishments. The machinery, then, for national quarantines, seems to be already provided, and in such constant motion as to prevent its getting rusty or being taken unawares by any sudden invasion. But little legislation is required. Additional appropriations for the maintenance and equipment of the government quarantine stations are necessary, and an enactment providing a penalty for violation of the United States quarantine laws. If all maritime quarantines were under the control of this bureau, the responsibility for their effectiveness would be fixed and definite, and their administration would be marked by unity of purpose, which would insure justice to all sections.

Dr. Holt.—While it appears the most natural and the most proper thing that could possibly be done to just put this whole question of quarantine right into the hands of the United States government, having it so perfectly easy to be manipulated right from one head in Washington, and everything systematized just to work in one particular way,—I say, while theoretically this appears to be the very best solution of what is truly a difficult question, when we undertake to apply this in practice, and see how it works in practice, and see how it will work in the long run in practice, I can only say, as expressing my earnest conviction to this Association, that when you talk about making the whole quarantine work of the United States a centralized affair, centred in one person in Washington, I would beg of this Association to go slow, because it is so easy, when taking a first glance at a thing, looking at a thing which appears perfectly plausible upon the face of it, to commit ourselves to its endorsement, and then find, upon a further investigation of the question, reasons that had not occurred to us, reasons which perhaps if they had occurred to us would have changed our course of action. Now, with so important a body as the American Public Health Association, standing preëminent in public esteem as it does, having to deal with a question which, when you come to investigate it carefully, is a mixed question, as we are bound to admit, I would only beg that the Association be extremely cautious in committing itself to any particular course. When you consider habilitating any bureau in Washington with this power, you have also to consider a man or a bureau brought under tremendous influences by conflicting interests that are separate from the scientific view of the matter as we would prefer to look at it to-day. There are trade interests in tremendous rivalry ;—proper that it should be so. It is not any one's fault that different sections of the country should be in a state of trade rivalry. It is an open rivalry, and the people derive the benefits that accrue from open competition instead of monopoly. Now, gentlemen, when you consider the hundreds of millions of dollars that are invested in this trans-continental or laitudinal railroad trade; when you consider the tremendous struggle that is coming on, on the part, we will say, of the Atlantic seaboard, to hold in its entirety the enormous bonanza of trade of this great heart of this great continent that we call the Mississippi valley,—we do not blame New York or Philadelphia, the Atlantic seaboard, for its course in this matter. It is healthful; it is natural; it is enterprise. But, then, we do demand that other coast lines of the United States should have an equal showing in this matter; and when it rests with one man in Washington, just upon his option, to put his finger upon that great artery which is the natural artery of this valley, we have clothed that man with a dangerous power. No matter what this Association may say, you will find that your states will take a more serious view of this question, and consider a long time before they would consent to any such thing. Now, in the practical application of quarantine in the hands of one man, it would be absolutely impossible for him, even clothed with the foresight of divinity, to put in practice that system without begetting hostility, without begetting jealousy, without giving offence, that would keep the thing eternally in a turmoil. If the port of Charleston feels that it has been discriminated against and is being rather oppressively used in this matter of keeping out—yellow fever, we will say; or the port of New York feels that it is being unnecessarily hampered, or that there is some influence other than just the pure one of health protection operating in the matter,—they become at once resentful. New Orleans, Galveston, or Mobile would equally be resentful. How to have these states of the maritime seaboard awakened to the necessity of doing their duty in this matter, and, when they are approached by their health officers in regard to equipping quarantines, instead of giving a little beggarly amount of a thousand dollars or two thousand dollars, to come forward and vote fifty thousand or eighty thousand dollars, which they can, any one of them, easily do, is the first step towards really equipping those quarantine stations and maintaining them properly, because there is, in the first place, no one on earth who is going to watch your own household as anxiously and zealously to protect it as you yourself who are in that household, and whose family constitute the household. Now, to have national aid without national control is a different thing. Now there is that bureau of health;—if you, gentlemen, remember, I called it to your attention at Washington. There was a bill formulated to have a bureau of health similar to the bureau of agriculture, that information, assistance, advice, could all radiate from that, and that, through that bureau, there could be brought about a harmonizing of all these quarantines. Here is the marine hospital service;—the marine hospital service is now attending to many remote points that were not provided for, and, we will say, is doing good service.

Now to enable the marine hospital, by a larger appropriation, to do still better service by better equipping these several points is a very important thing, and one vastly appreciated by us here. For instance, take Ship Island. Ship Island, gentlemen—I am not saying anything reflecting upon the marine hospital service, I am simply telling a fact—Ship Island is just as absolutely unprovided, or was a year ago, to keep yellow fever out of that coast as a place could possibly be; and there is not any better proof of what I say than that, operating its service, there came yellow fever into the coast and affected Biloxi. There was not any lack of honest intention on the part of the officers at Ship Island. I never, for one, and I do not believe anybody else, had any idea of reflecting any censure on anything at all upon the marine hospital service, but the marine hospital service was put in an important position there and not properly armed. It should have had that station thoroughly and properly equipped, so that when a yellow fever vessel came in there, instead of lying day after day and day after day a yellow fever vessel, she ought not to have remained a yellow fever vessel six hours after she got into port; and that is the only way a place of that kind becomes a guaranty against the introduction of disease, because otherwise it becomes a menace. You invite yellow fever vessels to come to this point—for what? In order to menace the land. Ship Island was just this way. There was a task imposed upon Dr. Murray that nothing less than an angel, and an archangel at that, could have attended to, because it was necessary for a man to stand here and know, all times of night and day, what was going on way over yonder in his quarantine grounds, and at the same time over here in his hospital grounds. He was not provided with any means of keeping up a guard around that place constantly, and disinfecting that ship and everything on board absolutely and certainly at once. The consequence was, that when Dr. Murray was taking the sleep he was compelled to take at his proper quarters, there was that vessel lying out there, and here were these little smacks running out from the shore with their chickens and eggs and little plunder, one thing and another, and here was perfectly raw material spending the night on a yellow fever vessel. A disease breaks out in a healthy family, and begins to attack all of its members, and then breaks out in the next household, and people begin to throw up black vomit, and the citizens, seeing this thing, start a panic. We come over and find it is undoubtedly yellow fever. Where did it come from? This illicit intercommunication between the shore and Ship Island. Had the United States government properly equipped Ship Island, properly clothed it with that power to do what was necessary, which money alone can confer, and enabled that service to perfect its several stations, that thing would not and could not have occurred. Now, that the marine hospital service should be made capable of completing these stations, and making them safeguards instead of menaces, would be a grand thing. But when it comes to centring in the marine hospital service, or in a national board of health, or in one of the departments at Washington, that absolute and sovereign power which can put its finger down and say to you, "It is not necessary to explain the reasons why I do it," it seems to me that we are begging for the conferring of a power which in the use and in the long run will be exceedingly dangerous. [Applause.]

Dr. Bell. I hope that the remarks I have to make on this subject will be considered as descriptive, and not as criticising anybody or anything. I am here in the same independent relations to the health service as I have been for the last thirty years; and it has been fully that length of time since I have been considering quarantines, and using the best of my abilities with regard to both national, state, and provincial laws, and to their efficiency, and I would like to begin with a few remarks, in reply to my friend as uttered yesterday, as to how the screws should be put to the state and port of New York in order to make the quarantine effective. The resolution which I presented this morning for the consideration of the Executive Committee will be a screw to accomplish more, if carried out, as I hope it will be, than anything ever done before, because it will deal with the agents that bring these diseases to our shores; it would reach the sanitary officers of ships and those who have charge of ships. As I explained yesterday, when a medical officer comes and tries to explain away cholera by stating that the patient died by perforation of the intestine by lumbricoides because he did not want it to be known that the vessel had cholera aboard, how can we get competent officers aboard of these ships? We can do that through congress. We have emigration laws, so-called, but there is not a ship that sails the ocean that cannot sail through them. They will tell you that regulations governing certain passengers do not apply. "I did not bring them in the cabin," "I did not bring them in the saloon," "I did not bring them in the steerage," "I brought them in some other place that is not named in the immigration law;"—and yet we have laws upon laws called immigration laws; and we have people here among us who suggest we should restrict immigration in order to restrict the importation of disease. We should enact laws that would restrict the immigration of paupers and those who populate our insane asylums, as well as cholera and yellow fever and all that class of diseases; and we can do that through congress.

The President.—I shall be obliged to restrict the discussion to ten minutes for each member.

Dr. Bell.—I will try and come right at one point. I am sure New York would be very much obliged to the representatives of the marine hospital service. They have already spent a million dollars. They ask for no such service. To these political discords the wealth and commerce of New York are as much opposed as you or I, or any member of the Association. If I believed that the marine hospital service had ever in its past shown any practical knowledge of this matter above what has been shown in New York and other quarantines, I should be most heartily in favor of it; but I beg to keep before this body one clear distinction the reader of the paper brought out—the distinction between curative skill applying to the treatment of the diseases of sailors, to which that service has been thus far applied, rather than to preventive measures to preserve the hygiene of ships and sailors. So long as they confine their service to hospitals and the treatment of sailors, they cannot claim that that makes them competent to take care of the health of the people of the nation.

Dr. WYMAN.—I made no claim that we wished to look after the health interests of the nation.

Dr. BELL.—I didn't understand the remark. I don't want to make any misrepresentations. With reference to Dr. Holt's remarks on the Ship Island quarantine, I would make a few observations. I am sure that Dr. Holt has not so far mistaken the purpose of the national board of health in choosing, through my instrumentality, Ship Island as a reefing station. They never attempted to equip it for detaining yellow fever vessels; had no means to do it. The purpose of the national board was to equip that as a reefing station, with all the necessary apparatus for the cleansing and despatching of ships and the promotion of commerce. It was never intended to be a detention station; but the suspension of the national board of health was a suspension of authority to go one step further since. I would do all I could, I am sure, and I would use every word and effort I could, to promote it, if they had shown any comprehension by which they could make use of the bases at Ship Island, or elsewhere, for the promotion of public health.

Dr. FALLIGANT.—I know that it was a death struggle, almost, to get any legislation in any shape that would accomplish any good, with all these varied collisions of local and state interests, and local, state, and national authorities. We have got a solution partly on the way that we want put in a little better shape. I expect I represent that state idea about as well as any one here. In our local quarantines we are not afraid of having those stations near us, or that the national government is going to choke us. Not at all. We have got the control of the commerce of our ports as it comes in. What we do complain of is a sort of nonentity: it is a menace. What do they do? They have got a little kind of a cabin for the surgeon to stay in; they have got a few boatmen, that they get around Savannah or New Orleans, to carry their boat backward and forward; some man at a cheap salary to stay there a few months during the summer,—just get the best man they can for a small amount of money; and about the first of November here comes an order from Washington to abandon the whole thing. If a vessel comes in there with small-pox or cholera, we have got to let it come to our local quarantine just below Savannah on the river, and where the whole commerce of the port comes to the city. That's what we don't like; and I would oppose the centring of authority in Washington—I know that our senators and representatives would never yield it in the world; but if we can get them to sustain us in equipping these reefing stations, we would like to have them equipped like the New Orleans stations. We don't want a little appropriation merely to raise the salary of the surgeon and keep him there the year round, and not fit the station so he can do his work. What we want is the equipment. We don't care anything about the surgeon, so he knows his business; and we are prepared, from the most absolute states rights point and local interests point of view, and the avoidance of jealousies between different sections of the country, and from the standpoint of commercial rivalries, to enforce the complete, thorough equipment of these stations in every way they can be fitted to do effective and good work. What we want is, that when an infected vessel gets to the station it shall cease to be infected inside of twenty-four hours; and if any of these runners go down and slip in, even then the danger has been so much destroyed by this disinfection that we are running comparatively little risk about them.

Dr. LaChapelle, of Quebec, Canada.—This question of quarantine is certainly, I consider, the most important and most practical one we have had to deal with at this meeting of the convention. Being quite a stranger, and not knowing at all your constitution and the relations between your states and the national government, I cannot venture to give an opinion on the advisability of having what you call a national system of quarantine, or of having the one already existing—I mean your state system. But what I say is this,—that as it is now, although we found out by the explanations given yesterday that the port of New York, the most important commercial port of this continent, was not prepared and is not yet prepared to meet the emergency, although several other ports are not better prepared, we have no power to which we may address ourselves and complain to. As it is now, for one instance, every state may be afraid, may be alarmed, and may find reason to complain,—but to whom shall they complain? They have nothing to do with the government of New York state. New York state may just as well answer, "Mind your own business; we will manage our own quarantine as we choose." If it were in the hands of the national government, every citizen might look to his own government, and ask that any wrong be remedied. And not only that: quarantine being an international question, our government might go to this government, and ask that the quarantine be better enforced. But as it is now, although we feel quite anxious, we do n't see how we can do anything to have that question put in the right way; and, so far as I know, I think that the system we have in Canada is better, in that way, because the whole thing being in the hands of the federal government, the government is interested to protect one part of Canada as much as another. We do n't take into consideration the commercial interests of one port. So long as you leave it in the hands of the states, you may expect the commercial interests will overcome the general interests so as not to injure the trade—divert the trade from that port. Suppose Portland, or New York, or Baltimore may hide the extent of the danger, and diminish the restrictions they will apply to navigation: if it were in the hands of the national government, that question would come entirely free from those local interests. I am not prepared to make any practical suggestion in that way; but as a representative of Canada, I ask the members of this convention to do all that can be done to protect not only the United States, but Canada. So far as the St. Lawrence route is concerned, we are prepared to protect ourselves and you; but what will be the use if the enemy have only to turn and enter by the next door,—because we receive as many goods and as many travelling people from New York as by Halifax and Quebec; so you understand that we feel very anxious about that question. I hope this discussion will bring such conclusions in the way of settling that question as that our country people, who are looking to us to protect them in this emergency, will feel that we did our duty; and that in the future, if it happens again, we shall not be in the same position we were in when it happened in New York a few weeks ago; and that any port that may be visited by cholera or any other contagious disease will be prepared to meet the emergency immediately, and deal with it as it ought to be dealt with.

Dr. Wyman.—I want to make an explanation. I don't think I will let the occasion go by without stating that the surgeon-general of the marine hospital service has once or twice, at least, asked congress for an appropriation for the equipment of these stations, and it was denied. Also, that a resolution referred to the Advisory Council yesterday calls upon the Association to request congressmen to use their influence for an appropriation for the equipment of these four stations already established.

Dr. Salomon.—If I understand the constitution of the United States, it would require an amendment for the national government to take charge of the quarantine of the different ports of entry of the country. The establishment of a system of quarantine, the United States government taking charge of the matters of the several ports, is an interference with the police powers of the several states; consequently, it appears to me that a discussion of a national system of quarantine should be based upon a suggested amendment to the constitution of the United States. This discussion has taken a little turn which was brought about by Dr. Wyman's paper: that was in regard to national aid. I think it very proper that in places such as the one I am familiar with—the Mississippi coast—where there is no protection at all against the invasion of disease, where a large number of vessels enter the Mississippi sound from different ports of the world, for getting lumber, come in sight of Ship Island, and lie there waiting for their cargo,—it is perfectly proper, in the absence of any other provision on the part of Mississippi and Florida for a refuge station, that the national government should establish a refuge station at Ship Island, upon being asked by these states. The question ought to be, Ought not the government, when asked, to give such aid for the establishment of refuge stations? If the discussion were limited to that, I think there would be no dissent in regard to an affirmative reply.

Dr. Horlbeck.—The rest of the country is interested just as we are. An explanation will be in order, to describe the situation of the Charleston marine hospital station, about three and a half miles from the city, right in the track of all vessels. We have very large commercial relations, recently established, with ports infected with cholera, and we are two or three times a month receiving vessels from those ports. It is a menace to the country to have them come without having some place to send them, because, only three miles from town, it is almost impossible to keep vessels that come in from coming into the city. In case a vessel comes which has sickness on board, the preliminary disinfection is done at Sapelo Sound reefing station. It is out of the track of vessels, about 150 miles from Charleston, so that any vessel coming to these ports will have the opportunity of going there and being carefully taken care of. The trouble is, it is not properly equipped. As has been said, an office is taken temporarily, and unless that place is properly equipped, it may be a menace, practically. This year there has been a vessel with small-pox sent there and successfully handled. There was another case, in May, of a vessel from Brazil, with yellow fever. It was sent there, and properly handled. It being, as Dr. Salomon says, at the present juncture considered unconstitutional to have the national government take charge of maritime quarantine, I think we can take such steps as may assist in the establishment of outside barriers, just to help these ports along. This is a wise movement, gentlemen, and not yesterday established. It was established years ago by the national board of health, and two vessels, with two dread scourges, cholera and yellow fever, have been successfully taken care of at Sapelo sound; and it is a live question that such vessels shall be taken care of in proper form.

Dr. Bell.—If it is no encroachment, may I take five minutes more?

The President.—I must first hear the rest of those who desire to speak on this question.

Dr. Falligant.—May I make an explanation?

The President.—I think we must first hear from every other gentleman who wishes to speak.

Dr. ———.—I would ask, How are we to act upon this?

The President.—The question is introduced to us by the Committee on State Boards of Health, and should be properly discussed by the representatives of the different state boards of health. In any further discussion I shall decline to hear more than one representative of a state board of health until all others have been heard from. Prof. Brewer is a member of the committee, and is entitled to the floor.

Prof. Brewer.—This is not a subject which is to us of such immediate importance as it is to others. I think that the paper read covered all the more important grounds. I think all will allow that there should be some uniformity of restriction, so as not to give one place a great advantage over others in commercial matters, and also that it is exceedingly desirable that this outside aid that the United States furnishes to the smaller places should be encouraged; but I am not prepared to say I should like to see the steps taken by which the whole quarantine operations in the United States should be put into the hands of the central government. A great many ports, like our own, have little foreign commerce. I can conceive of conditions under which we should be entirely unprepared to meet the danger. I should wish, then, that there might be some larger power we could go to for help at such times; but such cases are of such extreme improbability that I do not know that it is proper to go to the enormous expense to meet this extremely improbable condition. If we try to guard against all possibilities that can be conceived of by science or suggested by the ingenious, I fear life would not be worth living.

Dr. RUTHERFORD, of Texas.—If the question is the idea of taking the authority now vested in the state boards of health, and transferring that authority entirely to a board created by the national government, I say, for Texas, No. But I do n't wish to be construed in that to mean that we do n't appreciate what has been done for us by the old organization of the national board of health. We received benefits from them and from the United States marine hospital service at a time when they were of incalculable benefit. I think the infusion of this question into a national one, and inculcating upon it the idea that we must transfer all our rights to the national government, is wrong from the standpoint that I do not wish to release something I know to be in operation. Now, to ask of the national government the sufficient support and sustenance of a vidette duty done by the marine hospital service is another thing. In Texas, sometimes, we get out of money, and we have to call on somebody. At Brownsville, you remember, we got so we could n't handle the epidemic, and had to turn over the whole management to Dr. Swan, of the United States marine hospital service. I think we ought to separate the two questions, so that to ask congress for aid to help the local authorities out, and the commitment to the opinion that we are ready to turn over our quarantine matters to the national government, will not be confused. The latter idea is dead, but this fact does not preclude us from asking from the national government a support where we are weak.

Dr. FALLIGANT.—If I may recall it to your mind, yesterday there were two resolutions introduced here, one of which trenched upon that very subject, and they were sent by this body to the Advisory Committee. Quite a discussion occurred over them yesterday, and so much of this very wrangling resulted that the Advisory Committee divided the two subjects.

The PRESIDENT.—That question will be brought up at the next meeting of the Advisory Committee.

Dr. BAKER.—I wish to suggest that, in considering the question, What are the views of the members of the state boards of health? we do so by the alphabetical order of states.

The PRESIDENT.—We are considering that question now, and have done it in that manner.

Dr. BAKER.—I thought we were not hearing from members of state boards of health on this subject, but from quarantine officials and others.

Dr. HUNT, of New Jersey.—The committee suggested this order, but it was the design and opinion of the committee that it was not best to call by states. It sometimes would give rise to talks not relevant, and that it would be better to have it discussed by those members of state boards who are familiar with the subject. Therefore it was the decision of the committee not to take up the order by states.

The PRESIDENT.—Your motion, Mr. Baker, has not been seconded.

Dr. McCORMACK, of Kentucky.—I understood this was a question especially desired to be answered by state boards of health, and as we have had the views of nearly everybody except the members of state boards of health, I move that this question be referred to the Committee on State Boards of Health, after having heard the discussion by other members of the Association not members of the state boards of health.

Motion seconded.

Dr. BELL.—Mr. Chairman, before that motion is put, may I state what I have to say?

On motion, Dr. Bell was given permission to speak.

Dr. BELL.—In reply to my friend here from the Dominion, as to whom he should complain to, at the risk of being wrongfully interpreted, I will say the home government goes on the principle of self-defence, and acknowledges no superior power with regard to quarantine—just as we were placed with regard to small-pox from Canada: we had to defend ourselves. Therefore it comes down to a question of coast quarantines and their proper care and appointment. One other question, as to what the national government should do. It always has aided local quarantines. I, in my own observation for a good many years, know it has so aided them. I can refer to most of our sea-ports,—New York, Charleston, New Orleans. We have all had government aid in many years gone by. Houses were built by congress, constructed with special reference to bond privilege for goods in quarantine. The government has always given such aid, and I suppose always will, when applied to by states. This responsibility in New York is not so divided. The executive officer has as much authority as any person: his office is executive. If anybody takes exception to his action, the commissioners are an appellate board. The health officer is the prime and superior executive in all matters. This simply does away with that part of the objection raised by the paper.

Dr. McCormack's motion was put, and carried.

The PRESIDENT.—There will be a meeting of the Advisory Council to-day at 3 o'clock, and at that session all the business on hand is to be completed—nomination of officers and the questions which have been under consideration.

The President announced the next topic for discussion, "What are the privileges and experiences of state officers as to the investigation of epidemics in other states or provinces thereatening them?"

The PRESIDENT.—If nobody proposes to discuss this question, I shall proceed to the next one, "What diseases should be subject to interstate notification, and should these be uniform in their method?"

Dr. McCORMACK.—I would say, as an officer, that a system of interstate notification has already been formulated and adopted by the various state boards of health of the Union, and is now in operation, covering cholera, yellow fever, small-pox, and under certain contingencies—that is, where there is special danger of their importation into contiguous states or provinces—diphtheria and scarlatina. A uniform blank has been adopted by the various state boards of health, and is now in use; and, with the exception of the State Board of Health of New York, I believe there has been, during the past year, a faithful compliance with this system. I believe that covers the whole ground,—that we not only believe it should be done, but that it has been done, and is now in operation.

Dr. Hunt.—With regard to these two questions, the design of the committee was to draw out two points. There have been cases in which, as in the Biloxi case, it seemed necessary for a board of health to go over into another state, and it was desired to draw out the views of this body as to how that should be done. I have known two or three other cases where a board has sent a telegram. As to this second point, the great difficulty we have in regard to these notifications is, they are so formal. A gentleman from Philadelphia notifies me that there is a case of small-pox in Pittsburgh. It seems to me that it is defective, because not sufficiently explicit. We want to know whether the case is under surveillance, and if so, what kind; whether there has been any inspection of the premises, and other details. It was the design of the committee to draw out the views of the members of state boards of health as to how that notification should be made effective—not a mere form of detail; whether there should also be uniformity through the states, and how best adopted.

Prof. Brewer.—This belongs to the state boards of health. It seems to me that there is the place to settle that, rather than here.

Dr. Falligant.—Dr. McCormack has already stated what has been done in the Conference of State Boards of Health. The objection made by Dr. Hunt I do not think is tenable. When the state board of health informs the officers of other state boards of the existence of an epidemic disease, it is to be presumed that this board of health is taking all the necessary precautions to prevent the spread of the disease. It is not necessary to say, We have a case of small-pox; we have isolated the house; and are using all necessary precautions! It is unnecessary to send a notification of that kind. If I may be allowed to reply to the question asked by Dr. Hunt in regard to the second inquiry, a solution of that difficulty has been arrived at by the states bordering upon the Gulf of Mexico. We are annually threatened with an invasion of yellow fever, and had a conference of the state boards of the gulf states something over a year and a half ago. It was agreed that, upon report or rumor of the existence of an infectious disease in one state, the authorized representatives of another state should have every facility given them to make investigation. When a case of that kind occurs where we are not in possession of full information, or all that we would like to have, in regard to the appearance of an epidemic disease in a certain locality, all that is necessary is for the president of the state or local board of health to send his authorized representative to the place where the disease is supposed to exist, and he will be immediately afforded all facilities. That problem has been solved with us in the South, and it appears to me the same system could be adopted in other states.

Dr. Hewitt.—I should like to say one word for the information of my friend from New Haven. Dr. Bell has just shown a misapprehension of the object of the appointment of this committee. The object of the discussion was to draw out, for the edification of the Association, from the representatives of state boards who happened to be present, such information as it was desirable to popularize in the country. This Association is one of the ways in which state and local boards of health get at the people. This notification between states is an old story. I had been doing it with adjacent states for years. I had an agreement established between Minnesota and Manitoba years ago, and we carried it out. For instance: The law requires the health officer of a village or city to report constantly the existence of infectious diseases in his locality, and if he finds there is any danger of that disease taking the route to Iowa; for example, he immediately notifies me, and I notify the Iowa health authorities. Our system goes further than that. We have a good deal to do in the way of notification in the case of diseases of animals. Our system of notification includes both animal and human diseases. It does n't seem to me there ought to be all this amount of machinery and formality. It is a matter of common-sense and common justice. If anything of that sort occurs in my district, I should notify the authorities in the adjoining district. It ought to be a matter of universal comity between us, and we should have a great deal more sympathetic administration on such a basis than if notification of infectious disease was secured by a bond.

Dr. Holt.—I consider that one of the very best services of the American Public Health Association is the bringing together of these gentlemen, and making them personally acquainted with each other—making them to know each other in that way—so that when we scatter abroad and return to our several stations, we then know with whom we are dealing,—I might say, feelingly. I am satisfied that a great many dissensions, a great many misunderstandings, have taken place because men are strangers, which would n't have taken place if they had been acquainted. Now in New Orleans our doors are always open, we keep the latch on the outside, and call upon any one to honor us with a visit at any time, simply because we know the tremendous pressure under which our fellow-officers in surrounding states are placed during this terrible quarantine period,—that position of anxiety, that position of being looked to all the time by the people, and sometimes querulously taken exception to: "Why are you not doing something?" and "Why do n't you find out what they are doing in New Orleans?" or one place or another; and if those gentlemen, acting upon that, as Dr. Thornton did last summer, come to New Orleans, or to the place which appears to be the point of anxiety, he appears to his people to be doing something. He goes down there, and he is cordially received, and everything that can possibly be of information to him is thrown in his way. If we once adopt that plan of freely going anywhere in the defence of our people,—it is a right we have,—there is no question about it. If any state feels anxious in regard to the safeguards of Louisiana, she has a right to go in there with her representative and see exactly to what extent those safeguards are being maintained: and so in regard to the rights of Louisiana in other states. Now, acting upon this theory, when our people there were beginning to get in a terrible panic about the fever at Biloxi, railroad trains were beginning to come into the city from that sea-coast crowded with people, and the panic of yellow fever was beginning to spread, I telegraphed to the health authorities of Biloxi. I could get no information, and I immediately, with Dr. Salomon, went over there, and there investigated for myself. Now, the place should at all times have been open to me freely and cordially to make this investigation; and I think that the cultivation of this cordial feeling between state officers of health, and that understanding that these different towns and cities and ports were at all times to be open for free investigation on the part of those who feel themselves concerned in the matter sufficiently to investigate, ought to be endorsed as a principle by the American Public Health Association and by the state boards of health. [Applause.]

Dr. THORNTON.—I am requested by Capt. Tobin, one of the members of the Local Committee, to say to the gentlemen here, that any of them who would like to go out to Montgomery park this evening to the Memphis Jockey Club can meet him at a quarter past three, sharp, on the corner of Third and Monroe streets, and will go on the Dummy Line. Montgomery park is four miles out. He will have you back here at half past five. The gentlemen who have ladies—the excursion is provided for ladies—can take their wives or lady friends with them, if they wish.

Adjourned to 7:30 P. M.

EVENING SESSION—7:30 O'CLOCK P. M.

In the absence of President Sternberg, Vice-President Hewitt called the Association to order.

It was moved and carried that Dr. Rohé act as secretary in the absence of Secretary Watson.

Chairman HEWITT.—There are two papers to come before the Association to-night,—first, "River Pollution in Connecticut," and another, "The Pollution of the Water-Supply." Dr. Lindsley, I believe, is prepared to read the paper of Prof. Williston on "River Pollution in Connecticut."

Dr. KENNEDY.—I was instructed by the Advisory Council to make a partial report this evening——

Chairman HEWITT.—Well, I think it would be well to come after the regular business. I should first bring in these papers, and then proceed with the miscellaneous business.

Dr. LINDSLEY.—This paper is in some sort a preliminary report to a report to be made by Prof. Williston to the State Board of Health of Connecticut, and is an outcome of legislation a little over a year ago instructing the state board of health to make such investigations as were in their judgment advisable, in reference to the sanitary and economic results of the pollution of streams in Connecticut. The state board of health employed Prof. Williston to undertake this work, and during the past few months he has been engaged upon it. This, therefore, is only a report of progress. The report will be made more fully to the state board.

Paper read. (See page 267.)

Chairman HEWITT.—With the permission of the Association, I would beg to suggest that the next paper be read before any discussion, as both relate to the same topic. The other is a paper relating to the purely chemical composition of river water, and the address relating to the consideration of river water as a source of supply—"The Pollution of the Water-Supply," by Dr. Charles Smart, U. S. A.—to be read by Prof. Daniel, of Madison, Wis.

Prof. DANIEL.—I do not see how I can read the paper; I have n't it.

Chairman Hewitt called Dr. Lindsley to the chair, and said,—

Dr. HEWITT.—I know from having read that paper its value and interest, and I am very sorry indeed it is not here. I have read a paper by Dr. Smart, which I suppose is a summary of this report, and I can give in a moment, I think, just the results of the paper.

Prof. DANIEL.—The work of Dr. Smart was done in Dr. Hewitt's laboratory—laboratory of the State Board of Health of Minnesota, and was performed with the assistance of Dr. Hewitt. The object of Dr. Smart in examining these waters was to see if the rivers which emptied into the streams of Minnesota—if the rivers having sewerage emptied into them by the cities upon their banks were so seriously affected by the contamination which took place as to make them unfit for the purposes of water-supply for cities which lay below upon the banks of the river. Water was taken from the river above the cities, opposite the cities, and somewhat below the cities, and examined for their organic constituents mainly, especially for free ammonia and albuminoid ammonia, with the object of seeing how far oxidation took place, and consequently to what extent the organic matter of sewage was converted chemically, so that it would be harmless. The results of the examination were that it was found the material was not oxidized. It was very largely diluted, and perhaps so largely diluted as to make it a material which could not be considered dangerous,—that is, it was so largely diluted, according to the English standard for free and albuminoid ammonia, it was still suitable for potable purposes; but it was simply diluted sewage, very largely diluted. The nitrogenous organic material was not oxidized,—converted into nitrous and nitric acids,—but remained as albuminoid ammonia; consequently showing the nitrogenous material existed in the sewage still in the form of ura, rather than these oxidized products. Consequently his conclusions were, that the waters *below* were not safe because oxidation had taken place. Possibly they would be safe simply because this matter was very largely diluted, but not oxidized.

Dr. HEWITT.—If you will allow me to supplement the professor's remarks, the object of the investigation was this: We had been making analyses in my laboratory for over ten years, and had a large number on record—several hundred—of various samples of water. All of them I had collected, and there was some question with respect to the influence of the addition of sewage and offal, which I wished to settle, because the large slaughtering establishments are moving West, and the probabilities are that many of them will locate near Minneapolis and St. Paul; in fact, some have already done so, and are owned by the same parties now connected with similar establishments at Chicago. Two of our towns along the river below those cities take their water-supply from the river. The charge of the water-supply of the state is the care of the state board of health by the law, and we wished to see if we could not accumulate evidence whereby we could influence the incoming legislature to increase our authority to such an extent as to make our control of such establishments and their offal sufficiently complete to guarantee the sustained purity of the river, and provide for the sewage of our two great cities. I had found a curious condition of organic matter in the water, and though satisfied myself, I wished the opinion of Dr. Smart, and I prepared for his coming by getting samples of water. The river has quite a number of origins in the north-western part of the state,—little lakes,—and flows through pine-lands, swamps covered with tamarack and what not, so the water brings down a large amount of soluble organic matter incident to the growth and decay of the trees. To that is added another curious thing which one would n't think of,—the doctor did n't,—the sap from a large number of pine logs which float down the river, and make one provision for that great lumber trade at Minneapolis. All this I put before him, getting samples of the water from places where habitation was slight, and going on as population increased to the city of St. Paul, then up the Minnesota river, then down to Red Wing and Winona. Those waters were brought into the laboratory, and we did n't examine their origin or record until the analyses were complete. We examined between seventy and eighty samples of water and specimens of ice. We examined some specimens of ice from St. Paul, composed almost entirely of sewage. The sewage did not have time to settle, and was congealed in the ice. Of course it was not allowed to be used, and very little would have been cut of that character, any way. We made examinations of ice in all stages, and confined them to the purely chemical side of the question. The outcome of it all was the conclusions which water analysts have reached before this, that analysis of water is only one of the ways by which we arrive at its sanitary condition. We have a widely extended state, as you are aware, and it is divided physically into some convenient divisions. I numbered them for the purpose of classifying them, and whenever I receive waters from any of those neighborhoods I do not send the analysis till all questions are answered, and if necessary I visit the locality myself. The consequence is, out of several hundred analyses we have been able to create a certain kind of standard for each district. We know the water is not contaminated by animal matter. The purity of many of our springs and ponds or lakes is established: all our ponds are called lakes, many of them very large and permanent ponds. I classified these in such a way that I found I could get an average of what I thought to be pure, and an average of what I suspected; and I could make an average of what I was very sure were pure not only from analysis, but from the history of the water itself. In that way I established a standard for each of these districts, and when water comes, if we find it to range above the average, what is the use of going any further? One of the elements of that standard—and I am surprised that health officers do not use it more than they do—is the amount of chlorine. It is very easy to make a test for chlorine. Any standard book will give it. Even if it is done to test merely the comparative cloud of chloride of silver, you can soon accustom yourself to the test in such a way that you can estimate the thousandth part of the grain of chlorine in a gallon of water with very little trouble. Examine all the waters in use in the district, which you know are of absolutely pure origin; find out the amount of chlorine they contain; if there is not something peculiar in the geology of the district—you would not want to do that near a salt mine—you will very soon get a norm: you can have a norm of chlorine. Now, in our state it is a fact that whenever the amount of chlorine in the water amounts to more than a grain and a half, or the maximum of two grains, to the gallon of water, I am very strongly suspicious of that water. The chlorine in our ordinary spring and well water comes probably from decaying animal matter, unless there is some geological peculiarity in the district. In the majority of cases the chlorine comes from animal matter simply—excreta. For ammonia, Nessler's reägent is the best. Be sure it is sensitive, and then you discover the ammonia by dropping the Nessler into a tall test tube of the water. The slightest tinge gives you the evidence of the presence of ammonia, and the lime, if any, is thrown down by the caustic alkali of the Nessler, and takes with it a color, and from the brownness of that color you get an estimate of the ammonia the water contains. Of course, this test is of no use except as a suggestion of impurity. The analyses Dr. Smart made with me are parts of a series, which will be conducted in the same way, and continued during the coming year; and I hope to have the pleasure of presenting to you the results at our next meeting, if everything goes well. I intend to add to it the result of the biological investigation, though I have not a particle of faith in it at present. I am very well satisfied, as I have no doubt you are, that the non-pathogenic bacteria they talk about are a good deal more numerous than the other fellows, and that there is no peculiar mark on their shoulders by which you can differentiate them in water; though when you have thousands in a centimeter, it sounds like a big thing. It is claimed, I believe, that the specific germ of typhoid fever can be recognized by an expert; but what we want is a germ that can be recognized by you and me with a reasonable amount of apparatus, so that we may be able to use the fact in our every-day work. One aim of our work in Minnesota is to make these methods and results of scientific research available for every one concerned.

Dr. KENNEDY.—How far below St. Paul did you examine that water?

Dr. HEWITT.—Down to below Winona.

Dr. KENNEDY.—How many miles below?

Dr. HEWITT.—A mile or two.

Dr. KENNEDY.—Was that ice, too, cut below, or near, the sewers?

Dr. HEWITT.—The ice was taken in the Mississippi river below Fort Snelling, and then opposite St. Paul, and then close by the sewage inflow of St. Paul and some below. We had quite a number of samples, perhaps a dozen.

Dr. KENNEDY.—At Davenport, they cut their ice below the city.

Dr. HEWITT.—That is a very important point. It is just as sure as fate that the ice-cutters go below a town to get their ice, instead of above—right below where a town's sewers empty into the river.

Dr. KENNEDY.—One of our ice-men told me that wherever he had supplied ice one summer there was diphtheria.

Dr. RUDOLPH HERING.—I jotted down a few notes yesterday, which I will read.

Paper read. (See page 272.)

Dr. BRODIE.—These two questions go so closely together you can say little of the purity of water without at the same time taking measures to take care of the material that pollutes the water—the garbage from the cities. This was the question with the city of Detroit, situated on the Detroit river, which must carry the garbage down very rapidly—three miles an hour. But we found it was necessary it should be taken away; so the board of public works have been moving it at the rate of 30, 40, and 50 tons a day, some three or four miles down the river, into a sort of a bay grown up with rushes, for the purpose of filling up the grounds. But when the wind blows in certain directions we find that some seven or eight miles below that, the people living on that river, getting their water-supply from the edges of it, find their water is defiled, simply because they see on the surface an oily-like substance eliminated by the heat from this garbage. We have no other way except to burn our garbage. Hitherto, until within the last two years, it was very immaterial whether the supply of ice for the city was taken below or above the city; but for the last two years, through the influence of health officers and others, the entire ice-supply for the city is taken above the water-works, above where any sewers empty into the river; so we have the purest kind of ice, and of course a great abundance of it. The water-supply, as our citizens claim, is pure. I do not think they can get any purer water. This question of destroying garbage I think comes in fully abreast with the subject of the pollution of the water, because if there is no foul material thrown into the water it will not be polluted. I think that is the great desideratum—to destroy the garbage in such a way as not to allow it to pass into the water at all.

Prof. Brewer.—There appears to be a little confusion regarding certain evidences of the impurity of water as given by the death of fishes, and also the presence of bacteria. If you take a fish to the London sewers, it will live; a short distance below, fish may be killed. Fish may be killed in polluted streams in two ways,—by the pollution of the stream by chemicals, as they doubtless have been in the Nantucket river, described in the paper of Mr. Williston; but when organic matter is undergoing decomposition in water, it is attended by the consumption of the oxygen dissolved in the water, and such waters then have a diminished supply of oxygen, and we not unfrequently find fish killed in such waters simply and solely because of a lack of oxygen; they are drowned there, so to speak. That same water which will kill fishes will support bacterial life in abundance: in fact, the decomposition which goes on by microbes goes on the fastest when the microbe has to break up and destroy the organic components of the water to get the oxygen for its own existence. It seems to me as if a series of careful observations, some already undertaken, by the river commissions, relating to the agitation of water, leads to some positive evidence on the other hand that every agitation kills the microbes. We find there is considerable of confusion in this. We have water so deficient in oxygen that fish die, but in which, after all, most of the organic matter has already been oxidized.

Dr. ———.—The practical question that has suggested itself to me arises in fresh water rivers where we have an inflow of tide. Formerly we used the Savannah river water. Now, to get an exact calculation of the amount of water that flows out to the ocean and never gets back might reduce it to a point where we might tell how much contamination occurred in the water; but an estimate of contamination based upon the volume of water in a river where the tide is all one way would not give you a proportional estimate as to what amount of contamination might occur in a fresh water river subject to the inflow and outflow of the tide, on which to base your estimates of the fitness of the volume of the water for drinking purposes: that is why we adopted the artesian system in Savannah. The sewage emptied into the river did not all go out with the tide, but remained in the river unless it was deposited at the bottom by mingling with the clay; a great deal passed backward and forward, and only a portion was carried away to the ocean. It seemed to me that was a very grave point in determining the value of those river waters for drinking purposes where they are subject to this back pressure from the ocean, causing their inflow and outflow with the tide all the time.

Dr. Crosby.—Our rivers in Ohio are being polluted with what is generally recognized as a disinfectant—chloride of lime; and I have not heard anything from the other states as to whether they are being troubled. I should like to be informed in regard to it. In Ohio there are quite a number of large manufacturing interests making paper and straw-board, and in the process of manufacture chloride of lime is used as a bleaching agent, and this material being thrown into the streams has killed all the fish in several instances for three and four miles down the river; and in this manner the streams have become very seriously polluted so that cattle refuse to drink the water. In Columbus, at the present time, they are having very serious trouble from the pollution of the Scioto river. It is a very small stream. At the present time you could probably confine it in a three-foot sewer, and yet they are discharging the sewage of perhaps one third of a city of 8,000 inhabitants into this stream; and the city engineer, two years ago, to overcome the difficulty in some manner—or expected to—constructed a dam across the stream about a thousand yards below the outlet of one of the main sewers, with the idea of examining the water-bank and having the sewage discharged into the running water. At the present time the river is so low that no water is running over the dam, and in consequence they have a cesspool probably two miles in length in the worst imaginable condition. Now the proposition has been made to blow up the dam, but as we have no water to wash away what would be found there we cannot do that. There has been a committee appointed and money appropriated to help them out of their trouble.

Dr. DUFFIELD, of Michigan.—While Prof. Hewitt was describing the process of estimating albuminoid ammonia, it occurred to me that this other professor—I have forgotten his name—it occurred to me it might be well for the Association to establish a method, as the best method, that all chemists, in investigating the subject of water, should follow, because there are so many different processes given by which we arrive at certain results, and several different methods of analyzing water, that unless we establish a definite standard which shall govern us and which shall be used so that we may know by what process these estimations have been made, we will find it rather difficult to draw just and careful conclusions. I see no objection to appointing a committee composed of the best men on that subject in your society, and allowing them to suggest the most accurate methods of investigation known up to the present time. Otherwise, if one operates with what he sees in the zitsfri-frinlalijisshehami this year, he may be upset by the gentleman who writes the next year; and so it goes on, and we have no standard on which to fall back in the estimations.

Dr. ———.—It is a well known fact that when quiet water gets above eighty degrees in our reservoirs, a growth of microscopic vegetation takes place. It is claimed that this is the cause of the fishy tastes and other bad tastes. It frequently takes place by decomposition in the pipes. So far as I know the artificial aeration of water is done by pumping air into the water already in the pipes. This summer it has been tried in certain reservoirs, and also has been attained with beneficial results in the diminution of the smell, undoubtedly coming from the oxidation of this microscopic vegetation. Regarding what has been suggested by the last speaker, I do not think this Association can define what is the best way of analyzing waters. It belongs strictly to the chemists. I believe when they are analyzed it is the custom of chemists to state the method. I hardly think that any resolution passed by this body would prevent chemists from taking those means they consider the best. What is more important is, that a rule should be established by which those results should be expressed. That thing has been discussed so much by chemists, I think we shall get in a lot of business if we attempt to settle it.

Dr. Rauch.—This is a subject of very great importance at this time, and is daily becoming more so throughout this country. It is one in which Illinois is very much interested. I have been paying some attention to the pollution of streams, or at least of the Illinois river, by Chicago sewage for the past ten years. Our board this coming year will make a careful study of the pollution so far as it affects all the rivers of our state, and also, so far as we can, the water-supply of the entire state. That will be part of our work the coming year. Massachusetts is doing the same thing, and I think it a matter of great importance. This Association should encourage investigations of this kind. We need as much light as possible upon the question. There was objection made to Chicago sewage coming to the Mississippi river. I answer, it would not reach the Mississippi river. Several years ago I presented a report to the Illinois State Board of Health urging the erection of pumping-works at Bridgeport, and that report was submitted to the common council. The pumps were built, and during the past summer about 45,000 cubic feet of water has been pumped daily. Last December the pumps broke down, and for nearly a month only about 17,000, and part of the time only 15,000, cubic feet of water went through by gravitation in the canal to the Illinois river. I have had the water at Peoria, 158 miles below Chicago, examined since the erection of the pumping-works, until this break-down. That was the first that I could discover the presence of Chicago sewage, 158 miles below that city. It so happened that at the time of this break, or two or three days afterwards, the canal became frozen over, and it took the sewage of Chicago nearly twenty-seven days to get to Peoria. I had the water examined at Chicago, Joliet, Ottawa, and Peoria, while this break occurred, and the 27th day after the break occurred I discovered the presence of Chicago sewage at Peoria. By that time, however, the pumps were in operation again, and just as fast as we pumped the water from Chicago river into the canal, the presence of sewage disappeared, that is, the greater part of it. I must confess I was surprised at the slow dispersion of the sewage. I was astonished. I expected that it would disappear much faster than it really does. In winter, before the construction of these pumps at Bridgeport, by cutting into the ice at Peoria the odor was found to be exceedingly offensive. At that time only about ten thousand cubic feet of water went through by gravity from the Chicago river, and of course it contained a large amount of organic matter, and I think one winter it was noticed fifteen miles below Peoria. It depends entirely on how much water is sent down from Lake Michigan. I believe that this deep cut can be made at Chicago in the interests of commerce, and without impairing the sanitary interests of the country below, provided enough water is sent. If 14,000 cubic feet of water is sent down from Lake Michigan for every hundred thousand people, I am satisfied the water-supply will not be polluted, and that the Chicago river will be in comparatively respectable shape—no offence at the town of Joliet, and the potability of the water at Peoria will not be interfered with. I therefore hope this subject will be brought up at the next session, because I really do not know of any one more important, and I think it would be well to have a standing committee. I believe there is a committee now upon this subject, and I think it should continue.

Dr. Walcott, of Mass.—The experience of my own state has a certain amount of interest in this matter from the fact that what you all speak of as possibilities have become realities with us. The state board of health, at its first organization, in 1869, was given a very complete authority in the way of the investigation, and to a certain extent the control, of the pollution of the streams of the commonwealth. From that day to this we have made at short intervals very careful examination of the various rivers and water-supplies, and within the last year, with the assistance of a much larger appropriation, we have undertaken very extensive examinations, and have arrived at certain results: and one of them is, there is no river in New England so large that it may not be polluted, and polluted so as to be unsafe as a source of water-supply. In 1869 the legislature exempted from the immediate operations of the legislation for the prevention of the pollution of streams the Connecticut river and the Merrimack river, assuming that, from the very large amount of water flowing in those streams, it would be impossible there should be a pollution sufficient to impair their usefulness. The state board of health of that day, and the succeeding boards for fifteen years, agreed in that conclusion. At the end of fifteen years, we found that the streams which, during the previous time had been tolerant of the filth of 200,000 people, had ceased to be able to properly dispose of these matters, and had become so offensive—not simply suspected to be dangerous by sanitarians, but known to be offensive to the people who used the water—that it became a matter of most imminent danger. It is true now that the Merrimack river, which I have seen pouring ten thousand cubic feet of water a second over the dam at Lawrence, betrays the impurity added to that stream by the people along its banks in the states of Massachusetts and New Hampshire. We have taken water from Lake Winnipiseogee, which represents the fountain-head of the Merrimack, and found it very free from organisms of any sort—only an infinitesimal amount of chlorine, with only the amount of albumen belonging to every surface collection of water. We find it at Lowell receiving the sewage of 65,000 people in that city,—receiving all the refuse of the largest manufacturing town in Massachusetts,—and we found it fifteen years ago absolutely, to chemical analysis, purer below than above Lowell. To-day we find it so impure below Lowell that when the surface of the water is covered with ice in winter, it is offensive to both taste and smell. In Lawrence, which takes its water-supply from the river, fifteen miles below that point, we have made chemical analyses of these streams, and at the same time had a competent investigator determine the various algæ which belong to the water, the infusoria of one sort and another, and in addition to that we had a careful counting of the bacterial colonies. We have not gone so far in this matter that we can discriminate between the injurious and the healthful bacteria, but we hope to show at the end of a year—of course, there is no very great certainty at the end of a year, but at the end of a reasonable period of years—some correspondence between our three readings. We have in one column chemical analysis, which has meant little hitherto: a chemical analysis taken any one day is about as worthless an indication of the purity of a water-supply as you can have. It is simply one link in a chain, and you must know what the others are to determine its value; but if, at the end of a year, we find our albuminoid ammonia to correspond to a certain increase in bacterial colonies or infusoria, we may find an index not hitherto recognized. As to the harm done by a lack of uniformity in the chemical analyses, that seems to me a danger altogether imaginary. The methods of the laboratory are well known: a chemist can understand them, at any rate. Col. Bolton's method of making analyses enables us to convert them into the methods of any standard laboratory. It is perfectly easy to attach a relative value to the various water-supplies of London in comparison to those on this side of the Atlantic. The various chemists who have from time to time been analysts for the board assure me there is no great difficulty in that. But as I say, we have reached conditions which you consider simply possibilities; we have got to the point, we have reached relations which I hope the introduction of the drainage of the Illinois river into the Mississippi will not bring to your doors. The little state of Rhode Island is limited to two rivers, one of which the state of Massachusetts has converted into an open sewer. The Blackstone reaches the border lines of Rhode Island,—a stream hopelessly unfit for domestic uses. It did to a certain extent recover itself fifteen miles below Worcester; but within the last year it has become, or within the last few years examinations have shown it to have become, so polluted at the Rhode Island line that it is of very little use. What remedy is one state to have against another? There is no process known to state or constitutional law by which Rhode Island can protect itself against this most unfriendly treatment on the part of its larger neighbor. But that, sir, is only one of the various interesting questions that arise in this connection, and it seems to me it is one which, in connection with the subject of the disposal of sewage at Chicago, ought not to be kept out of view.

Adjourned.

FOURTH DAY.

FRIDAY, NOVEMBER 11, 1887.

MORNING SESSION—10 O'CLOCK.

President STERNBERG.—The Association will please come to order. Announcements from Committee of Arrangements. [None.] Announcements from Executive Committee.

The SECRETARY.—The Executive Committee recommend the discharge of the Committee on Disinfectants; they have completed their work.

On motion, the recommendation was accepted, and the Committee on Disinfectants discharged.

The SECRETARY.—The Executive Committee recommend to the Association the adoption of the resolution offered yesterday by Dr. Bell, of New York:

Resolved, That a committee of three be appointed to consider and report upon such sanitary and medical services on board emigrant passenger vessels as may be subject to congress.

The PRESIDENT.—You have heard the resolution. What is your pleasure?

On motion, the resolution was adopted.

The SECRETARY.—The Executive Committee recommend the adoption of the resolutions offered yesterday by Dr. McCormack, in a new draft, in which Dr. McCormack concurs.

WHEREAS, This Association has heard with regret that after four years of warning, Asiatic cholera found the authorities of the port of New York very inadequately prepared to deal with it; and

WHEREAS, The faithful administration of the quarantine regulations of all ports, and especially at the port of New York, is at this time of the highest importance to the whole country;—therefore be it

Resolved, That the quarantine authorities of our maritime ports be urged to exercise the greatest possible caution in admitting ships from infected ports to free pratique.

Resolved, That these quarantine authorities be requested to coöperate with state and municipal boards of health in the effort to prevent the spread of contagious and infectious diseases from ports at which they may exist, by furnishing to the health authorities of communities in social or commercial relations with such ports prompt information as to all real or suspected cases, and of immigrants, their destination and routes of travel.

The PRESIDENT.—Gentlemen, you have heard the resolutions. Any motions?

On motion, the resolutions were adopted.

The SECRETARY.—The Executive Committee recommend the following named persons for membership: [List read, and applicants elected.]

The nominations of the Advisory Council were read, and on motion confirmed, as follows:

For President,
Dr. CHAS. N. HEWITT, of Minnesota.

For First Vice-President,
Dr. G. B. THORNTON, of Tennessee.

For Second Vice-President,
Dr. JOSEPH HOLT, of Louisiana.

For Members of the Executive Committee,
Dr. H. B. BAKER, of Michigan.
Dr. S. H. DURGIN, of Massachusetts.
Dr. J. N. MCCORMACK, of Kentucky.

Place of Meeting, Old Point Comfort, Va.

The place for next year's meeting, as recommended by the Executive Committee, was announced, and moved confirmed.

Dr. ———.—Before putting that question, I would like to add as an amendment to the recommendation—it appears that the invitation from Old Point Comfort restricts the time. I would like to ask, if there has been anything further received.

The SECRETARY.—I have a telegram received from the proprietor. [Reads the telegram.] So it seems he prefers it should be between the dates named in the letter, but will accept the Association as late as the first week in November.

Dr. ———.—What are the dates named in the letter?

The SECRETARY.—"I will entertain the members of your Association and their families and friends, each for two dollars and a half per day, any time between the first of September and the fifteenth of October."

Dr. ———.—It seems to me that due consideration should be given to election time next year. It will be a very important election, and gentlemen are going to pay some attention to it. I do not think you will have a very good meeting if you have it about the time of the election. It would be better it should be a week or ten days afterwards. I suppose some other place could be had just as well as that point.

Dr. HEWITT.—In the name of the North-west, I should like to urge the acceptance of the invitation to Milwaukee. The Association must remember that we have something else to consider besides the convenience of the members: the influence of the Association, if it is what we propose it shall be, will be a very great advantage to us in the North-west, if you will do us the honor to come up there. Milwaukee is distinguished for the hospitality of her citizens, and the gracefulness and heartiness of her entertainment; the facilities for delightful railway excursions and trips on the lakes are perfect. So far as your interests are concerned, you cannot possibly light in a softer place: you are only two hours and a half from Chicago; trains are running between Milwaukee and Chicago very many times a day, and at Chicago you are at the centre of the railroad system of the West, and can go in any direction at any time you please. But the point which impresses me is, the necessity we feel for the presence of the Association. On that ground I, as a Minnesotian, second the nomination of Milwaukee, and hope the Association will come there. I think it would be well to leave the exact date to the Executive Committee, and they can arrange the matter in a way which in their judgment will most thoroughly meet the ends of the Association.

Dr. FALLIGANT.—I was one of those who voted for Old Point Comfort yesterday, but I am not altogether satisfied with the telegram and our arrangement at that hotel; and I think, under the appeal made by Dr. Hewitt, and the very warm invitation which has come to us from the mayor and people of Milwaukee, I can very well reconcile myself to the inconvenience of going so far, and I would now be glad to go there.

Dr. ———.—I would suggest that the time and place of meeting be left to the Executive Committee. There are a great many reasons why this should be done. I make that motion.

The PRESIDENT.—The discussion is upon the motion to adopt the report of the Advisory Council. We shall have to act upon that motion before the other is in order.

Dr. FALLIGANT.—It is understood, I suppose, that it would be either one place or the other?

Dr. ———.—It seems to me we might as well decide the matter—the Association might as well decide the matter. The Association has been meeting in the West for several years, and I doubt whether it is advisable to make it entirely a Western Association. Of course I appreciate the fact that the star of empire moves in the usual direction, and all that sort of thing; but we must remember that a good many of our members belong a good ways east. The only objection that I have heard expressed against Old Point Comfort as a place of meeting is the fact that the meeting could not be held at a sufficiently late period in the year to accommodate certain of our members. If the meeting were held in the North-west, it would be exceedingly uncomfortable to go much later in the season.

Dr. ———.—There is one objection against holding the meeting at Old Point Comfort which I feel bound to express, though it may be wise for the Association to make the experiment: we could not get the support of the local press, because they have none. But there is a great deal of news constantly sent from Old Point to the papers in the cities near by,—Baltimore, Philadelphia, and New York, especially,—so that possibly the publication of very extended abstracts in the papers in the large cities might give us an equivalent for the loss of the prestige we should obtain and which we have always derived from a local press. That is the only objection. Old Point is a delightful place, especially any time after the middle of September, and we must hold our meetings either before the 15th of October or after the 15th of November, else a great many of our members will not be present on account of the election, and the newspapers can give us no space at all; and every one knows very well how much we need and appreciate the support of the press.

Dr. Bell.—I hope it will be in order to amend the proposition to hold our next meeting at Old Point, and also, to answer the very good reasons assigned as to the time of meeting being too early in that section, by amending it to meet at Norfolk. We would do, in my judgment, a great deal more good at Norfolk, even though we might enjoy ourselves a little better at Old Point. We would put ourselves in contact with the people in Virginia, where they very much need public health,—at Norfolk more than at Old Point. I do not believe in that somewhat fashionable custom of certain scientific societies, of undertaking to meet at the famous resorts to advertise themselves. We need no advertising. We should meet where we can do most good. We can meet in Norfolk after the election, and I am in favor of meeting in that section rather than in the North-west. We have been going in that direction a long while. Meanwhile we must understand that the public health service is well under way throughout the North-west: I wish it were so in Virginia. The board of health there need stimulation. We shall stir up the legislature, I hope, to make an appropriation to sustain the Board of Health of Virginia. If we meet at Fortress Monroe we are isolated, and meet people who perhaps care for the novelty of the thing, and perhaps become members, and then we never see them again. There is nothing there to work upon. We cannot touch the people of the state with half the facility that we can at Norfolk. I move to amend by substituting Norfolk.

The President.—We have no invitation from Norfolk.

Dr. Hewitt.—That is the point: there is no invitation. As to the Association's meeting so much in the West,—last year we met in Toronto, and the year before in Washington.

Dr. Bell.—Invitations, to me, sir, are nothing. In the meetings of this Public Health Association, we pay our own way and meet where we please. I have no doubt the hotels anywhere will be glad to entertain us.

Dr. Holt.—I can speak as entirely dispassionate in this matter, for with us in the South it is just as convenient to go East as to go Northwest. But Dr. Rohé touched incidentally what seemed to me to be conclusive as against Old Point Comfort. Looking purely to the interest of the Association, I think we ought to have our place of meeting in those large centres of population where we have right around us the press, and where we can have a large local membership, and all of those incidents to our growth and our success. We need sustaining and being felt, and we can only be sustained and felt by having our meetings where we can produce the greatest effect, and that is in the centres of population. I do not know of any place on this continent, perhaps, that more thoroughly needs this Association to meet there than Milwaukee. It needs us there, and needs us badly: not perhaps as New Orleans needs us;—it needs us to show us what grand things they have got. I am certain I would like to go up and see how they have things in Milwaukee.

Dr. Johnson, of Chicago.—I only rise to say one word, suggested by what has been said here. I think this Association ought to meet where its purposes can be best accomplished, without reference to the invitation. It should meet, not as the guest of the city, but wherever its objects can be best accomplished, and especially in bringing to the knowledge of the community those facts they ought to know in order to second the health officials. To me it is a matter of no consequence where we go, because I can go to one place as well as to another. I simply rise to suggest that the fact that we have or have not an invitation should not influence us. We are well enough off to pay our own expenses. I think we should act independently of all invitations, and go wherever, in the judgment of the members, the interests of this Association require.

Dr. FALLIGANT.—I move that we meet at Milwaukee.

Dr. HORLBECK.—There is another question: If we meet at Point Comfort between the middle of September and the middle of October, or up to the first week in November, we shall shut out many of our active members in the South who are in active quarantine duty and cannot leave their stations before the first of November. If they cannot leave before the first of November, it would be impossible for them to reach there and attend and return the first week in November; and besides that we must take into consideration the fact of the presidential election. I heartily favor the idea of going to a large city.

The PRESIDENT.—If there are no further remarks, I shall put the substitute for the original motion, which is now in order, which is that we meet in Milwaukee.

Motion carried.

It was moved and carried that the time of meeting be left to the Executive Committee.

Dr. Rohé read the report of the Advisory Council on the recommendations of President Sternberg:

The committee appointed by the Advisory Council on resolutions relating to the recommendations of the president, begs leave to report as follows:

We recommend the adoption of the following:

WHEREAS, in the judgment of this Association some form of national health administration is essential to the protection of the nation and to a proper use of the various facts and statistics that can be collected from the states and territories,—

Resolved, That the Advisory Council heartily endorse the recommendation of the president of the Association relating to the creating of the office of health commissioner by the general government, and, further, that we earnestly recommend that the Association use every and all honorable means toward bringing about the necessary legislation to create such an office.

Resolved, That a committee of five be appointed by the president for the purpose of recommending such legislation, the members of the committee to be named by the president.

On motion, the report was adopted.

The following resolution, recommended by the Advisory Council, was adopted:

Resolved, That the Association urges its membership to recommend their representatives in congress to further by all means in their power additional appropriations for the maintenance and equipment of the United States quarantine stations of Delaware Breakwater, Sapelo, Cape Charles, and the Gulf of Mexico, and that legislation providing a penalty for the violation of the United States quarantine laws is, in our opinion, an urgent necessity.

On the following resolution,—

Resolved, That the surgeon-general of the marine hospital service be requested to cause the detail of an additional officer to serve in the bureau, to act as registrar of vital statistics, and that such statistics be made part of the weekly abstracts,—

the Advisory Council recommend that it be not adopted. Carried.

The secretary read the list of persons recommended for membership by the Executive Committee.

On motion, the applicants were elected members.

The PRESIDENT.—Before proceeding to the papers of the morning I will announce the standing committees for the next year. (See "Officers and Committees.")

Dr. KENNEDY.—I do not think I heard any announcement for member of the Advisory Committee from Iowa.

The PRESIDENT.—Yes, sir, I made an announcement, Dr. Kennedy—yes, I must have passed it. I have your name here, Dr. Kennedy; I must have skipped it in reading the list. At the request of Dr. Johnson, who was named on the Advisory Council for the state of Illinois, I will leave the name of Dr. DeWolf, who was on the council last year.

Dr. BELL.—You adopted the resolution I offered, and I have heard no committee announced.

The PRESIDENT.—Did the resolution state that a committee was to be named?

Dr. BELL.—Yes, sir.

The PRESIDENT.—I beg your pardon, Dr. Bell; I had forgotten there was a committee to be appointed upon those resolutions. I will name Dr. Bell, Dr. Duffield of Michigan, and Dr. Rice of Massachusetts.

Dr. ROHÉ.—I have some resolutions which I do not think require any reference to the Executive Committee:

Resolved, That the thanks of the American Public Health Association be hereby extended to Dr. George B. Thornton, chairman of the local Committee of Arrangements, and his committee for the excellent arrangements made for the present meeting; to the members of the government of the Taxing District of Shelby County for the many courtesies extended; to the editors and reporters of the *Memphis Appeal*, *Memphis Avalanche*, *Memphis Evening Scimitar*, *Memphis Evening Ledger*, and the *Sunday Times* for their full and excellent reports of the proceedings of the meeting, and for their editorial comments; to the Hon. R. L. Taylor, governor of Tennessee, and Judge J. W. Clapp, for their eloquent addresses of welcome; to the Western Union Telegraph Company, the various railway and transportation companies, the Cotton and Merchants' exchanges, the governors of the Tennessee, Chickasaw, and Memphis jockey clubs, the proprietors of the Gayoso, Peabody, and other hotels, for courtesies extended; to Hon. E. S. Hammond, United States district judge, for the use of his court-room in the custom-house as a meeting-room; to Capt. T. F. Tobin, United States surveyor of customs and custodian of custom-house, for many courtesies extended; to Mr. Hugh Anderson, for one of his rooms adjoining the court-room for the use of the treasurer; to Maj. John D. Adams and Capt. James Lee, Jr., for proffered courtesies; and to all the ladies and gentlemen of Memphis who have contributed so much to our pleasure and entertainment during the meeting.

Resolutions read and adopted.

The PRESIDENT.—It is customary for the president of the Association to appoint a chairman for the local committee at the place of meeting. I will appoint Dr. Robert Martin chairman of the local committee at Milwaukee, and the arrangements for the completion of the committee will be left to him.

On motion, Dr. Lindsley was reëlected treasurer for the ensuing year.

Dr. CONN.—As we are doing the matter of courtesy to the different parties, I wish to offer the following resolution in reference to the hotels:

Resolved, That the American Public Health Association regret that the invitation from the manager of the Hygeia Hotel required the meeting of the Association to be held so early in the season that they are unable to accept.

Resolved, That the Secretary of the Association be instructed to communicate to the manager our regrets, and ascertain if at some future period it will not be possible to arrange for a meeting later in the season.

Adopted.

The PRESIDENT.—The first paper this morning is upon "The Sanitary Work of the Department of Health, Brooklyn, N. Y.," by A. Otterson, M. D., Commissioner of Health, Brooklyn, N. Y. Dr. Otterson not being present, the paper will be read by title only. (See page 56.)

Next is a paper on "Prime Requisites and Suggested Improvements in the Construction and Method of laying Sewers and Drains for House Drainage," by Dr. L. A. Falligant, Savannah, Ga. (See page 280.)

Dr. FALLIGANT.—When the circulars were sent out to us as to the proceedings for this meeting, it was mentioned that house drainage would come up on one day, so I had anticipated introducing some diagrams with comments upon them, explaining some modifications in the ordinary method of laying the pipes, and I would prefer, instead of handing in the paper in an incomplete condition at present, to explain these changes verbally and finish up better the paper which has been in your hands merely for revisement of the principles embodied in it. In the Mortimer method of laying the flush-pipes they come in laterally. I I have been told by engineers that that was done upon the theory that a flush current sent down a central drain-pipe operates conjointly with the house-pipes which enter into the central drain. If that were a fact in house drainage as it is in nature and the flows of tide-waters, the principle would be all right; but such is not the fact. When you send down a flow of water along a pipe for house drainage, if the joinings are lateral, unless there is at each opening at the same moment, instantaneously and conjointly, a flow from the house-pipes into the central drain, you have a backing out at the other point, just on the same principle that tide-water coming up backs out into the creeks, so that for every opening that you have along the line of the pipes, as a flow goes down you have an eddy at every one of these gaps. To overcome that it occurred to me that by placing the openings entirely upon the top of the pipe as I have delineated here, we would have a perfectly clean body and sides, offering no resistance to the flow of the flush current, and then the opening would be at the point of least resistance, on the top of the pipe, and to obviate any abutment which might be occasioned by the entrance of the house-pipe into the central drain, which is constructed very often in the manner which I have shown. It will be seen that if the flow is sent that way the contents are gathered in sufficient quantity to fill the pipe, and the pressure causes expansion and it gets to this point of this opening; it gets this expansion, and the little point presents an abutment. To overcome that, I have suggested that the opening should be on the top, a slope on the lower part of the opening, so the pressure would force the contents along without any trouble and leave nothing against the point of abutment. One of the difficulties which was suggested to me by the engineer in charge of the works of this character in Savannah was, that no very long pipe could be constructed without a great deal of trouble in case of repairs. He said, "How are you going to run a pipe 4,000 feet, that you can with one single point of flush just as well cleanse a pipe 4,000 feet as 400 feet." I admit it is true, but if any break occurs you have to take up the whole pipe to repair it; so it became a serious question to know what to do with that, and I suggested to him that at intersecting points along the lines of those pipes escape pipes might be constructed so the water would be forced out, so we would not have to take up or examine any more than the distance between two escape pipes to find out where the exact point of obstruction was. Now, sir, with regard to the cost of this pipe. We went to the different plumbers in the city, and we found that a pipe of 12 inches diameter could be put down in the ground for about a dollar a foot. I was myself the author of the Georgia law which arranged the method of assessing the cost of a pipe in the centre of a lane, which is to assess it upon the lot holders on each side by frontage and not by the value of property, upon the principle that each holder pays according to the frontage of his lot. Thus it will be found that if there were two 30 feet lots fronting each other, only 30 feet would be assessed to those lots, 15 feet to each side, and it would be $15 to each one. In concluding these remarks, Mr. President, I would say to most of the older gentlemen, and as we are about to part at present, sometimes in going through a period of epidemic we are impressed with a sadness of feeling that while it occasions sorrow it wakes up the most intense feelings of our nature. It leaves upon our minds in going away from scenes of desolation such intense feeling as is the very groundwork and inspiration of the good work of sanitation thereafter. After a visit of mine to this city, sir, in December, 1878, and on going to Washington to attend the sessions of the yellow fever commissions at that time, I had written up some verses which I hope will not be out of place in concluding my remarks here, and I hope they will leave that same—

The PRESIDENT.—Have they reference to the subject of the paper?

Dr. FALLIGANT.—They have reference to the condition of Memphis prior to its drainage, and what would be done with it. As we are about to part I would simply introduce these verses as illustrating my own intense feeling at the time, and my own pleasure at the change created by just what was suggested in these very lines. It is headed "A Lament on Memphis in 1878."

The PRESIDENT.—I do not think it would be proper to read them without the permission of the Association.

On motion, Dr. Falligant was allowed to read the poem in connection with his paper, which he proceeded to do.

Dr. ———.—Would it not be proper to have a report from the Committee on Necrology? [Laughter and applause.]

The PRESIDENT.—Gentlemen, if there is no further business before you this morning, it becomes my pleasure to introduce to you your president for the next year,—Dr. Hewitt, of Minnesota. It is entirely unnecessary to make any remarks in introducing Dr. Hewitt, and in resigning the chair I simply wish to say I feel very much indebted to all the members present for their kind consideration of the difficulties of the president's position, and for the support I have had in this meeting, which I feel has been a very successful and profitable one. [Applause.]

President HEWITT.—My long service in your Association has made me familiar somewhat with the details of your work. I accept the position you have given me, subject to the conditions with which it is environed. I hope that the members of the Association will begin the practice, in my administration—which has not been very common in the recent ones—of communicating with the president directly during the interregnum, in regard to the work of the Association. My impression is there is not enough freedom in this respect, and a great deal of good would be accomplished if the president could become thoroughly familiar with the wishes and wants of the sanitarians throughout the country as respects the business of the succeeding meeting. You are well aware of the restrictions placed by our laws and custom upon an incoming administration, and the sphere of action of the executive officer is limited and confined in regard to laying out the work for the succeeding year; but there is room enough left for laying out a good deal of work in addition to routine work, if the members will think the matter over and make such suggestions as occur to them during the year. [Applause.]

Dr. RICE, of Massachusetts.—If it is in order, I move that the thanks of the convention be extended to our late president, Dr. Sternberg, for the able, impartial, and eloquent manner in which he has presided at this meeting

Motion carried.

Adjourned *sine die*.

The following letter, received by the secretary from one of the active and honorable ex-presidents of the Association at the close of the meeting, is herewith given:

U. S. NAVAL HOSPITAL,
MARE ISLAND, CALIFORNIA, 1 Nov., 1887.

IRVING A. WATSON, Esq., M. D.,
Secretary of American Public Health Association:

MY DEAR DOCTOR: It is with very great regret that I am compelled to deny myself the privilege and pleasure of meeting at Memphis my old friends and associates in the American Public Health Association. For the first time in eleven years I shall fail to respond to your roll-call, and this only from circumstances wholly beyond my control. Permit me, therefore, to greet yourself and colleagues at this distance, and to beg you not to attribute to me any waning interest in the body which so recently conferred upon me its highest honors, and with whose fortunes I hope to be identified all the remainder of my life.

The future of this Association is assured. The conservation of the public health, through "the advancement of sanitary science and the promotion of organizations and measures for the practical application of public hygiene," is so commendable a purpose that an association which exists for this sole object must live and prosper with even less zealous workers than the earnest, enthusiastic men who constitute its membership, and who, year after year, with unselfish aim, come together to devise better methods for banishing disease. The number of health organizations that have multiplied under its influence, the printed record of its contributions to sanitary science, and the unfaltering attachment of its members, are evidences of its satisfactory administration.

How much of the growing interest in preventive medicine among the members of the medical profession is due to its example and influence can hardly be approximated. To-day hygiene has its place in the faculty of medicine—no longer as adjunct, but as principal—and the most distinguished of American surgeons and the foremost of American physicians have left as dying messages to the new generation of medical men their testimony that the highest aim of our science and the triumphs of our art are to be sought in the department of preventive medicine, whose truths are being echoed in every medical society and set forth in every medical journal. Only a few days ago a professor of the principles and practice of medicine, in his introductory address before one of the great schools of this country, Da Costa of Philadelphia, impressed upon the men about to study medicine the importance of sanitary precision, and the task upon which every member of the profession must enter with the aggressiveness of decided conviction of making people generally understand this; and he quoted freely in illustration from the pages of the Transactions of this Association.

Crowning triumph of all, the International Medical Congress at Washington, with its nearly three thousand members, has been followed in friendly rivalry by the International Congress of Hygiene at Vienna, with its more than three thousand members, among whom famous physicians and surgeons, like Virchow, Bronardel, Ludwig, Pettenkofer, and Spencer Wells, vied in discussing sanitary questions.

With such fruition already won, may the American Public Health Association find encouragement to persevere in its noble, philanthropic mission, and at Memphis, as at former places, adhere to its resolve to make its meetings not festive occasions, but seasons of good work.

With assurances of personal esteem, I have the honor to be

Faithfully yours,
ALBERT L. GIHON.

REPORT OF THE COMMITTEE ON NECROLOGY.

OSCAR FITZALLEN FASSETT, M. D., was born at Enosburg Falls, Vt., Feb. 28, 1827, and died at St. Albans, Vt., July 22, 1887. He was educated at the public schools and at Bakersfield academy, Vt. He received his medical degree at the Medical School of Woodstock, Vt., in 1851. He commenced practice at Swanton, Vt., but soon after removed to East Berkshire, Vt., where he remained twelve years. He then removed to St. Albans, where he resided twenty-two years, till his death. He was a member of this Association, the American Medical Association, the Vermont Medical Society, and the district medical societies of northern Vermont.

One of his professional colleagues writes,—

"Dr. Fassett was preëminently a gentleman, with scholarly tastes and a well balanced, logical mind. He had travelled much, and although ready enough to appreciate the good things in foreign countries, he returned with no diminution of affection for his own state and her republican institutions. He seemed above the petty jealousies which so sadly deform many of the brightest minds in our profession. He rarely, if ever, spoke of a brother practitioner in terms of disparagement, and doubtless it was largely owing to his influence that the medical profession in St. Albans has stood so high for many years, and remained free from the dissensions which in many other towns have greatly impaired its credit.

"Dr. Fassett was an excellent practitioner. His diagnoses and plans for treatment were well thought out, and were the logical results of careful examination of his cases and close reasoning from all available data.

"In consultations and society meetings no physician in the state equalled him in the clearness with which he stated his opinions, and the train of reasoning by which he arrived at his conclusions.

"To his intimate professional friends it was a source of regret that he did not turn his attention to teaching in some department of medicine, and that his characteristic modesty caused him to decline a professorship in the Burlington Medical College, which was twice offered him. If he had accepted the appointment, his practical experience, pleasing address, elegant diction, and clear way of conveying his ideas would undoubtedly soon have raised him to a high rank as a lecturer."

Dr. Joseph Gibbons Richardson, Professor of Hygiene in the Medical Department of the University of Pennsylvania, and member of the Board of Health of Philadelphia, died of apoplexy at his residence in that city, November 13, 1886, in the fifty-first year of his age. A native of Philadelphia and a member of the Society of Friends, he pursued his studies at the University of Pennsylvania, from which he received his medical degree in 1862. Subsequently he was resident physician in the Pennsylvania hospital and the Wills hospital, and resided for five years at Union Springs, Cayuga county, New York, returning to Philadelphia as his place of permanent abode in 1868. He was the author of a work on Medical Microscopy, and a frequent contributor to medical journals. He was secretary of the Biological and Microscopical Section of the Academy of the Natural Sciences, a Fellow of the College of Physicians, a member of the Philadelphia County Medical Society and of the American Medical Association, and a corresponding member of the Société Française d'Hygiène. For several years he was microscopist to the Pennsylvania hospital, and visiting physician to the Presbyterian hospital in New York.

Dr. John P. Gray was born in Half Moon, Centre county, Penn., August 6, 1825, and was educated in the common schools, at Bellefonte academy, and at Dickinson college, and in medicine at the University of Pennsylvania. Receiving the degree of A. M. from Dickinson college in 1846 and of M. D. from the University of Pennsylvania in 1848, he was in the latter year appointed one of the resident physicians of the Pennsylvania hospital. He was invited to the New York State Lunatic Asylum, in Utica, in 1851, to become third assistant physician. So marked were his qualities and so valuable his services that his promotion was very rapid, for he was appointed second assistant physician in 1852, and first assistant and acting superintendent in 1853, when only twenty-eight years of age. In that year, also, he was appointed medical superintendent of the Michigan State Lunatic Asylum, and designed the plans for the asylum at Kalamazoo. The managers of the institution at Utica had learned his merits and efficiency, and in 1854 he gave up his position in Michigan and chose the scene of his life-work, beginning his notable career as medical superintendent of the Utica asylum. His labors as editor-in-chief of the *American Journal of Insanity* began in the same year. Dr. Gray was shot in the upper jaw, March 16, 1882, by an insane patient, and died from the wound, November 29, 1886, at the asylum in Utica.

Nicholas Jones, Esq., was born in Merthyr Iydfil, South Wales, June 3, 1822, and died at Pittsburgh, Penn., May 17, 1887. Mr. Jones was interested in sanitary progress, and for four and a half years prior to his death was a member of the Pittsburgh Board of Health. He was a member of the Episcopal church, a Mason, and an Odd Fellow. Mr. Jones was engaged in the real estate business at the time of his death. He was a man of great force of character, genial in disposition, and wielded considerable influence in religious, social, and political circles.

George Engs, M. D., was born at Newport, R. I., Feb. 24, 1840, and died at the same place July 7, 1887. He graduated at Yale college in 1860. The same year he commenced the study of medicine with Dr. David King, of Newport, and attended medical lectures at the College of Physicians and Surgeons, New York, receiving his medical degree in 1863. He located in his native town, and remained there till his death. He was in Europe in 1866 and 1867, and again for six months in 1882. He was one of the attending physicians to the Newport hospital. Dr. Engs became a member of the American Public Health Association in 1876. He was unmarried.

Valentine H. Taliaferro, M. D., of Atlanta, Ga., was born at Oglethorpe, Ga., Sept. 24, 1831, and died at Tate Springs, Tenn., Sept. 17, 1887, where he had gone for his health. He received his degree of M. D. at the University of New York in 1852. The same year he commenced the practice of medicine in Coweta county, Ga. He removed to Atlanta before the war. After the war he located at Columbus, but after five years he returned to Atlanta, where he resided till his death. He was a member of the Georgia Medical Society, the American Medical Association, the Atlanta Society of Medicine, the American Public Health Association, and other societies. For several years prior to his death he was secretary of the State Board of Health of Georgia. He was Professor of Obstetrics and Diseases of Women and Children in the Atlanta Medical College, and at one time Professor of Materia Medica in the Georgia Medical College at Savannah. In 1852 he married Mary A. Jones. They had four children. He entered the Confederate army when a young man as a surgeon, but soon went into the ranks, and for a while abandoned his profession. He was promoted for bravery, and was finally commissioned as colonel. He was a member of the Episcopal church. As a surgeon he stood high in the profession. He also devoted much time and interest to sanitary work. His life abounded in good works and deeds, and he was kind and charitable to the poor.

Charles Shaler Smith, C. E., was born at Pittsburgh, Penn., Jan. 18, 1836, and died at St. Louis, Mo., Dec. 19, 1886. He was a son of Frederick R. Smith, and grandson of Judge Charles Shaler, of Pittsburgh, Penn. He received his education at the University of Pennsylvania. He married, May 23, 1865, Mary Gordon Gairdner, by whom he had six children. He was a member of the American Society of Civil Engineers and of the St. Louis Academy of Science. He became a member of the American Public Health Association in 1884.

William Stephenson Robertson, M. D., died at his home, Muscatine, Iowa, Jan. 20, 1887, in the fifty-sixth year of his age. He was born in Georgetown, Penn., but at the age of seven years moved with his parents to the then territory of Iowa, making his home at Burlington; thence, when he was thirteen years old, moving to Columbus City, at which place, and subsequently at Knox college, Illinois, he received his academic education. He received his medical degree from Jefferson Medical College, Philadelphia, March 8, 1856. Soon after receiving his degree, he located at Columbus City, his old home, and there entered upon his brilliant professional and public career. Here he remained for twelve years in the enjoyment of a large and remunerative practice. On the outbreak of the Rebellion he recruited the first company raised in the state, and tendered it to the governor, though from some cause the company was not accepted until a later date. He was mustered into the United States service as major of the Fifth Iowa Volunteer Infantry on June 13, 1861, and served his country with distinguished bravery. Upon the death of Col. Worthington, Major Robertson was elected colonel of the regiment. At this juncture he resigned his commission as major, was called home on very important business, did not return to the service, and resumed his practice at Columbus Junction. He spent the winter of 1868–'69 in the hospitals of New York city, under the special direction of the late Prof. Frank H. Hamilton. On his return from New York he sold his property in Columbus City, and removed to Muscatine in the spring of 1869, where he remained in uninterrupted practice until the time of his fatal illness. For years he labored for the establishment of a state board of health, and when, by the efforts of himself and others, this board was created by the legislature, he became its first, and up to the time of his death its only, president. He labored with tireless energy for the advancement of sanitary reform.

EDWARD WILHELM GERMER, M. D., was born at Alt Breisach, Baden, Germany, May 27, 1831, and died at Erie, Penn., Aug. 22, 1887. When the famous German rebellion of 1847 broke out, he was scarcely eighteen years of age, yet he shouldered a gun, and went into the field to lend aid in the effort of the populace to overthrow the government. In a decisive engagement he received a sabre cut on the back of the neck, which healed badly, and left a scar which he carried to the time of his death. Almost immediately after the close of the war Mr. Germer was sent to the Gymnasium at Freiberg, where he remained until 1854. After finishing his Gymnasium studies in that year, he was sent to Vienna, where he entered the Vienna Medical University, graduating with high honors in 1859. Upon advice of his relatives and friends in America he then moved to Erie, Penn., where he remained till his death. He was deeply interested in everything that tended to better the physical and moral condition of humanity. For seventeen years he was health officer of Erie, which position he held at the time of his death. He was also president of the State Board of Health of Pennsylvania. When a medical student, his attention was called to the science of hygiene, then little understood, and he attended the earliest lectures given in Europe upon that subject. He became himself a sanitarian of note, and some of his papers on sanitary subjects show how thoroughly he understood his work and with what earnestness he applied himself. The members of this Association who knew him will never forget his vigorous speeches, his imperfectly accented English, his abruptness of manner, his remarkable expression of countenance, and, above all, his spontaneous good nature.

JOSEPH CHRISMAN HUTCHINSON, M. D., LL.D., was born at Old Franklin, Mo., Feb. 22, 1827, and died at Brooklyn, N. Y., July 17, 1887. He was educated in the University of Missouri, after which he studied medicine, receiving his medical degree at the University of Pennsylvania in 1848. He commenced the practice of medicine at Arrow Rock, Mo. In 1853 he removed to Brooklyn, where he resided till his death. Dr. Hutchinson was a member of several societies and associations, among which may be mentioned the New York State Medical Association, King's County Medical Association, New York Pathological Society, New York Academy of Medicine, New York Surgical Society, American Medical Association, British Medical Association, and the American Public Health Association. He was president of the Board of Health of Brooklyn from 1873 to 1875. He was lecturer on diseases of women in the University of New York, and was professor of surgery in L. I. Medical College from 1860 to 1867. In 1849 he married Susan H. Benedict, by whom he had six children. Dr. Hutchinson was distinguished for his rare professional skill, an eminence to which he attained by his own hard and constant application to the duties and labors of his chosen profession.

Rev. JOHN DAVIS BEUGLESS was born at Middletown, Penn., Oct. 18, 1836, and died at Magasaki, Japan, July 31, 1887. He was educated at the high school of Philadelphia, and graduated at the Theological college at Louisburg. He served as chaplain during the war, and was afterward transferred to the regular army. At the breaking out of the Rebellion he was instrumental in raising a regiment of Rhode Island volunteers. He participated as its chaplain in several leading engagements, and at the battle of the Wilderness, where the regiment was decimated, seized the colors from the color-bearer, who had fallen, and mounting a horse rallied the survivors of the regiment. He was severely wounded in the right arm, and soon after was tendered by the governor of Rhode Island the colonelcy, which he declined. He remained in the service till after the battle of Cold Harbor, when at his own request he was transferred to the navy. After the close of the war he served on the Brazil, the North Atlantic, the European, and the Asiatic stations. In 1862 he married Kate Griffith, of Philadelphia, by whom he had five children, all living. In 1884 he became a member of the American Public Health Association, and was an earnest worker in the interest of sanitation. He strongly advocated the claims of cremation, and otherwise took an active part in the meetings of the Association.

ANNUAL REPORT OF DR. J. BERRIEN LINDSLEY,

Nashville, Tennessee, Treasurer of the American Public Health Association, November 8, 1887.

RECEIPTS.

Balance brought forward,	$1,121.34	
From sale of *Public Health*,	184.32	
From annual fees of members,	1,630.00	
From Henry Lomb, Esq., reimbursing all expenses in printing and publishing the Lomb Prize Essays,	303.18	
		$3,238.84

DISBURSEMENTS.

Printing, binding, and distributing Vol. XII of *Public Health*,	$1,345.11	
Secretary's postage and help,	309.00	
Treasurer's postage and help,	64.54	
Secretary's travelling expenses,	93.39	
Treasurer's travelling expenses,	112.20	
To Committee on Disinfectants,	384.25	
		2,308.49
Balance to new account,		$930.35

The above expenditures were ordered by the Executive Committee, and vouchers are herewith submitted.

J. Berrien Lindsley, *Treasurer.*

Memphis, Tenn., Nov. 8, 1887.

To the President of the American Public Health Association:—

Sir: The undersigned, an auditing committee appointed to audit the Treasurer's account for the year ending November 8, 1887, respectfully report that they have examined the vouchers and find the same correct.

Very respectfully,

H. A. Johnson, *Chairman.*
Joseph Holt, M. D.
Walter Wyman.

CONSTITUTION

OF THE

AMERICAN PUBLIC HEALTH ASSOCIATION.

TITLE.

I. This Association shall be called "THE AMERICAN PUBLIC HEALTH ASSOCIATION."

OBJECTS.

II. The objects of this Association shall be the advancement of sanitary science and the promotion of organizations and measures for the practical application of public hygiene.

MEMBERS.

III. The members of this Association shall be known as Active and Associate. The Executive Committee shall determine for which class a candidate shall be proposed. The *Active* members shall constitute the permanent body of the Association, subject to the provisions of the constitution as to continuance in membership. They shall be selected with special reference to their acknowledged interest in or devotion to sanitary studies and allied sciences, and to the practical application of the same. The *Associate* members shall be elected with special reference to their general interest only in sanitary science, and shall have all the privileges and publications of the Association, but shall not be entitled to vote.

Delegates from national, state, provincial, and municipal boards of health, organized sanitary associations, and the army, navy, and marine hospital service, shall be entitled to be enrolled as active members upon presentation of their credentials to the Executive Committee. Members, not delegates from such bodies shall be elected as follows:—

Each candidate for admission shall first be proposed to the Executive Committee, in writing (which may be done at any time), with a statement of the business or profession and special qualifications of the person so proposed. On recommendation of a majority of the committee, and on receiving a vote of two thirds of the members present at a regular meeting, the candidate shall be declared duly elected a member of the Association. The annual fee of membership in either class shall be five dollars.

OFFICERS.

IV. The officers shall be a President, a First and Second Vice-President, a Secretary, and a Treasurer.

All the officers shall be elected by ballot, annually, except the Secretary, who shall be elected for a term of three years.

PRESIDING OFFICER.

V. The President, or in his absence, one of the Vice-Presidents, or in their absence, a Chairman *pro tempore*, shall preside at all meetings of the Association. He shall preserve order, and shall decide all questions of order, subject to appeal to the Association. He shall also appoint all committees authorized by the Association, unless otherwise specially ordered.

SECRETARY.

VI. The Secretary shall have charge of the correspondence and records of the Association; and he shall also perform the duties of Librarian. He, together with the presiding officer, shall certify all acts of the Association. He shall, under the direction of the Executive Committee, give due notice of the time and place of all meetings of the Association, and attend the same. He shall keep fair and accurate records of all the proceedings and orders of the Association; and shall give notice to the several officers, and to the Executive and other Committees, of all votes, orders, resolves, and proceedings of the Association, affecting them or appertaining to their respective duties.

TREASURER.

VII. The Treasurer shall collect and take charge of the funds and securities of the Association. Out of these funds he shall pay such sums only as may be ordered by the Association, or by the Executive Committee. He shall keep a true account of his receipts and payments; and, at each annual meeting, render the same to the Association, when a committee shall be appointed to audit his accounts. If from the annual report of the Treasurer there shall appear to be a balance against the treasury, no appropriation of money shall be made for any object but the necessary current expenses of the Association, until such balance shall be paid.

STANDING COMMITTEES.

VIII. There shall be the following standing committees: (1) The Executive Committee, (2) the Advisory Council, (3) the Committee on Publication.

EXECUTIVE COMMITTEE.

IX. The Executive Committee shall consist (1) of the President, First Vice-President, Second Vice-President, Secretary, and Treasurer; (2) of six active members, of whom three shall be elected annually by ballot, to serve two years, and who shall be ineligible to reëlection for a second successive term; and (3) of the ex-Presidents of the Association.

It shall be the duty of the Executive Committee to consider and recommend plans for promoting the objects of the Association; to authorize the disbursement and expenditure of unappropriated moneys in the treasury for the payment of current expenses; to consider all applications for membership, and, at the regular meetings, report the names of such candidates as a majority shall approve; and, generally, to superintend the interests of the Association, and execute all such duties as may, from time to time, be committed to them by the Association. At least one month preceding the annual meeting of the Association, the Executive Committee shall cause to be issued to members a notice of such meeting, and they are authorized to publish the same in medical, scientific, and other periodicals, but without expense to the Association; and such notice shall contain the order of business to be followed at said meeting, and, briefly, the subjects to be presented, and the special points of discussion.

ADVISORY COUNCIL.

X. The Advisory Council shall consist of one member from each State, Territory, and District, the Army, Navy, and Marine Hospital Service, the Dominion of Canada, and each of the Provinces, who shall be appointed by the President on the last day of each session, and who, besides acting as a nominating committee of officers for the ensuing year, to be announced at such time as the Executive Committee may appoint, shall consider such questions and make such recommendations to the Association as shall best secure the objects of the Association. They shall at their first meeting elect from their own number a Secretary, whose record of their proceedings shall be made part of the records of the Association.

COMMITTEE ON PUBLICATION.

XI. The Committee on Publication shall consist of the Secretary and two active members, selected by the Executive Committee, who shall contract for, arrange, and publish, under authority of the Executive Committee, the proceedings of the Association, including such papers as have been examined and approved by the Executive Committee, or which have been submitted to them by the latter for their discretionary action.

REPORTS AND PAPERS.

XII. All committees, and all members preparing scientific reports or papers to be laid before the Association at its annual meetings, must give, in writing, the title of such reports or papers, the time to be occupied in reading them, and an abstract of their contents, to the Executive Committee, at least one week preceding the date of such meeting, to secure their announcement in the order of business.

MEETINGS.

XIII. The time and place of each annual meeting shall be fixed at the preceding annual meeting, but may be changed by the Executive Committee for reasons that shall be specified in the announcement of the meeting. Special meetings may be called, at any time or place, by concurrence of two thirds of the Executive Committee. There shall be no election of officers, or change of By-laws, or appropriation of money to exceed the amount at that time in the treasury, at such special meeting, except by a vote of a majority of all the members of the Association. Whenever a special meeting is to be held, at least one month's notice shall, if possible, be given by circular, to all the members, together with the order of business.

QUORUM.

XIV. At the annual meeting nine members shall constitute a quorum for the election of officers, a change of the Constitution, the election of members, and the appropriation of moneys.

ORDER OF BUSINESS.

XV. The order of business at all meetings of the Association shall be fixed by the Executive Committee, and such order must be completed before any other business is introduced, except such order of business is suspended by a vote of four fifths present.

ALTERATION OF CONSTITUTION.

XVI. No alteration in the Constitution of the Association shall be made except at an annual meeting, nor unless such alteration shall have been proposed at a previous meeting, and entered on the minutes with the name of the member proposing the same, and shall be adopted by a vote of two thirds of the members present.

BY-LAWS OF THE EXECUTIVE COMMITTEE.

QUORUM.

1. Five members shall constitute a quorum for the transaction of such business as may come before the committee.

MEMBERS RESTRICTED.

2. No elective member of the Executive Committee shall be at the same time a member of the Advisory Council, if there is another member of the Association from his state or service.

PARLIAMENTARY USAGE.

3. Cushing's Law and Practice of Legislative Assemblies shall be the guide of parliamentary practice until otherwise ordered.

PAPERS.

4. All papers presented to the Association must be either printed, typewritten, or in plain handwriting, and be in the hands of the Secretary at least twenty days prior to the annual meeting, to insure their critical examination as to their fulfilling the requirements of the Association.

5. If any paper is too late for critical examination, said paper may be so far passed upon by the Executive Committee as to allow its reading, but such paper shall be subject to publication or non-publication, as the Executive Committee deem expedient.

6. All papers accepted by the Association, whether read in full, by abstract, by title, or filed, shall be delivered to the Secretary as soon as thus disposed of, as the exclusive property of the Association. Any paper presented to this Association and accepted by it shall be refused publication in the transactions of the Association if it be published, in whole or in part, by permission or assent of its author, in any manner prior to the publication of the volume of transactions, unless written consent is obtained from the Publication Committee.

7. Day papers shall be limited to twenty minutes, and evening papers to thirty minutes, each.

DISCUSSION OF PAPERS.

8. After the leading papers on each subject, as indicated by the Executive Committee, have been read, discussion shall follow, and be confined strictly to the subject of these papers; and each speaker shall be limited

to ten minutes, and shall not speak a second time until after every other member who desires to be heard, and then only for five minutes, except by unanimous consent.

9. The Chair shall notify gentlemen who desire to speak to send up their names, and they shall be called on in the order sent up, and he may, at his discretion, limit the time of speaking to five instead of ten minutes, if in his judgment it may become necessary to do so in order to allow each one on the list an opportunity to be heard.

PUBLICATION COMMITTEE.

10. The Committee on Publication, charged with the duties of selecting and printing the papers and transactions of the Association, shall consist of three active members of the Association, and of whom one shall be the Secretary, appointed by the Executive Committee during the session of the Association, and selected with reference to their facilities of meeting.

11. All papers read by title, and others not definitely passed upon by the Executive Committee, shall be referred to the Publication Committee for critical examination; and said committee is authorized to reject such papers as in its judgment are not worthy of publication, and to omit such others as cannot be included within the limits of the annual volume.

12. The Publication Committee shall procure a copyright on the transactions in the name of the Association, and the committee shall have full charge of the publication of the transactions.

APPLICATION FOR MEMBERSHIP.

13. All applications for membership must be made upon the application blank of the Association.

14. Persons not members, having prepared papers to be presented at the meetings of the Association, shall be proposed for membership at the first business session of the Association.

EXPENDITURES.

15. All bills connected with the publication of the transactions shall, upon the approval of the chairman of the Publication Committee and the Secretary, be signed by the President of the Association, and paid by check of the Treasurer directly to the party concerned; and the President shall not approve any bill relating either to publishing or printing without the approval first of the chairman of the committee in charge thereof.

16. Bills for current expenses shall be first approved by the Secretary, then sent to the President, and on his approval they shall be paid by check of Treasurer directly to the parties interested.

17. The actual and necessary travelling expenses of the Secretary and Treasurer to the annual meeting of the Association, and to one meeting of the Executive Committee, shall be classed as current expenses.

RESOLUTIONS.

18. All resolutions presented to the Association shall be sent to the Chair in writing, and referred to a committee without discussion.

ARREARAGES.

19. The arrearages of all members remitting their dues for two years shall be cancelled up to the date of the last payment, but they shall be entitled to the transactions of the Association only for the years for which they have actually paid.

AUDITING COMMITTEE.

20. An Auditing Committee shall be appointed by the Chair to audit the accounts of the Treasurer, and report upon the same.

OFFICERS AND COMMITTEES

OF THE

AMERICAN PUBLIC HEALTH ASSOCIATION.

ORGANIZATION, 1887–1888.

President, . . .	Dr. CHARLES N. HEWITT, *Red Wing, Minn.*
First Vice-President,	Dr. G. B. THORNTON, *Memphis, Tenn.*
Second Vice-President,	Dr. JOSEPH HOLT, *New Orleans, La.*
Secretary, . . .	Dr. IRVING A. WATSON, *Concord, N. H.*
Treasurer, . .	Dr. J. BERRIEN LINDSLEY, *Nashville, Tenn.*

(*Ex-officio* Members Executive Committee.)

STANDING COMMITTEES.

EXECUTIVE COMMITTEE.

(Elective.)

Prof. GEORGE H. ROHÉ	*Baltimore, Md.*
Hon. D. P. HADDEN	*Memphis, Tenn.*
Dr. FREDERICK MONTIZAMBERT	*Quebec, Canada.*
Dr. HENRY B. BAKER	*Lansing, Mich.*
Dr. S. H. DURGIN	*Boston, Mass.*
Dr. J. N. McCORMACK	*Bowling Green, Ky.*

(The ex-Presidents, *ex-officio* members Executive Committee.)

Dr. STEPHEN SMITH	*New York city.*
Dr. JOSEPH M. TONER	*Washington, D. C.*
Dr. EDWIN M. SNOW	*Providence, R. I.*
Dr. JOHN H. RAUCH	*Springfield, Ill.*
Prof. JAMES L. CABELL	*University of Virginia, Va.*
Dr. JOHN S. BILLINGS	*U. S. Army.*
Prof. ROBERT C. KEDZIE	*Lansing, Mich.*
Dr. EZRA M. HUNT	*Trenton, N. J.*
Dr. ALBERT L. GIHON	*U. S. Navy.*
Dr. JAMES E. REEVES	*Chattanooga, Tenn.*
Dr. HENRY P. WALCOTT	*Cambridge, Mass.*
Dr. GEORGE M. STERNBERG	*U. S. Army.*

ADVISORY COUNCIL.

Alabama, . . .	Dr. JOHN C. DOZIER, *Birmingham.*
Arkansas, . . .	Dr. H. C. DUNAVANT, *Osceola.*
California, . .	Dr. H. S. ORME, *Los Angeles.*
Colorado, . . .	Dr. CHARLES AMBROOK, *Boulder.*
Connecticut, . .	Dr. R. S. GOODWIN, *Thomaston.*
Delaware, . . .	Dr. L. P. BUSH, *Wilmington.*
Florida, . . .	Dr. ROBERT B. S. HARGIS, *Pensacola.*
Georgia, . . .	Dr. L. A. FALLIGANT, *Savannah.*

Illinois,	Dr. Oscar C. DeWolf, *Chicago.*
Indiana,	Dr. John N. Taylor, *Crawfordville.*
Iowa,	Dr. J. F. Kennedy, *Des Moines.*
Kansas,	Dr. D. C. Jones, *Topeka.*
Kentucky,	Dr. William Bailey, *Louisville.*
Louisiana,	Dr. L. F. Salomon, *New Orleans.*
Maine,	Dr. Frederic H. Gerrish, *Portland.*
Maryland,	Dr. William T. Councilman, *Baltimore.*
Massachusetts,	Dr. Albert R. Rice, *Springfield.*
Michigan,	Dr. Samuel P. Duffield, *Detroit.*
Minnesota,	Dr. Samuel S. Kilvington, *Minneapolis.*
Mississippi,	Dr. John A. Mead, *Pearlington.*
Missouri,	Mr. Robert Moore, C. E., *St. Louis.*
New Hampshire,	Dr. G. P. Conn, *Concord.*
New Jersey,	Dr. William K. Newton, *Paterson.*
New York,	Dr. William C. Otterson, *Brooklyn.*
North Carolina,	Dr. Thomas F. Wood, *Wilmington.*
Ohio,	Dr. C. O. Probst, *Columbus.*
Pennsylvania,	Dr. Benjamin Lee, *Philadelphia.*
Rhode Island,	Col. George E. Waring, C. E., *Newport.*
South Carolina,	Dr. Henry B. Horlbeck, *Charleston.*
Tennessee,	Dr. W. C. Cook, *Nashville.*
Texas,	Dr. R. Rutherford, *Houston.*
Vermont,	Dr. A. P. Grinnell, *Burlington.*
Virginia,	Dr. J. G. Cabell, *Richmond.*
West Virginia,	Dr. C. T. Richardson, *Charleston.*
Wisconsin,	Dr. Robert Martin, *Milwaukee.*
Dist. of Columbia,	D. E. Salmon, D. V. M., *Washington.*
U. S. Army,	Dr. Joseph R. Smith, *New York city.*
U. S. Navy,	Medical Director Albert L. Gihon, *Mare Island, Cal.*
U. S. M. H. Service,	Dr. Walter Wyman, *Baltimore, Md.*
Dominion of Canada,	Dr. Charles W. Covernton, *Toronto.*
Province of Ontario,	Dr. Phillips P. Burrows, *Lindsay.*
Province of Quebec,	Dr. E. P. Lachapelle, *Montreal.*
Manitoba,	Dr. Wm. R. D. Sutherland, *Winnipeg.*
New Brunswick,	Dr. Wm. S. Harding, *St. John.*

PUBLICATION COMMITTEE.

The Secretary, *ex-officio.*

Dr. Alfred F. Holt . . . . *Cambridge, Mass.*
Dr. Granville P. Conn . . . . *Concord, N. H.*

SPECIAL COMMITTEES.

ON STATE BOARDS OF HEALTH.

Dr. Ezra M. Hunt, Secretary State Board of Health of New Jersey.
Dr. Frederic H. Gerrish, President State Board of Health of Maine.
Dr. Joseph Holt, President State Board of Health of Louisiana.
Dr. Granville P. Conn, President State Board of Health of New Hampshire.
Dr. John H. Rauch, Secretary State Board of Health of Illinois.
Dr. J. N. McCormack, Secretary State Board of Health of Kentucky.

Dr. J. W. Redden, Secretary State Board of Health of Kansas.
Dr. Henry B. Baker, Secretary State Board of Health of Michigan.
Dr. Benjamin Lee, Secretary State Board of Health of Pennsylvania.
Dr. Peter H. Bryce, Secretary Provincial Board of Health of Ontario.

ON THE POLLUTION OF WATER-SUPPLY.

Maj. Charles Smart, U. S. A.	Washington, D. C.
Dr. S. W. Abbott	Wakefield, Mass.
Dr. G. C. Ashmun	Cleveland, Ohio.
Prof. W. W. Daniells	Madison, Wis.
Dr. Edward Playter	Ottawa, Canada.

ON THE DISPOSAL OF GARBAGE.

Dr. James E. Reeves	Chattanooga, Tenn.
Dr. Louis Laberge	Montreal, P. Q.
Prof. William H. Brewer	New Haven, Conn.
Crosby Gray, Esq.	Pittsburgh, Pa.
Dr. J. F. Kennedy	Des Moines, Iowa.
Dr. Robert Martin	Milwaukee, Wis.

Note. The chairman is authorized to appoint an additional member from each state, province, etc.

ON ANIMAL DISEASES AND ANIMAL FOOD.

D. E. Salmon, D. V. M.	Washington, D. C.
Dr. Peter H. Bryce	Toronto, Ont.
Dr. Ezra M. Hunt	Trenton, N. J.
Prof. James Law	Ithaca, N. Y.
Dr. Charles W. Chancellor	Baltimore, Md.
Dr. John H. Rauch	Springfield, Ill.
Dr. D. W. Hand	St. Paul, Minn.
Lt. Col. Joseph R. Smith, U. S. A.	New York city.
Dr. Azel Ames, Jr.	Chicago, Ill.

ON FORMS OF STATISTICS.

Dr. John S. Billings, U. S. A.	Washington, D. C.
Dr. Henry P. Walcott	Cambridge, Mass.
Dr. Ezra M. Hunt	Trenton, N. J.

ON INCORPORATION.

Dr. Charles N. Hewitt, *President*	Red Wing, Minn.
Dr. Irving A. Watson, *Secretary*	Concord, N. H.
Dr. J. Berrien Lindsley, *Treasurer*	Nashville, Tenn.
Dr. P. H. Bailhache, U. S. M. H. S.	Washington, D. C.
Dr. J. H. Baxter, U. S. A.	Washington, D. C.
Surgeon-General John M. Browne, U. S. N.	Washington, D. C.
Dr. Smith Townshend	Washington, D. C.
Samuel A. Robinson, Esq.	Washington, D. C.

ON PROTECTIVE INOCULATIONS IN INFECTIOUS DISEASES.

Dr. George M. Sternberg, U. S. A.	Washington, D. C.
Dr. Hosmer A. Johnson	Chicago, Ill.
Dr. Henry P. Walcott	Cambridge, Mass.
Prof. William H. Brewer,	New Haven, Conn.
Prof. Joseph H. Raymond	Brooklyn, N. Y.

LOMB PRIZE ESSAYS.

Dr. Charles A. Lindsley	New Haven, Conn.
Dr. George H. Rohé	Baltimore, Md.
Dr. Victor C. Vaughan	Ann Arbor, Mich.
Mrs. B. H. Richards	Boston, Mass.
Miss Emma C. G. Polson	New Haven, Conn.

ON RESOLUTIONS IN RELATION TO COMMISSIONER OF HEALTH.

Dr. Henry P. Walcott	Cambridge, Mass.
Col. J. M. Keating	Memphis, Tenn.
Dr. J. N. McCormack	Bowling Green, Ky.
Dr. J. Berrien Lindsley	Nashville, Tenn.
Surgeon-General John M. Browne, U. S. N.	Washington, D. C.

ON SANITARY AND MEDICAL SERVICE ON EMIGRANT SHIPS.

Dr. A. N. Bell	New York city.
Dr. S. P. Duffield	Detroit, Mich.
Dr. A. R. Rice	Springfield, Mass.

LIST OF PERSONS ELECTED TO MEMBERSHIP AT THE FIFTEENTH ANNUAL MEETING OF THE ASSOCIATION, HELD AT MEMPHIS, TENN., NOV. 8–11, 1887.

ACTIVE.

Dr. CHARLES HENRY ALDEN, Surgeon U. S. Army . . . . West Point, N. Y.
Dr. AUSTIN WHITE ALVORD, 67 West Main St. . . . . . Battle Creek, Mich.
Dr. A. A. AMES, Mayor of Minneapolis . . . . Minneapolis, Minn.
Dr. SAMUEL W. BATTLE, Passed Asst. Surgeon U. S. Navy . . Asheville, N. C.
Dr. FREDERICK J. BANCROFT, University of Denver . . . . . . Denver, Col.
Dr. D. C. E. BEARDSLEY, Member Ohio State Sanitary Association . . . . Ottawa, Ohio.
Dr. FRANK EDWIN BECKWITH, 139 Church St. . . . . . New Haven, Conn.
Dr. MICHAEL BESHOAR, ... Trinidad, Col.
Dr. JOHN E. BLACK, Surgeon-in-Chief City Hospital . . . . Memphis, Tenn.
Dr. A. H. BRUNDAGE, Member Ohio State Sanitary Association . . . . Xenia, Ohio.
Dr. AUGUSTUS PECK CLARKE, ... Cambridge, Mass.
Dr. EDMUND FRANCIS XAVIER CLEVELAND, Rector St. James Parish . . . . Dundee, Ill.
Dr. E. A. COBLEIGH, Secretary Board of Health, 729 Chestnut St. . . . . Chattanooga, Tenn.
EDWARD WILLIAM COLE, Member Tennessee State Board of Health . . . . Nashville, Tenn.
Dr. JOHN HENRY COLLENDER, Superintendent Central Hospital for the Insane . . . . Nashville, Tenn.
GEORGE W. COOLEY, C. E., Member Board of Health, 3026 Lyndale Ave. . . . . Minneapolis, Minn.
Dr. WM. ALFRED HENDERSON COOP . . . . Friendship, Tenn.
Dr. WILLIAM THOMAS COUNCILMAN, Associate in Pathology Johns Hopkins University . . . . Baltimore, Md.
T. G. DABNEY, C. E., 41 Madison St. . . . . Memphis, Tenn.
Dr. J. A DAVIES . . . . Alpika, Miss.
Dr. ROBERT CHALMERS DAVIS, Chairman Board of Health . . . Seneca, S. C.
Dr. FREDERICK F. DICKERMAN, Member Board of Pension Examiners, 322 National Ave. . . . . Fort Scott, Kansas.
Dr. GEORGE TILTON DOOLITTLE, 219 Orange St. . . . . . New Haven, Conn.
Dr. JOHN CALHOUN DOZIER, Health Officer Jefferson Co., 313 23d St. . . . . Birmingham, Ala.
Dr. FRANK WINTHROP DRAPER, Member State Board of Health of Massachusetts, Professor of Legal Medicine Harvard University, 304 Marlborough St. . . . . Boston, Mass.
Dr. THOMAS MESSINGER DROWN, Chemist Massachusetts State Board of Health, Professor Analytical Chemistry Massachusetts Institute of Technology . . . . Boston, Mass.

Dr. SAMUEL P. DUFFIELD, A. M., Ph. D., Health Officer City of Detroit, No. 2 Market Building . . . . Detroit, Mich.
Dr. S. R DUNN, President Tri-State Medical Society . . . Greenville, Miss.
Dr. GUSTAVUS ELIOT, 27 Wall St. . . . . New Haven, Conn.
Dr. JOHN ELSNER, Professor Theory and Practice Gross Medical College, 1410 Curtis St. . . . . Denver, Col.
Dr. A. ENFIELD . . . . Bedford, Penn.
Dr. H. V. FERRELL, Member Illinois State Board of Health . . Carterville, Ill.
Dr. CHARLES JAMES FOX, Surgeon-General of the State, President Windham County Medical Association, 168 Main St.. . . . . Willimantic, Conn.
Dr. ANDREW L. FULTON, Editor Kansas City Medical Record, 812 Wyandotte St. . . . . Kansas City, Mo.
Dr. JOHN BAPTISTE COLUMBUS GAZZO . . . . Thibodeaux, La.
Dr. ASHBEL PARMELU GRINNELL, Professor of Theory and Practice Medical Department University of Vermont, 272 Main St. . . . . Burlington, Vt.
W. C. GRISWOLD, M. D., Druggist, 423 Main St. . . . . Memphis, Tenn.
Dr. PETER JACOB GUILLOT, Main St. . . . . Bushkill, Penn.
Dr. B. HATCHETT, Secretary Board of Health, Garrison Ave. Fort Smith, Ark.
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AMERICAN PUBLIC HEALTH ASSOCIATION,

1888.

This list includes those who have maintained their membership to the present time, excepting those elected at Memphis, which will be found in another place. The secretary should be notified of any errors or omissions.

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Dr. Richard A. Neale	Washington, D. C.	1885.
Dr. E. M. Nelson	St. Louis, Mo.	1884.
Dr. R. B. Nevitt	Toronto, Ont.	1886.
Dr. W. H. Newell	Jersey City, N. J.	1882.
Dr. William K. Newton	Paterson, N. J.	1883.
Dr. Edgar H. Nichols, U. S. M. H. S.	Savannah, Ga.	1882.
F. A. Nims, Esq.	Muskegon, Mich.	1883.
Dr. R. J. Nunn	Savannah, Ga.	1881.
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QUORUM.

1. Five members shall constitute a quorum for the transaction of such business as may come before the committee.

MEMBERS RESTRICTED.

2. No elective member of the Executive Committee shall be at the same time a member of the Advisory Council, if there is another member of the Association from his state or service.

PARLIAMENTARY USAGE.

3. Cushing's Law and Practice of Legislative Assemblies shall be the guide of parliamentary practice until otherwise ordered.

PAPERS.

4. All papers presented to the Association must be either printed, typewritten, or in plain handwriting, and be in the hands of the Secretary at least twenty days prior to the annual meeting, to insure their critical examination as to their fulfilling the requirements of the Association.

5. If any paper is too late for critical examination, said paper may be so far passed upon by the Executive Committee as to allow its reading, but such paper shall be subject to publication or non-publication, as the Executive Committee deem expedient.

6. All papers accepted by the Association, whether read in full, by abstract, by title, or filed, shall be delivered to the Secretary as soon as thus disposed of, as the exclusive property of the Association. Any paper presented to this Association and accepted by it shall be refused publication in the transactions of the Association if it be published, in whole or in part, by permission or assent of its author, in any manner prior to the publication of the volume of transactions, unless written consent is obtained from the Publication Committee.

7. Day papers shall be limited to twenty minutes, and evening papers to thirty minutes, each.

DISCUSSION OF PAPERS.

8. After the leading papers on each subject, as indicated by the Executive Committee, have been read, discussion shall follow, and be confined strictly to the subject of these papers; and each speaker shall be limited

to ten minutes, and shall not speak a second time until after every other member who desires to be heard, and then only for five minutes, except by unanimous consent.

9. The Chair shall notify gentlemen who desire to speak to send up their names, and they shall be called on in the order sent up, and he may, at his discretion, limit the time of speaking to five instead of ten minutes, if in his judgment it may become necessary to do so in order to allow each one on the list an opportunity to be heard.

PUBLICATION COMMITTEE.

10. The Committee on Publication, charged with the duties of selecting and printing the papers and transactions of the Association, shall consist of three active members of the Association, and of whom one shall be the Secretary, appointed by the Executive Committee during the session of the Association, and selected with reference to their facilities of meeting.

11. All papers read by title, and others not definitely passed upon by the Executive Committee, shall be referred to the Publication Committee for critical examination; and said committee is authorized to reject such papers as in its judgment are not worthy of publication, and to omit such others as cannot be included within the limits of the annual volume.

12. The Publication Committee shall procure a copyright on the transactions in the name of the Association, and the committee shall have full charge of the publication of the transactions.

APPLICATION FOR MEMBERSHIP.

13. All applications for membership must be made upon the application blank of the Association.

14. Persons not members, having prepared papers to be presented at the meetings of the Association, shall be proposed for membership at the first business session of the Association.

EXPENDITURES.

15. All bills connected with the publication of the transactions shall, upon the approval of the chairman of the Publication Committee and the Secretary, be signed by the President of the Association, and paid by check of the Treasurer directly to the party concerned; and the President shall not approve any bill relating either to publishing or printing without the approval first of the chairman of the committee in charge thereof.

16. Bills for current expenses shall be first approved by the Secretary, then sent to the President, and on his approval they shall be paid by check of Treasurer directly to the parties interested.

17. The actual and necessary travelling expenses of the Secretary and Treasurer to the annual meeting of the Association, and to one meeting of the Executive Committee, shall be classed as current expenses.

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