

show you where and when a boost is needed. Drugs at bargain prices do not inspire confidence.

After your inventory is completed, see to it that you are properly covered by an adequate amount of insurance. To sum it up, a pharmacist, to meet the competition of to-day, must study business conditions and methods just as carefully and thoroughly as the principles of his profession, and it pleases me to note that your University appreciates this condition, as is evidenced by the program of this course.

AERIAL OR GASEOUS DISINFECTION.*

BY SEWARD W. WILLIAMS, PH.C., F.C.S.†

The term aerial disinfection is employed to mean the use of the air as a vehicle for diffusing, to all exposed surfaces of the room and its contents, a gaseous germicide. The disinfection of the air itself, more or less loaded with germ-laden dust particles as it usually is, may be regarded as incidental, just as would be the case with water used in making a disinfectant solution. Air and water are the natural agencies for cleansing an infected apartment. Why should we not render the former germicidal as well as the latter? A room, subjected to gaseous disinfection and aired, should be a safer place for a scrub woman, paperhanger, or painter to work in than if not previously fumigated, and these workers¹ deserve consideration as well as future occupants.

The subject is timely because of the recent decision of the New York City Health Department to abandon gaseous disinfection after most of the communicable diseases.

As fumigating devices and materials are handled by the pharmacist, and as, in his position of "Chemist to the Medical Profession and the Public," he is likely to be asked numerous questions about gaseous disinfection, an effort is here made to give him an idea of its present status among sanitarians.

FACTS ABOUT FUMIGATION IN NEW YORK CITY.

The following letter was addressed to Dr. M. C. Schroeder, bacteriologist, New York City Department of Health:

As the number of cases of measles, for an equal period of time before and after abandoning fumigation in Manhattan, is given as evidence that fumigation did no good, the following questions suggest themselves:

1. Did the board always fumigate after *measles*, during the period in which fumigation was generally practised?
2. Was the method of fumigation as efficient as it could easily have been made with more disinfectant material?

* Read before Chicago Branch of the American Pharmaceutical Association, November 16, 1915.

† Scientific Department, Bauer & Black, Chicago.

¹ Even if we had tests for determining natural immunity to the principal communicable diseases, such as the recently-introduced Schick test for determining susceptibility to diphtheria, no one would probably think it practical to apply them to those about to clean up infected apartments.

3. Is the viability of the measles germ such as to make it a fair basis for comparison?
4. Was the process, given in your article in the Journal of Public Health of August, 1912, used up to the time fumigation was abandoned? If not, what process was employed at that time?

Dr. Schroeder (under date of October 7, 1915), replied as follows:

1. Yes.
2. Method of fumigation was adequate. If penetration was desired, more fumigation material would have brought about this result.
3. Too little known about this organism to make it of use as a basis of comparison.
4. There was no change made in the quality or quantity of the disinfectant or in the time period which was deemed necessary.

The quantities used were:

| | |
|------------------------------|--------------------------------|
| Paraformaldehyde | 1 oz. |
| Potassium permanganate | 2½ oz. (medium-sized crystals) |
| Water | 3 oz. |

The time allowed for disinfection was four hours. The testing organism was *B. pyocyaneus* on cotton threads enclosed in sealed tissue paper envelope and suspended at least four feet above and six feet distant from the fumigating pan.

It should be noted (a) that, in using one ounce of paraformaldehyde (solid formaldehyde) with permanganate, a part is consumed in the reaction, so that less than one ounce is generated as formaldehyde gas; (b) that Dr. Schroeder found that with this small amount the gas went through an envelope and killed the test organism in an exposure of only four hours; and (c) that he says greater penetration would have resulted from using more formaldehyde.

FORMALDEHYDE GAS DISINFECTION IN CHICAGO.

The following letter from Dr. Spalding and instructions for fumigation by Dr. Rawlings explain the present method of the Chicago Department of Health:

. . . . In reply to your letter of October 18, I am attaching hereto our method for gaseous disinfection.

We require that the rooms be sealed and articles of wearing apparel, etc., be thoroughly exposed to action of the formaldehyde gas.

HERMAN SPALDING,
Chief, Bureau of Medical Inspection.

When all the pans used for the space to be disinfected have been prepared, proceed as follows:

If Paraform is Used.

Place in mixing pan—

| | |
|------------------------|------------|
| Chlorinated lime | 60 grammes |
| Paraform | 30 grammes |

Mix *quickly* and add (pour over) 90 Cc. of water *immediately*. The mixture of chlorinated lime and paraform will commence to react even before the addition of water. Therefore, it is necessary to work rapidly.

If Formalin is Used.

Place in mixing pan—

| | |
|------------------------|------------|
| Chlorinated lime | 60 grammes |
| Add water | 20 Cc. |

Mix thoroughly.

| | |
|--------------------|--------|
| Add formalin | 75 Cc. |
|--------------------|--------|

over the moistened lime.

In performing disinfections, material should be added to the pan farthest from the exit and then in succession to the others in the order of distance from the exit. Before mixing ingredients, remove all surplus material and equipment from the room.

WARNING: Quarantine officers must follow carefully the method outlined. It is very easy to cause injury to woodwork, fabrics, etc., if any of the disinfecting material comes in direct contact with any articles or materials in the premises under disinfection. Chlorinated lime will be furnished in one-pound cans with a small pry-up lid at the top. Employees must use care in handling this lime. If any of it gets on clothing or leather, these articles will be injured by it.

The present method will be used as long as the quarantine officer has a supply of permanganate of potash. After supply of permanganate of potash is exhausted, the quarantine officer will use the paraform-lime method. When the supply of paraform is exhausted, the quarantine officer will then use the formalin-lime method.

By direction of the Bureau Chief,

I. D. RAWLINGS, M.D.,

Asst. Chief, Bureau of Medical Inspection.

In their standard work on "Practical Sanitation" published last year, Doctors Gardner and Simonds, speaking of "solid formaldehyde," say: "Used with moisture in the proportion of one ounce per 1000 cubic feet, it is very convenient and effective."

With so much evidence that one ounce kills the test organisms, it seems reasonable to conclude that two ounces would provide working margin enough to cover difference in resisting power of pathogenic germ life and some variation in the tightness of the room and condition of atmosphere; it being understood that formaldehyde should be used in fairly warm, humid air for best results.

QUANTITY OF PARAFORM ADVISED BY U. S. GOVERNMENT AUTHORITIES.

An expert of the Public Health and Marine Hospital Service of the United States (Bulletin No. 42, p. 13), in speaking of the use of paraform, says: "The paraform is placed in the cup and a flame applied underneath. The flame should not be too strong, for should the paraform ignite no formaldehyde gas will be produced and there will be no disinfection. The space to be disinfected should be tightly closed and all cracks pasted up. For each 1000 cubic feet of air space two ounces of paraform should be used. The time of exposure should be about four hours. If necessary the flame under the utensil containing the paraform can be left burning during the time of exposure."

The formalin-permanganate method will be treated on another page in connection with the formalin-dichromate process.

TWO QUESTIONS INVOLVED.

Edwin O. Jordan, Ph.D., Professor of Bacteriology in the University of Chicago and in Rush Medical College and author of the standard work on "General Bacteriology," replies to a letter of inquiry as follows:

In regard to the efficacy of room disinfection I hope you will pardon me for not replying in detail to your *questionnaire*. It is my feeling that a subject of this sort cannot be settled by a majority vote. There are two questions involved: (1) The efficacy of gaseous disinfectants, such as formaldehyde, in destroying bacteria; and (2) the efficacy of room disinfection in preventing the spread of certain infectious diseases. The latter question, at least, demands more study, and it seems to me that the gathering of evidence is needed more at present than the expression of opinion.

In his "General Bacteriology" (1915 edition) Dr. Jordan says: "If the solid polymer of formaldehyde is heated, not ignited, formaldehyde is evolved. A lamp has been especially constructed for this purpose, and with the use of tablets or pastilles of paraform affords an easy and effective means of disinfecting small rooms (Schering system)."

As pharmacists, both retail and manufacturing, our part is fairly done if we supply fumigators which actually kill disease germs. But as citizens we are interested in knowing how much benefit the community derives from gaseous disinfection so that we can give trustworthy answers to other citizens who, as customers, ask for information. Good business and good citizenship run parallel. At least they should; and will ultimately.

Dr. Victor C. Vaughan, in an address last summer at Lapeer, Mich., on "The Doctor's Dream," looked forward to the time when the province of the medical profession will be principally to prevent, instead of cure, disease.

Surgeon-General Gorgas, who has worked such wonders in practical sanitation in Cuba, the Canal Zone, and elsewhere, lays special stress upon getting at and remedying the underlying causes of disease. In a letter on another page he says: "I feel confident that the most important sanitary measure that any community could adopt would be a taxation on land values." As citizens we should inform ourselves regarding the merits of this statement, made by an authority who has a better right to express himself on a question of practical sanitation than any one else on earth.

To secure the best available information from practical sanitarians, seven questions were addressed to each State Board of Health. When it is considered that State health officers have had access to practically all the evidence there was, it will probably be admitted that their expressions of opinion come very near to being a presentation of evidence up to date.

The answers received are here classified alphabetically by States, under each query:

SYMPOSIUM OF HEALTH OFFICERS.

1. *After What Diseases Do You Think It Desirable To Fumigate?*

ARIZONA.—Governor Geo. W. P. Hunt, President State Board of Health, Phoenix: . . . Your form inquiry, regarding aerial disinfection, is being referred to Dr. R. N. Looney, State Superintendent of Public Health, so that due attention may be given to the somewhat technical inquiries which you have presented. . . . R. N. Looney, M.D., Phoenix, answers: All contagious or infectious diseases.

ARKANSAS.—C. W. Garrison, M.D., State Health Officer, Little Rock: After Asiatic cholera, acute anterior poliomyelitis, epidemic cerebrospinal meningitis, diphtheria, leprosy, measles, plague, scarlet fever, smallpox, tuberculosis, and whooping-cough.

DISTRICT OF COLUMBIA.—Wm. C. Woodward, M.D., Health Officer, Washington, D. C.: After yellow fever, to destroy mosquitoes; after plague, to destroy rats and fleas; and after typhus fever, to destroy lice. Premises, or parts of premises, that may reasonably be believed to be infected, should be *disinfected* after exposure to Asiatic cholera, smallpox, leprosy, plague, glanders, scarlet fever, diphtheria, epidemic cerebrospinal meningitis, anterior poliomyelitis, and communicable form of tuberculosis. Whether this disinfection shall be by mechanical methods plus the use of germicides in solution, or by fumigation alone, or by any combination of these, depends upon the circumstances of each individual case. Mechanical methods of disinfection—that is, thorough mechanical

cleaning—plus the use of germicides in solution, undoubtedly represent the most effective way of disinfecting. When this method cannot be satisfactorily employed, fumigation may well supplement it.

FLORIDA.—Joseph Y. Porter, M.D., State Health Officer, Jacksonville: After none whatever. We advise, as a routine procedure, boiling of clothing, bedding, dishes, and other articles used by the patient, and a thorough mechanical cleansing of the infected quarters; followed by free sunning and airing for several days.

IDAHO.—W. R. Hamilton, M.D., member and ex-president of Idaho State Board of Health, Weiser: Scarlet fever, measles, variola, tuberculosis, diphtheria, infantile paralysis, meningitis, etc.

ILLINOIS.—C. St. Clair Drake, M.D., Executive Officer State Board of Health, Chicago: Probably smallpox and tuberculosis, if any. As a matter of enforcing general airing of infected premises, however, liberation of strong gases is important. Free airing, thorough washing, and sunshine will do.

ILLINOIS CENTRAL R. R.—A. E. Campbell, M.D., I. C. Health Officer, Chicago: Pulmonary tuberculosis, smallpox, scarlet fever, measles. As we do not know the cause of the last three, I favor thorough fumigation until we do.

INDIANA.—J. N. Hurty, M.D., Phar.D., Secretary State Board of Health, Indianapolis: Personally, I have very little faith in disinfection. At one time I was strongly in favor of thorough disinfection of all infected premises, but my experiences have been corroborative of those of Dr. Chapin and other writers upon the subject. It may be that if disinfection is perfected and made better different results would be obtained. If we are to disinfect at all we should disinfect after all infectious diseases.

KANSAS.—O. D. Walker, M.D., President State Board of Health, Salina: All infectious and contagious diseases.

LOUISIANA.—Oscar Dowling, M.D., President State Board of Health, Shreveport: For over two years the Board of Health has been making investigations relative to fumigation and we are going to get out a pamphlet on the subject some time in the near future, and we shall be glad to send you a copy.

[The following quotation from pages 59 and 62 of the 1911 edition of "Sanitary Code State of Louisiana" (the latest obtainable) will give an idea of what has been the attitude of the board toward formaldehyde fumigation and the fomite theory:

"When a patient recovers from pneumonia, the room must be thoroughly fumigated with formaldehyde, not less than 12 ounces of formalin per 1000 cubic feet of air space, and the floors scrubbed with lye soap and the walls and wood-work wiped with a cloth wet with a 2 percent solution of carbolic acid. All washable fabrics that have come in contact with the patient must be boiled."

Section 159 reads:

"The sleeping apartments of tuberculosis patients must be thoroughly disinfected at least monthly; and on the death or removal of the patient, re-disinfected; if, in spite of the thorough disinfection and renovation, new cases should arise in a house that has been occupied by a consumptive, the premises may be condemned and destroyed by the State Board of Health whenever it seems advisable so to do."

Section 160 says:

"The sale or donation of clothing, bedding or other objects which have been in use by consumptives, or others suffering from any contagious or infectious disease, is prohibited, unless accompanied by a certificate that the same have been disinfected under the supervision of the Municipal or Parish Health Officer." W.]

MAINE.—A. G. Young, M.D., Secretary State Board of Health, Augusta: I do not wish to answer this question now. I am formulating new rules for submission to the Board.

MARYLAND.—John S. Fulton, M.D., Secretary State Board of Health, Baltimore: With some reluctance, I am making tentative answers to your inquiries. This whole matter of disinfection is in the melting pot and the form in which you have put your seven questions shows very clearly which side of the contest you have taken up. Personally, I do not care about the use of the word "fumigation," or about the use of the term "aerial disinfection." This business of public hygiene is in eternal oscillation, and we are probably right in describing the limits of oscillation as "extreme."

Substituting the word "disinfect" for the word "fumigate," I reply that terminal disinfection is done in Maryland after tuberculosis, scarlet fever, diphtheria, smallpox, and some other acute infectious diseases.

MICHIGAN.—Victor C. Vaughan, M.D., Ph.D., LL.D., Ann Arbor, President State Board of Health, Dean University of Michigan Medical School, President American Medical Association (1915), etc.:

Dear Williams:—I have not answered your questions for the very simple reason that it would take a volume to do so. I should want to give a great deal of time and attention to the matter and look up much research work before I answered your questions.

[Looking back to nineteenth century student days at Ann Arbor, when the writer enjoyed the privilege of being in some of the good Doctor's classes, it is hard to realize that the Professor (*mirabile dictu*) is perhaps a bit puzzled himself. Nothing could better emphasize the fact that doubt attaches to many theories. No better backing is needed for the sanitarians who prefer to remain on the safe side until these doubts are removed. W.]

MINNESOTA.—H. M. Bracken, M.D., Secretary and Executive Officer State Board of Health, St. Paul: None under proper conditions. Our circular on disinfection sets forth the views of the Minnesota State Board of Health to some extent. These views are, in effect, that a good housecleaning is better than the ordinary attempts at disinfection by means of the use of gaseous disinfectants.

MISSOURI.—G. B. Schultz, M.D., President State Board of Health, Cape Girardeau: Tuberculosis, smallpox, measles, diphtheria, erysipelas, various cocci infections.

NEBRASKA.—E. Arthur Carr, M.D., President State Board of Health, Lincoln: Tuberculosis, scarlet fever, smallpox, erysipelas, diphtheria, epidemic cerebrospinal meningitis, etc.

NEVADA.—Mark F. Boyd, M.D., Pathologist and Bacteriologist University of Nevada Hygienic Laboratory, Reno: Dr. W. H. Hood, President of our State Board, has turned over to me your letter with request that I answer it. Fumigation after the commoner infections apparently does not materially decrease the incidence of these diseases in communities where the practice has been in use, as compared with their incidence following the discontinuance of terminal fumigation. In these diseases, I think that terminal fumigation might be discontinued without any harm. At the best, it is only a weapon of exceedingly slight service, and attention is too apt to be exclusively directed to it to the neglect of more important prophylactic measures. With certain exotic diseases, such as plague and typhus, it assumes a rôle of greater importance.

NEW YORK.—F. M. Meader, M.D., Albany, Director Division of Communicable Diseases, State Department of Health: After communicable diseases when

soap and water cannot be obtained. Particularly rooms recently vacated by a person acutely ill with the disease.

Joseph J. O'Connell, A.M., M.D., Rosebank, Health Officer of the Port of New York: I think it desirable to fumigate after all communicable diseases. I know that there has been much said recently by some sanitarians as to the uselessness of disinfection, but until the causative organisms of some of the most common of our infections have been at least isolated and identified, I cannot bring myself to the conclusion that it is scientific to abandon measures which we know to be fatal to some of the pathogenic organisms that have been identified and are at least unfavorable to the growth of nearly all of such. Two years ago Dr. C. V. Craster, a bacteriologist in this service, did some experimental work in our laboratory at my direction and the report of his experiment you will find on pages 90 *et seq.* of the annual report of this department for the fiscal year ending September 30, 1913, a copy of which I am sending to you under separate cover. You will note that in his work he succeeded in destroying some of the organisms and that the sulphur dioxide fumigation inhibited the development of such of the organisms as were not killed. Fumigation is unfavorable to the growth of pathogenic organisms and is fatal to some of them. Consequently, while it may not be a complete protection, it is a protective measure of great value, reducing the danger of infection where it doesn't entirely eliminate it. I think it would be dangerous if conclusions were too hastily drawn from the action of the New York City Health Department in abandoning the practice of fumigating rooms after cases of communicable disease. The fumigation of living quarters in a congested city is very difficult. The mere direction to the family of the patient to burn sulphur or generate formaldehyde gas in the room lately occupied by the sufferer from an infectious disease was of course without effect. There are immense practical difficulties in the way of a proper fumigation of domiciles, particularly in the congested sections of a city, and this consideration was doubtless determinative with the New York Health Department.

Dr. M. C. Schroeder, M.D., New York, Bacteriologist New York City Department of Health: The New York Department of Health fumigates with sulphur after Brill's disease, typhus, smallpox.

NEW MEXICO.—L. G. Rice, M.D., President State Board of Health, Albuquerque: All contagious diseases, especially smallpox, diphtheria, tuberculosis and scarlet fever.

NORTH CAROLINA.—J. Howell Way, M.D., President State Board of Health, Waynesville: Scarlet fever and tuberculosis.

OHIO.—E. F. McCampbell, Ph.D., M.D., Secretary and Executive Officer State Board, Columbus: Terminal disinfection is required by the Ohio State Department of Health following smallpox, diphtheria and scarlet fever. Its use is recommended following acute poliomyelitis and epidemic cerebrospinal meningitis.

ONTARIO (Canada).—J. W. S. McCullough, M.D., Chief Officer of Health, Toronto: All communicable diseases.

OREGON.—Calvin S. White, M.D., State Health Officer, Portland: Smallpox, chicken-pox, scarlet fever and epidemic "la grippe."

PENNSYLVANIA.—Samuel G. Dixon, M.D., Commissioner Commonwealth of Pennsylvania Department of Health, Harrisburg: We are using formaldehyde gas for disinfecting purposes after all communicable diseases except those which are animal in type.

S. Solis Cohen, M.D., Professor of Clinical Medicine, Jefferson Medical

College, Philadelphia; Physician to Philadelphia General and Jefferson Hospitals: All of the so-called contagious diseases as distinguished from those which although infectious are not transferred by contact or by fomites—thus after smallpox, measles, scarlatina, diphtheria, tuberculosis, but not after typhoid fever or malaria.

SOUTH DAKOTA.—David L. Rundlett, M.D., Sioux Falls (replying by request of Dr. L. G. Hill, President State Board): In a general way, after all contagious and infectious diseases, viz.: smallpox, chicken-pox, epidemic cerebrospinal meningitis, acute anterior poliomyelitis, diphtheria, erysipelas, measles, pneumonia, scarlet fever, tuberculosis (lungs), typhoid fever, whooping-cough, and some of the diseases common to both man and beast, as, anthrax and glanders.

TENNESSEE.—Ambrose McCoy, M.D., Jackson, President State Board of Health: Scarlet fever, diphtheria, smallpox, tuberculosis, cerebrospinal meningitis.

UTAH.—T. B. Beatty, M.D., Secretary State Board of Health, Salt Lake City: Scarlet fever, smallpox, tuberculosis and possibly diphtheria.

WISCONSIN.—C. A. Harper, M.D., President State Board of Health, Madison: I desire to state that I believe in aerial disinfection as a factor in destroying the infectious agency of the so-called communicable diseases. I consider, however, of equal if not more importance the general cleaning of premises where communicable diseases have been prevalent, believing that the two procedures are the means of preventing a large number of cases of communicable disease and that neither one of the processes is entirely sufficient in itself.

Would disinfect after diphtheria, scarlet fever, smallpox, tuberculosis, measles, anterior poliomyelitis and epidemic cerebrospinal meningitis.

WYOMING.—Herbert T. Harris, M.D., President State Board of Health, Basin: Smallpox, scarlet fever, diphtheria, cholera, typhus, cerebrospinal meningitis. In measles and whooping-cough we doubt the efficiency of any fumigation, but the use of some fumigating agent following the two diseases certainly does no harm.

[Replies to number 1 may be classified as follows: Favorable to fumigation, 19; partly favorable, 3; unfavorable, 5; doubtful, 3.]

2. *Do You Regard Formaldehyde as The Most Satisfactory Aerial Disinfectant? If Not, What in Your Opinion Is Better?*

ARIZONA.—Dr. R. N. Looney: Yes.

ARKANSAS.—Dr. C. W. Garrison: Probably so, under favorable conditions. When the temperature is above 60 degrees F. or the atmosphere very humid, some preparation of sulphur is more efficacious, but troublesome in that certain articles are damaged by sulphur fumigation. No fumigation is satisfactory under all conditions.

DISTRICT OF COLUMBIA.—Dr. W. C. Woodward: If by the term "aerial disinfectant" is meant the disinfectant for the purpose of killing the germs in the air, formaldehyde in gaseous form and in the presence of moisture is, in my judgment, as satisfactory a disinfectant as anything we have; but I can hardly conceive of the necessity for disinfecting air alone, as distinguished from the surfaces with which the air comes into contact. Formaldehyde gas, under proper conditions of temperature and humidity, is as satisfactory a gaseous disinfectant as anything that may be used in ordinary practice, except in cases in which it is desirable to destroy insects or rodents, in which last-named cases the use of sulphur dioxide, hydrocyanic acid, carbon monoxide, and carbon bisulphide, each in its appropriate sphere, is better.

FLORIDA.—Dr. J. Y. Porter: Yes, where an aerial disinfectant is practicable or necessary.

IDAHO.—Dr. W. R. Hamilton: Yes.

ILLINOIS.—Dr. C. S. Drake: Formaldehyde, without permanganate of potash, is least damaging, least expensive and most provocative of airing.

ILLINOIS CENTRAL R. R.—Dr. A. E. Campbell: Yes, providing it is efficiently done. If not it is useless. Where we have smallpox with the patients living in cars, I favor sulphur.

INDIANA.—Dr. J. N. Hurty: In my opinion, of all the disinfectants, formaldehyde is the best.

KANSAS.—Dr. O. D. Walker: I know nothing better; but I do not think it covers sins of omission, such as thorough scrubbing with soap and water.

MAINE.—Dr. A. G. Young: Yes.

MARYLAND.—Dr. J. S. Fulton: We never try to disinfect air. We sometimes have to kill winged insects. Hydrocyanic acid vapor and sulphur dioxide are both better than formaldehyde for this purpose.

MINNESOTA.—Dr. H. M. Bracken: Yes.

MISSOURI.—Dr. G. B. Schultz: Yes.

NEBRASKA.—Dr. E. A. Carr: Yes.

NEVADA.—Dr. M. F. Boyd: Formaldehyde, if used in sufficient amount for the space to be fumigated and if attention is paid to temperature and humidity, is undoubtedly the most satisfactory agent at our disposal. Proprietary preparations of this substance offer no material advantages over the formaldehyde-permanganate mixture, and are not to be recommended.

NEW YORK.—Dr. F. M. Meader: For bacteria, yes.

Dr. E. H. Porter, ex-President New York State Board of Health: Yes.

Dr. J. J. O'Connell: Formaldehyde under proper conditions is an efficacious disinfectant. I regard it as one of the most practicable aerial disinfectants in certain circumstances. Like nearly all of the agencies through which we must work in this world, it is not perfect. Very frequently sulphur dioxide, with such hydration as natural atmospheric conditions furnish, may be more satisfactorily employed. In all fumigation, whether with formaldehyde gas or sulphur dioxide, or even with live steam, bed clothing and other articles liable to contain insect agencies of the transmission of infection or etiological factors themselves, should be broken open or very loosely bundled while under exposure. In spore form certain bacterial organisms will resist even boiling, and the ordinary fumigants lack sufficient penetration to destroy organisms protected by thick layers of intervening fabric.

Dr. M. C. Schroeder: The best one we have at present for vegetative forms of disease, not insect borne. Sulphur or hydrocyanic gas where animal life is to be destroyed.

NEW MEXICO.—Dr. L. G. Rice: We use formaldehyde, for I know of nothing better.

NORTH CAROLINA.—Dr. J. H. Way: Yes, it is the best we have.

OHIO.—Dr. E. F. McCampbell: The Ohio State Department of Health recommends formaldehyde for terminal disinfection, if such insects as lice or bed-bugs are not present. In the latter contingency sulphur is recommended.

ONTARIO (Canada).—Dr. J. W. S. McCullough: Yes.

OREGON.—Dr. C. S. White: Yes.

PENNSYLVANIA.—Dr. S. G. Dixon:

Almost immediately after Germany had declared war I realized that the old method of liberating formaldehyde gas from its water solution by the use of potassium permanganate would have to be abandoned, as the latter was all made

in Germany. Therefore, our chemist, Mr. Charles LaWall, was requested to proceed at once to experiment along a line that would likely lead to the discovery of a new and an economic method of liberating the formaldehyde gas. Within three weeks from the time the experiments were started, following a suggestion from Dr. George Rosengarten to try sodium dichromate, he succeeded in producing a more rapid liberation of the gas from the water solution than was possible by the old process.

The reaction is produced by a combination of the dichromate with sulphuric acid. The most suitable proportion appears to be the following:

Sodium dichromate 10 ounces avoirdupois.

Saturated solution of formaldehyde gas 1 pint.

Sulphuric acid, commercial, 1½ fluidounces.

The sulphuric acid can be added to the solution of formaldehyde and the mixture kept on hand for use. It should, however, be more carefully handled, as the presence of the acid would render it destructive to furniture, fabrics, etc.

This solution can be added to the crystals of sodium dichromate spread out in a thin layer over the bottom of the vessel having ten times the capacity of a volume of the ingredients used.

The reaction is more nearly instantaneous than with potassium permanganate. This necessitates a very prompt withdrawal from the room in which the chemical reaction has been started.

The residue is somewhat corrosive and therefore it is well to pull our tin container out of the room by an attached cord one-half hour after the reaction has been started. The residue should be removed from the can immediately and the vessel scrubbed with soap and water.

Dr. S. S. Cohen: In most instances, if thoroughly applied.

SOUTH DAKOTA.—Dr. D. L. Rundlett: Yes, it is one of the most useful and one of the best because of its high value as a germicide, its non-poisonous qualities, and it is not destructive to other materials. With it, however, you must have a large volume of gas produced in a short period of time, to make its effectiveness most marked.

TENNESSEE.—Dr. Ambrose McCoy: Yes.

UTAH.—Dr. T. B. Beatty: Yes.

WISCONSIN.—Dr. C. A. Harper: I believe formaldehyde the most satisfactory aerial disinfectant. It must be liberated in sufficient quantities in a well-closed room in the presence of plenty of moisture and heated close to 70 degrees Fahr., or thereabout, in order to be efficient, and a sufficient amount of formaldehyde should be used.

WYOMING.—Dr. H. T. Harris: Formaldehyde is in my opinion the best fumigating agent.

[Summary for Number 2: 28 regard formaldehyde as the best gaseous germicide, 2 qualify their approval.]

(To be continued.)