With the exception of the experiments of Vaudin, Donard and Labbé,[1] in 1906, on the use of concentrated solutions of maisin in alcohol or glacial acetic acid as the material for the manufacture of capsules, no further work along this line appears to have been attempted until the subject suddenly received attention in America in 1914. The American experimenters appear to have had no knowledge of the earlier work done in Europe, and the processes developed by them are, with one exception, similar to that patented by Hausmann as is shown by the following descriptions:

Method of Smith.[2]—"Immerse the filled capsules in a 10% aqueous solution of formaldehyde during 15 minutes. Wash in running water for 20 minutes and dry in a dish on a water-bath for 5 hours, or until free from the odor of formaldehyde."

Ballenger and Elder (Method No. 1).[3]—"Immerse the filled capsules for 1 minute in a dilution of 1 part of 40% formaldehyde solution to from 40 to 60 parts of water. The strength should vary with the aging allowed. From the time that the dilution mentioned is used, 2 weeks should be allowed to intervene before administering the capsules."

Ballenger and Elder (Method No. 2).[3]—"Place the capsules in an open box in a closed vessel in which they may be subjected to the vapor of Liquor Formaldehydi. About 15 Cc. of the solution should be used for each cubic foot of space in the closed vessel and should be placed on cotton or gauze in a saucer or tray. Six hours' exposure or less is sufficient for capsules which are not to be administered at once, while 12 hours may be necessary in preparing capsules for immediate use."

Method of DeLanney.[4]—"Number 00 capsules were soaked for a few hours in a 20% solution of formaldehyde and then dried. They became very brittle and somewhat distorted, but not so much as to prevent subsequent filling."

Method of Scoville.[5]—"Immerse the filled capsules for 30 seconds in a 1% aqueous solution of formaldehyde at ordinary temperature, drain them quickly, dry them, and store for 2 weeks before using."

Scoville calls attention to the fact that capsules treated as described by the American investigators increase in hardness with age and are unfit for use after about a year. Rumpel claims that capsules treated according to his process are not subject to this change. The final chapter in the history of the development of the enteric capsule, therefore, must be added at some future time.

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GENERAL USES OF DISINFECTANTS.*

BY L. E. SAYRE.

Disinfectants are used for the prevention of germ activated waste. They are

[1] Maisin is prepared from corn by treating the ground material first with benzol to remove the fat and then digesting with hot amyl alcohol for 8 hours. The amyl alcohol extract is filtered and the maisin precipitated by adding 3 volumes of benzol. Maisin is stated to be more resistant to the acid secretions of the stomach than either keratin or glutin and, in concentrated solution, to be more easily moulded into capsules than gelatin. *Bull. Comm.*, 33, 465, through "Year-Book Pharm. and Trans.," p. 142, 1906.

[2] Cited by E. F. Cook, *Am. J. Pharm.* 86, 185, 1914.

[3] *J. Am. M. Assoc.*, 62, 197, 1914.

[4] *The Military Surg.*, 35, 320, 1914.

[5] *The Southern Pharm. J.*, 7, 745, 1915.

* Presented before Kansas Academy of Science, a contribution for public information.

destroyers of the bodies causing infectious diseases of animals, plants and foods. They are preventives of the growth and multiplication of noxious germs. They are destroyers of the microörganisms of disease already active in decomposition of organic matter.

These are essays towards a definition, but not a complete definition in the lot. One needs a definition applicable to each form or condition of perishable matter.

The universal, all-potent, omni-applicable disinfectant has not been devised or discovered.

If there are micro-bodies that can resist moderate boilings and prolonged intense freezings without destruction—that can withstand varied and various approved germicides, but which will succumb unresistingly to some one body discovered by patient research and innumerable experiments—the particular bodies selected and adapted to individual cases as disinfectants and germicides are patently very numerous. Dr. A. C. Walters has shown that there is a specificity in disinfectants; and, so, the universal, easily applied germ killing body is yet to be devised; the public that asks for such a preparation will have to go unsatisfied, and remain content with merely approximate remedies.

For a long time carbolic acid—phenol—was regarded as being almost omnipotent and efforts for improvement were in the line of searching for a body superior and more efficacious. When a chemical body was found that would slay its greater number of thousands it was welcomed exultantly. The mere counting of the dead was the test.

Yet again there are disinfectants which if compared with phenol efficiency would be found inert and worthless if thus superficially estimated, but on some given virulent organism they may be actively germicidal where the phenol itself is inert. And, reversely, a disinfectant which may compare favorably with phenol in some respects, is found wanting; when placed in general use its utility is almost nil. Specificity, therefore, is the most important factor in estimating the value of a disinfectant.

The original method of ascertaining the value of a disinfectant—that utilized by the Hygienic Laboratory—which did not carry its examination beyond its effect on a single or maybe a few microörganisms, is therefore shown to be an insufficient and faulty way of evaluation. Still, important and respected National Councils and States have sanctioned the Hygienic Laboratory method and many there are who will even now rely on its approvals, because they have not learned of the, then, undiscovered fallacies of the decisions arrived at.

The personal factor affects the determining manipulations of an observer. No two men will handle the test and the material tested equally efficiently. So hard and fast lines cannot be drawn in worth-comparisons—only relative judgments are possible.

Freedom of thought and action on the part of investigators must be less trammeled than it is. The dicta that "this is so" and "that is not so" when applied to general health, welfare or commerce, or manufactures, must be applied liberally or much injury will result in restraining progress. We plead for more freedom and less of the "hard and fast" restrictions, with, however, the reservation that all investigations should be made by the undeniably competent, the absolutely honest,

the actively constructive and perhaps the financially uninterested. There is no such thing as finality in research—there is always more beyond: The imposing of the letter of the law is frequently a branding that hurts and does not always protect. Dogma, for instance, has no place in a can of disinfectant.

Again a false sense of danger is given vent to by the restriction to unnecessarily small amounts of preservatives permissible in canned goods, for instance. Nature may normally utilize more of the same body or a variant of the article, unsuspectedly and freely, and such nature-guarded food is healthful and even craved. The hobbyist has occupied the saddle too long and too completely. When it has become patent that unnecessary restrictions have been made, a manly modification should be instituted even before the people sense the need of relief. A bureau of administration must also be a bureau of improvement. Laws should be interpreted by regulations. Wise regulations, changed to make them wiser when necessary, would strengthen any basic law which intentionally leaves regulations to official administrators.

Very efficient disinfectants are frequently of such a poisonous character that they cannot be used in connection with foods and beverages. The toxically inert but germicidally potent remedy is often the desideratum. We can treat a cesspool and care not how noxious the disinfecting agent is to human life, but if we wish to combat some of the germs existent in the human economy, which may infest the cesspool later—then the most good and service and the least, or no harm, is the desired quality.

In times of epidemics special measures for special uses have to be evolved. Infection must be resisted at every avenue of approach. Influenza prevailed for many winters and lingered and survived persistently in spite of all methods for attempting control. It had been conjectured and found that the necessary soda fountain was a dangerous disseminator of the disease. Even with scrupulous care and attention the infecting organisms would survive plain washing and rinsing of glasses and dishes. The danger was as present in the clean as in the carelessly conducted store. The drinks themselves fed the microörganisms. The persistent tacky glutinosity of syrups and fruits completely sealed up morbidity, so that perfunctory cleansing availed not. The Board of Health of Kansas, through its secretary, Dr. Crumbine, requested and requested vigorously that something be done to protect the public and inexpensively assist the soda dispenser. Boiling water and steam disinfection would involve a greater expenditure for cleaning a glass than the profit on the consumed drink afforded. Small stores would have to quit business if compelled to use that method. In response, and in connection with P. A. Patty, the writer plunged into the sea of trouble. The more or less uninjurious disinfectants were called to mind; many were dismissed at once on account of objectionable odor or taste. The substance must be hard working, rapid in action, and easily banished from the glassware. Sterility complete and unassailable must be secured in almost a flourish of the hand. The remembrance of the cheap but efficient Labarraque solution of hypochlorite clung persistently to our minds. Was there no way of making it the solution in quest?

Then came the tests. Laboratory work was planned and carried out. Three microörganisms were selected for the experiments: a culture of a micrococcus concerned in the genesis of boils and abscesses, a culture of the typhoid bacillus, and a

culture of the streptococcus causing sore throat and skin eruptions. The last mentioned is hard to kill. Every precaution was used to secure perfect taste—the smallest detail was observed—the speed used was purposely made the same as it would be in actually serving and selling glasses of soda water, and the cleansing afterward was performed before any drying process had taken place. Nineteen solutions were made and used. All contained available chlorine. The amount of free chlorine was not the only factor that determined efficiency. The solutions containing the greater amounts of free chlorine were no more efficient than those containing half or three-quarters less. The power depends also on the degree of alkalinity of the solution. Solution number 18, that in our test service was the nearest to neutrality but still alkaline, with only 0.05% of available chlorine in it, was the best. Hot water is not bactericidal in the time period practical. Addition of sodium salicylate added no power, although germicidal in itself. Solutions containing mercuric chloride are highly satisfactory as germicides but impractical on account of its highly poisonous character. The neutral bath, containing 1/20 of 1% of chlorine, killed all three of the microörganisms whether the bath was fresh or twenty-four hours old. Dip a recently water rinsed glass into the bath, allowing all parts to come in contact with the solution and sterilization is complete. A rinse in plain water and rapid drying finished the process.

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Few people can conceive how many natural disinfectants—antiseptics really they had better be called when used on living tissues—Mother Nature utilizes and for the same purposes. Years ago the writer took part in a discussion or controversy with other chemists, among them an esteemed co-worker, R. G. Eccles, M.D., of Brooklyn, N. Y., in which the claim was advanced that Nature in her normal processes formed antiseptic bodies as protective agents and for the insuring of reproduction and perpetuation.

Quite recently while investigating and estimating commercial disinfectants and sterilizers, the ideas formulated in the years before were vividly recalled. That time has strengthened the opinions then expressed was proved on my writing to Dr. Eccles to find if he also felt as conclusively on the matter as he had in previous days. Our combined views are nearly a perfect consensus, which I may present crudely.

There is no tissue, animal or vegetable, that does not contain to some degree the basic radicals that are the chemical nucleus of our chief organic antiseptics. Their abundance is greatest where destructive danger is greatest. In the proteins are familiar bodies containing the benzene or some derivative nucleus from which we get creosote, phenol, salicylic acid and benzoic acid. We carelessly class our synthetic antiseptics as being coal-tar products—of course coal tar is of vegetable origin and the proteins of the vegetables supplied the aromatic radicals now present in that coal tar. Plants produce their alkaloids and glucosides from these primary compounds. They are found richest in parts subject to destructive infection. Among them are amygdalin, gaultherin, salicin and tannin and they all give every indication of giving service protectively. In many seeds like plum, peach, apple, amygdalin is coupled with emulsin. Injury to these seeds does not affect the

glucosides until dampness favors fungoid or bacterial destructive growths; then the emulsin becomes active and releases benzaldehyde which soon oxidizes to benzoic acid. Small external damage receives a little of the antiseptic; larger wounds, a larger amount of the acid. In wintergreen and birch the protective glucoside is gaultherin which when reacted on by gaultheride is converted into the antiseptic methyl salicylate. To follow up further would be tiresome; suffice it to say that in all instances of the occurrence of glucosides and enzymes, the benzene ring plays its important part—the source that bestows antiseptic qualities.

We are now treating of present growths and their protective accompanying bodies; but if we apply the same principle to the past we reach the conclusion that if there had not been natural disinfectants we should not now have coal to burn. The only part of the vegetable material which made coal, that is preserved to us, is that part which was protected by the antiseptics from fungoid and other decay. Changed by heat and pressure and some chemical action, the portion that remains for our use and comfort was preserved and concentrated by the parts of the trees and plants that afforded the antiseptics. In the laboratory to-day from coal we reclaim these same nuclei and put them to further and similar uses.

To our senses the odors of plants residing in their essential oils mainly are very apparent and it is these aromatic principles that are the tissue preservers and the securers of reproductive processes. Some are simple at first, but become more complex and potent as they oxidize into new bodies, often losing their original characteristic odor and becoming nearly odorless but more efficient.

The practical use for antiseptics in food supplies is well known and appreciated. The extremists by baseless denunciations have made their use seem almost criminal. Interested propaganda by some manufacturers of some less perishable articles, widely advertised, has contributed to the scare, which ought never to have arisen. The practice of the housewife of adding certain simple bodies to "make things keep" has never hurt one, and has for generations afforded good summer food in cheerless winter days. It has long been known that cooked fruits and vegetables, cooked meat and fish, when exposed to warmth and non-sterile air, decompose more quickly than the same food will when perfectly fresh and under the same exposure. Fresh unheated foods resist infection longer because they self-contain aromatic radicals easily released by cell enzymes to preserve the food. Heat-sterilized foods are ideal for the propagation of putrid growths. That is why the manufacturer instructs one to take contents from the can and if any portion is unused to keep it refrigerated. The heat used in canning destroys nature's protecting agents—why should not the preservatives be restored to a reasonable extent before sealing after sterilization is complete? The extremists have at times given people to understand that it was possible that salt and other innocent substances which have been used domestically since meats were first preserved would be forbidden to be used by packers. To be consistent the hobbyists should prevent the smoking of hams, bacon, fish, sausage and the like because of the many (empyreumatic) products generated and absorbed—creosote, acetic acid and unknown chemical combinations that have given us the harmless and dainty foods for generations. Dr. Eccles says that strength for strength in antiseptic power benzoic and salicylic acids are very much less harmful than salt or vinegar but our food dictators would hold up their hands in horror if these were put into use.

Perhaps it will now be seen why we fear that progress will be hindered, commerce unreasonably hampered and restricted by unwise theorists who would cling to their shibboleth of law though the nation should starve. If Nature's processes are in themselves largely self-preserving and of proven innocence, why cannot there be a greater leeway afforded to manufacturers who would have to disclose their formulas and if not generally approved offer themselves up to destructive and ruining criticism?

The burden of this rather excursive consideration of antiseptics may be given briefly: there is no intention of advocating unnecessary and indiscriminate use of antiseptics in the preservation of foods, but the point is emphasized that if we legally and commercially discourage and make unpopular the study of antiseptics for the purpose mentioned we are absolutely hindering progress. In this day and age when the transportation of food products immense distances is of vital importance, we should rather offer rewards and encouragement for research of this character than to practically condemn such work by greeting it with chilly indifference or faint praise.

CAUSE OF DELAY.

The delay of the May number of the JOURNAL A. PH. A. was caused by a printers' strike; though this is not ended, the conditions are such that the intervals between the succeeding issues will soon be adjusted, and it is hoped the August number will be mailed on the regular date, the preceeding issues as near the mailing dates as possible.—THE PUBLICATION COMMITTEE.