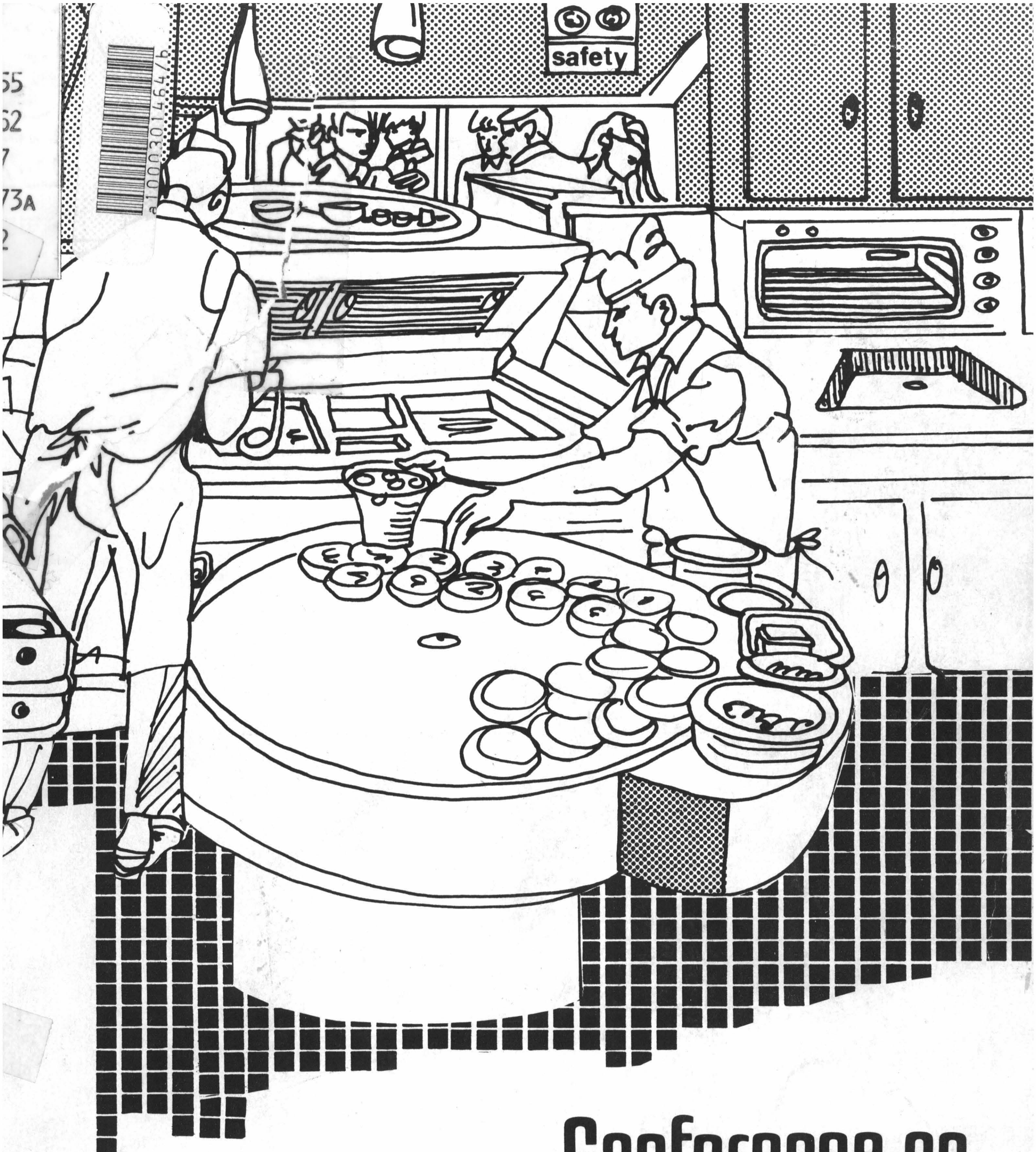

Conference on Sanitation and Food Safety

Virginia Polytechnic Institute and State University

Blacksburg, Virginia 24061

Proceedings

Sanitation and Food Safety Conference

August 21, 22, and 23, 1973

Sponsored By

Extension Division

State Technical Services

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Virginia School Food Service Department

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CONFERENCE SPEAKERS

OFF CAMPUS

Dr. J. C. Ayres, Professor and Head
Food Science Division
University of Georgia

Mr. J. C. Birchfield, Director
Residence Halls and Food Services
University of Tennessee

Dr. F. L. Bryan, Chief
Food-borne Disease Activity
Center for Disease Control

Mr. M. G. Hagerty, Deputy Director
Child Nutrition Division
U. S. Department of Agriculture

Dr. O. W. Kaufmann, Supervisory Microbiologist
Cincinnati Training Facility
Food and Drug Administration

Mr. D. L. Lancaster, Assistant Director of Education
National Sanitation Foundation

Mr. J. F. Miller, State Supervisor School Lunch Program
Virginia Department of Education

Dr. J. C. Olson, Director
Department of Microbiology
Food and Drug Administration

Dr. J. N. Perryman, Executive Director
American School Food Service Association

Dr. M. I. Shanholtz, Commissioner
Virginia Health Department

Dr. J. F. Spencer, Chairman
Department of Preventive Medicine
Medical College of Virginia

Dr. E. A. Zottola, Extension Food Microbiologist
University of Minnesota

ON CAMPUS

Dr. J. D. Baldock, Assistant Professor
Food Science and Technology

Dr. E. N. Boyd, Assistant Dean and Director
Division of Basic Sciences
College of Agriculture and Life Sciences

Dr. F. W. Cooler, Associate Professor
Food Science and Technology

Dr. E. O. Essary, Professor
Food Science and Technology

Dr. G. J. Flick, Assistant Professor
Food Science and Technology
State Technical Services

Dr. P. P. Graham, Assistant Professor
Food Science and Technology

Dr. N. R. Kreig, Professor
Biology

Dr. R. V. Lechowich, Professor and Head
Food Science and Technology

Dr. L. F. Malpass, Vice President
Academic Affairs

Prof. E. C. Marsh, Associate Professor
Business Administration

Dr. P. J. Muldoon, Assistant Professor
Food Science and Technology

Dr. M. D. Pierson, Assistant Professor
Food Science and Technology

Dr. W. H. Robinson, Assistant Professor
Entomology

THE ROLE OF SCHOOL CAFETERIAS IN THE FUTURE

by Mr. M. G. Hagerty

It is a pleasure to be here and to bring greetings from federal employees who support you in operating the Child Nutrition Programs.

To discuss the future of the School Cafeterias with you it is necessary to briefly examine the recent past and the present. Our progress in reaching out and serving all children, with emphasis on the needy, has been truly remarkable. The landmark legislation to improve and to expand the child nutrition programs was passed May, 1970 and that put the Nation's largest food system into high gear. In May of 1972 we reached 8 million needy children with free or reduced price lunches. Total participation is over 25 million per day. Three years ago we still had 25,000 schools in the Nation without food service; that number has been decreased to 18,000. In three years the number of breakfasts have increased from one-half million per day to about one million per day last year. In three years the Federal share of total School Lunch costs increased from 500 million to 1.2 billion. This means that for an average of all lunches, including commodities, the Federal Government is paying 40 percent of the cost of lunches. Yes, our programs are in high gear!

The activities and the new programs now in progress are exciting, too. There is a wide spread interest in the child feeding programs, not only by governmental agencies, but by private industry as well. This has brought some welcome changes in child feeding programs, especially, in the area of food technology. But, first, I want to bring you up to date on what is happening at the Federal School Lunch Office.

We have had a Uniform School Lunch Accounting Manual prepared by the Peet, Marwick, Mitchell & Co. accounting firm. This handbook is now complete and it will be tested in eight school districts the next semester; it will then be revised or rewritten as necessary. The following year, or the year after next, we will have the Uniform Accounting Manual available for all schools in the Nation. It is anticipated that all schools will be able to bring their food service accounting into conformance with Federal Standards. Standard accountability of food service is not only desirable, it is necessary across the country. A few months ago, a trade magazine made a survey to determine what it is costing various school districts across the country to produce and serve Type A lunches. Maybe you know exactly what it is costing your school to prepare and serve a Type A lunch. However, this indicated that the costs of Type A lunches ranged from 5 cents to over $1.00 each. This range of costs illustrates that these districts are using different accounting procedures. Since the Federal subsidy for serving Type A lunches is 6 cents, but at least 40 cents for free lunches, it is necessary to insist on uniform accounting procedures. The subsidy cannot be more than the cost of preparing and serving a lunch.

Another current project is an in-depth study of food service in vice program to the 18,000 schools still without food service. This is our No-Program school project. With improvements made in the Food Technology Staff, it is now possible to develop a food service program around the facilities that are available. We plan to contact most of these schools during the next year and to explain the details of the program with proper school officials. Then we will inform them of the alternatives of food delivery systems that would fit into their facilities. It may be a cup-can lunch or a frozen T.V. type lunch, but, whatever the system, it will meet Type A lunch requirements and it will satisfy the needs of the children.

Another current project is an in-depth study of food service in high schools to determine those factors that influence high participation as well as those that appear to cause low participation. In the course of the year we will develop ten or more sample situations which incorporate one or more of the "plus" factors and test the validity of these factors in on-going school food service programs. Specific objectives will be:

1. To note the characteristics of high schools with high and low participation of students in the Child Nutrition Programs.

2. To develop guidelines for State and local use in increasing participation in Child Nutrition Programs in high schools.

To those of us who have operated a cafeteria system we know that such things as "open campuses" and smoking privileges on the campus can make the difference between a successful high school program and an unsuccessful lunch program. However, the problem is so pronounced in some areas of the country that we felt an exact study is necessary. If we can pin point the reasons for low participation and offer suggestions to schools across the Nation it could favorably affect participation.

The Role of School Cafeterias in the Future can be stated briefly as they will

1. be busier

2. be teaching centers for nutrition education

3. introduce many new foods

By far, the greatest role of the future for school cafeterias, as I see it, is that school cafeterias will become community feeding centers. In addition to the conventional lunch program, breakfast program, and snack program, new feeding horizons will open up and demand public school service.

Many schools are involved now in the food preparation and service of food under the Special Food Service Program, often referred to as the Summer Lunch. The Summer Lunch was devised three years ago to bridge the hunger gap between June and September when children are out of school. Presently a large portion of these box-like lunches are provided by commercial food catering firms. However, more and more school districts are becoming active in this program and are providing the lunches even though the children are served at the city recreation areas or playgrounds, and are usually served by playground supervisors. Although this program has grown rapidly, more than doubled this summer over the past summer, it is still small compared to the National School Lunch Program. The Summer Program is reaching less than 2 million low income children per day, while the school lunches reach more than 8 million needy children every school day. This summer program is unique in that the site is approved in a low income area. It now appears that school-operated summer programs are doing a better job than the recreation or playground supervisors. This is natural as we have a well-trained professional staff in an operating kitchen. One State has only approved summer feeding programs that are school connected.

The other relatively new program is the Food Service for the Elderly that is operating almost exclusively in our schools. This program is not operated by the U.S. Department of Agriculture nor is it a part of the Child Nutrition Act which covers all of our programs. Although this is a separate program, the fact that the schools are involved makes us a party to the program. The record keeping must be entirely separate and the use of USDA commodities must be considered.

The Elderly Feeding Program is also growing rapidly and, again, it has proven successful where it is handled by the trained school personnel.

The Role of School Cafeterias in the future is also going to be deeply involved with the nutritional training of students. It has often been said that school cafeterias will be successful when they become a part of and not apart from the academic portion of the school. We are moving in that direction. A Federal grant has recently been made to a group of States that want to train the teachers and cafeteria managers together, and will offer college credits upon completion of special summer school classes. It is sound theory that classroom instruction coupled with practical exhibits every day of a nutritionally balanced meal will more likely impress students. The Type A lunch will be used as a basic tool in nutrition training in the classroom so that students will better understand the value of each of the major nutrients in the Type A lunch. Many organizations and agencies are interested in the measureable impact the child feeding programs have on growth and development, progress in school, and nutritional training values of the programs. These values are the most difficult to pin point and to evaluate. Nevertheless, we will be charged with the responsibilities of making these determinations in the future.

It also appears that the Role of the School Cafeterias, in the future, will be to introduce new foods to children. We often refer to those groups of foods as "engineered foods". The most noticeable engineered food is texturized vegetable protein, most of which are made from soya beans. Despite recent news releases the useage limit is still no more than 30 percent of the meat used. Another example is the fortified breakfast drink "Sustocol" which has been approved to fullfil the requirement of a snack in the Special Food Service Program or Summer Lunch Program. We would like to emphatically point out that as a government agency we are not selling or promoting engineered food. The individual school districts have the right to use engineered food as prescribed by our regulations, if they choose, but they are not required to do so. Another experimental project consists of a State using a fortified hamburger, milk, and fruit, which nutritionally meets the requirements of the Type A lunch. The reason behind this experimental project is the aforementioned project to study the reason for general, low participation in the high school Type A lunch program. It has been suggested that we need Type A lunches that fit into the "Life Style" of this new generation. If the nutrient intake is the same between a conventional hot Type A lunch and a fortified hamburger, milk, and fruit does it make a difference? Especially, if consumption of one of these lunches is much higher than the other? You must be the judge!

It strikes me somewhat adversely that engineered foods are getting a foothold in school cafeterias before such foods are commonly accepted by our adult population. Are we using our children to test new foods, or are we trying to indoctrinate them into new eating habits -- a new way of life? You must be the judge of that!

I want to close my remarks by saying that I am certainly not trying to influence you either way in the use of new foods. It may interest you to know that the last school district where I worked served 70,000 children in 101 school cafeterias and we were on record of not using engineered foods. We felt that if a student bought a hamburger or meat loaf from us, he would get a meat product, not a soya product.

We further were of the opinion that schools using more than a trace of soya extender, that the students should be advised of what they were buying. Again, however, you must be the judge in your district.

I have appreciated the opportunity to meet with you on this occasion and I'd like to wish you another happy, successful year serving our school children.

THE ROLE OF THE HEALTH DEPARTMENT IN SAFE FOOD SERVICE

by Mack I. Shanholtz, M.D.

In today's modern, advanced, mobile society more people are eating meals away from home than ever before, including more children eating at school. The efficiency, speed, and convenience of modern food services in this country are without comparison in the world. The magnitude of the problem of assuring the consumer safety in what he is eating is increasingly becoming a burdensome, overwhelming task.

Public health responsibility for food safety goes back many years. The publics health was thought to be well protected when food handlers were periodically examined for the presence of communicable diseases. But intelligent surveillance of foodborne diseases over the years, has established that over 200 specific diseases can be transmitted by food.

Food poisoning is a broad term to include those diseases transmitted by food. Diseases transmitted by food are frequently classified as either intoxications or infections. Intoxications are caused by consuming toxicants which are found in tissue of certain plants and animals, metabolic products (or true toxins) formed and excreted by microorganisms while they multiply on foods, or poisonous substances which may be incidentally added to foods as a result of producing, processing, transporting or storing. For example, many pesticides are used in agricultural produciton which constantly pose a threat to the adulteration of food supplies. Control measures are well known and contamination can, in most instances, be prevented. Infections are caused by the entrance of pathogenic microorganisms into the body and the reaction of body tissues to their presence or to the toxins they generate within the body.

Better understanding of ecological relationships has opened the door to new concepts in safety. Industrial pollution of the land and waters has finally been recognized as potential lethal force. Pollution of this nature, including heavy metals, organic acids, sulfur and nitrate compounds is gradually being fought by tough local, state and federal laws.

Mercury poisoning from food in the form of fish was first recognized in Minamata, Japan, in 1953. An industrial plant poured its wastes into a river where fishing was a common practice for the people of this small village. Mercury, a heavy metal, was a major constituent of the waste and was absorbed and concentrated in the fish to many times the tolerance level. Over 100 people became ill from consuming these poisonous fish. Thirty people eventually died, but many suffered irreversible brain damage, blindness and progressive dementia.

An outbreak of mercury poisoning occurred in Alamogondo, New Mexico last year. A mercury-containing pesticide was implicated as the source of exposure.

In the United States about sixty percent of all outbreaks of foodborne disease are caused by bacteria. The most common are the Staphylococcus, Clostridium Perfringens, Salmonella and Shigella. Each organism has its own distinct epidemiology and pathology. We can often forecast the probable causitive agent or narrow down the possibilities by the incubation period.

The Staphylococcus is a common organism known to all as the cause of furuncles, or skin boils. Certain of these organisms have the capability of producing a toxin harmful to man. With poor food handling techniques, staph can contaminate food items, particularly those made of milk products and eggs. Staph food poisoning occurs only a few hours after ingesting the contaminated food. The incubation period is 1 to 6 hours and usually is 2 to 4 hours. It produces symptoms characterized by nausea, vomiting, abdominal cramps and diarrhea. The illness is usually self limited, but the sick individual is usually incapacitated for several days. Washing the hands prior to handling food, and removing food handlers having infections on their hands will generally prevent this disease by protecting the food from contamination.

The Clostridium Perfringens organism produces a similar illness to that of staph. Poor personal hygiene is usually the cause of the disease. The reservoir of these organisms is the gastrointestinal tract of man and animals. The vehicle of transmission is usually beef that is improperly refrigerated following preparation.

Shigella and Salmonella are two of the bacterial organisms that produce a severe systemic illness. They invade the lining of the GI tract. Shigella only resides in the human GI tract, and is therefore exclusively a human disease transmitted by poor personal hygiene and cleanliness. Its incubation period is 1 to 7 days and usually less than 4 days.

Salmonella is similar in this regard, but is not as fastidious an organism. It can thrive in non-human environments and is commonly found in ducks, chickens, eggs and turtles. Human disease can result from exposure to this source. The disease produced by these organisms is commonly so severe that medical care or hospitalization is required. Fever, explosive diarrhea - often with blood - and dehydration are typical symptoms. Death can result. Also disseminated infection can result in distant organs, such as the brain, heart, bones and blood stream. Ten percent of all foodborne outbreaks are due to these bacteria. The incubation period is 6 to 48 hours and usually is 12 to 24 hours. Other foodborne illnesses are botulism and infectious hepatitis. Botulism is caused by a bacteria that grows only in the absence of oxygen. It classically, then, results from the consumption of home-canned foods. Insufficient precaution in food preparation and sterilization is usually the cause. The bacteria, <u>Clostridium botulinum</u>, produces a highly lethal toxin. The toxin interrupts nerve functions to the muscles of the body. Symptoms of unusual weakness and paralysis can begin in a matter of hours, followed shortly by death. The incubation period is 12 to 36 hours. The disease can be treated by an antitoxin, but it must be administered very early.

Infectious Hepatitis, a viral illness, is another disease that can result from poor hygiene. Almost any food can transmit this illness, once the food is contaminated by the food handler. Recently hepatitis outbreaks due to contaminated ice cubes have been investigated. The incubation period is 10 to 50 days, and usually is in the range of

30 to 35 days.

It is estimated conservatively that 15,000 foodborne outbreaks occur in the United States yearly. The number of people involved in these outbreaks totals over one-half million. The cost of this human disease is staggering. In terms of cost of medical care and of loss in productivity, several billions of dollars are annually lost due to foodborne diseases.

In the first six months of last year the source of food mishandling was identified as follows:

1.	Food Processing Establishments	10%
2.	Homes	12%
3.	Food Service-Including School Cafeterias	33%
4.	Unspecified	45%

In the food service category, approximately 1,250 of the reported outbreaks were due to errors in technique at school cafeterias. This constitutes 8% of the total of all outbreaks.

Continued surveillance, or the reporting and subsequent investigation, is important for many reasons. Maintaining a barometer of the trends in foodborne disease can permit public health to adjust priorities and activities depending on the type of disease being reported. The shortcomings in food processing systems and establishments can be revealed and the institution of controls can then be levied in the public interest. New health hazards can be discovered such as the vibrio parahemolyticus, and organism similar to that which produces cholera, which is associated with shellfish. The report of the outbreak led public health officials to identify this organism as the causative agent. It was previously thought to be harmless to man.

Two examples of a foodborne outbreak in Virginia point out many features of the illnesses and the importance of investigation. Last year from a cafeteria serving 500 persons daily at a state institution 100 people became ill with a severe gastrointestinal disorder. Forty individuals sought medical attention and 25 were hospitalized. Food histories implicated barbecued beef as the source of the disease. A survey of the staff of the cafeteria revealed that four food handlers were temporary, being hired on a day-to-day basis from a local manpower agency depending on the demand for service at the establishment. One of the food handlers was found to be a carrier of a pathogenic organism and guilty of poor practices in personal cleanliness. A positive outcome of this outbreak was that the school careteria has now abandoned the practice of employing extra help and has initiated periodic inspection of all personnel for health and the manner in which they perform their duties. The local health department now inspects the institution at more frequent intervals.

The personal cost to the students, however, was irretrievable. The students lost a cumulative total of 500 hours of classroom time and a medical care cost of $8,100 was absorbed by both the students and the institution.

Another outbreak at a church picnic in which 40 persons became ill reveals a most difficult area for public health control. Outings such as this - including private outings, bazaars, fire house suppers and the like - are not under jurisdiction of the regulations of the health code for food service establishments.

The ice cream served at this outing was contaminated with bacteria. further study revealed that the eggs used in the preparation of the ice cream were obtained from a local farmer who was unlicensed to sell his product. The eggs were contaminated at the time of packaging for sale. All the sick individuals sought medical attention, and five persons were hospitalized.

Nearly one-third of all reported outbreaks are related to food handling practices in a private setting, beyond health department jurisdiction.

Health department jurisdiction began when the 1948 legislature of Virginia enacted the first comprehensive restaurant law at the state level and delegated the department of health as the enforcing agency. Prior to this date some local counties and cities had local restaurant ordinances; however, there was not uniform enforcement across the state, which the legislature desired. The state law contained authority enabling the state board of health to promulgate official rules and regulations from time to time in order to keep abreast of advances in technology in the food industry. Modifications in the law have been made on several occasions at subsequent meetings of the general assembly and the rules and regulations have been upgraded as needs presented themselves.

There are approximately 11,000 public eating establishments under supervision in the state of Virginia. In addition to these public eating establishments, the dining accommodations of all state institutions are covered by the law and are under supervision. This, of course, includes the 1,400 public school cafeterias. Every city and county in the state is served with local health personnel which make periodic inspections. Departmental policy requires a minimum of one complete inspection each sixty days.

Although the state restaurant law makes certain requirements with the authority of law, it has been the philosophy of the department to achieve reasonable compliance by the use of education. Training courses for food service personnel are conducted periodically. Food consulting specialists within the department of health conduct these courses in cooperation with representatives of local health personnel and the restaurant industry. Training films, slides, and simple demonstrations and teaching aids are used. The department of distributive education has also been involved in the instruction of some of these classes.

In order to insure uniformity of enforcement from county to county and city to city, the department conducts official service ratings of all local food sheds at least once each two years. The recommended food service code and ordinance of the United States public health service - food and drug administration is used as a standard to measure compliance. The department employs six food service survey officers who have all been certified by the public health service as being proficient in the interpretation of this code. Virginia has more certified food survey officers than any other state at the present time. These survey officers also make inspections of interstate carrier food operations. The Federal Government accepts the findings and recommendations of these survey officers under the authority of an extension of the Federal Quarantine Law.

MOLDS, YEASTS AND VIRUSES IN FOODS

by Dr. Noel Kreig

I want to tell you something about the significance of the presence of molds, yeasts and viruses in foods and in water, and to begin with there are two aspects of these microorganisms that one has to consider: first, their ability to cause infections or poisonings in humans- i.e., their public health aspects - and second, their ability to cause spoilage and deterioration of foods. I think I'll spend most of my time on the first aspect - the public health aspect - and let's begin this by mentioning the viruses.

There are relatively few viruses infectious for man that are transmitted by food or water, but the few there are are real dandies. Let's start with the virus of infectious hepatits. Now, there are too kinds of viral hepatitis, serum hepatitis, which is spread by improperly sterilized hypodermic needles, and infectious hepatitis, which is spread via water and food, and of course it is only this last that concerns us here.

Infectious hepatitis is a disease contracted by eating or drinking the virus when it is present in infected food or water. After ingesting the virus, there is an incubation period of 1-6 weeks during which no symptoms occur, but then the symptoms begin. These symptoms include fever, intestinal distress, headache, loss of appetite, weakness and exhaustion and because the liver is damaged, a yellow jaundice occurs. Jaundice is a sure sign of liver damage. These symptoms may last for anywhere from a few days to several weeks, and complete recovery may take some months. Occasionally the disease is fatal. The important point for our purposes is that during the incubation stage, the clinical symptoms, and also the convalescent phase, the virus is excreted in the stools or feces of the patient. Therefore, it is this human excreta from patients that serves as a long-term source of the infection for other people. Now in 1970 in the U.S., there were 57,000 cases of infectious hepatitis, and in 1971 there were 59,000 cases, and therefore it seems clear that quite a lot of people in the U.S. are consuming food or water contaminated with human excreta from persons with infectious hepatitis. I want to give you just one recent example of such an outbreak.

This outbreak took palce in 1970 in Hatfield, Arkansas, and affected 77 persons. All of the patients lived, worked, or ate meals in Hatfield which is a small town having a population of 337. Of the 77 patients, 71 had eaten in one particular Hatfield cafe, and the other 6 cases occurred among family members or close contacts of this first group. Of the 71 patients who had patronized the cafe, 66 recalled drinking the water served to them, and the other five weren't sure if they had or not. The cafe had opened for business in April, and it specialized in sandwiches and short orders and catered to a largely male clientele. On May 13 the first of the hepatitis cases occurred, and in June the cafe closed down. Actually the sanitary conditions in the cafe appeared to be excellent, but then the tap water was examined and was found to contain coliform bacteria, a sure sign that fecal matter was present in the water, and where human fecal matter is present, the virus of infectious hepatitis could be present as well. On june 25 authorities placed a fluorescent dye in the toilet and the drinking water, but the public health reports as yet have not indicated just what the nature of this connection was.

Now in a restaurant, there are other ways in which human fecal matter can gain access to food or water. One of these is the failure of some person connected with preparation or serving of food to wash his or her hands after going to the toilet. The imperfectly cleansed hands may contain enough fecal matter to contaminate the food and eating utensils, and in fact this is how the famous "Typhoid Mary" was able to infect nearly 30 people - although typhoid fever is a bacterial infection, not a virus infection, nevertheless the way in which typhoid fever is transmitted to humans is nearly identical to the way in which infectious hepatitis is transmitted. Besides improperly cleansed hands, there is another common source of infectious hepatitis virus, and I refer here to consumption of shellfish which have been grown in sewage-contaminated sea-water or estuary water and which are often consumed raw, such as oysters. In 1965 a study showed that various human intestinal viruses could be isolated from oysters as far as 4 miles from the nearest outlet of raw sewage into an estuary. Moreover, even shellfish which have been cooked have been known to give rise to hepatitis; for example there was a recent case where a whole family on Cape Cod contracted the disease after consuming kill the hepatitis virus but only if applied long enough, and steamed clams are not cooked very long. Moreover, it has been found with several viruses, including the poliomelitis virus, that certain components of food may hepp to protect the virus against destruction by heating. And speaking of killing hepatitis and polio viruses, chlorination of municipal water supplies is usually effective in killing these viruses. Also chlorination of the effluent from second stage sewage treatment also appears to be effective .

The polio virus that I mentioned is also a virus that is excreted in human feces, and therefore its transmission is similar to that of the hepatitis virus. However, I know of no outbreaks that have been associated with shellfish, but there is no reason why this could not occur. Now many people who become infected by poliovirus do not exhibit the symptoms of paralysis. Most people in fact may think they have just a cold or stiff neck or back, or an intestinal upset, but in fact even where the paralytic symptoms do not occur, the virus is excreted by infected persons for 5 - 8 weeks and sometimes longer. Therefore, sewage-contaminated water or improperly cleansed hands can transmit poliovirus just as was the case with infectious hepatitis. Also milk and dairy products appear to have been sources of poliovurus in several outbreaks, although here the evidence is mainly circumstantial. For example, there was one outbreak involving 22 persons which was traced to pasteurized milk. Now cows do not become infected by poliovirus, and if the virus is in milk, it is of human origin. In the case I mentioned, it turned out that the virus was coming from the hands of one of the people involved in bottling the milk after it had been pasteurized - i.e., unsanitary bottling conditions. Pasteurization will kill most poliovirus in milk, incidently. Besides milk, foods made with infected milk or dairy products can also give rise to outbreaks of polio. For example, one outbreak was found to be associated with cream-filled pastries.

Next, there is a virus disease of man called ornithosis. You may be more familiar with a related disease called psittacosis which is contracted from certain imported parrots and budgies that may be infected. In ornithosis, the symptoms are a high fever, headache, sore throat, nausea, vomiting, and loss of appetite. Actually, ornithosis is not mainly a human disease, but instead is a disease of fowls and wild birds. Most human cases occur in poultry plant workers and farm workers who come into contact with infected meat or breathe infectious dust derived from the birds, but I mention here today because cooks or chefs have also been known to contract the disease. I should emphasize that the ornithosis viruses are not intestinal virus like hepatitis or polio-viruses, but are instead transmitted by direct contact with infected meat or inhalation of infectious dust derived from fowls.

Then there is the disease known as Q fever. This disease is caused by a rickettsia, not a virus. Now a rickettsia is not exactly a bacterium, nor is it exactly a virus. Rickettsias look like very small bacteria and are more complex than viruses, but on the other hand rickettsias are obligate parasites just like viruses and they cannot be cultured on meat broths and like. Microbiologists classify the rickettsias therefore somewhere between the bacteria and the viruses. In man, the disease Q fever is a respiratory disease characterized by high fever, but actually the disease is mainly a cattle disease, and infection of dairy cattle is very widespread in the U. S.. What makes Q fever interesting to us here is that the rickettsia is present in milk from infected herds, and perhaps 32% of all cases of Q fever in humans can be attributed to the drinking of raw milk. Pasteurization will definitely kill the organism and render the milk safe.

Now we come to the molds and yeasts. Although some of the most hideous infections of mankind are caused by molds and yeasts, the interesting thing is that none of these infections appears to be transmitted by food or water. Moreover, mold and yeast infections are relatively rare anyhow, except for some minor diseases like scalp infections or athlete's foot. Also, there are very few molds and yeasts that are infectious for man - most molds and yeasts appear to be quite harmless. However, within the last 20 years, several supposedly harmless molds have been found to make poisonous substances, called toxins (or mycotoxins since they are made by molds), and these poisons can affect animals and man. The diseases that result from eating these toxins are not infections, they are poisonings, and they go under the general name "mycotoxicoses". Actually, one example of a mycotoxicosis has been known since mediaeval times - this is the poisons known as ergotism. In Europe in the Middle Ages, famines sometimes necessitated using a poor quality flour for making bread. In many cases, a mold called ergot (otherwise known as <u>Claviceps purpurea</u>) had grown on the grain, and the grain had turned black. Once it is ground up, the bad grain is not very noticeable however. The mold forms a poisonous substance that is very similar to LSD, and in small amounts hallucinations occur. In larger amounts the symptoms are far more serious, however. There is vomiting, feelings of intense heat or cold, pain in the muscles of the calf, a yellow color in the face, convulsions, and the limbs may die - i.e. become gangrenous - and may even fall off. Ergotism is not only a disease of antiquity, however, because in 1951 an outbreak occurred in a town in France, resulting in 4 deaths and hospitalization of over 150 other people. Thirty of the townspeople became insane and believed that they were being chased by demons and snakes, but eventually most of them returned to normality. Incidentally, just as the poison digitalis is used beneficially in medicine, so the ergot poison is also used sometimes in medicine; for example, it is useful in stopping internal hemorrhaging.

Besides ergotism, however, it is only within the last 12 years that the existence and importance of a large variety of other mold toxins has begun to be recognized. Now before going any further, we should recognize that mold spores are everywhere in the air, and therefore any food will become contaminated by these spores within a few moments of exposure to the air. Whether they will germinate and multiply however, is something else. If a food is dry, such as flour, they will not multiply readily, but if flour becomes moist then mold growth will occur rapidly. Refrigeration will slow down the growth of molds, but eventually they will grow in a moist food, even in the refrigerator. One thing that molds require for growth besides moisture is air. I'm sure everyone is familiar with the practice of putting a layer of paraffin wax on top of jars of jelly to keep the air away from the surface of the this is to prevent mold growth. Molds generally develop on the surface of foods rather than inside the food, and this is because of this requirement for air. In connection with this, I want to emphasize that in some cases mold growth in a food is actually désirable. For example, the characteristic flavor of Roquefort cheese is due to methyl amyl ketone, a chemical that is produced by the mold Penicillium roqueforti when allowed to attack butterfat. In making Roquefort cheese, a milk curd is deliberately inoculated with the spores of this mold, and to make sure the mold will grow, airholes are punched into the curd mass to provide plenty of oxygen to the interior of the cheese, Without the airholes, the mold would grow only on the surface. Camembert cheese is another food where mold growth is desirable - in this case the metabolic products of the mold Penicillium camemberti provide the slightly ammoniacal flavor of the cheese. So mold growth is not always detrimental to a food, but usually it is and results in spoilage or rotting of the food and formation of very bad flavors.

Getting back now to the mycotoxins, these mold poisons were first detected in animal feeds. It has been a common practice in the past to regard mold-damaged crops as acceptable for use in animal feeds, and although this is in fact usually OK, enough cases of poisoning of domestic animals have occurred to make this practic very undesirable, if only from the viewpoint of economics for those who raise the animals. Moreover, there is also a definite problem for human health associated with cereal grains on which molds have grown, and very probably this applies to moldy fruits and vegetables for human consumption as well.

The first group of mold toxins I want to discuss are the "aflatoxins" which were first discovered in 1960, and which are produced by a mold called Aspergillus flavus (this is where the name aflatoxin comes from). In 1960, a disease of unknown cause wiped out about 100,000 turkeys in Great Britain. In attempting to find out the cause of this epidemic, it was found that the turkey feed was responsible, and in fact one component of the turkey feed contained the poisonous agent. This agent was contained in peanut meal that had come from Brazil. Finally the poisonous substance was extracted in pure form from the peanut meal and was found to cause death or at least characteristic liver damage, not only in turkeys but in a large variety of animals.

Subsequently it was discovered that it was not only Brazilian peanut meal that contained this toxin, but also peanut meal from a wide variety of locations throughout the world. Moreover, not only peanut meal has been found a vehicle for the toxin, but also a lot of other materials - cottonseeds, soybeans, maize, rice, wheat, barley, sorghum, beans, yams, and in fact it has been found in significant amounts in moldy cheddar cheese and even samples of commercial wine and beer. Of course fruits are involved in the manufacturing of those latter beverages. Actually, it is likely that just about any food on which the mold has grown would be found to contain the toxin, but peanut meal seems to be most frequently associated with it, probably because this meal has an unusually high moisture content which is conducive to mold growth. Incidentally, Aspergillus flavus is a very common mold and is likely to be found just about anywhere. Now, we are not sure just how much effect aflatoxins in food have on humans, but there is circumstantial evidence that it may be quite significant. Also, considering what effects aflatoxins have in a large variety of domestic and experimental animals, when fed rather small doses for several days, it is a pretty safe bet that aflatoxins would be capable of causing considerable damage to human tissues as well. Quite small amounts of aflatoxins can cause death or extensive liver damage in cattle, swine, ducks, turkeys, dogs, rabbits, guinea pigs, rats, hamsters, mice, monkeys, and even fish - for example, aflatoxins are quite deadly for rainbow trout. In all of these animals the liver is damaged, but the most interesting thing of all is that aflatoxins have been shown to cause liver tumors - i.e. aflatoxins are carcinogenic agents. This has been shown in rats, ducks, and also in rainbow trout which seem to be unusually sensitive. In rats, even when extremely small doses are given, for example, 15 micrograms a day for 30 days, tumors begin to form in the liver about 10 months later, in 4 out of 5 rats. Since the carcinogenic action of aflatoxins was discovered, laboratory workers who are investigating the action and properties of aflatoxins have become noticeably more careful when handling and working with the toxin, and they consider it dangerous enough to warrant rather elaborate safety procedures when working with the toxin.

Now as far as humans go, as I said before, it is not yet clear to what extent aflatoxins in moldy food affect humans, the main reason being the difficulty in doing controlled experiments with human volunteers. Personally there is no amount of money that could induce me to eat aflatoxin for experimantal purposes. However, even though deliberate experiments with humans are not desirable or possible, nevertheless some circumstantial evidence exists that aflatoxins are dangerous for humans. First in 1958, some African children were unwittingly fed protein concentrates which were later found to contain aflatoxin. Two of the children were less than 1 year old, and the medical history of these children was followed up and reported in 1966. One child had some alteration in his liver cells, but not of a serious nature, while the other developed cirrhosis of the liver. Of course it is not possible to state with certainty that aflatoxin was responsible, since nutritional deficiency is frequently a cause of cirrhosis. Then, in 1967, a review of disease cirrhosis indicated that this disease is particularly prevalent in tropical countries, and primarily affects young children. It should be noted that in tropical countries, mold growth on cereal grains is also most prevalent, because of high humidity and warm temperatures. In 1968, in Taiwan, three children died after eating moldy rice containing aflatoxin. Unfortunately no post mortems could be carried out on the children because the cases were reported to the authorities too late. Then, in 1969 the urine and feces of a large number of Philippinos who had been consuming moldy peanut butter were examined, and aflatoxin was found in the urine and feces of many of these people. The more peanut butter which had been consumed, the higher the amount of aflatoxin found. This indicated that aflatoxin is not destroyed by the human system, and also that it seems to be excreted rather quickly. Now one way to study the effect of the toxin on human cells without using people as subjects is to add the toxin to cultures of growing human cells in the laboratory-tissue cultures as they are known. It has been found that aflatoxin in very low concentrations stops the multiplication of human cells in tissue cultures, and also, depending on the concentrations used, it can cause death of human cells, or inhibition of DNA, RNA and protein synthesis. There is as yet no indication of a cancer-producing effect in tissue cultures but this is still a possibility. Another interesting aspect of aflatoxins that may have significance for humans is the fact that cows fed on diets containing aflatoxin excrete the poison in their milk. Cosequently milk may be a vehicle of transmission of the toxin to humans. In fact, in one study done in 1968 of retail milk in South Africa, 5 out of 21 samples showed the presence of aflatoxin, but it was present only in very small amounts. Still, small amounts over a long period of time might produce some damaging effects.

Well, A. flavus is not the only mold to make mycotoxins. Shortly after World War II, Japanese microbiologists studied molds occurring in yellowed (that is moldy) rice, both Japanese rice and also rice imported from other countries including the U.S.. Some of the moldy rice shipments were found to be contaminated with various members of a genus of molds called Penicillium. Some members of this genus make the antibiotic penicillin but in this case the species that were found made mycotoxins. One of these toxins was found to cause liver damage and also liver tumors in rats, and in this respect resembled the aflatoxins, although it was a different toxin. A second toxin was found to cause damage to the kidneys. A third toxin was found to cause death or paralysis in mammals - the symptoms included a progressive paralysis in the hindlegs and flanks of the animals, vomiting and convulsions, and gradual respiratory disorder. In animals that survived a severe case of the disease, residual paralysis and blindness persisted for some time.

In recent years, a rather large number of additional mycotoxins have been discovered and studied, and we don't have time to review them all here. There is one group of toxins however that we should finish up with, because here the hazard to human health has been definitely shown to exist. The disease in humans is known by the name Alimentary Toxic Aleukia, it is a disease that has occurred in epidemic form among human populations in Russia, and it was especially severe during the war years 1941 - 45. The disease occurs in three stages. In stage 1, the patient feels a burning sensation in the mouth, tongue, throat, and stomach. The tongue may feel swollen and stiff. There is vomiting, diarrhea, and abdominal pain. There may be fever and sweating, and usually headache, dizziness, and exhaustion. The second stage is called the latent stage, because the patient feels as if he has recovered. However, there is a decrease in the number of white blood cells and red blood cells. The red cell decrease means an anemia is being produced, and the bone marrow can no longer supply enough new red cells to supply the blood. The patient feels weak, has low blood pressure, headache, and some jaundice. This stage lasts from 3 - 4 weeks. Then stage 3 begins. And it begins very suddenly. The first sign is the occurrence of purplish-red spots on the skin of the trunk and other areas of the body. These are actually small hemorrhages just under the skin. Similar hemorrhages may also occur in the mouth and tongue, and in the stomach and intestines. Then areas of dead tissue occur in the throat and there is pain when the patient swallows. The dead tissue becomes infected by a variety of bacteria. The lymph nodes of the neck become enlarged and infected. Resistance to bacterial infection becomes practically non-existent, because the white blood cells decrease to practically zero. The mortality rate has been as high as 60%.

What causes all this damage? In Russia, it was due to eating wheat on which a mold called Fusarium has grown. In particular, the disease was associated with development of the mold on cereal grains during over-wintering where the grains remained under snow all winter and were harvested after the snow had melted in the spring. It is during the spring thawing that the mold makes the toxin. Alternate freezing and thawing appears to enhance formation of the toxin and also contact of the grain with the soil during the winter-spring period seemed to be essential. With regard to the toxin, it persists for up to six years in stored grain and is not destroyed by baking or even pressure-cooking.

Remember now that alimentary toxic aleukia is one of the few mycotoxoses that has caused epidemics in man. Ergot is another. But one should also be aware of a large number of other mycotoxins, such as aflatoxin, and should realize their effects on animals and human tissue cultures, especially their cancer-inducing properties. One should keep in mind also the possibility that human liver disease such as liver cancer and cirrhosis might be associated with the eating of toxins such as aflatoxin. Effective protection against the possibility of human diseases caused by mycotoxins is to eliminate or at least minimize the growth of molds on foods for human consumption. For example, one way that is used to discourage the growth of molds on bread or on cheese, is to impregnate the wrappers for these foods with calcium propionate. Since molds will grow on the surface of foods, and since the wrappers impregnated with propionate are in contact with the surface of the food, this is an effective way to stop mold growth. As far as cereal grains are concerned, rapid and thorough drying seems to be quite effective; as we mentioned earlier, molds need moisture in order to grow and produce toxins. Also, the use of fumigants and fungicides offers a further approach. Studies have shown that various chemical can inhibit the growth of toxin-producing molds, and some of them block toxin synthesis without interfering with the growth of the molds. But chemical treatment often solve one problem while introducing another, and perhaps the best procedure of all is simply to keep conditions dry enough to prevent mold growth.

CHEMICAL FOOD POISONING

by Dr. John C. Ayres

Need for Chemicals

Man has eliminated many of the uncertainties of an adequate harvest by employing agricultural chemicals as fertilizers and insecticides, herbicides, fungicides and rodenticides. He has used animal feed additives and plant growth regulators to increase yields and stabilize growth. These raw commodities have been converted into desirable products through the use of one or more of the following additives: coloring and flavoring materials, vitamins, essential amino acids, preservative agents, antioxidants, stabilizers and thickeners, emulsifiers, firming agents, coatings, humectants, buffers, and neutralizing agents. Additional end products have been derived as a result of processing changes induced by heat, freezing, dehydration, fermentation, radiation and/or enzymatic action. Usually by the time that many food products reach the consumer they have been packaged in a rigid or flexible container or have been smoked or otherwise treated.

The need to transport foods over great distances and to store them for extended periods of time coupled with the consumer's desire for products that are uniform, attractive, convenient to use and available throughout the year has increased the need for food additives. However, the use of such additives is warranted only if they have the following characteristics:

1. Prevent the growth of microorganisms
2. Delay spoilage, oxidation, rancidity or other undesired changes
3. Be nonirritant
4. Not be injurious to the health of the consumer
5. Be readily available or conveniently prepared
6. Be detectable without excessive difficulty
7. Not be too costly for ready usage

An additive should not be used indiscriminantly for foods that can be satisfactorily prepared without it or if the nutritive value of the product containing the additive is lower than that of the original material. Further, use of the additive should not make possible the utilization of unfit raw material nor should it serve as a substitute for cleanliness. Food products containing an additive should be completely digestible and under no circumstances should the additive change its form to a substance of greater toxicity during its metabolism.

Except for the natural substances found in food products - of which all are chemicals - the remainder must be considered intentional additives to retard decomposition, fermentation, oxidation, instability, flaccidness, staling, acidification, or other undesirable changes or to improve nutritional and/or aesthetic properties.

Tolerances have been established for many of the chemicals used to preserve foods and if an excess amount of the chemical is found, such foods may be considered adulterated and subject to seizure. In order for an additive to be properly used in a food product it should function as a preservative agent and/or as a quality improving agent. Additives within the first category can be further subdivided according to whether they are (a) inorganics or (b) organics.

Preservative Agents

Inorganics

Inorganic acids and their salts, such as the sulfites have proved extremely useful in preventing enzymatic browning and protecting the flavor of sliced potatoes, apples and other fruits and vegetables. A residual of less than one part per million of sulfur dioxide should remain in heated foods since SO_2 is corrosive. Alkalies and alkaline salts are employed principally as cleansing agents or detergents. Appreciable quantities of certain of the polyphosphates, in addition to serving to soften water, have marked binding capacity when introduced into flesh foods and, for this reason, have been used in the processing of meat and poultry. It is not known if such use of polyphosphates results in products that are not wholesome or nutritious. Phosphoric acid is used in many soft drinks. The use of boric acid for food products was outlawed in the U.S. over 65 years ago.

The halogens (Cl, Br, I, F) and their salts are widely used especially for drinking water supplies, and for food processing as chemical disinfectants. It should be stressed that although all of the halogens have well known toxic properties, when properly used they have not caused injury to man via foods. On the other hand, administration of iodine in trace amounts - as in iodized salt - aids in preventing goitre in those areas where the element is deficient in food and water supplies. This halogen has been omitted from many food service formulations and with the even larger number of meals eaten away from home, it is increasingly important that iodized - rather than plain - salt be used in institutional recipes.

Sodium chloride may be applied directly to foods or may be used in brines to retard certain microbial growth and spoilage while at the same time permitting acid producing organisms to persist. In the early '60's, a sodium chloride solution was administered to infants instead of the glucose solution they should have received. As a consequence of this error, a number of deaths resulted. This merely serves to illustrate the truth of W. E. Baier's saying "there are no harmless substances; there are only harmless ways of using substances."

Hypochlorites, while effective bactericides when there is little organic matter present, are quickly neutralized in the presence of animal or vegetable tissue. For this reason, they are used primarily for water treatment. Owing to its high toxicity, fluorine (F) is restricted to the fluoridation of water supplies in extremely dilute solutions (1-2 ppm). This halogen is carefully regulated by city and/

or state health authorities. A bizarre incidence of food poisoning occurred a few years ago when fluorine was accidentally used in a bakery formulation rather than the flour that was intended. While fluorine is useful as a rat poison it has no place in an institutional kitchen or commissary.

Nitrates and nitrites are often used as "curing agents" for meats, poultry and fish. Some waters and certain vegetables such as spinach, beets, celery, collards, eggplant, lettuce, radishes, and turnip greens have high nitrate content and several microorganisms have the ability to reduce nitrates to nitrites. Since nitrites have bacteriostatic effect in acid solution, they have been recommended for the preservation of fish. Nitrites also reduce the redox potential, thus reacting with the heme pigment of heated pork muscle to produce the desired pink color associated with ham. Recently, there has been great concern regarding the formation at acid pH of N-nitrosamines by the reaction of secondary amines with nitrous acid, nitrite, or oxides of nitrogen. In 1954 Barnes and Magee established a causative relationship between the occurrence of liver disease in two industrial workers and the introduction of N-nitrosodimethylamine as a plant solvent. In 1963-65 much more general interest in the nitrosamines developed when liver toxicity in sheep and mink was observed when these animals were fed fish meal containing N-nitrosodimethylamine and it was shown that that compound was produced by the addition of large quantities of nitrite as a preservative prior to high temperature drying (viz. Wolff, pers. commun. 1972). It should be mentioned that the processing procedure used for preserving and drying the fish left much to be desired.

The toxigenicity and carcinogenicity of the nitrosamines is well known and, apparently, varies with the alkyl group. However, dose-response relations have yet to be determined and limits of toxicity, i.e., levels having no effect for laboratory animals and man, remain to be determined. Nitrosamines have been reported to be present in cured meats and fish and other food products, but there is question concerning the authenticity of some of these findings (Wolff and Wasserman, 1972).

Metals and metalloid elements including antimony, arsenic, barium, bismuth, boron, cadmium, chromium, cobalt, copper, gold, iron, lead, manganese, mercury, nickel, phosphorus, selenium, silver, tin and zinc have recognized toxic properties and have been found to possess marked bacteriostatic or bactericidal properties. Some of the metallic cations and their salts such as copper (Cu), gold (Au), mercury (Hg) are extensively used as bactericides, fungicides, or algacides.

Copper salts have relatively little effect on bacteria but are quite useful for destroying algal growth in water supplies and in preventing fungal infection of plants. Since gold salts and complex organic gold compounds are expensive, their usage has been limited to the therapy of tuberculosis and leprosy. Silver compounds and especially those in the form of nitrate, citrate, lactate and protein-silver or colloidal silver preparations are useful as antiseptics.

Simple mercury salts such as mercuric chloride, mercury oxycyanide and potassium mercuric iodide are often used as disinfectants but their lack of specificity makes their use hazardous for man and domestic animals. Fildes (1940) demonstrated that mercury combines with sulfhydryl (- SH) for metabolism. In mid-1970, unexpected levels of mercury were recovered from canned tuna and swordfish and later the association of this contaminant with industrially polluted water caused widespread concern regarding the wholesomeness of certain kinds of seafoods. Wide variation in mercury content in natural unpolluted waters and the variability of different aquatic food forms to accumulate dangerous body loads (>.5 ppm) are known to relate to metabolic rates and life duration of these biological entities. It appears that the chlorine-alkali industry is a major industrial source of contamination. Other sources are seed treating agents, slimicides in the pulp and paper industry, turf fungicides and mercury paints. In 1970, a fatal misuse of seed grain treated with mercurial fungicide occurred when a farmer fed his hogs the grain and later butchered the animals for consumption by his family.

Scandinavian work has shown that in fresh water fish, 90% of the mercury is in the form of the extremely toxic methyl mercury. However, all mercury is not in this form in all tissues.

Lead, cadmium and other metals have occasionally been incriminated as the cause of food poisoning. Lead poisoning has resulted from bread baked in ovens in which lead-painted wood was used as fuel. In California an incident involving a family of five was reported to have been caused from long use of a Mexican earthenware pitcher, as an orange juice container, in which lead was a component. From time to time poisonings involving pewter containers have been recorded with wine and fruit drinks as the usual vehicles. Similarly, acid foods stored in cadmium or zinc galvanized containers and kitchen utensils in which antimony or other toxic ingredient was used during manufacture have caused illness. There are guidelines for permitted levels of toxic metals in manufactured products and the consumer has reason to expect that governmental regulation will prevent the incorporation of hazardous materials into items intended for usage with foods. However, legislation can hardly be devised that will avoid illness or poisoning if some one decides that a galvanized pail or an earthenware flower crock would be a handy pickle vat or receptacle for lemonade.

Inorganic aresenic occurs naturally in fish and shellfish. Arsenicals are quite toxic to protozoan parasites, spirochaetes, yeasts and other microorganisms but much less poisonous for man and higher animals. Quite to the contrary, the use of organic arsenic compounds for poultry have not only helped to free these birds of parasites but when administered at sufficiently high dilution, have stimulated appetite and growth. Since arsenicals are extensively used as insecticides, the FAO/WHO Expert Committee on Food Additives has established a maximum acceptable load of 0.05mg/kg body weight. On the average, this would permit 1 ppm in all foods as contrasted with an estimated average consumption by man of 0.05 ppm.

The situation with respect to selenium is even more paradoxical than that for arsenic. In small amounts, selenium has been shown to be a dietary essential for sheep and cattle and in areas of the West where the soil is deficient in selenium, a defect called white muscle disease develops in these animals. The disease is quickly alleviated when selenium is incorporated in the animal's diet. Conversely, when selenium is fed in larger amounts to animals, they develop anorexia, depression, polyuria, dyspnea, coma and death. Further, since in rats it is a carcinogen and produces hepatomas, it cannot be added to wheat for interstate shipment, but selenium-containing grain can be transported across state boundaries.

Hydrogen peroxide (H_2O_2) is a potent oxidizing agent that has been used for sterilizing fluid whole milk and as a surface sterilizing agent. Although excess peroxide can be decomposed by the use of catalase, and the enzyme in turn can be inactivated by heat, use of H_2O_2 is not permitted in the U.S. Federal regulatory agencies consider that the use of H_2O_2 for milk would make possible the use of an inferior raw material and that the level of usage of the additive is too difficult to determine.

Of several fugitive gases employed for foods, carbon dioxide (CO_2) is the most widely used. Levels of 10-15% CO_2 control maturation of the storage quality of fresh fruits while introduction of CO_2 at elevated pressure enhances the preservative effect of the gas when used for carbonated beverages. Also, there are applications wherein CO_2 serves as a preservative for unbaked biscuits and to prolong storage of bacon. There is ample evidence showing that there is a linear relation between carbon dioxide content and the germination time required by bacterial cells. No food poisoning incidents have ever been reported from the use of CO_2.

Organics

Organic acids and their salts are among the most common food additives. Several of these, such as acetic, ascorbic, citric, lactic, malic, and tartaric, may be present initially in various plant juices or develop as a result of microbial fermentation. In addition, benzoic, oxalic, and salicylic acids often are found in plant tissues. Benzoic acid occurs naturally in cranberries and is an effective yeast inhibitor in oleo margarine, fruit juices and several other acid foods. Oxalic acid is found in rhubarb, spinach and sorrel and small amounts of salicylic acid occur in most fruits. Propionic acid occurs in milk products.

By increasing the hydrogen ion concentration in foods, organic acids exert antiseptic effect but, in addition, the concentration of the undissociated acid controls microbial growth. When used in too large amount, any of the fatty acids damage cell membranes but benzoic, oxalic and salicylic acids also interfere with enzymatic processes. A tolerance level of 0.1% for sodium benzoate has been established for fruit juices; also, benzoic acid is allowed in ice used for preserving fish. When properly used, there is no evidence of any untoward effects from this acid or its salts.

While spinach and rhubarb have a higher oxalate content than most other foods, a consumer having a diversified diet would be in no danger. Yet case reports have appeared from time to time of acute poisoning resulting from the ingestion of rhubarb leaves. According to Sollman (1957) and Locket (1957), these reports are suspect; the latter worker indicates that in order for rhubarb to be fatally toxic, almost nine pounds would need to be consumed.

The use of salicylic acid and salicylates is permitted in some European countries as food perservatives, but such usage is not permitted in the U.S. In this country, the physiological effects induced by this acid and its salts are considered too harmful to tolerate its presence in foods. Such a view seems justified in view of the fact that over 200 deaths a year are attributed to the ingestion of overdoses of aspirin - mostly taken by infants, young children, and those with suicidal intent.

Formaldehyde is not permitted as a direct additive to foods but is present, together with several phenolic and cresylic compounds in cured, smoked meat, fish, poultry, and cheese as minor constituents of smoke. These agents combine with proteins in cells to form protoplasmic poisons and insoluble proteinates. Dungal (1961) reported that an unusually high incidence of gastric carcinoma in Iceland could be attributed to smoked mutton and fish that were kept in smokehouses for long times and eaten over extended periods. The smoked mutton and fish exhibited an unusually high content of 3, 4 benzpyrene and, further when the flesh was fed to rats, malignant tumors were produced.

Formely, ethylene oxide and propylene oxide were used as fumigants for preserving starches, gums, nuts, dried prunes, other dried - and glace fruit, as well as for spices. However, Wesley et al (1965) indicated that the two oxides may combine with the inorganic chlorides in foods to form very toxic chlorohydrins. Present federal regulations permit the use of epoxide for spices and nuts only.

The alcohol content of beer, ale, and unfortified wine is sufficient to limit microbial growth but does not prevent the eventual spoilage of these products. Ehtanol is the most extensively used alcohol and is a preferred solvent for most food flavor and color extracts. Since, in high concentrations it coagulates and denatures cell proteins, it must be considered a toxicant. Most alcohols other than ethanol are toxic and their use is not permitted for foods.

There are a host of other toxic organics that occur in foods naturally. For example, paralytic shellfish poison, or saxitoxin, is produced by dinoflagellates and they, in turn, are ingested by butter clams and other shellfish. Saxitoxin is one of the most toxic chemicals known. Mushroom poisons, such as the amatoxins, phallotixins and muscarines of the Amanitas are equally deadly.

On rare occasion, man has been fatally poisoned by cyanogenic glucosides. One of these, linamarin, has been associated with the sap located just beneath the bark of the cassava tuber. However, 0.06 g is the smallest dose of hydrocyanic acid (HCN) fatal to an adult (Nicholas, 1951). Only bitter cultivars of cassava have more than 100 mg HCN/kg. Also there are reports of individuals being poisoned by ingesting large quantities of cyanogenic glucosides present in almond kernels, apple seeds, and legumes (fava beans, lime beans, etc.). In fact, serious outbreaks of poisoning from cooked lima beans have occurred in various parts of the world (NAS Publ. 1354).

Certain other food components can cause harmful effect when consumed in sufficient quantity. For example, attacks of migraine have been attributed to tyramine and other pressor amines present in cheese, fish, beans, chocolate, diary products and alcoholic beverages. Cabbage, carrots, rurnip, rutabaga and spinach may contain goitrogenic substances and, when ingested in large amounts, decrease the rate of iodine uptake.

Almost all raw legumes contain proteins that are able to agglutinate red blood cells (hemagglutinins). This activity is destroyed by heat. When hemagglutinin levels exceed 0.5 percent for kidney beans or 1.0 percent for black beans, there is growth inhibition and even death of experimental animals. Action of hemagglutinins is believed (Jaffe, 1960) to be due to interference with absorption on nutrients through the intestinal wall.

Among antienzymes (inhibitors) the alkaloid solanine, high levels of which are associated with "green" potatoes, may present a real hazard due to the powerful cholinesterase inhibition that this chemical presents. Since cholinesterases control nerve impulses, poisoning could be attributed to interference with their acitivity.

The antitrypsins are of lesser concern since their impact on health is not as drastic and direct. There are many trypsin inhibitors among plant species and at least two antitrypsins of animal origin. These agents result in excessive losses of essential amino acids.

Antivitamins, estrogens, stimulants, and depressants occupy a similar status. Raw foods often contain antivitamins. Cereals and liver have been shown to be rachitogenic, fish oils destroy vitamin E, the lipoxidase of raw soybeans oxidizes and destroys carotene, vitamin A levels are decreased by consumption of yeast, raw fish flesh contains the enzyme thiaminase that destroys thiamin and the protein avidin, present in raw egg white, binds biotin. While many plants exhibit estrogenic, stiumulative, or depressant activity, their effect is so elusive that the health of the consumer can hardly be considered at risk unless completely atypical consumption patterns are adopted.

Quality Improving Agents

As was done with the antimicrobial agents, quality improving agents also can be subdivided into two groups, i.e. (1) those used to produce larger yields and/or those that are less defective and (2) those chemicals added to stabilize or improve the processed product.

Chemicals to Improve Yields

Pesticides. Of several hundred pesticides registered for use by the United States Department of Agriculture, about 90 are permitted in food crops. The major concern of public health officials is with the persistent organochlorine types. The organophosphorus and carbamate types are regarded as non-persistent; yet Parathion residues have been found on frozen spinach after six months and Diazinon can be found in carrots seventy days after treatment. Also, they are more toxic than the chlorinated hydrocarbons.

Dichlorodiphenyltrichorethane (DDT) is probably the least poisonous of all the powerful insecticides but owing to its widespread and practically universal application over the past three decades, DDT has progressively accumulated in our environment to the stage that it can be recovered from almost every body of water and from most plant and animal products. While man functions normally with 200-300 ppm in his fat, apparently DDT interferes with reproductive processes in certain forms of wildlife. Also, evidence of liver tumor production in laboratory animals fed high levels of DDT contributed to federal action curtailing its use this year.

A few years ago, use of aminotriazole as a herbicide for clearing bogs was restricted when it was found that the chemical accumulated in cranberry fruit and that it produced malignancy in experimental animals. While the chemical is permitted for use during early stages of growth, it must not be applied after the blossoms have opened and fruit has set.

Chlorinated phenols are used in wood preservatives, fungicides, disinfectants and as contact insecticides. These chemicals are suggested to be contamination vectors in fats, shortenings and fatty acids.

Diethylstilbestrol (D.E.S.) was recently outlawed after many years of use as a growth promoting agent in livestock feeds. During an earlier period of its usage, stilbestrol pellets were implanted in the neck near the base of the head of poultry but this practice was stopped when it was found that the chemical accumulated in the skin, liver, kidney, and adipose tissue of treated birds and further, that its dissolution was incomplete at time of sale. Since the head was used by some consumers, it was feared that significant levels of stilbestrol might still be present and would produce undesired physiological effects. However, evidence presented to show that stilbestrol was converted to innocuous metabolites in ruminant animal feeds led to a decision permitting its use for this purpose until this year. Quite recently evidence was reported indicating that under certain conditions residual stilbestrol was able to produce malignant tissue in cattle and its usage in foods is banned.

The Delaney Clause of the 1958 Food Additive Amendment provides that no food additive may be used that is found to produce cancer when ingested by test animals even at excessively high levels in the diet. This concept restricts the application of sound scientific judgment in determining the safety of chemicals for use in foods since it does not accept the possibility that a substance that is carcinogenic at high levels in the diet is not carcinogenic at low levels, or that a substance that produces a tumor in one animal species may not produce it in other species or in man. Scientific evidence for both of these possibilities in relation to certain food chemicals is available. The Clause has never been strictly enforced because it is not possible to do so. Yet, food additive laws provide adequate mechanisms for preventing the addition of hazardous chemicals to foods without the Delaney Clause. The Delaney Clause should be stricken from the law.

Contamination during processing. Heating or cooking foods has many advantages and benefits such as destroying microorganisms or their toxic products, inactivating various enzymes and natural toxic components such as the hemagglutinins, goitrogenic substances and cyanogenic glucosides in various vegetables and improving acceptability of some foods from the standpoint of flavor, variety and digestibility. Indeed, the serious hazards of the inadequate use of heat in a commercial process was recently demonstrated by a fatality due to a botulinal toxin in vichyssoise. This toxin has been recovered from insufficiently heated home canned foods that have caused illness or death. While cooling may destroy vitamins or leach out of essential minerals, the benefits of heating far outweigh its disadvantages.

Last year (1971) considerable notoriety was given to a polychlorobiphenyl compound (PCB's) when this solvent was recovered from considerable quantities of contaminated fish meal. A commercial fish meal drying plant in North Carolina was observed by the supplier (Monsanto) to be using inordinate amounts of the solvent. Supposedly the firm was using the PCB's in a closed system heat exchanger, but wide scale leakage of PCB's was occurring. The problem was recognized by several egg-hatching firms after several settings failed to hatch. The problem was traced to the egg producing firm and, in turn, to the fish meal supplier. At first the problem was thought to be due to DDT because gas-liquid chromatography (GLC) analysis was typical of DDT; however, PCB's and DDT's have similar GLC retention times and eventually the true culprit was found. Since PCB's accumulate in adipose tissues, eggs from laying hens that were receiving the contaminated fish meal diet had high PCB and poor fertility. Since the time of finding PCB in hens and eggs, other segments of the poultry industry using fish meal in feeds have been monitored and recoveries from broilers and turkeys have been made. Similarly, the presence of PCB's in plastic containers - where polychlorinated compounds are used as a solvent for making plastics - has been reported.

Chemicals to Improve Quality

Intake of a chemical substance without evidence of any adverse effects does not prove its safety. Public health officials must be alert to the possibility that injury due to unrecognized sources may have been caused by substances long considered safe for use in foods. Delayed and/or insidious harmful effects are extremely difficult to attribute to specific causes.

In 1958 the Food and Drug Administration listed some 200 substances that had been used as food additives and were judged by qualified experts as "generally recognized as safe" (GRAS) for addition to foods without being subjected to rigorous regulatory control and extensive toxicologic testing. Subsequent to that time the list was expanded to include more than 600 items. However, in 1969 widespread distrust of the GRAS list developed when several of its members, such as the cyclamates, saccharin, monosodium glutamate and the brominated vegetable oils, came under suspicion. As a result of recommendations from several active consumer groups, a review of the GRAS list was initiated to determine the commercial output and the extent and manner of use in foods of each item, and to examine all the toxicologic data known about each. This undertaking will require several years. It is predicted that the GRAS list will survive without extensive changes because it is largely comprised of dietary supplements such as vitamins, minerals and other, and of natural flavoring materials and spices that have long been in use.

Although no evidence of adverse effect in humans was ever shown for agene, a bleaching and maturing agent for flour and for coumarin and safrole, flavoring agents of natural origin, use of these chemicals was discontinued when it was shown that, in very large doses, they produced harmful effects when fed to experimental animals. Similarly, the use of monosodium glutamate in processed baby foods was voluntarily discontinued when large amounts resulted in cell damage in the hypothalamus (brain) of infant mice.

The cyclamate artificial sweetening agents had been in use in foods over many years without any adverse effects in man but, in 1969, they were officially recalled as a result of controversial findings with experimental animals that they might be carcinogenic, mutagenic and teratogenic.

Food packaging materials. Hundreds of chemical substances are used in the manufacture of various types of food wrappers or containers. In these materials chemicals function as adhesives, antioxidants, coating and sizes, germicides, plasticizers, printing inks, stabilizers, etc.

The technology of the production of food packaging materials and of the methods for testing them for extent of migration of their chemical components into foods or for their interactions with the chemical ingredients of foods have become highly developed and well controlled by law. As a result of established precautions and practices, there is no evidence that toxicologically significant amounts of chemicals are gaining access to our foods from this source.

Summary

The need for chemicals has been discussed. Those chemicals occasionally implicated in episodes of food poisoning were subdivided under two main headings: preservative agents and quality improving agents. The preservative agents were split into two subgroups; i.e., inorganics - such as SO_2, fluorine, arsenic, selenium and mercury and inorganics - such as benzoic and oxalic acids, formaldehyde, ethylene oxide and linamarin. Quality improving agents have been subdivided into those that improve yields - such as DDT, D.E.S. and P.C.B. and those that improve quality - such as GRAS chemicals, cyclamate, and food packaging materials.

PREVENTION OF FOODBORNE ILLNESS FROM TURKEYS SERVED IN SCHOOLS

by Dr. Frank L. Bryan

In recent years, significant advances have been made in food technology, in kitchen equipment design and in overall foodservice operating efficiency. Despite advances, however, foodborne illness continues to be a public health problem.

Data gathered by the Center for Disease Control, Atlanta, Georgia, the governmental agency responsible for disease surveillance at the national level, indicate that during the past four years there were 1355 reported foodborne outbreaks involving 91,749 persons. Of the total outbreaks, 143 occurred in schools and accounted for 35,843 cases of illness. These statistics reflect the fact that school outbreaks tend to be large and are more likely to be recognized and reported by local health authorities than foodborne outbreaks in commercial establishments open to the general population.

A food most commonly incriminated in foodborne illness is turkey. Nationally, turkey has been associated with 11 percent of the total outbreaks reported during the past 10 years. In Georgia, where the Center for Disease Control is located, turkey has been associated with 20 of the 104 foodborne outbreaks reported and investigated during the same time period. Of the total Georgia outbreaks, 22 occurred in elementary and high schools, and 13 of these were associated with serving turkey. These turkey-associated outbreaks resulted in 2939 cases of illness in children and teachers.

Why Turkey?

Why is turkey so frequently incriminated in foodborne illness? To answer this question one must first understand the bacteria most often involved. These bacteria are *Staphylococcus aureus*, *Salmonella* and *Clostridium perfringens*.

Staphylococcus aureus bacteria cause staphylococcal food poisoning. These bacteria are found in the nose and throat of more than 25 percent of normal, healthy individuals. They are a common cause of minor skin infections, as well as of boils and carbuncles.

Staphylococcus bacteria get into food from a worker who coughs or sneezes over food or who handles food while he has an infection in the nose or on an exposed area of the body, particularly the hands. Food thus contaminated must have been cooked and must be of a highly perishable nature - ham, milk, eggs, poultry, custard - that will support growth of these bacteria. Contaminated foods must stay at or near room temperature for several hours for the bacteria to grow to large enough numbers to produce a toxin that causes the illness. Once formed, the toxin is very stable and is not destroyed by temperatures obtained in ordinary cooking procedures.

Salmonella bacteria cause an intestinal infection in man known as salmonellosis. These bacteria occur frequently in the intestinal tract of domestic animals, especially swine and poultry. For this reason, raw pork, chickens and turkeys are frequently contaminated with these bacteria when they enter the kitchen.

Humans who ingest food contaminated by Salmonella may carry these bacteria in their intestinal tracts temporarily, whether they are ill or not. Salmonella are easily destroyed by ordinary cooking (i.e., heating to 165°F.), but cooked food may become contaminated if it contacts equipment that was first used in preparation of raw meat or poultry, or if cooked food is touched by workers who have previously handled these raw products and have not subsequently washed their hands. Cooked food also may become contaminated by a worker who is carrying the germs if he returns to work after using the restroom without first washing his hands.

Following contamination, sufficient time at a favorable temperature (around room temperature) allows these bacteria to multiply and reach large enough numbers to cause an infection in the person who eats the foods.

Clostridium perfringens bacteria are found naturally in soil, untreated water and dust. They also are found on a large percentage of raw meats and poultry, in the intestinal tract of man and animals and in condiments, such as black pepper. Clostridium perfringens bacteria are capable of producing spores. Spores are bacterial forms that have a relatively hard exterior covering and contain very little moisture. Such forms are generally resistant to the adverse environmental conditions of heat, dryness and chemical action.

Although the actively growing bacterial cells are easily destroyed by ordinary cooking (i.e., heating to 165°F.), spores of certain Clostridium perfringens bacteria can withstand up to six hours boiling. This, of course, is more heat than would be applied in almost any cooking procedure. Then, too, heating seems to enhance the bacteria's ability to emerge from their protective spore stage and to become actively growing forms once the food that they are in has been cooled to about 120°F.

Clostridium perfringens bacteria grow best in poultry, meats, gravy and meat stock and they grow very rapidly at temperatures between 85° and 120°F. For illness to occur, extremely large numbers of the growing stages of these organisms must be ingested. Assuming a turkey or other large cut of meat is contaminated with Clostridium perfringens spores when received in a kitchen (a very likely possibility indeed), all that is needed after cooking so that enough organisms develop to cause an outbreak is for these foods to stay at or near room temperature for several hours.

It should now be more apparent why turkey is so frequently incriminated in foodborne illness. In the first place, raw turkeys often are contaminated with foodborne disease bacteria as they are received into a kitchen. Inadequate cooking may allow these bacteria to survive. Even with adequate cooking, the mere fact that raw turkeys are contaminated and that they will be handled after cooking in the same general area by the same personnel who previously handled the raw turkeys provides an increased chance for recontamination.

Secondly, turkeys require considerable handling after cooking before they can be served. Cooked birds must be deboned and/or sliced. Handling not only increases chances for recontamination with Salmonella, but it also increases the risks of contaminating the product with Staphylococcus aureus or Clostridium perfringens bacteria.

Thirdly, and perhaps most important, turkeys almost always are prepared at least a day before serving. With this much time before being served, undesirable bacteria that may have gotten into the food during handling, or in the case of Clostridium perfringens, may have survived cooking, can multiply in cooked turkeys if they are not cooled rapidly to 45°F. or less and held at this temperature.

Sometimes, turkeys are even left overnight in warm ovens that have been turned off. This practice provides ideal conditions for bacterial growth. On serving day, turkeys, gravy or dressing often only are warmed and not heated to a temperature (165°F) that would kill any bacteria that may have emerged from spores or undesirable contaminants that may have multiplied during storage.

Unfortunately, cooling is seldom accomplished with satisfactory speed. Turkey meat cools slowly when refrigerated in the conventional manner, and very often school kitchens do not have enough refrigerator space to handle the number of turkeys that must be prepared to serve students.

Turkey Handling

With these problems in mind, the authors conducted bacteriological and time-temperature studies to get data on how turkeys were being handled in school kitchens. They evaluated practices at three school kitchens and made studies in these kitchens to find practical ways of improving the situation.

Turkeys in various stages of preparation and equipment used in preparing them were swabbed, and the cultures were tested in a laboratory for Staphylococcus aureus, Salmonella and Clostridium perfringens. All three types of bacteria were found on the raw turkeys. Salmonella and Clostridium perfringens also were found on equipment that was used to prepare raw turkeys, and Clostridium perfringens was found on cleaned equipment subsequently used for storing turkey meat and stock. These findings reemphasize what has already been said. Foodborn disease bacteria often enter a kitchen on raw turkeys where they may be transferred to workers' hands or to equipment that is used to prepare turkeys for cooking. From these, further cross contamination may occur.

Clostridium perfringens also was found on cooked turkeys and in the stock. This organism's spores can survive cooking temperatures that turkeys normally receive. However, in the investigation it could not be determined whether this organism survived cooking or was introduced during handling of the cooked products.

Regardless of how the turkeys became contaminated, remember that these organisms will multiply to large numbers if turkeys are left at room temperatures for long time periods of if they are refrigerated in large pots or pans so that rapid cooling does not occur.

To test the effectiveness of routine cooking in killing bacteria that are on turkeys and to assess the possibility of bacterial growth during storage, the temperatures and time periods to which turkeys were subjected during thawing, cooking, cooling and reheating were evaluated. These evaluations were made with thermocouples and continuously recorded by a potentiometer while turkeys were being prepared in the three cooperating schools.

Thawing

Frozen turkeys were thawed in refrigerators, in double kraft paper bags at room temperature and on tables at room temperature. Results indicated that thawing turkeys in refrigerators was the most satisfactory method, but three days or more were required to completely thaw a 20-pound bird. Thawing in double kraft bags was also found to be a safe procedure as long as the thawing period did not exceed one hour per pound. Thawing turkeys at room temperature without enclosing them in bags resulted in conditions that permitted spoilage bacteria to multiply on skin surfaces.

Cooking

Thawed turkeys were cooked in gas ovens, electric ovens, convection ovens, pressure-type steamers, steam kettles and in pots on a range. Contamination on skin surfaces was readily destroyed by all of these cooking methods. It was possible to reach temperatures of 165°F. within the center of the breasts that killed the growing stages of foodborne disease bacteria.

Whole (20-pound) turkeys, turkeys that had been cut in half and turkey rolls made from 20-pound turkeys were baked in an oven under the same conditions. Cutting a turkey in half only decreased cooking time by 20 minutes. Turkey rolls weighed less, but their bulk caused a cooking time increase of more than an hour. Because surface contamination is incorporated into the interior of rolls during deboning it is critical that these rolls be cooked long enough to ensure that growing stages of bacteria are destroyed (165°F. internally).

Dressing was baked in separate pans on the day that the turkey dinner was served. No problems were encountered as long as boiled stock was used for mixing with the bread and other ingredients and as long as the dressing was cooked to internal temperatures that exceeded 165°F. Dressing was normally cooked to temperatures higher than 200°F.

Cooling

Cooked turkey meat and stock cooled very slowly, particularly when put into large containers. Stock, stored in gallon glass jars in a refrigerator, took longer than 12 hours to cool to 50°F. When stock was stored in 14-gallon pots, the temperature remained within an ideal range to support bacterial growth - even after overnight storage in a refrigerator.

Whole cooked turkeys that were stored in a refrigerator stayed within the bacterial growth range for 15 to 18 hours. Under refrigerated conditions, three-inch layers of pieces of boned turkey meat stayed within this range for 7 hours, and turkey rolls that had been cut in half stayed within this range for 10 hours. These time periods were long enough to allow enormous numbers of bacteria or large amounts of their toxins to develop.

Because of the slow cooling rate that occurs when turkey meat and stock are refrigerated, rapid cooling methods must be used if foodborne illness is to be prevented. Experiments on practical methods of rapidly cooling these foods in a school kitchen were performed. Several methods were tried. They involved immediately putting sliced meat in refrigerators, freezers, water baths and plastic bags in ice and on cold pans.

Most rapid way of cooling proved to be slicing whole turkeys and putting the meat in contact with a cold pan, such as a stainless steel pan inserted into another pan filled with ice. This reduced the meat's temperature to about 70°F. in an hour. When the pan was filled with approximately three inches of meat, it was transferred to the refrigerator.

Turkey rolls were cooled most rapidly by cutting them in half, putting them into double plastic bags and then putting the bags in a pan and covering with ice. The pan of ice containing the roll was then stored in a refrigerator.

Stock was cooled most effectively by pouring 2-1/2 gallons in a 5-gallon stockpot and putting this pot in a larger container and filling this container with ice to a height above the level of the stock or by putting the stockpot in a sink with cold running water circulating around the pan to a height above the stock level. By these methods, the stock cooled to about 65°F. in an hour, at which time it was transferred to a refrigerator. Mixing the stock with a vertical mixer also hastened cooling.

Reheating

Chilled turkey meat or turkey meat and gravy was reheated on serving day in steamers, in kettles of hot gravy, in pans on a range, and in pans in ovens. Varying results were observed. All of these methods, however, can be satisfactory if heating time is long enough to assure that the meat reaches 165°F. and that the gravy boils.

What You Can Do

Based on these observations, the following procedures for preparing, thawing, cooking, cooling and reheating turkeys in a school kitchen are recommended.

Thawing

1. Always thaw turkeys completely before cooking them.

2. Thaw plastic wrapped turkeys in refrigerators whenever possible. The refrigerator temperature should be 45°F. or below.

3. If turkeys have to be thawed within 24 hours or if refrigerator space is not available, enclose frozen birds in double kraft bags and thaw at room temperature. When thawing in bags, do not allow turkeys to remain at room temperature for longer than 1 hour per pound.

Cooking

1. Never stuff the internal cavity of turkeys with dressing because turkeys will be overcooked before dressing reaches a safe temperature.

2. Cook turkeys until the internal temperature in the thickest part of the breast or the center of rolls reaches at least 165°F. (180° to 185°F. and 170° to 180°F. are recommended for thigh and breast internal temperatures, respectively.)

3. Test turkeys for doneness with a thermometer by inserting it into the center of the thickest part of the breast or the center of turkey rolls.

Holding, Slicing and Cooling

1. Never allow turkeys to stay in unheated ovens (such as for overnight holding after cooking).

2. Never refrigerate cooked whole turkeys for overnight storage without first reducing their bulk size.

3. Wear clean, disposable plastic gloves when deboning cooked turkeys.

4. As soon as the cooked turkeys cool to a temperature at which they can be handled, debone them and slice or cut the meat into small pieces.

5. Put pieces of cut-up, cooked turkeys directly into cold pans (pans setting in pans of ice).

6. Do not pile turkey meat more than 3 inches high in pans.

7. When equipment is available, cool cooked foods and leftover foods in a walk-in refrigerator that is set at 40°F. or lower.

8. Store turkey meat and stock in separate containers.

9. Never store large batches of turkey stock in large stockpots.

10. Rapidly cool hot stock by immersing containers (2-1/2 gallons in a 5-gallon stockpot) in an ice bath, in a water bath, or by mixing with a vertical mixer before storing stock in refrigerator.

Reheating and Hot Holding

1. Boil stock on day it is to be used either before or during gravy preparation.

2. Reheat turkey meat in steamers, in kettles of boiling gravy, in covered pans on a range or in open pans in ovens, until internal temperatures reach at least 165°F. Caution: proper heating in a 325°F. oven will require 45 minutes or more.

3. Bake dressing until it reaches an internal temperature of at least 165°F.

4. Hold cooked turkey meat, gravy, and dressing in warming devices that keep the food's temperature at 140°F. or higher until it is served.

Storing Leftovers

1. Rapidly cool (see above methods) any leftover food and store in shallow pans in a refrigerator.

Cleaning and Personal Hygiene

1. Thoroughly wash and disinfect all equipment (such as knives, cutting boards and storage pans) that contacts the raw turkeys before such equipment is used for cooked meat, stock or other foods.

2. Wash hands after handling raw turkeys and before handling cooked products.

Preventing Foodborne Illness

Turkeys, the chief offenders in outbreaks of foodborne illness in schools, are frequently contaminated with food-borne disease bacteria when they enter a kitchen. Therefore, they must be handled at all times as if they are, in fact, contaminated. This means that turkeys have to be thoroughly cooked to destory contamination and subsequently handled in a manner that will prevent recontamination.

Because turkeys are almost always prepared well in advance of serving, failure to promptly and adequatley refrigerate cooked turkey meat and stock creates conditions favorable to bacterial growth, thus contributing significantly to the foodborne disease potential. These products must, therefore, be reheated adequately (not just warmed) before serving to destroy any bacteria that multiplied during storage. By following these recommendations you can help prevent foodborne illness in your school.

THE SOCIAL RESPONSIBILITIES OF THE SCHOOL LUNCH MANAGER

by Dr. John Perryman

"The Social Responsibilities of the School Lunch Manager." This is an unusual title, and a stimulating and thought provoking one. Customarily, subjects given me for my talks are pretty routine: "What changes may be expected in the Type A pattern." "How do we increase participation in secondary schools?" or "How do we meet the increasing aggressiveness of labor unions in school foodservice?"

All of these are very real problems, they are all very important questions which must be answered, and in no sense do I mean to belittle them. However, the topic given me today has a deeper meaning, it goes to the very roots of involvement of each and every one of us in school foodservice inasmuch as it involves our determination to help the child, it sheds light upon the answers to all other questions in school foodservice.

Let me share a confidence with you. I used to say that the secret of getting through Graduate school was to adapt whatever knowledge one had to whatever question the professor asked. In much the same sense, and I am sure this is no secret to you, speakers adapt an already prepared talk or particular message they wish to leave to whatever subject has been given them.

In this case, my subject demanded better and I had every intention starting, building this cake from scratch as you ladies like to say. The title titillated and intrigued me until I actually commenced work on this talk and then I found I did not know where to begin.

To me, to speak of the social responsibilities of school foodservice is really a truism; it is redundant and repetitious for indeed social responsibilities and school foodservice are synonymous. It is like speaking of the social responsibilities of religion or of the goodness of God, or of the cleanliness of soap or of the beauty of an exquisite flower. School foodservice at its best is a manifestation of social responsibility -- school foodservice at less than its best is a tragedy, an un-requieted opportunity to serve our nation's youth. But how was I to say this again, how was I to say it anew when it had been my message to you, to our colleagues and other professional organizations, to our nation and to a substantial part of the world for the past 17 years?

Why then I ask myself, why say it anew? Why not say it as you have been saying it for 17 years? This is a political year. Probably the most frequently repeated words between now and November will be "I stand on my record." Let me stand on mine. Someone once said, "Would that mine enemy would write a book," the thought being that once a person has expressed sentiments in writing, they are there forever. My beliefs in the oneness of school foodservice and social responsibility have been expressed in writing many times in articles and talks. As a former classroom teacher, shall we review?

Let us start right out with my article in June 1972 issue of SCHOOL FOODSERVICE JOURNAL, the "Looking Glass Self."

The theory of the looking glass self consists of three principal parts -- the imagination of our appearance to the other person; the imagination of his judgement of that appearance; and some sort of self-feeling, such as pride or mortification.

And so now we come to the real meaning of this article -- the reflection of ourselves. Into whose eyes do you look? Into the eyes of your family, your friends, your co-workers, your boss and -- most important of all -- into the eyes of children.

What image does each of these groups see of you? What do you read into their eyes, and how do you react to that question -- with pride or with mortification? The answers to these reflections may be found in your own set of values and in your own opinion of yourself.

If your own primary values are based upon wealth and social position and prestige, then you may feel demeaned, as you look at yourself as you believe others are looking at you. If, on the other hand, your primary values are based upon social accomplishment, if they take into account the value of helping others, if you consider it important and exciting and meaningful to contribute to the health and to the learning ability of kids and to a good start on like for kids, then you can look at your reflection in the eyes of others with enormous pride.

What others think of us is important to each of us. We wouldn't be human if it weren't and we wouldn't be honest if we said we didn't care. But instead of relying on the looking-glass self and gauging ourselves by what others think of us, I would rather use as a measuring device the self-looking glass -- what we think of ourselves.

And in our jobs, if we want to check ourselves out with anyone else, let's turn to the people whom we serve -- the children. Pride of mortification? Well, I'll say this -- With your head held high, it may be a little difficult to look into their eyes, but you'll need never be afraid to look into their hearts."

Then some years ago, I wrote a narrative -- which I hope was humorous -- entitled, "Would I Want to be my Dog?" We had visitors in Denver and wanted to take them to mountains for dinner. A place was selected where the road was early pioneer, the staff Swiss peasant, the menu pre-war German, the prices post-war New York and the decor late discount house reject. Of course, all of this could be summarized in one word, "picturesque." Taking our dog and our guests, we began our expedition.

I fought my way through miles of six lane traffic, more miles of four lane traffic, quieter village streets and at last plunged up the mountain-side on a narrow, winding, unpaved, honest-to-goodness authentic old-type road. The pines closed in, the lights in the valley dropped far below, and the guests swooned, the dog slept.

After dinner there was the return trip, from forest primeval to traffic upheaval. The dog slept.

At length we arrived home and the other preceded me into the house while I put the car to bed. Now my condition was slightly exhausted.

Upon entering the living room, I was greeted by the unbridled enthusiasm renewed vim, vigor and vitality of my dog, the southern extremity of her anatomy vibrating wildly which is Patty's way of saying "Now how about a good rousing game of ball?" I groaned audibly and wondered who on earth it was that ever critized a dog's life.

But would I want to be my dog? I'd be well fed, well housed, well cared for. I'd have a life free from decision and initiative. But now we come to the part I would not like -- instead of being a planner, a dreamer, a doer, I would have to be a waiter, an accepter, a follower. No, I'd rather be me.

Which are you in school foodservice -- a doer or a waiter, a planner and leader or an acceptor and follower.

The children need you.

This is the name of our game -- the children need you. Their health in these formative years, their ability to learn, their eating habits for the rest of their lives can be affected positively by you and your work. A poorly educated man whom I had working for me recently made the very poignant observation that, "ignorance is the only bill you keep paying all of your life, just keep paying and paying and never get it paid up." In the article, "No, Dad But you Do," I wrote of a very moving occasion when a young father and his son were going for a walk. The neighborhood was strange to the boy and the night was dark. "Do you know where we are going Danny?" the father asked. Without a moment's hesitation the little boy tightened his grip on his father's hand and replied, "No, Dad, but you do."

More millions of children may soon be placing their hands in ours. Do they know where they're going? No, but we do. We must.

> "If a man say, I love God, and hateth his brother, he is a liar: for he that loveth not his brother whom he hath seen, how can he love God whom he hath not seen? And this commandment have we from Him, that he who loveth God loveth his brother also.?

I. John IV 20 and 21

It takes a lot of patience, and yes it does take a lot of love of God -- to put up with the riots, the complaints and the student boycotts and still think of those little monsters in the serving line as your brothers. But that is the social responsibility of school foodservice.

Perhaps this thought was never more fully conveyed than in the article, "Just Cooks?"

The most pathetic mistake we have ever heard a speaker make occurred at one of our state meetings. "I was somewhat confused about the nature of this meeting tonight," he said. "Before coming here I thought you were to be a group of teachers, but I now find that you are just cooks."

Brittle shock waves of anger and astonishment broke the charged air of the room like Iowa lightning on a hot summer night. Gasping at the awfulness of his own blunder, the speaker stumbled through a talk which neither he nor his audience seemed to hear.

Well, now, let's take a long look at that term, "just cooks". First of all, we know that the "just" part of it (meaning "only," in this instance) is no longer accurate by any stretch of the imagination. School foodservice from its very beginning has grown rapidly into professionalism. By every device available to them, from workshops to graduate classes and from the JOURNAL to Association meetings, our members constantly up-grade themselves. School foodservice personnel today are not only expected to produce excellent food in quantity amounts, but they are expected to be master mechanics, chemists, sanitarians, nutritionists and purchasing agents. A dash of child psychology doesn't do any harm either. Furthermore, today's alert manager, supervisor or director is also a teacher in the finest and most literal sense of the word, many times carrying his or her food crusade into every classroom of the building. Too, it is difficult to estimate the amount of learning accomplished by the child in the lunchroom itself under stimulation from lunchroom personnel, teachers and other children. The patient and friendly food server who urges a child to "just try a little" of a new food may have a greater influence on a student's life than his algebra teacher.

So, "just cooks" are not JUST cooks anymore. But suppose they were? What's wrong with being a cook? What's wrong with ministering to the needs, the health and happiness of children through the scripture of good food? Ours is a magnificent opportunity for service if we will only realize it and approach it in this frame of mind. To show you what I mean, let me tell you about Mabel.

Recently your Executive Director spent ten days of annual leave in one of Southern California's delightful coastal communities. My hotel maid proved to be one of the most memorable people I have ever met. Bubbling with enthusiasm, she told me shortly after my check-in, "Oh, I just love my job; each room I go into holds a different story. Why, it's like going to a new movie every half hour." From that moment on, Mable concentrated on ways of making my stay a pleasant one. She picked wild flowers from the cliff sides, arranged them beautifully and then compared their delicate colorings with her favorite canvasses. She brought her dog to see me (since I am a dog lover), left magazine articles she thought would be of interest and dreamed aloud of visiting her son in Europe. Whatever the official title of this lady's job, she uses it magnificently to brighten the lives of others. The opportunity for genuine service to others can be one of life's most rewarding experiences.

> In the words of St. Matthew: "Then shall the King say... For I was hungered and you gave me meat: I was thirsty and ye gave me drink... Verily I say unto you, inasmuch as ye have done it unto me of the least of these my brethren, ye have done it unto me."

Be enormously proud that you can give of yourself -- the finest gift of all -- to the children whom you serve.

In the article, "Pancakes A Go-Go" I wrote of eating breakfast in a neighborhood pancake house and being startled to see no fewer than sixteen teenagers come in for breakfast, two of them with small brothers in tow, during the 30 minutes or so I was in the establishment. The sight of these youngsters lanquishing coffee and cigarettes on the way to algebra class was frightentng, to say the least. Against this background of sloppy nutrition and teenage habits, perhaps it is time to re-examine the philosophy of school foodservice. As to the lunch program itself, why has it accelerated at a rate of a million meals a year for the past twenty years? Because school lunch has become an integral part of the school day.

First, one out of every three married women in the United States is gainfully employed.

Second, full schedules and fuller high schools have demanded the fullest possible use of educational facilities. The leisurely hour or hour and a half lunch periods of a generation ago are now thirty or even twenty minutes.

Third, with massive school district reorganization across the nation, consolidation has brought about the bussing of more and more students across more and more miles, making a mid-day trip home increasingly impratical.

Fourth, if rural schools are grappling with geographic unification, urban schools are grappling with racial and ethnic unification. Furthermore, urban traffic hazards prompt many parents to favor lunch at school as a means of keeping their children off the streets at noon.

Fifth, a gratifying number of administrators now welcome the noon meal at school as an effective device for both teaching and demonstrating good nutrition -- as valuable a lesson as a child will learn at school.

Sixth, the commodity distribution program made such good use of our socalled "surplus" foods that excessive reserves have been all but eliminated.

Seventh and finally, youngsters eat well at school, in some tragic instances receiving their only good meal of the day. Of course, it is on the all-important Point Seven that the philosophy begins to change. It is at Point Seven that we begin to move from nutrition education, length of lunch hours and transportation to problems of just plain hunger. It is on Point Seven that we collide full force with the frustration of attempting to teach the hungry child anything at all.

It has been said that there is little difference between a person who cannot read and one who does not. Likewise, there is little difference between a child who cannot eat and one who does not. Malnutrition is also a great problem to cigarette-smoking, coffee-drinking pancake eater.

Whether because of parental neglect or economic disaster, the awesome fact is that many children are coming to school hungry. Government plans for foodservice in schools expand from noon to morning to night, from winter to summer and from student to truant to toddler because there is a frightening vacuum -- a lack of ability in some homes, yes but a lack of responsibility in many others. More and more we are feeding at school because no one is feeding at home!

As we in school foodservice face this explosion in our area of activity, let us face it in two ways. First, as school foodservice people, let us remember that we are becoming more and more a part of the life and family of the children whom we serve. Let us respond with all the love and interest and affection of our very souls. Second, as human beings, let us try to make our influence felt in our own communities across the land so that the institution of the home may be strengthened, the breakdown of family life halted and the concept of personal responsibility preserved. These are truths that have brought us strength as a people. Let us not now lose them.

As I speak of strength of people, I'm reminded of war-time England. In the article, "What is Your Hill?" I wrote of a personal war-time experience in England during World War II. My memories were of a bicycle ride across the magnificent countryside of England during the month of May when the grass on the hill sides was of so vivid a green as almost to hurt the eye. Rhododendron were just beginning to give way to azalea and roses, although all were still blooming with a profusion beyond belief to one born and reared in an arid climate. On one particular afternoon, a friend and I had been riding for several hours over the rolling countryside. In need of a short breather, we were pushing our bikes along the roadside when we came upon a beautiful little cottage set back from the road in the midst of a sizeable orchard.

Peering over the hedge at the enchanted house with high pitched, thatched roof, wisteria-covered doorway and lovely rose garden, we were "discovered" by the owner. The lady of the house proved to be as charming as her domicile, a widow of Scottish ancestry and mature years. "I was just going in to put the kettle on for tea, lads," aaid Mrs. Bruce. "I'd be delighted to have you join me." Hungry and tired from a long ride, and fairly possessed with a desire to see inside the cottage anyway, we deliberated a polite one or two seconds before accepting.

The hearth was fascinating, the hot tea was delicious, the scones and raisin buns, the home made strawberry preserves, apple butter and Devonshire clotted cream were even better. But best of all was the warmth and strength and personality of one Mrs. Bruce.

Our hostess was not a petite woman and most certainly she had reached an age at which neither man nor woman in our country would likely be riding a bicycle. None of these problems deterred her. "I see you lads on your cycles." she said "and it gives me courage to tell you of a wonderful victory I had this morning. As you will note when you leave, there is quite a hill between my home and the village. Day after day I have ridden as far as I thought I could and then dismounted to walk ignominously to the top. Today I said to myself, "Katherine -- wear out, don't rust out. Stop letting that hill have the better of you every morning." And so, this morning I kept at it and at it and at it, and I sailed over that hill -- still astride -- and I felt the fresh breeze strike my face at the summit and saw the village below me in the valley and I knew that I had won! I had won!"

So what's your hill; There are lots of them in school food service -- lots and lots of tiresome and worrisome and unpleasant jobs. But they can all add up to a keen and fine and genuine sense of satisfaction; satisfaction first of all for a job well done, whatever that job might be, and satisfaction of even greater meaning in your case because your work contributes to the well-being of our nation's youth.

Next time the pots and pans seem just too much, remember Mrs. Bruce's hill. There is only one difference. At the top of your hill lies the ability to help another human being. As they say it in the Big Brother's orgainzation, no man stands as straight as when he stoops to help a boy. You stoop to help many children every day -- walk straight and proud in that knowledge.

In one of my more fanciful moods I adapted Stephen Vincent Benet's short story, "The Devil and Daniel Webster" to the subject of school foodservice. In the closing paragraph of this talk, I portrayed Daniel Webster pleading with a school superintendent on behalf of the foodservice operation. After describing the importance of the whole educational process, I then had Daniel Webster say:

And then I speak to you of a child too hungry to hear. No food in the house? What a pity! Mother out late last night with Dad? No breakfast? How sad! Too broke for anything but a Coke? Too hungry to hear!

Now, gentlemen, I speak to you in the language of food--food to feed, food to teach and food that others may teach. I speak to you of a school foodservice in the vanguard of the learning process. Each of our children, whether he learns to master the universe or -- perhaps even more important -- to master himself, will need to speak well the language of food. Define not for me such language in terms of profit and loss. How dismal will be our profit and how tragic our loss if, as the soaring spires of tomorrow's learning reach ever higher, the child is too hungry to hear.

The superintendent rose, crossed the room and shook ole Dan'l by the hand. "Mr. Webster, you've helped me to see that foodservice facility of ours is already a multipurpose room -- it provides food, it provides knowledge of food, and it provides food that makes knowledge possible. Every part of our schools, every last corner, every last ounce of energy should be dedicated to teaching the child. How can we nourish his mind and spirit unless we have first nourished his body? You have asked, Mr. Webster, "How stands the Nation?" My answer is she stands as she stood, Mr. Webster, rock-bottomed and copper-sheathed, and so she shall so long as our schools the speak the language of our children, and our children are not too hungry to hear.

And finally, I borrowed from Theodore Bonnet's moving short story, "The Mudlark," the tale of an entire country excited over the doings of one little boy. The little boy was an orphaned urchin named Wheeler who had been virtually enslaved to the master of a coal barge on the Thames River. As the boy had gone his lonely way through life, he had often heard the expression that Her Majesty the Queen was sovereign and mother to all her subjects. In one of the grimy pockets of his coat, the lad

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One foggy night Wheeler slipped from his coal barge while it was in the vicinity of Windsor castle and crept into the grounds past the guards. Whether by fate or destiny, a careless workman ahd left open a coal chute into which the boy tumbled unknowingly, next to find himself in the tunnels beneath the great castle. Breathlessly, trembling with fear on one hand, but driven by a determination to see hes royal mother on the other, the boy made his way through the corridors until he stumbled onto the Throne Room and the Queen herself.

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For a time after his discovery and capture, it appeared that the outcome would not be happy for Wheeler. As often happens in groups and nations, politics arose, fanned by personal jealousy and ambition. The opposition party in the government took hold of the matter and claimed that no mere boy unaided could have reached the Throne Room of great Windsor Castle, that it was all a part of a plot by the Irish extremists to assassinate the Queen, that Wheeler was the focal point of a conspiracy against the life of both the Monarch and the Monarchy.

Eventually, the debate raged all the way to the House of Commons where the Prime Minister, Benjamin Disraeli, informed the House that any suspicion of an Irish conspiracy was rejected by Her Majesty's government since there were no facts to support such a charge.

"Now the House of Commons," Mr. Disraeli spoke, "is a strange place to try a boy. But it is the best of all places to discuss those aspects of the case that concern the Nation."

"How ever did Wheeler excape?: For only think how hard society tried to kill him. It laid an ambush for him at his birth, surrounding his cradle with rats and vermin. It sent off gasses from foul drains to pollute the air he breathed. It tried to poison his mother's milk through her drinking water, but succeeded only in poisoning his mother. She died of typhus before he could walk. It was not necessary to poison his father also, because he had never known a father. His country did not stop at attacking his physical being. It also attacked his spirit, and his soul. It taught him nothing. It withheld the work of God from him. It did not tell him of his English heritage, for it never occurred to his country men that he had a heritage. And in the lanes and warrens of the river front, it exposed him to the worst influences of immorality and evil. It cast him out; it denied hope to him.

But somewhere it failed.

For one day he raised his head and looked about him, and he walked out of the mud, and went to see the Queen. Had the way been prepared for him? Windsor Castle's walls are high, but they were no let to Wheeler. The Household Guards, I am told, are the finest soldiers in England, but he passed them as if they had not been there. And he saw the Queen, as you have heard, and went trailing mud into Windsor Castle. And that is why I say that what he did was no mere boyish adventure. But it seems to me that no duke or admiral has ever paid the Queen of the

United Kingdom a handsomer compliment.

But the House must not suppose that I rose here to defend Wheeler. The true wealth of Britain is British character and by drawing attention to one facet of that character which seems to shine through the deed that Wheeler has done, I have only sought to advance the case of British children, among whom he is but a ha'penny bit of our great capital investment in the future.

I shall now have been left without a single argument with which to defend the boy -- save only one: That if in this case a conspiracy did exist as charged, then that conspiracy was not against the Queen, but against the boy."

To you assembled leaders, I say this is our purpose, our direction for the year ahead: That in this beloved land of ours there shall not be a conspiracy against the child!

You are the programmers of the health and education of our nation's youth. School foodservice IS social responsibility!!

INVESTIGATION AND REPORTING OF FOOD BORNE ILLNESS

by Dr. F. J. Spencer

The title of this talk should be "Reporting and Investigation of Food Borne Illness" since an investigation cannot be conducted unless a report has been made. There are, therefore, two distinct parts to this topic, i.e. the reporting of food borne illness and the investigation resulting therefrom. There are two main components of reporting.

1. By whom is the report to be made?
2. To whom is the report to be sent?

As for investigation, the fundamental question is this: Why should an investigation be made? Once the necessity of investigating food borne disease has been established, there are three questions to be answered.

1. By whom should the investigation be made?
2. How should the investigation be conducted?
3. What should be done with the results of the investigation?

REPORTING

It is estimated that only some 10% of food borne disease outbreaks in this country are investigated. The reasons for this under-reporting stem from the fact that food borne illness generally is mild in nature and does not come to the notice of the physician. Apart from that, doctors have the reputation of reporting few diseases because their time is spent in patient care and not in the administrative aspects of their practices. One of the reasons for the poor reporting record of physicians probably stems from the lack of feedback to them from the agencies to which they report. The additional factor of the stigma attached to having food borne disease associated with a food establishment may result in the proprietor or manager of the restaurant or lunchroom failing to initiate the report.

It is somewhat disturbing to see the statement made in the program of the meeting that "School lunch cafeterias had the largest incidence of food borne illness in the United States during 1968 and 1969 and second largest in 1967 and 1970." Reporting is based on the number of persons who become ill and the number of outbreaks containing these illnesses. Considering that there are some fifty million students enrolled in the nation's schools and that some one million of these are in Virginia, it is not surprising that schools rank high in the reporting of food borne disease. School lunch programs generally have conscientious persons in charge of their programs and this, of course, adds to the likelihood of reports being made. In addition, parents no doubt play a role in publicizing the food borne disease outbreaks in schools. The age of the student also must play a part as children are more susceptible to infectious diseases of any type because of their lack of immunity. This accounts for the age distribution of the so-called childhood diseases of measles, mumps, and chickenpox which result from susceptibility to the first exposure to the disease germs.

BY WHOM IS THE REPORT MADE?

In Virginia, the law is quite specific upon this point and states that "Every physician, practicing in this Commonwealth, who shall know or suspect that any person whom he is called upon to visit, or who comes to him for examination, or treatment, is suffering from an infectious, contagious, communicable and dangerous disease shall make report in writing, on blanks to be furnished for that purpose by the State Board of Health, to the State Health Commissioner... When no physician is in attendance it shall be the duty of the superintendent or other person in charge of any school, institution, hotel, boardinghouse, camp or vessel ... to report immediately the name and address ... to the local health officer."[1] Within the Virginia school lunch program, a form is used for reporting purposes. I assume that any school personnel may initiate a report through the accepted channels. On occasion, it has been my experience that the first report comes from a newspaper but, whatever the source of the report, an investigation should follow.

One further aspect of reporting which is quite often ignored is the reporting of disease in personnel working in food establishments. Again, the law is quite specific upon this matter and states "No person while affected with any disease in a communicable form, or while a carrier of such disease, or while afflicted with boils, infected wounds, sores, or an acute respiratory infection shall work in any area of a restaurant in any capacity in which there is a likelihood of such person contaminating food or food-contact surfaces ... If the manager or person in charge of the establishment has reason to suspect that any employee has contracted any disease in a communicable form or has become a carrier of such disease, he shall notify the Health Commissioner or his duly authorized agent."[2] The word "restaurant" in the law includes "schools and colleges both public and private."

There is therefore the dual responsibility of reporting in school lunch rooms, i.e. the reporting of disease in people who eat the food and the reporting of personnel who have communicable diseases and may therefore contaminate the food.

TO WHOM IS THE REPORT TO BE SENT?

In Virginia, the report should be sent to the local health department. Every county and city in the State of Virginia has a full-time local health department which is affiliated with Virginia State Deaprtment of Health. It is then the responsibility of the local health department to investigate the disease and, if indicated, to send reports to the appropriate State and National agencies, e.g. the Virginia State Department of Health, the Center for Disease Control (CDC) of the Public Health Service (PHS), the Food and Drug Administration (FDA), and the U. S. Department of Agriculture (USDA).

INVESTIGATION

WHY SHOULD AN INVESTIGATION BE MADE?

Obviously, the intent of an investigation is to reveal circumstances which will prevent further cases of disease being associated with the consumption of food. Perhaps the best example of this comes from experience with botulism in the past few years. Association of cases of botulism with various commercial products such as fish[3] and soup[4] resulted in these products being removed from the market, therby preventing further illness from occurring. In some instances, these precautions have international ramifications and result in changes in food practices and even in legislative action. One aspect of legislation is that occasionally litigation ensues from a food borne disease outbreak and a thorough investigation must be made to support or refute the allegations made.

Reporting and investigation contribute to establishing disease patterns and trends from local through state, national and international locations. The reporting of Salmonella derby infections from several states in the northeastern part of the country in the early 1960's resulted in the disclosure that these infections came from commercial producers of raw eggs which were being used in hospital diets.[5] It is now generally agreed that the use of raw egges in hospitals should be confined to those for whom a written order by a physician is required.

The natural history of a disease process is revealed by its investigation. Characteristic of this statement is the revelation that Clostridium perfringens was a common bacterial contaminant of food after special airless techniques were used to investigate disease outbreaks.[6] Currently, the appearance of Vibrio parahemolyticus as a food contaminant in this country substantiates the findings already well established in Japan.[7] The special culture techniques required for this germ will almost certainly reveal that it is a more common contaminant than previously supposed.

On occasion, investigation reveals that the supposed food borne outbreak has nothing to do with food. In my experience, this has occurred twice. The first time was when an outbreak of vomiting occurred in a band travelling by school bus. This was probably a combination of motion sickness, excitement, exhaustion, and the exuberation of youth. One further outbreak which was attributed originally to food was probably an outbreak of "epidemic winter vomiting" although the investigation revealed Salmonella typhimurium in ham and Shigella organisms in two of the ill persons. Clinically and epidemiologically, these were probably chance contaminants.

The ultimate aim of investigation is surveillance. This means the collection of data, and its analysis and correlation to maintain a watch on the patterns of disease in the country and the world. Distribution of reports resulting from surveillance is made to all persons who have an interset in the disease and need to know of its progress and patterns.

BY WHOM SHOULD THE INVESTIGATION BE MADE?

Ideally, the investigation should be made by a team consisting of a physician, a public health nurse, a sanitarian, a laboratory expert, and a clerk. The physician makes the diagnosis, the nurse interviews patients and personnel, the sanitarian inspects the food establishment, the laboratory expert examines the specimens submitted by the team members, and the clerk, of course, types the reports. Occasionally, consultants may be brought in but usually the work is done by local health department personnel.

HOW SHOULD THE INVESTIGATION BE CONDUCTED?

As indicated, the various members of the team play distinct roles in investigation. Generally, the sanitarian will be the member of the team with whom food personnel have most contact. He will inspect the kitchen and food service areas, with particular interest in the time and temperature relationships of food. In addition, he will ask for menus and the number of meals served to allow him to calculate attacks rates for the various foods suspected. He will collect food samples and transmit them under refrigeration to a laboratory.

In an investigation, the objective is to demonstrate the presence or absence of the suspected germ in the raw food or food handlers, in the actual food consumed, and in the persons who become ill, thereby establishing a chain of infection or intoxication. Specimens will therefore be required from all these sources. The form used for food borne disease investigation by the Center for Disease Control is comprehensive and technical in content. One final comment that should be made is that the cooperative and courteous reception of the investigating team is desirable and they should reciprocate by performing their work with minimum disruption and maximum courtesy and thoughtfulness.

WHAT SHOULD BE DONE WITH THE RESULTS OF THE INVESTIGATION?

A report should be made to one or all of the appropriate agencies already enumerated, e.g. Virginia State Department of Health, Center for Disease Control, Food and Drug Administration, U.S. Department of Agriculture and also, of course, to the school principal and to interested persons within the school and its lunch program.

SUMMARY

The reporting and investigation of food borne disease are two distinct entities. Reports should be made by physicians if consulted, and, if not, by school personnel. All reports should be made to local health departments in the State of Virginia. Investigation is necessary to prevent more illness and to contribute to the knowledge of disease and its patterns within the country and the world, thereby contributing to the overall surveillance of food borne illnesses. Investigation, made by a team, should be conducted in a courteous and cooperative manner and should result in a report which is transmitted to the appropriate authorities.

FOOD STORAGE AND HOLDING

by Dr. P. P. Graham

In your food service industry, storage serves to temporarily house purchased food items and may be called the "link between receiving and preparation". During this period of time there are some things that you should see. Not as the owl sees but:

<u>You should check</u> -

1. all purchased items promptly upon delivery for
   a) adherence to buying specifications. If items do not meet the requirements set forth in the purchase order, they should be returned. Don't just buy what you see delivered, actually "see" (check) what you buy.
   b) containers with physical damage.
   c) the product for visual defects such as discoloration or leakage.
   d) for many other product deficiencies such as improper temperature, shrinkage, etc.
   e) canned items for abnormalities which might indicate the condition of the product: broken seals, swells, rusts, etc.

You shold know the Composition of the food products to be stored. If they are plant origin the wastage during storage will fall into two general categories:

1) Pathologic - defined as those losses due to microbial disease, insect attack, or physiologic disorders aggravated by faulty storage conditions.

2) Natural - difined as losses from respiration, loss of water, and sprouting (in root crops). Natural wastage is a more insidious type and is more difficult to control. In contrast to plants, animals cease to respire in product form. Thus animal product losses are generally related to microorganisms.

With some knowledge of composition, we should selectivity <u>Control</u> the storage of these products.

Available controls are generally limited to temperature and air circulation but certain facilities allow some control of relative humidity. The relative humidity of the air in storage rooms is directly related to the keeping quality of the products stored therein. Low relative humidity causes weight losses as manifest by wilting or shriveling of some fruits and vegetables. If it is too high, it favors decay especially if temperature varies in the room.

Relative humidities for leafy vegetables and root crops should be about 90 to 95 per cent. For most other vegetables 85 to 90 per cent is recommended. Meat and eggs require 90 per cent relative humidity.

Air movement is related to relative humidity and a doubling of the rate is equivalent to abcut a 5 per cent drop in relative humidity. Thus the drying effect on the product would increase by about one third. The types of controlled storage are generally provided for satisfactory preservation of food quality according to the respective requirements of the foods. For dry items such as staples and canned goods, "dry storage" is provided. This type of storage serves food items which do not require refrigeration but must be protected from freezing, excessive heat, and dampness and from rodents and insects. Dry storage rooms may be generally classified as "cool" storage since they should be at a cool temperature (50-70°F), well ventilated, and dry. A relative humidity of 50-60% is satisfactory for many products kept in dry storage.

This type of storage room is frequently located in a basement and thus all sorts of pipes with hot and cold water and sewage may run overhead. Continuous surveillance for leaks is a must when these conditions prevail. It is also important that hot water and steam pipes are insulated to avoid unfavorable high temperatures in the storeroom. Temperature can also be increased to an undesirable degree by sunlight entering through glass windows.

Cold storage generally refers to refrigerator storage with temperatures set at the optimum temperature for the particular food. Dairy products and eggs are stored near 40°F, meat and poultry at 30-36°F, fish are kept near 32°F and fruits and vegetables between 35 and 45°F. Caution should be taken to check and recheck the temperatures that actually prevail in a refrigerator. Correct temperatures are too often assumed which, in reality, do not exist. Frequent regular checks are necessary to determine the warmest spot within the refrigerator and adjust the temperature so this spot will not be higher than the maximum desirable for the particular food housed.

Freezer storage is recommended at a temperature of 0°F or below, except for ice cream to maintain the culinary quality of frozen foods. Ice cream is usually stored at 6-10°F because it is more easily handled at these temperatures and is is said that its culinary quality is enhanced. Constant care should be taken to protect the containers of frozen foods and when foods are wrapped for the freezer, moisture-vapor proof materials should be used.

Foods should be covered for storage. Dairy products and eggs absorb odors from other foods and should be stored separately. Eggs are stored with the pointed ends down and should not be disturbed more than is absolutely necessary. Crates should be stacked to allow for circulation of air and so should crates containing fruits and vegetables.

It goes without saying that prolonged storage does not improve the quality of perishable food. Even when microbiological safety is not a consideration, culinary quality may deteriorate. Therefore, you should circualte stock to keep it current. Certain generalizations can be made about the rapidity of using various food products. Fluid milk should be used very rapidly since it readily assumes off-flavors. Among meats, lamb, pork, and poultry do not improve in quality with prolonged storage. Beef can be held under proper conditions for 7 days or more. Eggs will keep fresh for a long period of time at the proper temperature and relative humidity. Fruit and vegetable storage are limited most often by natural wastage and the time of storage must be determined for each food establishment.

And now the last thing you should see is Clean. Sanitary care of all storage areas involves frequent inspection of the food supplies and removal of items suspected of quality deterioration. In addition, regular cleaning of floors, walls, and shelving. The ingredients most often left out of a cleaning program are not hot water and soap, but good brushes and "elbow grease".

So in regard to food storage and holding, Ollie the Owl says you should see clearly that it is wise to check carefully, categorize according to composition, control storage by storing under the proper conditions and for correct periods of time, and clean continuously.

HOW CLEANING COMPOUNDS DO THE JOB

by Dr. Edmund A. Zottola

The topic assigned for discussion this morning is How Cleaning Compounds Do the Job. But, first, let us try to establish why we have to clean. What are the objectives of a cleaning program? What is the job that cleaning compounds have to do? Cleaning and sanitation mean different things to different people. (1) To an entomologist, cleaning and sanitation mean control of insects. To a microbiologist, cleaning and sanitition mean control of microorganisms. Since I am a microbiologist, we are going to spend our time this morning talking about cleaning as it relates to control of microorganisms.

When dealing with microorganisms, one must consider what I like to call the microenvironment. You have had a discussion about microorganisms, and I am sure you are aware that they are very small creatures indeed. We have to consider the area which immediately surrounds this very small creature. This is the microenvironment. When cleaning to control microbial activity, we have to take into consideration the microenvironment. One may consider that a piece of equipment is clean. A casual look at the equipment will lead one to believe that it is clean. But, if you closely inspect it, you might see that there are scratches on the surface of the equipment. This scratches are microenvironments which will harbor bacteria. These bacteria can grow and create problems with your product that is processed in this equipment. You have to keep the concept of a microenvironment in mind when dealing with a cleaning program. Then, in answer to our question, why do we clean, the objectives are given on this slide. (2)

1. We want to control microbial activity
2. Preserve freshness and palatability of the food that we are producing
3. Insure the food is free from disease-producing organisms, healthful and nutritious

Whether or not these objectives are met, depends upon an understanding of the requirements of an adequate program. Our purpose is not to tell you how to clean, but help you to understand what is required to do an adequate job. What is required for an adequate cleaning program? (3) These are listed on the next slide. We must have, first of all, an adequate water supply. We must know how detergents work. We must have a knowledge of the performance of the detergents. We must know something about sanitizing agents; and last but not least, we have to know the type of soil that has to be removed. Once these requirements are understood, the cleaning process becomes clearer and easier to understand.

(4) What is the nature of the soil that has to be removed in a food service operation? This next slide defines soil. Soil is dirt deposits or residues or anything which must be removed from the surface in a cleaning operation. (5) Soils with very few exceptions in food processing are composed of fats, proteins, carbohydrates, and minerals. The soil or dirt is going to be the same in a bakery, a candy factory,

or a meat processing plant, or a restaurant, or a school kitchen. The only thing that varies is the amount of each one of these components. And further, in relationship to understanding the nature of the soil, (6) we have to know how much there is to remove. Is it a thin film, a thick hard crust, or is there no visible film? In what condition is it? Is it dried on, baked on, or burned on? (7) Is it fat, carbohydrate, protein, mineral, or a combination of these? We will talk more about this in a few minutes.

One of the first requirements listed was an adequate water supply. The attributes of an ideal water supply are listed on this next slide. (8) It should be free from microorganisms which cause disease or product defects. It should be clear, colorless, cool, and free from odors either scale forming or corrosive, and soft. Water hardness is caused-by the calcium and magnesium salts which are present in the water. Permanent hardness salts that are not precipitated by heat, temporary, or bicarbonate hardness in water are heat precipitated; and in addition, some cleaning compounds have the ability to precipitate out this hardness causing cleaning problems. It is not always possible to have a water supply that meets all these requirements. So what one should do, is attempt to tailor your detergent to take care of what problems you may have with the water. We will not dwell on this at this time, but merely point out that this can be done; and in most cases detergent suppliers are glad to tailor make a detergent for use or help you if you have a hard water problem.

(9) The second requirement in our program was a knowledge of the function of cleaner ingredients. Let us take just a few minutes and look at how these cleaner ingredients work. (10) What are soaps and detergents? How do they differ? And how do they work? Let us start with soaps made from natural fats. (11) Soaps are cleaning agents because each soap molecule has two distinct parts. (12) One part is called a carboxylate group. This group is attracted to water. (13) The other part, know as a hydrocarbon chain, is repelled by water. These distinct parts enable soap to work as a cleaning agent. (14) If we have oily greasy dirt on clothing, as an example, water alone will not remove the dirt because the oil in the dirt repels the water molecule. (15) If we add soap, the hydrocarbon end of the soap molecule is repelled by the water, but is attracted to the oil in the dirt. Meanwhile, the (16) water seeking end of the molecule is attracted to the water molecule. The soap molecule is active at the surface as a surface acting agent or surfactant. (17) Most surfactants are wetting agents. They lower surface tension of the water, and thus improve water's ability to penetrate and loosen the soil. One end is attracted to the oily dirt, the other toward the water. (18) These opposite attractions loosen the dirt. Agitation in a washing machine or by hand scrubbing helps pull the dirt free. (19) Soap molecules surround and suspend the dirt particles in the water until they are flushed away. (20) This ability to dislodge or free dirt from a surface is known as detergent action. Thus, soap is a natural detergent. (21) Soaps are produced by the reaction of an alkali with animal fats or plant oils. This reaction produces a soap molecule with a water seeking portion at one end and the dirt seeking portion at the other. (22) Soap, however can pose a problem. The minerals that cause the hardness in hard water that we talked about

earlier, react with soap to form an insoluble curd. (23) This insoluble curd is also responsible for the ring that we see around the bathtub. (24) Thus, in many cases, soap is not a very useful detergent, and in many cases, may cause cleaning problems because of this curd formation.

A synthetic detergent works in much the same way as a soap, except that there is no reaction causing a curd formation. Let us compare soaps which are surfactants and surfactant portion of detergents. (25) Both have the same basic type of dirt seeking hydrocarbon end. However, the water seeking ends are different The water seeking end of soap forms curds in hard water. (26) The water seeking end of detergent surfactant does not. (27) Since the surfactants of detergents do not form curds even in hard water, clothes are cleaner.

(28) Basically, a detergent consists of a surfactant and a builder. Builders control properties in wash water that tend to reduce the surfactant's effectiveness. Phosphates are excellent builders especially for heavy duty cleaning compounds. Phosphates contain phosphorous. (29) The simplest phosphate has a single phosphorous atom. Sodium tripolyphosphate, a complex phosphate with three phosphorous atoms, is used most often as a builder in detergents. Why are phosphates used as builders in detergents? Actually, phosphates perform seven different functions.

(30) 1. Phosphates enhance the wetting effect and cleaning efficiency of detergents
(31) 2. Phosphates emulsify oily, greasy dirt by breaking it up and freeing it from the soil's surface.
(32) 3. Phosphates suspend dirt, loosen dirt, and keep it from settling back on the clean surfaces.
(33) 4. Phosphates provide the alkalinity necessary for effective cleaning without being hazardous.
(34) 5. Phosphates buffer or maintain the proper alkalinity in wash water.
(35) 6. Phosphates soften water by keeping minerals dissolved and, thus, prevent them from settling on clothing and dishes.
(36) 7. Phosphates help reduce numbers of bacteria associated with a clean surface.

(37) Therefore, adding a builder such as phosphate to a surfactant, provides a much better cleaning agent at a lower cost.

In formulating a detergent, various other materials may be added besides the surfactant and the phosphate. (38) These would include particularly in a detergent formulated for home use such as brighteners, bleaches, suds control agents, substances such as carboxymethylcellulose which prevents the resettling of dirt, and lastly because, apparently, the American likes to have the soaps smell good or the detergents smell like good perfumes. This then, basically, is how detergents work.

(39) The primary function of a detergent in water is to take a soil that is insoluble in water and make it soluble in water so that it can be flushed away form the surface. During our discussion of how

detergents worked, we used some terms that refer to how cleaner ingredients function, and we should perhaps spend a few minutes and define these terms.

(40) First of all, we talked about hard and soft water, and the function of softening a water is the removal or inactivation of the hardness of water. This may be accomplished in one of two ways, either by (41) sequestration which is the removal or inactivation of water hardness by the formation of a water soluble complex or ring structure with water hardness constituents. This is illustrated in this next slide. (44) And then, of course, another way that water can be softened is through an ion exchange method. The first two methods, sequestration and chelation, can be carried out by phosphates or other compounds in the formulated detergent.

(45) Wetting or penetration refers to the action of water coming in contact with all surfaces of soil or equipment.
(46) Dissolving is a production of water soluble products from water insoluble soils.
(47) Rinsing is the condition of a solution or suspension which enables it to be flushed from a surface easily
(48) Suspension is the action which holds up insoluble particles in a solution.
(49) Emulsification is the mechanical formation or breaking up of fats and oils into various small particles which are uniformly mixed with the water used.
(50) Peptizing is the physical formation of colloidal solutions from soils which may be only partially soluble.
(51) Saponification is the chemical reaction between an alkaline compound and animal, or vegetable fat resulting in the formation of soap.
(52) Deflocculation or dispersion is the action of breaking up aggregates or flocks into individual particles.

We have defined these terms because as we talk about how to remove some of our soils later on, we will use these terms quite frequently.

(53) What kind of chemical compounds can we use to make up cleaners? These are listed on our next slide. (54) They are the alkaline compounds, the phosphates, the wetting agents, the inorganic acids, and the chelation agents. Let us briefly run through some examples of each of these. (55) First of all, we have caustic soda or you may call it lye, Drano, or things like this. Caustic soda is a very high alkaline compound. It peptizes or suspends dirt, it saponifies oil and fats. It has a high germicidal power, but it is very corrosive; and consequently, it is not very seldom used alone. (56) Metasilicate is another alkaline. It has a good wetting, and emulsifying, and deflocculating powers, and has anticorrosive properties. (57) Orthosilicate is high active alkalinity, offers high neutralizing and saponification power, very corrosive, is often used in floor cleaners to clean up grease. (58) Sequisilicate has good wetting, emulsifying, and soil suspending properties, not highly corrosive, removes saponifiable material, and is very useful where you have a bicarbonate problem. (59) Soda ash is one of the oldest alkaline cleaners we have used. It is not effective alone. It acts as a buffering agent in combination with other cleaners, and it

does form scale in hard water areas. (60) Sesquicarbonate is another alkaline cleaner ingredient. It dissolves rapidly, has excellent water softening properties, and good buffering power.

Phosphates would include such things as (61) trisodium phosphate which has emulsifying power. When used alone, it does have a spangling effect on tin and aluminum when used hot. (62) Tetrasodium pyrophosphate is another alkaline cleaner which has some application. Sodium tripolyphosphate and sodium tetraphosphate are water softeners and detergents, sodium hexametaphosphate is another one that is used as a water softener.

(63) The third type of cleaner ingredient was the wetting agents, and these compounds increase the ability of the detergent solution to penetrate into soil and remove it from the equipment. Three types of wetting agents are: anionic, non-ionic, and cationic. We will not dwell on how these work right at the moment.

(64) Acid cleaners which are used primarily to remove mineral deposits, and these would include both inorganic acids and (65) organic acids.

Before we finished up our discussion on how cleaning compounds do the job, we should point out that there can be some complicating factors, (66) and these would include such things as: temperature of the process involved, the drying of films, the presence of acidity in the product, the nature of the product whether or not there has been denaturation of the protein, and finally mineral deposits.

(67) What is required to remove various soils? Fats. (68) We need warm water. Fats are much more easily removed from equipment if they are in a liquid state so warm water is a necessity. It is a good idea to have some alkali in your detergent because it saponifies the fat. Emulsifying agent in the detergent surface, and a good detergent for fat removal usually contains both strong alkali and emulsifying agents.

(69) Proteins are soluble at alkaline pH's, they adhere very rigidly to surfaces. Alkaline cleaners with compatible wetting agents are effective for protein removal. Chlorinated alkaline cleaners are helpful in removing protein deposits. In this case, the chlorine in the alkaline cleaner does not act as a sanitizer, but is very effective in peptizing any protein. And if you remember the definition of peptizing, which was the physical formation of colloidal solutions from soils which may be only partially soluble, we can see that a chlorinated alkaline cleaner should be a very effective cleaning compound.

(70) Carbohydrates, another one of our soils, are readily soluble in water, and most any detergent that will remove protein will readily remove carbohydrates.

If you have followed what I have said, you noticed that there are some striking similarities between the compounding of detergents that can be used for the removal of fats, proteins, and carbohydrates.

All three can be removed with an alkaline detergent, and many of the cleaning compounds which are formulated for general usage in a food operation would take care of these three soils.

(71) The fourth type of soil, the mineral deposit, is the one that usually causes the most problems. And these can be easily removed by using an acid cleaner. Man people get into problems with mineral deposits because they do not use an acid cleaner. The normal alkaline formulated detergents will remove fats, proteins, carbohydrates, but will leave behind the minerals that may be present on the equipment. That is why it is necessary to use an acid cleaner. If we were to establish a cleaning program particularly in a hard water area because the cleaning process is complicated by the presence of hard water salts, the program should be such that a detergent formulated for general cleanup use is used daily, and then an acid cleaner should be used at least once a week after the alkaline detergent has been used.

I have given you some generalizations on how these soils can be removed. Each processing operation is quite different. You should attempt to utilize this information to improve upon what you are presently doing. I do not consider myself by no means to be an expert in all aspects of cleaning food processing plants. Each kitchen has a different problem, and the only way that these problems can be solved, is through experience, working with them, and utilizing the best available cleaning methods. We have not spent any time on the mechanical aspects of cleaning. Here again, I think this depends upon the type of food processing that you are doing. I would only like to say, that if at all possible, that you attempt to use a system that reduces the hmman error as much as possible. The CIP systems or the Clean-In-Place system which have been developed through the years for many of our food processing plants seem to me to be one of the ideal ways to clean equipment. If you are in the process of engineering or designing a new plant or process, by all means make sure that you include a Clean-In-Place system for your cleaning. We will lecture later today on how sanitizers work.

Just an additional comment about cleanup procedures. No set rule will apply to all operations. (72) Each plant has a different condition of water, and the product process temperatures give rise to different needs. I can only suggest that you select a procedure that best fits your needs. And finally, let us delineate what we would consider to be an efficient and ideal cleaner. (73) First of all, it should soften water, suspend hardness, and prevent hard water precipitates. It should emulsify fats and certain proteins, and saponify fats also. It should penetrate into the soil through wetting action, disperse and suspend precipitates, peptize proteins, dissolve readily in water and rinse freely, will not corrode equipment, and adjust the pH for the work that has to be done. It would be difficult to achieve each of these attributes with one cleaner. The best approach is to use several or develop cleaning systems that best approaches what one would consider to be ideal.

(74) Remember clean surfaces prevent microbial activity and prevent (75) one hungry microbe from becoming many (76).

SANITIZERS FOR EFFECTIVE CLEANING PROGRAMS

by Dr. Edmund A. Zottola

In our talk earlier this morning, we spent considerable time talking about how cleaning compounds do the job to achieve the objective of controlling microbial activity. How does a cleaning program achieve control? The answer is relatively simple. Control is obtained by removing a microbial food source from the system. An adequate and efficient cleaning program will remove all the soil present in the microenvironment. Consequently, there should be no food available for utilization by microorganisms.

In most instances, the cleaning operation will remove available food from the system, but it may not destroy or remove the microorganisms from the microenvironment. To achieve this, requires the second step in the program, effective sanitization and that is what we are going to talk about at this time. (1) The terms, sanitize or sanitization, refer to the treatment of food processing equipment with physical or chemical agents to destroy all undesirable microorganisms that may be present. I should point out that not all of the microorganisms are destroyed. Treatments necessary to achieve complete destruction of all microorganisms in or on equipment are much more severe and are called sterilization treatments. In most of our food processing operations, sanitization of equipment is all that is necessary to control microbial activity. The primary requirement, sometimes overlooked, for an effective sanitization program is a clean surface. There is no chemical sanitizer available today that can sanitize a dirty surface. Heat is often tried as a sanitizing agent for dirty surfaces. This is costly and only complicates the problem which will eventually arise with dirty equipment. To truly achieve microbial control, the two programs, cleaning and sanitizing, must be thorough, compatible, and totally effective. A sanitization program will not cover up faulty cleaning practices. Sanitizers or sanitizing agents are often called germicides or bactericides. These are chemicals which are used to achieve sanitization of equipment. Two other physical procedures may be used. These are heat and radiation.

(2) Before we develop the means for sanitizing, that is, how we do it, let us spend a few minutes in looking at the factors that influence the action of a sanitizer. These factors must be understood for effective use of the sanitizers whether they are chemical or physical sanitizers. These are listed on this slide.

<u>Selectivity</u> - Some sanitizers are relatively non-selective. By non-selective, we mean that they have the ability to inhibit or destroy all types of microorganisms. Some sanitizers as we will see in subsequent discussion only inhibit certain types of microorganisms. And, on the other hand, there are some microorganisms that are resistant to one or two of the physical or chemical methods of achieving sanitization. However,

the better sanitizers are relatively non-selective. They are very rapidly effective in destruction of a wide variety of microorganisms.

<u>Concentration</u> - is a second factor that influences sanitizer activity. In general, the destruction effect increases as concentration of sanitizer increases. However, in some cases, other reactions which may occur because of high concentration may create more problems that the rapid kill time. In some cases, increased concentration of chlorine type in solution decreases sanitizing effect. A good rule to follow is to follow directions to achieve desired degree of sanitation.

<u>Time</u> - The longer time a sanitizer has to act, the greater its killing effect. It is important to know how long the sanitizer in use will take to do the required job.

<u>The Number of Microorganisms</u> - The more microorganisms present, the longer time required to achieve desired kill.

<u>Individual Characteristics of the Microorganisms</u> - The effectiveness of a sanitizer is influenced by the comparative resistance of the microorganism to be destroyed. Spore forms are more resistant than vegetative cells of the same species.

<u>Age</u> - of the microorganism may also be a factor. Old cells are generally more resistant than young active cells.

<u>pH</u> - The pH of the sanitizing solution exerts a pronounced effect on the effectiveness. Chlorine compounds are most effective at alkaline pH's between pH 7.5 and 9.5. Iodine compounds show best effectiveness at pH 5.0 or lower. Quats present varied reactions to pH dependent upon the type of microorganisms to destroy.

<u>Incompatible Materials</u> - One of the most important factors influencing the effectiveness of chemical sanitizers is the presence of incompatible materials, organic compounds, or mineral deposits; thus, the primary requirement for a clean surface. If these materials are present, the sanitizer will react almost immediately with them and will not be available to attack the microorganisms.

Sanitization means the act of sanitizing or reducing the number of microbial contaminents to safe or relatively safe level. To sanitize is to render something sanitary. A sanitizer is an agent usually a chemical used to sanitize. Heat can also be used. There are presently three means whereby equipment can be sanitized.
These are:

(3) 1. Heat, either steam or hot
2. Radiation
3. Chemical sanitizers. These would include chlorine compounds, iodine compounds, quaternary ammonium compounds, and acid wetting agents.

(4) Heat in the form of steam or hot water is an effective means of giving equipment a sanitization heat treatment. When used properly with sufficient time and at a high enough temperature, it is the best means of sanitizing equipment. However, not all equipment used in food processing can be sanitized with heat. Construciton of the equipment may be such that it would be impossible to reach the desired temperature. But in a closed system such as in a washing machine or in a Clean-In-Place system, where the temperature can be maintained, heat is excellent.

When steam is used, a temperature of no less than 200°F is necessary. The equipment must be maintained at that temperature for no less than 5 minutes. For hot water to be effective as a sanitizer, it must be heated high enough so that its temperature at the outlet of the closed system can be maintained in no less than 170°F for a period of at least 5 minutes.

The second physical method of achieving sanitization is radiation. Radiation in the form of ultraviolet light, high energy cathode or gamma rays will destroy microorganisms. Ultraviolet light has been used extensively in the form of lamps to destroy undesirable microorganisms in schools, hospitals, homes, and for other similar applications. However, the total effectiveness of destroying all undesirable microorganisms with this system in a kitchen is doubtful. The effective killing range of ultraviolet light is extremely short. Thus, its use in a food operation is limited.

There are a variety of chemical sanitizers available for use in a food processing operation. These vary in chemical composition and activity under different use conditions. It is essential that the individual characteristics of each chemical sanitizer is known and understood so that the one most suitable for a specific sanitizing condition can be correctly selected. In other words, a chemical sanitizer suitable for one system may not be the best for another. Before any chemical can be labeled as a sanitizer, it must pass the Chambers Test. Those which in recommended concentration produce a 99.999% kill of 75 to 125 million E. coli Attc 1129 and 75 to 125 million Staphylococcus aureus Attc 6538 within 30 seconds at 70 to 75°F should be considered satisfactory. The pH at which the compound must be used is generally specific. (5) Chemical sanitizers as we indicated earlier are divided into four groups based on the agent that kills the microorganisms. These materials are: chlorine, quaternary ammonium compounds, iodine, and acids synthetic detergents. We will briefly discuss the four types of materials, their advantages, their disadvantages, and where one would be used in preference to the other.

Chlorine -Chlorine type sanitizers are divided into two classes: sodium or calcium hypochlorites, and organic type chlorine products. Although these vary, basically all chlorine types of sanitizers depend upon the formation of hypochlorous acid HoCl to kill the bacterial cell. (6) The advantages of chlorine compounds over other sanitizers are as follows: fast acting chlorine compounds passed the Chambers Test at a concentration of 50 parts per million in the required 30 seconds. Non-selective chlorine compounds kill all types of vegetative cells. Inexpensive chlorine compounds probably have the lowest use cost of any of the sanitizers that we use today. (7) Disadvantages of chlorine compounds - they are unstable. Chlorine is rather rapidly driven off with heat or contamination with organic matter. They are very corrosive particularly to stainless steel and other metals. Contact time of food handling equipment must be limited. When used, chlorine sanitizers can be used on any type of dishes or food handling equipment as long as contact time is limited. Chlorine should never be in contact with any type of metal for over 20 to 30 minutes due to possible corrosion. Rinsing equipment after use of chlorine sanitizers is not generally required; and when not required, is not recommended. (8) Chlorinated trisodium phosphate.

Iodine - type sanitizers are somewhat more stable in the presence of organic matter than are the chlorines. (9) Because iodine complexes are stable at a very low pH, thay can be used at a very low concentration of 6.25 parts per million and are used at 12.5 to 25 parts per million. Iodine sanitizers are more effective on viruses and spores than other sanitizers. Many spores can be killed with iodine concentrations of 50 parts per million. The advantages of iodine compounds are fast acting. Only 6.25 parts per million are required to pass the Chambers Test in 30 seconds. Non-selective iodine compounds kill all vegetative cells and many spores and viruses. Inexpensive, use cost a little higher than chlorine. The disadvantages of iodine compounds are: they vaporize it about 120°F, very sensitive to pH. Due to a low concentration used, iodines can be rendered ineffective by pH and hard water which may cause stains on skin, on clothing, equipment, and some types on food. Off-flavors in some foods have been reported. Iodine can be used on the skin. They are particularly recommended for hand dipping operations in food plants. They are also used frequently on food handling equipment.

(10) Quaternary ammonium compounds - are somewhat in disfavor with some health authorities in the United States. Generally, they are not recommended for food contact surfaces, but are still useful in reducing bacterial populations on other types of surfaces. The advantages of the quaternary ammonium compounds are: stable to heat and organic matter, less corrosive on metals than water, easy on the skin, effective at relatively high pH's. This permits their formulation with alkaline materials to make it an effective detergent sanitizer.

The disadvantages of quaternary ammonium compounds are: selectivity, they are not effective against gram negative organisms. Some quaternary ammonium compounds are, however, and you should make sure that if you have problems with Salmonella and E. coli, that the quaternary ammonium compound that you are using will take care of these gram negative organisms. Further disadvantages, they may form films on food handling equipment, they are not compatible with anionic type synthetic detergents, and care must be used that they are not contaminated with them. When are these used? The quaternary ammonium compounds are frequently used where corrosion is a problem or where organic matter would cause the inactivation of chlorine or iodine. Such uses would be on floors, walls, woodwork, and furniture in hospitals and nursing homes. Also effective for treating and deodorizing drains, garbage cans, and other areas that may not be completely clean. They are very effective for mold control on walls and high humidity rooms such as coolers, proof boxes, and bakeries.

Our fourth type of chemical sanitizer is the acids synthetic detergents which are particularly recommended on stainless steel surfaces or contact time may be long. The development of automation cleaning systems in food plants where it is desirable to combine sanitizing with the final rinse makes use of these products desirable. After the final rinse, the equipment may be closed to avoid contamination and held overnight with no danger of corrosion. These sanitizers are as safe on stainless steel as water. Although they are sensitive to pH change, they are less liable to be affected by hard water than the iodines as a much larger quantity is used. Previously, the disadvantage of the acids synthetic detergents in these automated cleaning systems was that the foam developed. This made it difficult to get good drainage of the sanitizer from the equipment. A development of the non-foaming acids synthetic detergents sanitizer has eliminated this problem and made these compounds even more valuable in the food industry. The advantage of the synthetic detergent sanitizer are: stable to heat and organic matter, they are completely nonvolatile and can be heated to any temperature under boiling with no loss of strength, and non-corrosive to stainless steel. They are safe as water in most food handling surfaces, they are non-selective and will kill all vegetative cells. The disadvantages of the acids synthetic detergents are: the acid may corrode iron and certain other types of metals; they are more costly than most of the other types of sanitizers although they are cheaper in replacing equipment that has been corroded. Where used, the acids synthetic detergents are recommended for all stainless steel food handling equipment.

We have briefly gone through the advantages and disadvantages of all of the four different types of chemical compounds available for sanitizing. We have spent a few minutes talking about heat as a sanitizing agent. It is difficult to recommend one system that will satisfy all your needs. I think that it is essential that the individual characteristics of each chemical or physical sanitizer is known and understood, and the one that is most suitable for your specific use be used. You may have to experiment a little bit to find the right one, but this is the best way to do it. Thank you for listening.

MECHANICAL DISHWASHING

by Dr. D. L. Lancaster

Introduction

The role of multiple-use eating utensils in the spread of infections was pointed out by A. J. Cummings and his associates early in 1919 in an article which appeared in the American Journal of Public Health entitled "Distrubution of Influenza by Indirect Contact - Hands and Eating Utensils." Cummings made recommendations for proper washing and sanitization of utensils to render them safe for use. Since that time, health agencies have set up many regulations in an effort to secure a bacteriologically safe eating utensil.

The mechanical dishwashing machine has been used for many years. However, until 1947 no attempt was made to conduct studies regarding effective dishwashing cycles, or to determine the effectiveness of the machines in the removal of physical soil or the destruction of micro-orgainsms. This can be attested to when codes around the country, at that time, required two or three minutes exposure to water at 170 to 180°F for all dish sanitization, irrespective of whether the work was done by hand or by machine.

The first comprehensive studies of the mechanical dishwashing process were carried out by Doctor W. L. Mallmann at Michigan State University. He published his first research report October 1, 1947. A subsequent report was published August 1, 1949. This work was carried out under the sponsorship of the National Sanitation Foundation, and much experience and knowledge was gained. New concepts in dishwashing, as well as new dishwashing techniques, were evolved.

By 1964 it became apparent that further investigation of commercial spray-type dishwashing machine design, construction, and operation was necessary if the restaurant industry, other users, and manufacturers were to avail themselves of modern day advances and potential economics. In March of 1964 the National Sanitation Foundation Testing Laboratory published its summary report on the Study of Commercial Multiple Tank Spray-Type Dishwashing Machines. The purpose of this report was to review, study, and establish the most economical combination of water temperatures, times and water volumes for the wash, power rinse and final rinse cycles of commercial spray-type dishwashing machines that would produce effective soil removal and sanitation

Current specification for commercial spray-type dishwashing machines are based on the combined knowledge gained from these various research studies. (See Table 1).

A. <u>Physical Soil Removal</u> - The effective removal of physical soil from a utensil is of primary importance and is dependent upon several factors:

1. Prescraping of the utensil
2. Placement of the utensil in the dishwashing equipment

(i.e., racking)
3. Time of wash
4. Volume of water passed over utensil
5. Velocity of water
6. Temperature of water
7. Detergent

B. Sanitization (heat) - Effective sanitization of utensils by the use of heated water is contingent on a combination of factors which affect the toatl accumulative heat at the utensil surface:

1. Volume of water passed over utensil
2. Time of exposure
3. Temperature of exposure (See Graph A for typical heat accumulation curve.)

C. Sanitization (Chemical) - The revision of National Sanitation Foundation Standard No. 3, amended April of 1965, provides for the evaluation of single tank stationary rack door type chemical sanitizing dishwashing machines. The specification of the Standard delineates the specific volume of water which must be sprayed over the surface of the utensils during the wash and rinse cycles. The rinse cycle must be designed and equipped to automatically dispense a sanitizing chemical into the final rinse water in a quantity sufficient to provide the required concentration.

A typical sanitizing solution will be chlorine at a concentration of 50 ppm or an iodophore at 12.5 ppm.

General Requirements for A Successful Dishwashing Operation

A. Selection of the proper dishwashing machine, correctly sized to suit the needs of the particular operation.

B. Properly sized and installed water heating equipment to supply the dishwashing operation.

C. Effective layout of the equipment and utilization of labor.

D. Training of the operator in the use and the maintenance of the equipment and the correct use of detergents and/or other chemicals used in the dishwashing process.

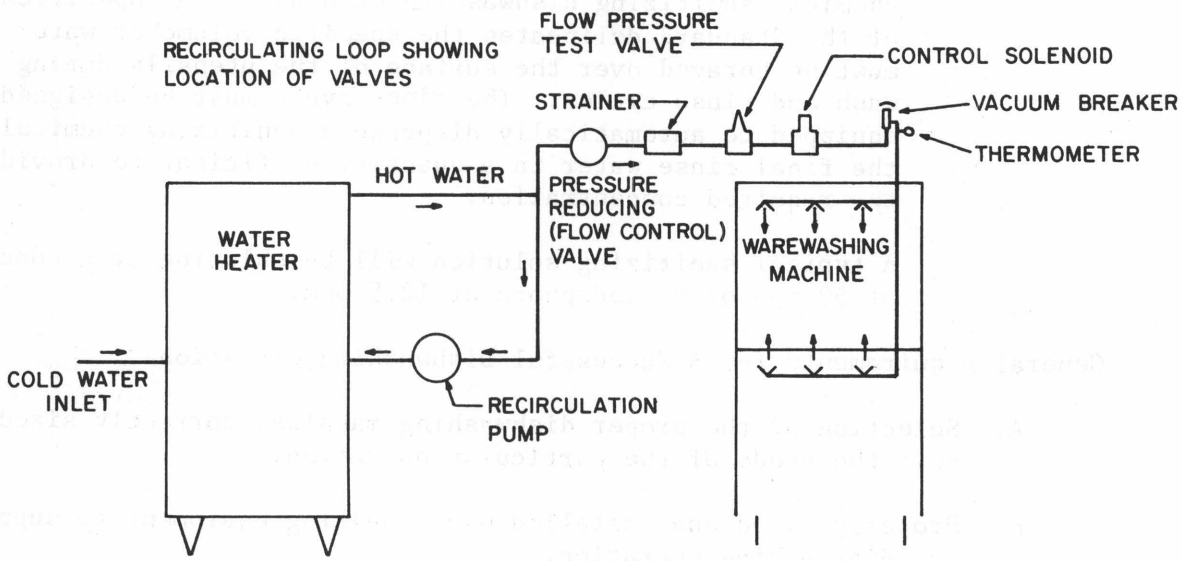
E. Managerial surveillance of the operation to determine that the dishwashing procedure is carried out properly by the trained personnel.

F. A protected dish handling and storage system to assure dishes when required for use.

The majority of commercial spray-type dishwashing machines on the market today will do the job required of them. The major problems with this type of equipment are aperational and require periodic surveillance. Selection of a particular machine for a given food service operation requires knoledge of the demands to be placed on the machine, type of utensils to be washed, quantity of utensil at peak periods, etc. A properly sized dishwashing machine engineered to conform to the requirements outlined in National Sanitation Foundation Standard No. 3, properly installed and maintained will do a satisfactory job. (See Figure 1 showing typical installation.)

Procedure for Determining Wash Power Rinse and Final Rinse Temperatures

The perennial problem of determining whether or not a dishwashing machine is effectively washing and sanitizing utensils being processed therein is a complex and confusing one to many individuals. Considerable discussion as to the relative merits of various techniques, methods



and guide lines has been noted and reported. The National Sanitation Foundation Testing Laboratory has evaluated such mehtods. Based upon these evaluations, field observations, and experience, it can realistically and scientifically be said that:

A. The passing of a maximum registering thermometer through the dishwashing machines (stationary rack or conveyor type) <u>will not</u> give an accurate indication of the sanitizing effect within the machine.

B. There is <u>no</u> commercially available <u>field</u> temperature sensing-indicating device now on the market which, without undue recalibration and compensation for slow response time, will accurately reflect the temperatures reached at the dish surface within the dishwashing machine.

C. The requirements for wash, power rinse, and fineal reinse temperatures, times and water volumes of NSF Standard No. 3 relating to Commercial Spray-Type Dishwashing Machines are based on the scientific evaluation of physical soil removal and effective sanitization.

D. The Testing Laboratory, in evaluating and approving Commercial Spray-Type Dishwashing Machines, ascertains compliance with the requirements of NSF Standard No. 3. Reevaluation of the machines assures their continued compliance.

In view of the above it is recommended that the following procedures be utilized to ascertain that an NSF Listed Commercial Spray-Type Dishwashing Machine is capable of effectively washing and sanitizing utensils.

Determine that the dishes are visibly clean. If a more definitive test is desired, the Talc-dye method may be used.

Determine, using a calibrated thermometer, the temperatures of the water in the wash tank and power rinse tank (if a multiple tank machine) by immersion in the water in the respective tank(s). Either recalibrate the thermometer(s) provided on the machine or record the corrective differential for the thermometer(s) in an appropriate place.

The temperature of the wash water (and power rinse if applicable) is extremely significant in providing affective sanitizing of the dishes. Wash and power rinse water temperatures less than those prescribed will, even when the final rinse temperature is properly maintained, result in ineffective sanitizing of dishes due to the cumulative temperature effects of wash, power rinse, (if applicable) and final rinse waters.

Remove from the inlet manifold, the thermometer or sensing bulb, used to indicate the temperature of the final rinse water. Check the removed thermometer, or sensing element, against a calibrated thermometer by immersing both in a container of hot water. This calibration should be conducted at approximately the use range (180°F). Recalibrate the machine thermometer, if possible, or record differential correction.

NOTE: The sensing bulbs in certain machines are of such construction or so located that they cannot feasible be removed. There are two alternatives which will permit the determination of the final rinse water temperature in such instances. They are as follows:

1. The 1/4 inch test valve located in the final rinse line to permit determination of flow pressure may be opened and a maximum registering thermometer inserted in the valve by means of a compression type connector. Operate the final rinse and recalibrate the machine thermometer or record the differential correction.

2. Using a modified version of a standard capillary tube, dial type thermometer, place the bulb parallel to the direction of the rinse jets and 1/2 inch from the jets. (See Attachment 1) Operate the final rinse from 10 to 15 seconds, record the temperature on both the calibrated test thermometer and final rinse thermometer of the machine. Recalibrate the machine thermometer or record the differential correction. A 5° temperature variation may be expected between the water temperature at the thermometer location on the machine and the water at the rinse jet, depending on the design and construction of the individual machine.

3. Check that all spray nozzles in the wash, power rinse (if applicable) and final rinse spray arms are open and unobstructed.

4. Determine that the flow pressure of the final rinse supply line is 20 psi (15-25 psi range is permissible).

5. Operate the machine and determine the wash, power rinse and final rinse temperatures (corrected), and time periods.

TABLE 1

Specifications for Temperature, Volumes Water, Times, Pressures for Wash, and Rinse Water for Various Types of Ware Washing Machines

Type Machine	Wash			Pumped Rinse			Final Rinse @ 20 PSI (Flow Pressure)		
	Vol. Water	Min. Exposure	Min. Temp.	Vol. Water	Min. Expo-sure	Min. Temp	Minimum Volumes Water	Minimum Exposure	Min. Temp.
Single Tank Stationary Rack 16 × 16 18 × 18 20 × 20	60 gal. 75 gal. 92 gal.	40 sec. 40 sec. 40 sec.	150°F 150°F 150°F		NONE		1.15 gal. 1.44 gal. 1.73 gal.	10 sec. 10 sec. 10 sec.	180°F 180°F 180°F
Single Tank Stationary Rack Single Temp.	60 gal. 75 gal. 92 gal. DISCHARGED TO WASTE	40 sec. 40 sec. 40 sec.	165°F 165°F 165°F		NONE		14.7 gal. 18.6 gal. 23 gal. DISCHARGED TO WASTE	30 sec. 30 sec. 30 sec.	165°F 165°F 165°F
Single Tank Stationary Rack Chemical Sanitizing	Total 80 gallons includes sanitizing rinse DISCHARGED TO WASTE		120°F		NONE		Total 80 gallons includes wash vol.		120°F 50 ppm Cl_2 or other accepted sanitizing solution
Single Tank* Conveyor 20 inch width	3 gal./ lin. inch conveyor	15 sec.	160°F		NONE		6.94 gal. per min.	Max. conv. speed 7'/min.	180°F 6" spread 5" above conveyor
Multiple Tank* Conveyor 20 inch width	1.65 gal./ lin. inch conveyor	7 sec.	150°F	1.65 gal./ per lin. inch	7 sec.	160°F	4.62 gal. per min.	15'/ min. max. convey. speed	180°F 3" spread 5" above conveyor

*Note: Wash and/or pumped rinse make up water, may add up to 2 additional gallons/min. to final rinse volume demands.

Chemical and Physical Factors Affecting the Dishwashing Process

The following resume of commonly experienced dishwashing problems together with suggested remedial action will assist in correcting many situations encountered in the field.

Symptom	Possible Cause	Suggested Cure
Soiled Dishes	Insufficient detergents	Use enough detergent in wash water to insure complete soil suspension
	Wash water temperature too low	Keep water temperature within recommended ranges to dissolve food residues and to further facilitate heat accumulation (for sanitization).
	Inadequate wash and rinse times	Allow sufficient time for wash and rinse operations to be effective. (Time should be automatically controlled by timer or by conveyor speed.)
	Improperly cleaned equipment	Unclog wash and rinse nozzles to maintain proper pressure and flow conditions. Overflows must be open. Keep wash water as clean as possible.
Films	Water Hardness	Use an external softening process. Use more detergent to provide internal conditioning. Use a chlorinated cleaner. Check temperature of wash and rinse water. Water maintained above recommended ranges may precipitate film.
	Detergent Carryover	Maintain adequate pressure and volume of rinse water.

	Improperly cleaned or rinsed equipment	Prevent scale buildup in equipment by adopting frequent and adequate cleaning practices. Maintain adequate pressure and volume of water.
Greasy films	Low pH Insufficient detergent Low water temperature	Maintain adequate alkalinity to sponify greases, check detergent, water temperature.
	Improperly cleaned equipment	Unclog all wash and rinse nozzles to provide proper spray action. Clogged rinse nozzles may also interfere with wash tank overflow.
Streaking	Alkalinity in the water	Use an external treatment method to reduce alkalinity.
	Improperly cleaned or rinsed equipment	Maintain adequate pressure and volume of rinse water. Alkaline cleaners used for washing must be thoroughly rinsed from dishes.
Spotting	Rinse water hardness	Provide external or internal softening.
	Rinse water temperature too high or too low	Check rinse water temperature. Dishes may be flash drying, or water may be drying on dishes rather than draining off.
	Inadequate time between rinsing and storage	Allow sufficient time for air drying.
Foaming	Detergent	Change to a low sudsing product.
	Dissolved or suspended solids in water.	Use an appropriate treatment method to reduce the solid content of the water.

	Food Soil	Adequately remove gross soil before washing. The decomposition of carbohydrates, proteins, or fats may cause foaming during the wash cycle.
	Improperly cleaned equipment	Keep all wash sprays and rinse nozzles open. Keep equipment free from deposits of films of materials which could cause foam buildup in future wash cycles.

In conclusion, many factors affect the mechanical dishwashing process. In problem areas, all factors must be investigated and evaluated in their proper prospective.

INSECT PESTS OF FOOD SERVICE OPERATIONS

by Dr. W. H. Robinson

Introduction

Food service personnel are often expected to be knowledgeable on a number of seemingly unrelated subjects. A brief scan of food service trade magazines shows articles on student behavior, food nutrition, new equipment, menu planning, and others. Such diverse topics are of interest probably because they represent frequent problem areas throughout the industry. And the success of many food service operations may depend on managers being able to cope with these and other unexpected problems.

Another problem common to food service establishments is insect pests. Cockroaches, flour beetles, house flies, and other insects have learned to take advantage of these stores of food. Although not frequently mentioned, insect pests are probably common throughout the industry. Regardless of the cleanliness or dirtiness of an operation, these pests have tried to invade one time or another. The concern, then, should not be for the presence of a few small insects, but in allowing these pests to become permanent residents.

Insect pest problems should be treated like all other potential food service problems. And that is to make available pertinent and factual information, and suggest methods for controlling or eliminating the problem. For any program of prevention or control it is most important that the habits of the pest be known. In the following paragraphs I will present information on (1) those insects that are regular or potential pests of food preparation and storage areas; (2) the life history and feeding habits of some of these pests; and (3) suggestions on controlling (chemical and non-chemical) these insects.

Insects that are frequent "kitchen pests" include house flies, cockroaches, flour beetles, grain and meal moths. Others such as drain flies, silverfish, ants, fruit flies, and humpbacked flies are also encountered, but they are usually only occasional and not persistent pests.

Cockroaches

There are many (about 55) different cockroaches in the U. S., but only four -- the German, Brown-banded, Oriental and American -- are serious household or kitchen pests. Although each of these represents a different species with slightly different habits, they can all be controlled in a similar manner.

Cockroach habits are nocturnal and secretive. They hide during the day in dark areas, and come out at night to hunt for food. Cockroaches need food, water, and a hiding place to survive. Their diets are variable and have been known to include meat products, cheese, leather, beer, book bindings, and glue.

The life cycle of a cockroach consists of three distinct stages: egg, nymph, and adult. Females produce small purse-shaped egg capsules which contain tow rows of eggs. After hatching from the egg capsule, the nymphs begin moving about in search of food. They continue to grow and shed their skin until they become adults, at which time they have wings and can fly and mate.

German cockroach. German cockroaches, sometimes called the croton-bugs, are probably the most common cockroaches in the U.S.. Adults are about 1/2 inch long and light brown in color. This species can be distinguished by two dark stripes behind the head. Females are usually darker and larger than the males. Under average conditions an adult female will live for about 200 days, and produce about 175 young.

Because they are so abundant, German cockroaches are frequently carried from place to place in packaged food, boxed vegetables and fruit, soft drink cases, and other food storage boxes. Favorite hiding places for this pest include under table tops and chairs, behind and under sink fixtures, cabinets, in motor compartments of kitchen equipment and in switch and fuse boxes.

Brown-banded cockroach. In size and general appearance this species is similar to the German Cockroach, but some of its habits are different. The body color is dark brown while the wings are light brown with pale cross bands. Unlike the German, this species does not confine its activities to the kitchen area. Brown-banded cockroaches may travel and hide throughout a building. Female brown-banded cockroaches may produce about 250 young over a period of a year. The young usually require about 200 days to mature.

In certain areas of the Midwest these cockroaches are much more abundant than the German. And because of their habit of dispersing throughout buildings, they are probably a more difficult pest to control.

Oriental Cockroach. Oriental cockraoches are also called the waterbug and are common in all parts of the U.S. They are not as active as other cockroaches, and are less frequently seen because of their habit of hiding in dark, damp basements, etc. Both males and females are shiny brownish-black in color, and about 1-1/4 inches long. Adult females have very short wings, while males have wings that nearly cover the abdomen.

Adult females live for about 150 days, and produce from 100 to 135 young. There may be some tendency for a seasonal cycle with adults abundant in the spring and populations decreasing as fall approaches.

American cockroach. American cockroaches are the largest of the house-infesting species in the U.S. Although native to tropical America, they are distributed throughout the world. This wide range has given them a variety of colloquial names, including waterbug, Palmetto bug, flying water bug, and others. Both sexes are fully winged, reddish-brown in color, and approximately 1-1/2 inches long. Adult females may live for as long as a year and a half, and produce over a thousand young. The young can take from 160 to 900 days to become full-grown.

American cockroaches prefer warm, moist areas, and are commonly found in food handling situations and industrial plants. Because of their large size, they most often congregate in open spaces rather than cracks and crevices.

Cockroach Control Methods

An effective cockroach control plan must include both chemical and non-chemical methods. In most cases serious infestations of cockroaches should be treated chemically by a qualified pest control operator. However, insecticides should be used only to supplement a strong program of sanitation and exclusion.

Non-Chemical. Regardless of whether or not cockroaches are a problem in their particular operation, food service managers should be aware of certain preventive habits and procedures.

1. Cardboard boxes and wooden crates should be emptied of their contents and removed as soon as possible. Cockroach adults, nymphs, and egg capsules may be hidden in these containers.
2. Trash, especially cardboard boxes, should not be stored close to entrance ways to the building. This may allow adults and nymphs to move from the trash and folded boxes to the inside of the building. During warm weather trash should not stand overnight close to the building.
3. Areas where metal and cardboard containers are crushed and stacked for trash removal should be kept as clean as possible. Scraps of food in cans and glue on boxes will provide food and hiding for cockroaches.
4. Meat slicing machines should be watched for scraps that collect in hard to reach places.
5. The undersides of tables and chairs should be kept clean.
6. Mops and cleaning sponges should not be put away wet or even damp.
7. The rubber or plastic molding around refrigerator and freezer doors should be kept clean. This is a favorite place for all cockroach stages to hide.

These are only a few suggestions for a clean up program. Of course, there are many other areas that are prone to cockroach infestations. But, armed with some knowledge of their habits and common sense, food service personnel can produce their own prevention program.

Chemical. If heavy cockroach infestations do occur, it may be advisable to combine chemical control with the clean-up program. And because food service personnel usually lack the experience or the right equipment, a pest control operator should be contacted. Here are a few suggestions for chemical control procedures:

1. Be sure there is a need for each insecticide treatment and make a record of each use.
2. See that insecticides are used only in areas where they are needed.

3. Do not neglect trash storage areas.

Qualified pest control operators are aware of the current restrictions and appropriate chemicals for use in food service establishments. Any supplemental spraying by food service personnel would be unnecessary, and possibly dangerous.

Insect Pests in Flour and Dry Foods

Flour beetles and grain moths infesting dry foods are another problem facing food service operations. Several different insects live and breed in the dry conditions of stored food. They are a common problem in kitchens throughout the U.S. and around the world. Perhaps because of their small size they usually go unnoticed until a serious infestation develops. Dry-food insect pests are represented by several distinct species with slightly different life cycles, but a clean-up and control program can be designed to reach all of them.

Most flour and dry food pests are very small and difficult to see without the aid of a microscope. So, detailed descriptions of these pests are probably unnecessary. Instead, feeding habits and a general life-cycle will be presented for all. Adults deposit eggs on the outside of food containers (flour bags, cereal boxes, etc.) or directly on the food material. Eggs hatch in a short time and the young begin feeding immediately. However, they may have to chew a hole through a bag or box before finding food. They usually remain in the food material and continue to feed and grow. When full grown the caterpillars and beetle larvae spin cocoons, and in a week or so an adult emerges. Adult beetles may also feed on the infested food, but adult moths do not.

Infestations of saw-toothed grain beetles, mealworms, grain and meal moths usually originate from contaminated flour or other products. Their size and distribution make it almost inevitable that even the cleanest food service establishment will get these pests. Fortunately, they only rarely become numerous, and have not been shown to spread any diseases. Considering the charmed life they lead -- feeding on nothing but U.S.D.A. approved and enriched food -- they are some of the cleanest insect pests we have.

Control Methods for Insects Infesting Flour & Dry Foods

While it might be impossible to keep these common pests from invading kitchens and storage areas, they can be prevented from becoming serious pests. A steady clean-up program coupled with chemicals when necessary will keep these insects under control.

Non-Chemical. The suggestions made under cockroach control would certainly apply here, along with the following

1. Flour dust on machines, shelves in storage areas, and unused cans should be removed regularly.
2. Storage bins should be cleaned out regularly. Adding new flour, powdered milk, etc. over the old may lead to pest

problems.

3. Watch window sills and electric light receptacles for large numbers of dead insects. Flour-infesting beetles and moths are attracted to the window and electric lights. And when there is a large infestation of these pests, large numbers of them accumulate in these locations.

Chemical. Controlling these pests with chemicals is difficult because (1) there are restrictions on the use of chemicals in food preparation areas; (2) the pests are very small and probably widely dispersed through the building; and (3) re-infestation is frequent. If these insects have become numerous enough to warrant chemical control, a qualified pest control operator should be consulted. Remember, no chemical treatment can be effective unless followed by a strict clean-up program.

Armed with this life cycle and control information, food service personnel can better fight the invasion of certain insect pests. When fighting insect infestations the best defense is probably a strong offense. By this I mean a thorough and regular clean-up program, coupled with frequent checks of potential trouble spots. Keeping cockroaches and flour beetles in low numbers must begin with housecleaning; chemicals can and should be used (by a pest control operator) to quell outbreaks. Lastly, we should keep in mind that having a few pests is almost inevitable, but allowing them to become numerous is inexcusable.

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