FOODS AND CHEMICALS

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Foods are chemicals but all chemicals are not foods. You are familiar with the usual constituents of food, such as water, fat, protein, fiber, starch, sugar, and mineral matter. The constituents occurring in smaller and often in minute amounts, or traces, are not as familiar. These include vitamins, acids, enzymes, and mineral or other elements in very small amounts.

I have often wondered what forced the cave dweller to eat shellfish or parsnips. He certainly must have been really hungry for their outward appearance and taste is far from inviting. Even in the primitive states of society there was need for the preservation of food to tide over the seasons when natural food was not available, so gradually the simpler ways of preservation by fermentation of juices to produce alcohol from their sugars was developed. Sometimes the fermentation proceeded further, producing acetic acid. Salt from natural outcrops was used as a preservative and also in modifying fermentation of vegetable products to produce lactic acid. These four substances, alcohol, acetic acid, salt, and lactic acid were probably the first chemical additives to foods. Later, spices with their strong oils were used.

In "Foods, Their Composition and Analysis" by A. W. Blyth, it is stated: "Before Adulteration commences, commerce must develop. In primitive states of society there may be knavish tricks, ignorant bartering, substitutions of bad for good, falseness and meanness of all kinds, but no systematic sophistication is possible." The detection of brass for gold in the crown of Hiero by Archimedes 250 years before Christ is probably the earliest scientific detection of adulteration, even though in the royal crown, rather than bread. In the good old days, 1200 A.D., "false weights, false measures, and false pretences of all kinds were the instruments of commerce most generally in use."

Laws against adulteration were very severe. In 1444, in Germany, a seller of spice for selling false saffron was burnt at the stake, with his false saffron. A year later, 2 men and a woman were buried alive for the same offense. Bread was adulterated with clay, and rotten grain was used for grinding into flour.

At the beginning of the 20th Century, Leach in "Food Analysis" states, "Various processes have from ancient times been known and used for arresting the fermentative changes which food products in their natural form undergo on long standing. These processes include pickling with vinegar, drying, smoking, salting, preserving with sugar, and finally, in the employment of heat for sterilizing and pasteurizing, and of low temperature, as in cold storage. All of them are still in use and are universally considered as unobjectionable. In addition to these old and well-known methods of food preservation is the comparatively modern practice of arresting fermentation by the use of such antiseptic chemical agents as formaldehyde, beta-naphthol, boric, salicylic, benzoic, and sulphurous acids, or salts of these acids, etc., in regard to the wholesomeness of which there is considerable difference of opinion."

Later there was the use of insecticides containing arsenic, lead, and fluorine, which left poisonous residues on fruits and vegetables in objectionable amounts. These have been followed by the organic compounds, which have changed agricultural practices very greatly.

The use of inorganic insecticides began before 1870 with the use of paris green, an arsenical for the Colorado potato beetle. With the threat of the extinction of apples and pears by the codling moth in the 1920's, the use of lead arsenate in several sprays per year became general. Also, the use of lead arsenate was common on many other fruits and vegetables, cherries, celery, cabbage, tomatoes, etc., for various insects. Then fluorine compounds were in vogue for awhile.

These have been followed by the organic insecticides since World War II. First came DDT which for a time was the "wonder" insecticide. Then followed many similar organic chlorine compounds. Another type of organic insecticide was benzene hexachloride. More
recently there followed parathion and other compounds containing phosphorus.

It was formerly believed that organic poisons for insects could be found that would be innocuous to man and higher animals. Research developments have shown that most such poisons also have toxic effects on man. Residues from sprays stay on or penetrate into plants and animals. DDT accumulates in the fatty tissues; BHC in the brain; and chlor dane affects the liver and kidneys. Parathion may cause sudden death to people working with it. Both inorganic and organic poisons have effects on plants. Lead arsenate accelerates the metabolism of oranges but reduces the ascorbic acid. DDT increases carotene in alfalfa. BHC changes the flavor of fruit and vegetables.

The use of chemicals in affecting the metabolism of animals is becoming common. Thioura increases the weight of hogs for a given amount of feed and apparently improves the quality of broilers.

New chemical additives may improve foods. Processing of foods also improves in many instances by removing or changing deleterious ingredients.

The "Committee on Chemicals Introduced in Production of Food" of the American Public Health Association, concludes a recent report to the Society:

"The subject of chemicals introduced in foods is broad. There is material sufficient for a volume, which could be useful compendium of information that is scattered widely, if it is available at all in written form.

"Mortality records alone would seem to show that accidental deaths from toxic chemicals of all kinds are as insignificant part of the total causes of death. The toxicologic properties of many of the chemicals used in the production and processing of foods are unknown, especially the chronic effects of their long-time consumption in foods. Mistakes in judgment about the health qualities of chemicals introduced in foods may adversely affect the health of great numbers of persons. Just as fire prevention is an important part of the control of damage by fire, so also the effective control of chemicals introduced in foods may serve to prevent mass poisoning of the population. It does not seem that the consideration of preventing measures in this field should demand impressive statistics from the death records in order to justify the undertaking."

A good example of new chemicals being proposed for addition to foods is cetlytrimethyl ammonium bromide, a quaternary type of surface active agent considered as a poison, per se, which should never contaminate foods in any amount. The following is quoted from August 1951, Vol. 23, No. 8 of "Food Engineering":

"A new preservative coating for fruit and vegetables has been developed by the chemical research laboratory of D. W. Bingham & Co., Pty Ltd., Melbourne, food-processing and canning machinery firm.

"It consists of a carboxymethyl cellulose gel carrier that embodies cetlytrimethyl ammonium bromide. The coat is applied as an aqueous emulsion by spraying or dipping. If sprayed, the emulsion forms a film less than .001 in. thick when set and dried. Drying takes about three hours at normal temperatures and film formation is said to be hardly affected by treated surfaces being in contact with each other. Fruit takes on a slightly polished appearance.

"Claimed to be an improvement over wax or lacquer coatings, the composition slows down but does not stop the metabolic process, which continues in untreated fruit for some time after picking. This enables the fruit to "breathe" and delays the onset of autoenzymatic decay processes. On the other hand, the coating is claimed to set up an efficient barrier against penetration of micro-organisms.

"The gel is easily removed by washing with water, but does not impair the taste of the product when left on. Sampled separately, the gel is bitter to the taste.

"Bingham developed the coating to help its customers spread out the canning of fruit and vegetable crops without expensive cold-storage installations. The company's chemists are testing various other water-soluble cellulose derivatives with similar cationically ionized ammonium compounds in order to provide a more complete line for fruit and vegetable growers and packers."

Recently there has been an ever-increasing number and variety of chemicals proposed as additives to food for various purposes. The Food and Drug Administration, in the hearing before the Congressional Committee to investigate the use of chemicals in food products se-
lected from a master list of over 800 chemicals, a list of about 60 to tabulate for the Committee, giving their names, synonyms, principal manufacturer or distributor, known or proposed uses, and toxicity classification.

The following is a quotation from this tabulation, which was published on pages 69-80 inclusive of CHEMICALS IN FOOD PRODUCTS—HEARINGS BEFORE THE HOUSE SELECT COMMITTEE TO INVESTIGATE THE USE OF CHEMICALS IN FOOD PRODUCTS, HOUSE OF REPRESENTATIVES, EIGHTY-FIRST CONGRESS, SECOND SESSION, CREATED PURSUANT TO H. Res. 323, which was published in the report of the House Select Committee to investigate the use of chemicals in food products. This report may be procured from members of Congress:

**Borax—Toxicity class 1. “Toxic, should not be in foods in any amount.”**

**Thiourea—Toxicity class 1. “Toxic, should not be in foods in any amount.”** “Several years ago thiourea was proposed for use on frozen peaches for the prevention of the development of brown stain upon exposure to air. The Food and Drug Administration immediately began toxicological investigation of thiourea. The substance did not appear to be acutely toxic to the young rats which were used in the first experimental work. However, repetition of the experiment with old rats disclosed a high degree of toxicity, about 1 milligram of thiourea being sufficient to kill the test animal. About this time the Florida Citrus Commission conducted some experiments with thiourea for the preservation of fungus and rot on fresh oranges. Some of the treated oranges were sent to the Food and Drug Administration. The juice from these oranges was found by chemical examination to contain thiourea, and when fed to rats the animals promptly died, indicating both the extreme toxicity of the substance and also that it penetrated the rind of the oranges. Its proposed use on citrus fruit is believed to have been abandoned. Some time later, however, a packer of frozen peaches was found to be using thiourea as an antithawing agent. The shipment of peaches so treated had been made. The shipment was sampled by the Food and Drug Administration, and some of the treated peaches were fed to rats, which again promptly died. The peaches were removed from the market by seizure. It so happened that this was the only shipment the firm had made; and, so far as is known, there has been no other commercial food use of thiourea.

The extremely dangerous nature of this compound is further emphasized by investigational work conducted on thiourea for drug use. As a drug, thiourea is very useful in the treatment of hyperthyroidism. However, individuals vary greatly in their sensitivity to it, and its use even therapeutically must be approached with great caution. Further, when fed at low-intake levels for long periods of time, thiourea produces tumors and markedly enlarged thyroid in the experimental animals.

**Monochloracetic acid—**“This substance was proposed approximately 10 years ago for use as a preservative in wines and a number of other food products. Despite warnings from the Food and Drug Administration that the substance was poisonous and its use in foods would constitute adulteration, the product was distributed and used widely for several years. Numerous suits against the preservative and the foods containing it were instituted, and distributors of these products were prosecuted under the Food and Drug Act. In one instance a manufacturer of an orange beverage used monochloracetic acid and one batch of the orange drink resulted in numerous illnesses to the consumers. Prosecution of that firm resulted in a fine of $5,000. The vigorous regulatory campaign against this article has resulted in its being almost completely abandoned; however, it is still found in an occasional shipment.”

**Diphenyl—**“The acute toxicity of diphenyl is relatively low (LD/50 25 grams per kilo). It is, however, a sensitizing agent, i.e., continued dermal contact may result in the development of an allergy to the substance and severe allergic reactions may follow. There is an active interest in the use of this substance in food production and its volume of use is potentially very great. Diphenyl in appreciable amounts may adversely affect the taste and odor of food, rendering the food unpalatable. Thus the quantity in which it may be present in foods may be considered self-limiting. The chronic toxicity of diphenyl has not been sufficiently studied.”

Dr. Paul B. Dunbar, formerly Commissioner of the Food and Drug Administration, in a report to the Association of Food and Drug Officials on current developments, in Food and Drug Officials Quarterly Bulletin, Vol. XV, No. 3, 1951, made the following statement:

“I am satisfied that the food industry itself can do something in this respect. I have noted for instance the recent advertisements quoting outstanding scientific authorities in praise of the bread enrichment program. I am afraid, however, that these statements are couched in such restrained and highbrow language as not to reach the very audience they ought to impress.

“Certain things appear obvious. First, the entire American public is vitally concerned about the purity of its food supply; not only does it want freedom from positively or potentially harmful substances, but it is concerned about deficiencies in what it believes to be essential nutritional ingredients.

“Second, a growing number of consumers, egged on by nutritional quacks who are masters in the use of scientific information to reach a false conclusion, believe that the food industry is interested solely in immediate profit, is brutally reducing the nutritional standards of the people, and is permitted to do so by the inaction of Government.

“Third, a growing number of consumers seem to believe that not only are food products being debased by over-refinement but that dangerous chemicals are being added with a callous disregard of human health. Part of this apprehension is undoubtedly due to the publication of partial reports of the testimony presented to the Delaney Committee; testimony which accurately stated that many hundreds of different types of chemicals have been suggested from time to time for use in foods. This has been misinterpreted by the careless reader as meaning that this number of chemicals is being employed. There are,
of course, some authentic cases where dangerous substances have been employed by manufacturers after very cursory efforts to learn in advance whether they are safe. Such instances have been promptly and drastically dealt with under our laws. We know, however, that the food industry in general is aware of its obligations and takes adequate precautions to undertake suitable toxicological studies before using any chemical substance in food. But does the consuming public know it?"

Dr. Lehman has suggested a classification for additives to foods covering such classes as Artificial sweetening agents.

Food preservatives
Antioxidants
Wetting agents
Food-packing materials
Silicones
Insecticides, fungicides and herbicides
Colorants
Lubricants
and others.

Dr. Lehman has proposed an experimental procedure for establishing proof of safety of chemicals to which man may be exposed (See Journal American Pharmaceutical Association, Scientific Edition, Vol. XL No. 7, July, 1951). He places emphasis on chemicals that may be in the daily food supply. This procedure requires evaluation of the chemical from its chemistry, acute toxicity, allergic responses, subacute and chronic toxicity, biochemistry, and pathology.

I would like to close with a quotation from a recent address by Commissioner C. W. Crawford of the Food and Drug Administration before the Division of Food, Drug, and Cosmetic Law of the American Bar Association.

"It is time for some straight and decisive thinking on the erroneously labeled proposal to regulate the use of new chemicals in food. The issue is confused by employment of the term "chemicals," with or without the word "new." The real question is on the use of food of any substance, of whatever nature, when that substance has not been adequately tested, either through human experience or by all reasonably applicable laboratory and clinical procedures, to show either that it is not poisonous or deleterious, or, if it is and it is required in the production of a food, that it can be safely used.

"It would be both unfair and incorrect to appraise this problem on the assumption that we have an irresponsible chemical industry and an irresponsible food industry, both callous to the health of consumers. Nor can we appraise it on the assumption that there is no 'clear and present danger.' The facts rule out both these assumptions, but they show that there is a fringe of the careless or ignorant or unscrupulous who have used or are now using chemicals in food without sufficient testing to be reasonably certain they will not impair the health of consumers. That the dramatic equivalent of the elixir sulfanilamide disaster has not occurred in the food field speaks volumes, first for the conscientiousness of the food industry generally, and second, for the providential luck of its fringe operators—and of the public. We have had some narrow escapes.

"Much has been said about the impossibility of guaranteeing absolute safety of any food additive for all people under all circumstances, and about the toxicity of nearly every common food to hypersensitive individuals. The point is well taken. But this does not mean that nothing should be done toward setting up legal safeguards to minimize danger. There is a practical, common-sense solution.

"Leaders in the food industry have set the pattern. In their investigations of the prospective use of chemicals of unknown safety they have used every reasonably applicable test. Each point on which the chemical might be suspected is thoroughly explored. It is not until every reasonable check has been made, all with negative results, that the chemical is put into use. It would not be too much to require by law that all food producers live up to what is being voluntarily done by the conscientious majority. An amendment to accomplish this need not disturb any provision or procedure the law now contains.

"The sketchy character of the preliminary tests that are made before some chemicals are used is startling. When challenged, the sponsors of these chemicals sometimes undertake elaborate programs of research, but too frequently they indict their own sense of responsibility or even their own good faith by continuing to exploit their product while their investigations are still in progress."