Chapter 1

INTRODUCTION

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It is fitting that this symposium be sponsored by the Industrial Liaison Office at M. I. T., for this Institute has long recognized the unity and oneness of science and technology. It has long recognized the role of industry and industrial technology in advancing science itself.

Today, M. I. T. has the Industrial Liaison Program to assist in the creation of an intermingling, symbiotic, and synergistic relationship between the Institute and American industry. This has proved, I feel, to be mutually beneficial. Although this program has been in existence for only a decade, its spirit dates back many decades. In the field of food science and technology, then called "industrial biology," it dates back to the 1890's, when canning was placed on a scientific basis through the pioneering researches of Samuel C. Prescott and William Lyman Underwood at a place known familiarly to many as "Boston Tech." To this audience these two names and their work need no explanation.

Dr. A. W. Bitting, in his classic book Appertizing,* has said that "the canners of this country owe more to Prescott and Underwood for placing their industry upon a scientific basis than to any other investigators ... their first three papers were epoch-making in changing an industry based upon individual experience to one under scientific control."

The food and container industries recognized this pioneering work of an industrialist and a university professor. One of our Industrial Liaison Program members, the American Can Company, established the first laboratory for thermal processing research in 1906; the canning industry itself followed with the establishment of the National Canners' Association Laboratory in 1913, and I might add with justifiable, and I hope forgivable, pride that one of its outstanding research directors for many years, Dr. E. J. Cameron, was an alumnus of this Institute and a student of Dean Prescott.

Prescott's and Underwood's pioneering researches in canning were followed by many investigations here in freezing-preservation

*The Trade Pressroom, San Francisco, California, 1937, p. 50.

of foods and in dehydration by Prescott and later by Dr. Bernard E Proctor and his students.

Professor Proctor and his students in the 1940's and 1950's pioneered at M. I. T. in irradiation preservation of foods, a large proportion of the funds for these studies coming from the food and container industries and through the Industrial Liaison Program. Today, we begin to see irradiation preservation of foods emerging as still another and possibly important method of preservation. The recent publication of a regulation permitting the use of ionizing energy to sterilize bacon is a historic milestone. The decision legalizing the manufacture and sale of this preserved product, based solely upon proven scientific facts, now has rekindled interest among members of the food industry in this fascinating field of preservation, which has been one of the chief research interests of many of us for almost twenty years.

In this symposium we are presenting some of the existing research programs in the radiation preservation of foods and in freeze dehydration. By no means are these inclusive. They do not represent the entire research program in food science and technology here at M. I. T., nor does time permit the presence of all of our research staff on this program.

These papers, however, will illustrate some of the integrated research programs now active in the department on these two intriguing methods of food preservation. May I take this opportunity to reiterate our thanks to the various governmental and industrial organizations for their generous support of the research discussed here.

In most food preservation methods, science has followed technology — the university has followed industry. Radiation preservation of foods, however, is a notable exception to this generalization.

As many are aware, one of the key problems which has long stymied the utilization of ionizing energy for preservation of foods is the undesirable secondary side reaction induced by free radical and activated molecule formation in foodstuffs as evidenced by changes in color, texture, and flavor.

Many approaches have been suggested, among which is that of concurrent radiation-distillation. We, in this department, have been concerned with this method for almost ten years.

Ultimately, the solution of this problem will depend upon the basic research that will unlock some of the elusive secrets which are still within the molecules and are related to flavor, color, and texture. Such a basic program is under way here; for the past six years, this program has been spearheaded by Dr. Emily L. Wick, an organic chemist, whose research field is the chemistry of flavor. Dr. Wick's paper on the "Volatile Components of Irradiated Beef" discusses the concurrent radiation-distillation technique and reviews the knowledge of the radiation-induced chemical changes in beef.

One of the methods available to reduce the undesirable side reactions induced by ionizing energy is that of simply reducing the dose to which the food is exposed. To achieve this, we can employ one of perhaps three or four techniques. One of these, the use of bacterial sensitizing compounds, has been studied by Dr. Gerald Silverman and his associates here at M.I.T. for the past three years.

Dr. Silverman's paper discusses radiosensitizers, reviews this field, and presents some interesting data on vitamin K_5 and its derivatives.

Still another method of possibly reducing the undesirable side reactions induced when ionizing energy bombards foodstuffs is the use of the complementary effects of thermal energy and ionizing energy. Some time ago, work by Morgan, Reed, Kempe, Kan, and others indicated that this technique is one which allows for utilization of lower doses of ionizing energy by using a relatively small amount of thermal energy (sublethal quantities), or to put it another way, the utilization of sublethal doses of ionizing energy will permit the utilization of relatively small amounts of thermal energy.

The practical implications of this technique are obvious in the meat industry where thermal sterilization of large cans of meat products is impossible because of the difficulty in putting sufficient quantities of energy into the center of the can without overheating the outermost layers. Dr. Licciardello's paper discusses work on the complementary effects of thermal and ionizing energy and also presents some interesting data on the advantage of simultaneously applying both types of energy using an organism of important present-day public health implication, Salmonella typhimurium.

The paper by Professor Nickerson describes and exemplifies the unity of science and technology. It illustrates, too, the potentialities of ionizing energy as a means of food preservation (in contrast to sterilization). The ocean contains a vast source of food supply which as yet has not been fully exploited. Professor Nickerson's paper describes a research program which may, indeed, open up a means of greater utilization of sea food products in this country.

Among the newer methods of food preservation, freeze dehydration of foods has received a great deal of publicity and has had an enthusiastic response by the food industry and the consuming public.

While this method is in industrial use today by the food industry, there are a number of considerations relative to these products, their manufacture, and their reaction with moisture and oxygen which need careful attention. Dr. Karel's paper discusses the various unit operations involved in freeze dehydration and their

effect upon the quality of the final lyophilized foodstuff. The discussion is illustrated with experimental data.

The paper by Dr. Goldblith considers some of the microbiological aspects of freeze dehydration and delves into many of the unsolved problems as well as pointing out the tremendous quantities of microbiological data which have been obtained in the freeze-dehydration industry.

The Food Additives Amendment of 1958 awakened many people to a realization of the need for formal recognition of "food toxicology," "wholesomeness," or "food safety." Recognition of the field by universities again lagged behind industrial recognition. This is not surprising, inasmuch as the work done in the field of food safety had been done by the food and container industries using techniques developed largely by them and the drug industry in conjunction with the Food and Drug Administration. These techniques are costly procedures, by and large, and have been the subject of so much discussion that a review of this subject at the present time would prove to be superfluous and redundant. There are, however, some basic points which should be considered and which are relevant:

1. The test procedures now in use have been developed largely by toxicologists and pharmacologists for use with drugs, and they have been adapted for foodstuffs and food additives.
2. These tests are costly and of long duration.
3. Our laws, including those dealing with foods, are usually written by politicians (and here I refer to this word in its highest sense), and not by scientists.
4. Thus, if we do not like our present laws, we should do something other than telling the Food and Drug Administration. This agency simply does not make the laws.

What can universities do about the points which I have raised? The Massachusetts Institute of Technology has recognized the problems and the obligations of the university. It has formally established within the Department of Nutrition and Food Science a group in food safety under the leadership of Dr. Leo Friedman, whose paper presents some of the problems in the wholesomeness evaluation of foods and outlines the research program in this field and its rationale.