CONTENTS:

Food Technology · September 1989
Celebrating the 50th Anniversary of the Institute of Food Technologists

Editorial: IFT's 50th Anniversary .................................................. 10
John B. Klis, Editor, Food Technology, Director of Publications, IFT

Introduction to the IFT 50th Anniversary Issue .................................. 12
André Bolaffi, Bolaffi International, Ltd., 50th Anniversary Committee Chairman,
and Howard W. Mattson, IFT Executive Director, Co-Chairman

History of the Institute of Food Technologists: The First 50 years ............ 14
Neil H. Mermelstein, Senior Associate Editor, Food Technology

IFT's 50th Anniversary Committee ............................................. 57

Through the Looking Glass Brightly: My 27 Years as IFT Executive Director ... 58
Calvert L. Willey, IFT Executive Director Emeritus

IFT's Future: Mission 2000 ..................................................... 68
Theodore P. Labuza, University of Minnesota, 1988–89 IFT President

50 Years of Progress in Food Science and Technology: From Art Based on
Experience to Technology Based on Science .................................... 88
Samuel A. Goldblith, Massachusetts Institute of Technology

Food Science and Technology in Developing Countries During the Past 50 Years ... 108
Ricardo Bressani, Institute of Nutrition of Central America and Panama (INCAP)

Present and Future of Food Science and Technology in Industrialized Countries ... 134
Fergus M. Clydesdale, University of Massachusetts

Present and Future of Food Science and Technology in Developing Countries .... 148
Agide Gorgatti-Netto, Institute of Food Technology (ITAL)

Educational Programs in Food Science: A Continuing Struggle for Legitimacy,
Respect, and Recognition .......................................................... 170
O. Fennema, University of Wisconsin

Pioneers in Food Science and Technology: “Giants in the Earth” ............... 186
Richard L. Hall, Consultant

Biotechnology: Yesterday, Today, and Tomorrow .................................. 196
Susan Harlander, University of Minnesota

A Half Century of Food Microbiology .......................................... 208
E.M. Foster, Food Research Institute, University of Wisconsin

—Continued on page 6
CONTENTS: Food Technology • September 1989
(Continued from page 2)

Nutrition: Past, Present, and Future .................................................. 220
John W. Erdman Jr., University of Illinois

Food Packaging in the IFT Era: Five Decades of Unprecedented Growth
and Change ................................................................. 228
Theron W. Downes, Michigan State University School of Packaging

Food Processing: From Art to Engineering ....................................... 242
Daryl Lund, Rutgers University

The Evolution of Sensory Science and Its Interaction with IFT ................. 248
Rose Marie Pangborn, University of California-Davis

The Foodservice Industry: Continuing into the Future with an Old Friend ... 258
André Bolaffi, Bolaffi International, Ltd., and Dicki Lulay, Chef Francisco, Inc.

Food Toxicology and Safety Evaluation: Changing Perspectives and a
Challenge for the Future ......................................................... 270
Richard L. Hall, Consultant, and Steve L. Taylor, University of Nebraska

Development and Growth of the Food and Drug Administration .......... 280
Peter Barton Hutt, Covington & Burling

Regulating the Misbranding of Food ............................................... 288
Peter Barton Hutt, Covington & Burling

Regulating the Safety of Food ..................................................... 296
Roger D. Middlekauff, McKenna, Conner & Cuneo

Top 10 Food Science Innovations: 1939-1989 .................................... 308
Staff Report

IFT’s 50th Anniversary Song: “IFT, Inspiration For Tomorrow” .............. 309

IFT 50th Anniversary Meeting Photo Highlights ................................. 310

Special Honors Given to the Institute of Food Technologists on its 50th Anniversary ............................................. 314

Departments: Food Technology & IFT Information—8 • Reader Service Cards—217 & 333 •
Classified Advertising—317 • Advertisers’ Index—330

About our Cover Hologram: The holographic image in the forefront is a
3-D model of the IFT cornucopia combined with the 50th Anniversary seal.
The four background sketches represent the four areas in which most members
of IFT are involved, shown clockwise from the lower left: Engineering,
Processing, and Packaging; Education and Training; Research and Product
Development; and Regulation of Food Products, Processseses, Packaging, and
Labeling.
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FOOD TECHNOLOGY, established in 1947, is the monthly publication of the Institute of Food Technologists, an international nonprofit scientific society founded in 1939. The Institute of Food Technologists (IFT) maintains executive, editorial, subscription, and advertising offices at the Institute of Food Technologists Headquarters, 221 N. LaSalle St., Chicago, IL 60601. Phone 312-782-8424; Fax: 312-782-8348.

IFT's MEMBERS are food technologists, food scientists, food engineers, and food industry managers and executives, as well as government personnel and educators in the field of food science and technology, and other individuals working in closely related fields. Membership is open to qualified individuals anywhere in the world. The class of membership—professional, member, emeritus, or student—is assigned by the membership qualifications committee on the basis of information submitted by the applicant. An application for membership and the brochure, "Expand Your Opportunities in Food Science," may be obtained by writing to the Institute of Food Technologists at the above address.

THE EDITORIAL PURPOSE of Food Technology is to present information regarding the development of new and improved food sources, products, and processes, their proper utilization by industry and the consumer, and their effective regulation by government agencies.

EACH ISSUE of Food Technology includes: feature articles; news of the Institute; news of the industry, industry meetings, education, government, and people. Monthly departments cover the latest developments in: ingredients; processing equipment and controls; packaging equipment and materials; laboratory instrumentation and equipment; and pollution control equipment and instrumentation. Book reviews; patents; professional placement information; and a professional directory are also published every month.

FEATURE ARTICLES cover all aspects of food, ranging from harvesting to consumption. Topics include, but are not limited to: biochemistry, biology, chemistry, consumerism, education, energy analysis, engineering, equipment, experimental design, food safety, food service, history, information retrieval and documentation, laboratory equipment and instrumentation, management, marketing, microbiology, nutrition, packaging, pollution control, processing, process instrumentation and control, product development, quality assurance, regulatory matters, and research.

USEFULNESS AND ACCURACY of feature articles are assured by having each submitted article reviewed prior to publication by scientists known to be experts in the subject area discussed in the article.

INVITATION TO CONTRIBUTORS—Please submit an outline of a proposed feature article to the editor for consideration and approval of suitability. Feature articles should be prepared according to the Food Technology style guide, which appears on pp. 175–178 of the December 1988 issue.

NO RESPONSIBILITY is assumed by the Institute of Food Technologists for statements or opinions expressed by the contributors. Views advanced in the editorials are those of the contributors and do not necessarily represent the official position of the Institute of Food Technologists.

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EDITORIAL

IFT’s 50th Anniversary

In commemoration of the Institute of Food Technologists’ 50th Anniversary, we are proud to present this special issue of Food Technology as well as the limited-edition hardbound version described on p. 125.

The History of IFT’s first 50 years is excellently and accurately chronicled by Senior Associate Editor Neil H. Mermelstein. IFT Executive Director Emeritus, Calvert L. Willey, sketches the significant events in the growth and development of IFT during his 27 years as IFT Executive Director.

Important contributions made by ten pioneers who played key roles in the development of food science and technology and IFT are described by Richard L. Hall. The ten most significant innovations in food processing and product development during the past 50 years are presented in a Staff Report on p. 308.

A Look Into the Future is provided by IFT President Theodore P. Labuza. His article describes a study called “Mission 2000,” the purpose of which was to accelerate the development of an action plan to bring IFT into the 21st century.

Developments in a wide range of subjects of interest to food scientists and food technologists are covered in the remaining feature articles. The authors take a long hard look at what has taken place in the past, describe the current state-of-the-art, and then look ahead at what is likely to happen in the next 50 years.

Landmark Papers presented during the Plenary Session by Drs. Samuel A. Goldblith, Ricardo Bressani, Agide Goratti-Netto, and Fergus M. Clydesdale delve into some very important past and present accomplishments—as well as the future impact—of food science and technology in industrialized and developing countries.

Owen R. Fennema’s keynote address, presented during the Opening Session of the 1989 IFT Annual Meeting, analyzes educational programs in food science and technology. He notes that these programs face a continuing struggle for legitimacy, respect, and recognition.

Special 50th Anniversary Review Papers, most of which were presented during symposia or as introductions to technical sessions, are also published in this issue. The subjects of these papers and their authors, listed in the order in which they appear in this issue, are as follows: Biotechnology by Susan K. Harlander; Food Microbiology by E.M. Foster; Nutrition by John W. Erdman Jr.; Food Packaging by Theron W. Downes; Food Processing by Daryl B. Lund; Sensory Science by Rose Marie Pangborn; Foodservice by Andrey Bolaf and Dicki Lulay; Food Toxicology and Safety Evaluation by Richard L. Hall and Steve L. Taylor; Regulating the Misbranding of Food by Peter Barton Hutt; Development and Growth of the FDA by Peter Barton Hutt; and Regulating Food Safety by Roger D. Middlekauff.

The Planning and Production of this 50th Anniversary Issue has truly been a joint effort on the part of the authors, members of the 50th Anniversary Issue and Program Committees, and the Food Technology editorial staff.

Our special thanks go to Neil H. Mermelstein, who edited all of the feature articles; Bernard Schukraft, who was responsible for the design and production of the issue; Curtis L. Mattson, who assisted Mr. Schukraft; Betsy Baird, who proofread most of the articles; and Sam Thiewes, who produced the full-color illustrations that accompany the feature articles.

We also acknowledge the invaluable contributions of Mary K. Wagner, Chairman of the 50th Anniversary Program Committee, and Gilbert A. Leveille, Chairman of the 50th Anniversary Issue Committee, for the selection, acquisition, and screening of the plenary session and review papers published in this issue.

However, it is to the authors that we owe our deepest gratitude. Without their expertise, persistence, and cooperation, this Commemorative 50th Anniversary Issue would not have been possible.

John B. Klis
Editor, Food Technology
Director of Publications, IFT
Introduction to the
IFT 50th Anniversary Issue

André Bolaffi, Chairman, and Howard W. Mattson, Cochairman, 50th Anniversary Committee

This special issue of Food Technology commemorates a very special event in the history of the Institute of Food Technologists—its 50th Anniversary. Founded in 1939, IFT was based on a vision—the vision of a small group of scientists dedicated to the conviction that communication among persons of like persuasion was essential to the progress of this fledgling discipline. Since then, IFT has grown to a body almost 25,000 strong, composed of scientists and technologists in every aspect of food—from biotechnology and processing techniques to food regulations and package design, and everything between.

The IFT 50th Anniversary Annual Meeting & Food Expo, held on June 25-29, 1989, in Chicago, was a record-breaking event in every way—770 technical papers, 1,416 exhibit booths, and 15,082 food professionals attended.

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ing, with another 2,000 or so spouses and guests. Dedicated to honoring the people and events of the past, and to looking forward to the future, it was a unique, mind-boggling, and fitting event.

The articles contained in this special issue of IFT's monthly publication, Food Technology, were written to serve as capsule histories describing the progress during the past 50 years in various areas of the brand-new discipline designed to protect and improve America's food supply, as well as that of the entire world.

The articles also attempt to project where the future will lie, and what kinds of commitments are required to take us there. Whether we will be right in our projections, or whether food science and technology will outstrip even our wildest dreams (as so often happens in the world of technology), remains to be seen. We will look forward to the next 50 years with great interest, as we watch—and participate in—the advances sure to follow in the footsteps of our forebears.

Here's looking at the next 50!
History of the
Institute of Food Technologists:
The First 50 Years
Neil H. Mermelstein

In his keynote address at the Institute of Food Technologists' second Food Technology Conference in 1941, Samuel C. Prescott, IFT's first president and only president to serve two terms, said, "If at the time of our first Boston conference it had been predicted that in four years we should have an organization of approximately 1,000 members, including a majority of the leaders in the far-flung food industries of the United States and of Canada too, it would have seemed almost unbelievable. Yet this is exactly what has come about." What would he say today, now that IFT has more than 23,000 members?

IFT is 50 years old. It was founded on July 1, 1939, by unanimous vote of the persons attending the closing session at the Second Food Technology Conference held at Massachusetts Institute of Technology in Cambridge (Boston), Mass.

Since then, IFT has become a highly respected international organization, with two of the world's most highly regarded publications, more than 23,000 members, 50 Regional Sections, 5 Subsections, 12 Divisions, 1 Student Association, 38 Student Chapters, 19 Affiliate Organizations, 6 Specialized Technology Groups, and numerous committees.

This article reviews some of the highlights of IFT's history, grouped by topic.

The Founding of IFT

In 1936, the staff of the Biology Dept. at MIT began organizing a Food Technology Conference, which was held there on September 14-18, 1937. Nearly 500 people attended the conference, which was chaired by Samuel Cate Prescott, Dean of Science and head of the Biology Dept. at MIT. After three days of sessions featuring 39 invited scientific papers relating to the dairy, canning, and refrigeration industries, the conference ended with a farewell talk by Bernard E. Proctor, also of MIT, who thanked those who had attended and expressed the hope that through similar gatherings a clearinghouse of information concerning the scientific applications relating to foods and food products might become possible.

The conference was so successful that the organizers decided early in 1938 to hold a second conference in 1939. In the meantime, a group of scientists had been invited by G.J. Hucker to attend a meeting, possibly relating to canning, at the New York State Agricultural Experiment Station in Geneva, N.Y., on August 5, 1938. At that meeting, the idea of forming an organization of food-related scientists came up. Hucker was instructed to seek by letter the opinion of others who were not present. More than 30 people replied favorably and authorized use of their names to obtain further opinions. As a result, on September 7, 1938, a letter was sent to about 160 food technologists, chemists, bacteriologists, laboratory directors, and others, asking if they would be interested in the formation of an organization and would be willing to attend an organizational meeting.

The replies were favorable, and a meeting was held in New York on January 16, 1939, to discuss the details of the organization. At the meeting, L.V. Burton, editor of Food Industries magazine, presented a written document suggesting a definition of food technology, a name for the society, a list of essential committees, and a tentative constitution.

The purpose of the organization, according to the constitution, would be "to facilitate interchange of ideas among its members; to stimulate scientific investigations into technical problems dealing with the manufacture and distribution of foods; to promulgate the results of research in food technology; to offer a medium for the discussion of these results; and to plan, organize, and administer such projects for the advancement and application of science insofar as it is fundamental to wider knowledge of foods."

The Institute of Food Technologists is 50 years old. It was founded on July 1, 1939, by unanimous vote. . . Since then, IFT has become a highly respected international organization. . . .

The Second Food Technology Conference was held at MIT on June 29-July 1, 1939, under the chairmanship of Bernard Proctor. More than 600 people attended (Fig. 1). At the final session, session chairman Fred C. Blanch briefly described the proposed organization and its possible usefulness to the food industry and the public and called for a vote as to whether this "Institute of Food Technologists" should be established. The group unanimously approved formation of the organization, the provisional constitution, and the proposed slate of officers and council. Samuel C. Prescott was elected president, Roy C. Newton vice-president, and George J. Hucker secretary-treasurer. All were subsequently reelected for a second term the following year.

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The Council held its first meeting in Pittsburgh on October 16, 1940, and among other things appointed a qualifications committee, elected members of the Institute, considered the possibility of publishing a journal but postponed action on the matter, approved publication of a newsletter, and scheduled the first IFT conference in Chicago for the following June.

Thus, the Institute of Food Technologists began its operation.

**Name**

At the organizational meeting in New York on January 16, 1939, L.V. Burton suggested that the name of the proposed organization be the "Society of Food Engineers." The name "Institute of Food Technologists" was chosen instead because it included engineering as well as management and other branches of technological training involved in the food industry.

Nevertheless, the question of whether the name Institute of Food Technologists accurately represents the makeup and interests of the members has repeatedly been brought up throughout IFT's existence. Various names have been considered and voted on by the members over the years—"Institute of Food Science and Technology," "Institute of Food Technology," and "Institute of Food Science" in 1961; "Society of Food Science and Technology" in 1968; and "Society for Food Science and Technology" in 1979—but all have been rejected in favor of the current name.

A tag line, "The Professional Society of Food Technologists," was used with the name until 1977. In 1989,

In 1941, Samuel C. Prescott, IFT's first president . . . said, "If at the time of our first Boston conference it had been predicted that in four years we should have an organization of approximately 1,000 members . . . it would have seemed almost unbelievable. Yet this is exactly what has come about." What would he say today, now that IFT has more than 23,000 members!
The adoption of the tag line, "The Society for Food Science, Technology, and Nutrition," was considered and rejected. With the continued growth in membership and increasing diversity of backgrounds among the members, however, it appears likely that name changes will continue to be suggested in the future.

Membership

IFT membership has grown from the 839 founder and charter members who joined within the first year (list available on request) to more than 23,000 in 1989.

The provisional constitution adopted when IFT was voted into existence called for two classes of membership based on professional and educational qualifications—Member and Affiliate Member—and a possible third class of Corporate Member. From the very beginning, the Council stressed the importance of maintaining high standards for membership and rigidly enforcing qualification requirements.

The constitution adopted in 1941 listed four classes of membership: Member, one who has acquired formal university training and/or broad experience; Associate Member, one employed in regulation of the food industry but not qualified as a Member; Affiliate Member, one active in some aspect of food technology or scientifically trained and looking forward to a career in food technology; and Corporate Member, a company utilizing the services of personnel in the field of food technology. The Corporate Member classification was eliminated in 1946 because the Council decided that it was not appropriate to have corporate members in a professional society (there never were any in IFT). In 1948, the Associate Member classification was also eliminated.

By 1956, there were three classes of members—Professional Member (formerly the Member class), Member (formerly the Affiliate Member class) and Student Member.

In 1960, the Council approved the concept of Emeritus Membership for anyone who had been a member of IFT for 20 years or more or had joined prior to 1940 and who was retired from active professional life. In 1961, the classification was split into Emeritus Professional Member and Emeritus Member. These members would no longer pay dues and could subscribe to one of the IFT journals at a reduced rate. Emeritus Professional Members could continue to vote on Institute matters. Col. Charles S. Lawrence, IFT’s first Executive Secretary, was designated Emeritus Professional Member No. 1 upon his retirement in 1961.

Prior to 1968, a Student Member had to be at least a junior, but that year the Council voted to allow any student enrolled in a degree program to become a Student Member. The following year, student membership was opened to anyone pursuing a two-year or higher degree.

In 1971, a Member was redefined as anyone active in any aspect of the food industry who evidences interest in supporting the objectives of the Institute.

An Honorary Member classification for nonmembers who have made distinguished and significant contributions that advance the goals and objectives of IFT was considered in 1980 and approved in 1982. However, it was never put into effect and was dropped in 1985.

Currently, IFT has 9,347 Professional Members, 11,445 Members, 1,180 Emeritus Members, and 2,645 Student Members.

Professional Affairs

At the beginning, IFT referred to itself as "The Professional Society of Food Technologists." In 1944, a Committee on Professional Status attempted to define food technology and develop a plan for establishing professional standing. The committee urged that the Institute “avoid all so-called professional activities which would tend to trade unionism.”

IFT was incorporated on July 25, 1950, as a “nonprofit professional educational association to promote the appli-
cation of science and engineering to the production, processing, packaging, distribution, preparation, and utilization of foods. . . .” The Internal Revenue Service exempted it from income tax on May 14, 1946, and February 2, 1952.

In 1961, a committee to study the advisability of establishing a code of ethics was proposed, but the Council proposed instead that information concerning professional relations and status of membership be assembled. Similarly, in 1964, the Executive Committee recommended not preparing a code of ethics but instead preparing a definition for the public of what a food technologist is and does. Nevertheless, a Code of Ethics was adopted in 1969. It was changed to a Code of Professional Conduct in 1973 because of the impossibility of monitoring a person’s ethics. Failure to abide by the code was made a possible cause for expulsion, but this has never been necessary.

In January 1978, Calvert L. Willey, IFT’s second Executive Secretary, wrote an editorial in Food Technology pointing out that any actions of IFT that would endanger its nonprofit tax status—such as accreditation, certification, codes of ethics, lobbying, etc.—should be carefully considered.

Volunteer Structure

IFT has both a volunteer structure and a paid staff to carry out the business aspects of the organization as directed by the membership. The volunteer structure consists of the governing bodies (the officers, Executive Committee, and Council), committees, and the various organizational classifications—Regional Sections and Subsections, Affiliate Organizations, Divisions, Specialized Technology Groups, and Student Association (Table 1).

- Governing Bodies. When IFT was founded, a president, vice-president, secretary-treasurer, and Council were elected, and the tentative constitution that had been prepared at the January 16, 1939, organizational meeting was approved as a provisional constitution for IFT. A constitution committee appointed by the newly formed Council worked on the constitution for several years. It was approved in 1941 and has been revised periodically ever since.

In 1944, the fiscal year of the Institute was changed from a calendar-year basis to an Annual Meeting-to-Annual Meeting basis, the new year beginning with the election of officers at the final session of the annual meeting.

In 1947, the office of president-elect, who would succeed to the office of president the following year, was established.

In 1948, the office of vice-president was eliminated, and the term of office for the president-elect was increased from four months to one year. An Executive Committee consisting of the president, president-elect, secretary-treasurer, and five Council members elected by the Council was authorized, and in 1949 it established a pattern of reviewing all items of business and presenting recommendations for Council action.

In 1961, the Council considered replacing the Executive Committee with a board of directors to act as legal representative of IFT, but decided against it. Instead, in 1963 it established a new Council Policy Committee (CPC) and a new nine-member Executive Committee consisting of the president, president-elect, immediate past-president, and six members elected by the membership, two each year for three-year terms. The treasurer and executive secretary were made ex-officio members. The CPC was to consider committee reports and make recommendations to the Council concerning any matter of a policy nature, the Council would continue to be the policy-making body of the Institute. The Executive Committee, elected by members of the Institute in a general election, would have the responsibility for all business, legal, and financial matters, including the executive and editorial offices.

Prior to 1971, there were separate meetings of the Executive Committee and CPC before the Council meeting. This resulted in a lot of repetition and led to a major reorganization in 1971-72, eliminating the CPC and forming a new Executive Committee consisting of six Council representatives (the old CPC) and six member representatives (the old Executive Committee), plus the president, president-elect, and immediate past-president, with the treasurer and the executive director as ex-officio members. This system continues today. The current organization chart is shown in Figure 2.

The Council is composed of representatives from the Regional Sections, in proportion to their number of IFT members, plus all IFT past-presidents. The Regional Sections were given representation on the Council in 1941. In 1944, the representation was changed to allow each section to have one representative per 100 members instead of per 50 members. In 1979, a proposal to limit the number of councilors by changing the representation to one per 200 members was defeated. Figure 3 shows the past-presidents of IFT.

- Regional Sections. With the idea that a national organization would need local representation to be successful, the Chicago Group of Food Technologists submitted a petition for section status and became the first IFT Regional Section in 1941.

Since that time, Regional Sections and Subsections have been formed throughout the United States and in Canada, England, Australia, Japan, and Mexico. The sections were also allowed to have, in addition to IFT Members and Affiliate Members, people who did not qualify for IFT membership but were active in the food area, providing they accounted for no more than 25% of the section membership. These were referred to as Local Affiliates (renamed Regional Associates in 1972). In 1964, the Executive Committee recommended that Council strongly oppose the increasing percentage of Regional Associates and eventually eliminate them. A 1974 proposal to eliminate Regional Associates was rejected by the Council Committee on Regional Sections.

In 1942, Ellery H. Harvey, the first chairman of the Regional Sections and Subsections have been formed throughout the United States and in Canada, England, Australia, Japan, and Mexico.

—Text continued on page 30
Table 1—IFT's Volunteer Organization

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<td>Split into two sections, Australia Northern and Australia Southern, in 1952; the two sections became the Australian Institute of Food Science and Technology in 1967 and withdrew as Regional Sections; it became an affiliate organization in 1985</td>
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<tr>
<td>31</td>
<td>Washington, D.C.</td>
<td>1958</td>
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<tr>
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<td>1959</td>
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<tr>
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<td>Bluegrass</td>
<td>1960</td>
<td></td>
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<td>34</td>
<td>Gulf Coast</td>
<td>1961</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Texas Longhorn (now Longhorn)</td>
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<td></td>
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<td>36</td>
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<td>1962</td>
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<tr>
<td>37</td>
<td>Intermountain</td>
<td>1962</td>
<td></td>
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<td>38</td>
<td>Inland Empire (now Lewis &amp; Clark)</td>
<td>1963</td>
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<td>39</td>
<td>Carolina (now Carolina-Virginia)</td>
<td>1964</td>
<td>Name changed in 1972</td>
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<td>40</td>
<td>United Kingdom (now British)</td>
<td>1964</td>
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<td>41</td>
<td>Downeast</td>
<td>1967</td>
<td>Split from Northeast Section; deactivated in 1976</td>
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<tr>
<td>42</td>
<td>Nutmeg</td>
<td>1967</td>
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<td>43</td>
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<td>1968</td>
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<td>1970</td>
<td>Split from Dixie Section</td>
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<td>45</td>
<td>Arizona (now Cactus)</td>
<td>1974</td>
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<td>Oklahoma</td>
<td>1974</td>
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<td>Long Island</td>
<td>1976</td>
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<td>Northwest Ohio</td>
<td>1976</td>
<td></td>
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<td>49</td>
<td>Bonneville</td>
<td>1977</td>
<td>Split from Florida Section; deactivated in 1987</td>
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<td>1977</td>
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<td>Alamo</td>
<td>1978</td>
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<td>1978</td>
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<td>53</td>
<td>Ozark</td>
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<td>54</td>
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<td>1980</td>
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<td>---------------------------</td>
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<tr>
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<td>1981</td>
<td></td>
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<td></td>
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<td></td>
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<td></td>
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<td>11B</td>
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<td></td>
<td>Maryland</td>
<td></td>
<td></td>
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<td>28B</td>
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<td>Minnesota</td>
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<td>10B</td>
<td>Keystone Subsection of</td>
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<tr>
<td></td>
<td>Philadelphia (became full</td>
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<tr>
<td></td>
<td>section in 1989)</td>
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<tr>
<td>20B</td>
<td>Northeast Indiana Subsection</td>
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<td>of Indiana</td>
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**Specialized Technology Groups**

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</tr>
<tr>
<td>3</td>
<td>Fruit and Vegetable Products</td>
<td>1982</td>
</tr>
<tr>
<td>4</td>
<td>Extension</td>
<td>1982</td>
</tr>
<tr>
<td>5</td>
<td>Dairy Products</td>
<td>1982</td>
</tr>
<tr>
<td>6</td>
<td>Food Laws and Regulations</td>
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<td>7</td>
<td>Refrigerated and Frozen Foods</td>
<td>1971</td>
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<td>8</td>
<td>Carbohydrates</td>
<td>1971</td>
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<td>9</td>
<td>Quality Assurance</td>
<td>1972</td>
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<td>Sensory Evaluation</td>
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<td>Muscle Foods</td>
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<td>18</td>
<td>Toxicology and Safety</td>
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<td>Biotechnology</td>
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**Student Association**

1982

**Student Chapters**

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<td>Louisiana State University</td>
<td>University of Rhode Island</td>
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<td>University of California</td>
<td>University of Massachusetts</td>
<td>Rutgers University</td>
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<td>Clemson University</td>
<td>Michigan State University</td>
<td>University of Tennessee</td>
</tr>
<tr>
<td>Colorado State University</td>
<td>University of Minnesota</td>
<td>Texas A&amp;M University</td>
</tr>
<tr>
<td>Cornell University</td>
<td>Mississippi State University</td>
<td>Texas Tech University</td>
</tr>
<tr>
<td>Delaware Valley College</td>
<td>University of Missouri</td>
<td>Virginia Polytechnic Institute</td>
</tr>
<tr>
<td>University of Delaware</td>
<td>University of Nebraska</td>
<td>and State University</td>
</tr>
<tr>
<td>University of Florida</td>
<td>North Carolina State University</td>
<td>Washington State University</td>
</tr>
<tr>
<td>University of Georgia</td>
<td>Ohio State University</td>
<td>University of Wisconsin-Madison</td>
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<tr>
<td>University of Illinois</td>
<td>Oklahoma State University</td>
<td>Univ. of Wisconsin-River Falls</td>
</tr>
<tr>
<td>Iowa State University</td>
<td>Oregon State University</td>
<td>Brigham Young University</td>
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History of the Institute of Food Technologists (continued)

Fig. 1 (continued)

John C. Ayres * 
1976—1977

Howard E. Bauman 
1977—1978

B. S. Schweigert 
1978—1979

Walter L. Clark 
1979—1980

Frederick J. Francis 
1980—1981

Arthur T. Schramm * 
1981—1982

Owen R. Fennema 
1982—1983

Gilbert A. Leveille 
1983—1984

Bernard J. Liska 
1984—1985

Charles J. Bates 
1985—1986

John J. Powers 
1986—1987

Roy E. Morse 
1987—1988

Theodore P. Labuza 
1988—1989

* Deceased
History of the Institute of Food Technologists (continued)

Chicago Section, suggested that something be done to promote the development and growth of Regional Sections. The most concrete suggestion was that IFT members traveling in various parts of the country might serve as guest speakers at section meetings.

In 1962, Council established a Scientific Lectureship Program to make available to the Regional Sections highly qualified speakers that they might not otherwise be able to obtain. Each section is entitled to one speaker per year and pays only the local expenses of the speaker, while IFT pays the speaker’s travel expenses and an honorarium. Currently, the program consists of 19 speakers serving about 40 sections each year.

In 1969, sections were allowed to form subsections, and the Central Valley Subsection of Northern California became the first subsection.

Today, there are 50 sections and five subsections. They generally hold a dinner meeting once a month during the academic year, with a guest speaker. Some of the sections have established scholarships and instituted award programs, some have sponsored workshops and conferences, alone or in cooperation with other organizations, and some have cosponsored regional conferences with other sections—an approach which IFT has encouraged. A number of sections have also sponsored annual Suppliers’ Nights, featuring tabletop exhibits—miniature versions of IFT’s Food Expo.

Sections and subsections play a vital role in IFT—not only in providing IFT members with the opportunity to meet with their peers throughout the year and keep abreast of new developments through the section newsletters and guest speakers, but also in serving as a training ground for IFT officers and committee members.

- **Affiliate Organizations.** In 1957, the Council adopted a policy of affiliating with foreign food technology groups only through the established Regional Section structure of the Institute. However, in 1963, formation of affiliate organizations of food technologists outside the U.S. was approved, and the Chilean Society of Food Technology became IFT’s first affiliate organization. To date, there are 18 Affiliate Organizations.

- **Divisions.** In 1967, establishment of Divisions in specific food science and technology disciplines was approved, and in 1968 the Refrigerated and Frozen Foods Division became the first probationary division, receiving full division status in 1971. To date, 12 Divisions have been formed.

The Divisions publish newsletters, hold an annual business meeting, sponsor one or more half-day programs at the Annual Meeting, and serve as an information resource in their areas of expertise. Some Divisions sponsor awards and competitions. A new approach to begin at the 1990 Annual Meeting is for some Divisions to sponsor a lecture for which they will pay the speaker an honorarium.

- **Specialized Technology Groups.** In 1981, the formation of special-interest technical research groups which may or may not be commodity oriented was approved, and the following year the Citrus Products and Seafood Products groups became the first probationary Specialized Technology Groups. Today, there are six STGs. They operate in the same manner as the Divisions.

- **Student Association.** Interesting students in IFT was one of the earliest goals of the Institute. A Student Member classification was established in 1949.

Efforts to increase the involvement of students continued over the years. A student forum held at the 1972 Annual Meeting led to the formation of a Student Division in 1975. Since membership in the division was optional, only about one-third of the Student Members of IFT joined the division, and it had to request funds from IFT each year to support its activities. To solve this problem, the division was converted in 1982 into a Student Association of which every student member was automatically a dues-paying member.

Student chapters have been formed at 38 universities throughout the U.S. Prior to 1974, only food science clubs at schools whose curriculum met the requirements for participation in IFT’s scholarship/fellowship program could become student chapters. This was changed in 1974 to allow any food science club at any two- or four-year school to become a student chapter after two years (compared to one year for those that met the minimum requirements).

The chapters participate in a variety of activities throughout the school year and compete in the Student Association’s Best Student Chapter of the Year Competition and Intercollegiate College Bowl Competition, in which teams from schools in the six regions of the association compete in runoffs and the finalists from each region compete at the Annual Meeting. The first Chapter of the Year Award was presented in 1976 to the University of Georgia student chapter, and the first College Bowl Competition was won in 1985 by the North Atlantic Area student chapters.

The Student Association also publishes a newsletter and cosponsors the graduate and undergraduate paper competitions at the Annual Meeting in cooperation with the Phi Tau Sigma honorary society and Procter & Gamble Co.

- **Committees.** Much of the volunteer work of the Institute is accomplished through committees. IFT has had many committees, subcommittees, and ad hoc committees over the years. Without the efforts of these committees, IFT would not have functioned and developed as it did.

**Headquarters Staff**

IFT functioned on a strictly volunteer basis until 1949, with George J. Hucker serving as secretary-treasurer for the first five years of IFT’s existence, and Carl R. Fellers for the next five. In 1949, the Executive Committee was authorized to hire a full-time executive secretary and establish a national office in Chicago. The committee hired Colonel Charles S. Lawrence (Fig. 4), retiring Commandant of the Quartermaster Food and Container Institute for the Armed Services, to fill this position on a trial basis for one year. Lawrence set up a temporary office at 222 W. Adams St. in Chicago in October 1949, and a short time later moved the office to 176 W. Adams St. The secretarial work formerly handled by the secretary-treasurer was transferred to the new executive secretary and the treasury duties to the new treasurer.

In 1961, Col. Lawrence retired, and the Council passed a resolution thanking him: "In a great measure it has been through his untiring efforts and outstanding leadership that this Institute has grown from a small struggling Society at the
IFT functioned on a strictly volunteer basis until 1949 [when] the Executive Committee was authorized to hire a full-time executive secretary and establish a national office in Chicago.

added to the IFT staff. Woodard left IFT in 1983, and Jeffrey A. Kramer succeeded him.

Prior to 1972, IFT handled all recordkeeping manually. In that year, IFT began using computer service bureaus to maintain its membership and circulation records. In 1977, IFT leased its own in-house minicomputer system. In 1982, the IFT office acquired its own computer system to aid in membership and circulation as well as in word processing. The computer system has continuously been upgraded since that time.

The position of Director of Public Information was established in 1973, and Howard W. Mattson was hired to fill that position. In 1985, with the pending retirement of Cal Willey, Mattson was named Assistant Executive Director, eventually to succeed Willey as Executive Director. Charles W. Wixom was hired to replace Mattson as Director of Public Information. That same year, the Office of Scientific Public Affairs was established, and Richard A. Greenberg was hired as Director, with the Director of Public Information reporting to him. In 1988, a Director of Scientific Affairs, also reporting to the Director of OSPA, was established, with Rosetta L. Newsome filling the position.

—Continued on page 35

Fig. 4—Col. Charles S. Lawrence, IFT’s First Executive Secretary (1949–61)

Fig. 5—Calvert L. Willey, IFT’s Second Executive Secretary/Director (1961–87)

Fig. 6—Howard W. Mattson, IFT’s Third Executive Director (1987–present)
History of the Institute of Food Technologists (continued)


In 1988, as a result of recommendations by a management consultant, IFT established the position of Director of Finance & Administration, with Michael Cernauskas hired to fill that position, and the position of Director of Market & Membership Development, with Calvin A. Trout promoted from the marketing staff to that position.

On December 1, 1987, Cal Willey retired, and Howard Mattson (Fig. 6) became Executive Director. Willey was named "honorary professional food technologist" and Executive Director Emeritus and was presented with a portfolio of remembrances from old friends and colleagues. During the 27 years of Willey's tenure, membership had grown from fewer than 6,000 to more than 23,000, and the annual budget from about $203,000 to more than $5 million.

With the pending retirement of George Foster in late 1989, the position of Associate Director of Field Services was established in 1988, and Pamela Pierson was promoted from Executive Assistant to the Executive Director to that position.

From the time Col. Lawrence was first hired, the staff has expanded to handle the steady growth in membership and the resulting increase in activities. Although the staff today numbers 49, it should be noted that it is still small compared to other scientific societies of comparable size.

Publications

Since its inception, IFT has published a variety of material, including newsletters, proceedings, journals, directories, and books.

• Newsletters and Proceedings. Prior to 1946, IFT published occasional newsletters and the proceedings of the papers presented at the annual Food Conferences from 1940 through 1945. The proceedings were edited by C. Olin Ball and printed by the Garrard Press, Champaign, Ill. No Food Conference was held in 1945 because of a transportation ban imposed by the Office of the War Mobilization Director, but most of the papers that had been scheduled for presentation at the conference were presented at Regional Section meetings instead and printed as the 1945 proceedings.

• Journals. The subject of IFT's having its own journal came up as early as the first Council meeting. The Council considered the possible selection of Garrard Press's journal, Food Research, as IFT's official publication and also the offer of reduced-rate subscriptions to McGraw-Hill Publishing Co.'s Food Industries magazine. The Council felt that it was too early to decide on a journal.

By 1946, there were plans to expand the newsletters into a quarterly publication called Transactions, but the Council decided instead to combine this material and the proceedings of the 1946 Food Conference into an Institute journal, which would appear monthly and include advertising, news of the Council meetings, book reviews, and papers on industrial, economic, and legal matters.

The first issue of this journal, Food Technology, was published in January 1947, with C. Olin Ball as editor-in-chief, a board of associate editors, and George Hucker as managing editor. It had the same trim size as the proceedings—6% in × 10% in—and was printed by Garrard Press quarterly during 1947 and 1948. At the end of the first year, Hucker resigned as managing editor, and Ball took over that responsibility as well as the editorship.

In January 1949, the trim size was increased to 8% in × 11% in to facilitate the sale of advertising, and Food Technology became a monthly publication, with advertising included for the first time. By mid-1949, Food Technology had a circulation of more than 3,000. To facilitate the editor's work, the Council appointed an editorial board of nine members plus the editor to be responsible for editorial policy.

The popularity of Food Technology and recognition of the importance of basic research led the Council to consider publishing an additional journal. As a result, IFT in 1950 acquired Food Research, a journal which had been edited by bacteriologist Fred W. Tanner and printed by Garrard Press since 1936. IFT named Tanner Editor Emeritus, made the editor of Food Technology editor of Food Research as well, and appointed an editorial advisory board. IFT published its first issue of Food Research in 1951 and continued printing the journal bimonthly at Garrard Press, changing the title to Journal of Food Science (JFS) in 1961.

By the time that Food Research was acquired, C.O. Ball had been editor of Food Technology for four years, and he asked to be relieved of that responsibility. Zoltan I. Kertesz was named editor-in-chief of IFT journals, and the Executive Secretary was named business manager. With a year, Kertesz pointed out the difficulty of providing adequate attention to the editorial business of the Institute on a part-time basis, and the Council increased the editorial budget to cover additional office help. A committee on publications was appointed to make publication policy recommendations.

In 1952, Kertesz resigned because of pressure of other duties, and Martin S. Peterson was named to succeed him. Kertesz was given the title of Honorary Consulting Editor. In 1957, the Publications Committee was instructed to hire a full-time editor.

In 1960, Calvert L. Willey became Executive Secretary of IFT and publisher of the Institute's journals, and in 1961, George F. Stewart became Executive Editor, replacing Martin Peterson. He presented a new format for Food Technology and made various improvements in review procedures. Stewart resigned in 1966, and in that year most of IFT's publishing activities were consolidated in the IFT headquarters office. Karl O. Herz was hired as Director of Publications and Editor of Food Technology, and Walter M. Urbain was named Scientific Editor of both journals.

In 1970, John Klis succeeded Karl Herz as Director of...
History of the Institute of Food Technologists (continued)

Fig. 7—Changes in Cover Design of IFT Journals

Proceedings 1940

Food Technology 1947

Food Technology 1951

Food Technology 1952

Food Technology 1953

Food Technology 1953

Food Technology 1956

Food Technology 1957

Food Technology 1957

Food Technology 1958

Food Technology 1959

Food Technology 1960

Food Technology 1962

Food Technology 1964

Food Technology 1964

Food Technology 1965
### Table 2—IFT Annual Meeting & Food Expo Data

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<th>Year</th>
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<td>1957</td>
<td>Pittsburgh</td>
<td>R.E. Buch &amp; C.R. Stumbo</td>
<td>na</td>
<td>136</td>
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<td>Chicago</td>
<td>J.M. Jackson &amp; G.W. Beach</td>
<td>1,618</td>
<td>208</td>
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<td>1959</td>
<td>Philadelphia</td>
<td>W.L. Obold &amp; J.M. Sharf</td>
<td>1,240</td>
<td>140</td>
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<td>1960</td>
<td>San Francisco</td>
<td>G.F. Stewart</td>
<td>1,406</td>
<td>207</td>
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<td>1961&lt;sup&gt;e&lt;/sup&gt;</td>
<td>New York</td>
<td>F.C. Baselt</td>
<td>2,021</td>
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<td>1962</td>
<td>Miami Beach</td>
<td>B.M. Watts</td>
<td>1,187</td>
<td>211</td>
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<td>1963</td>
<td>Detroit</td>
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<td>1,808</td>
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<td>1964</td>
<td>Washington, D.C.</td>
<td>A. Kramer</td>
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<td>1965</td>
<td>Kansas City</td>
<td>H.E. Newlin</td>
<td>1,573</td>
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<td>1966</td>
<td>Portland</td>
<td>R.E. Moser</td>
<td>2,122</td>
<td>214</td>
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<td>R.E. Morse</td>
<td>2,182</td>
<td>155</td>
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<td>211</td>
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<td>2,742</td>
<td>198</td>
<td>147</td>
<td>229</td>
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<tr>
<td>1969</td>
<td>Chicago</td>
<td>S.A. Goldblith</td>
<td>3,266</td>
<td>181</td>
<td>162</td>
<td>256</td>
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<tr>
<td>1970</td>
<td>San Francisco</td>
<td>R.B. Davis</td>
<td>3,929</td>
<td>166</td>
<td>185</td>
<td>279</td>
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<tr>
<td>1971</td>
<td>New York</td>
<td>W.J. Hoover</td>
<td>4,485</td>
<td>174</td>
<td>170</td>
<td>249</td>
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<tr>
<td>1972</td>
<td>Minneapolis</td>
<td>E.L. Wick</td>
<td>3,358</td>
<td>255</td>
<td>175</td>
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<td>1973</td>
<td>Miami</td>
<td>H.O. Hultin</td>
<td>3,943</td>
<td>366</td>
<td>182</td>
<td>282</td>
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<tr>
<td>1974</td>
<td>New Orleans</td>
<td>E.F. Binkerd</td>
<td>4,752</td>
<td>356</td>
<td>174</td>
<td>292</td>
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<tr>
<td>1975</td>
<td>Chicago</td>
<td>T.P. Labuza</td>
<td>6,261</td>
<td>394</td>
<td>196</td>
<td>319</td>
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<tr>
<td>1976</td>
<td>Anaheim</td>
<td>F.J. Francis</td>
<td>5,424</td>
<td>449</td>
<td>217</td>
<td>373</td>
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<tr>
<td>1978</td>
<td>Dallas</td>
<td>J.H. Nelson</td>
<td>6,433</td>
<td>483</td>
<td>260</td>
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<tr>
<td>1979</td>
<td>St. Louis</td>
<td>O. Fennema</td>
<td>7,089</td>
<td>459</td>
<td>286</td>
<td>495</td>
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<tr>
<td>1980</td>
<td>New Orleans</td>
<td>L.B. Rockland</td>
<td>7,269</td>
<td>458</td>
<td>302</td>
<td>537</td>
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<tr>
<td>1981</td>
<td>Atlanta</td>
<td>F.M. Clydesdale</td>
<td>6,986</td>
<td>463</td>
<td>308</td>
<td>540</td>
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<tr>
<td>1982</td>
<td>Las Vegas</td>
<td>K.K. Stewart</td>
<td>6,916</td>
<td>545</td>
<td>300</td>
<td>547</td>
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<tr>
<td>1983</td>
<td>New Orleans</td>
<td>R.G. Cassens</td>
<td>6,766</td>
<td>503</td>
<td>325</td>
<td>593</td>
</tr>
<tr>
<td>1984</td>
<td>Anaheim</td>
<td>K.J. Wohlpart</td>
<td>8,322</td>
<td>440</td>
<td>393</td>
<td>706</td>
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<tr>
<td>1985</td>
<td>Atlanta</td>
<td>L.D. Satterlee</td>
<td>8,213</td>
<td>480</td>
<td>425</td>
<td>810</td>
</tr>
<tr>
<td>1986</td>
<td>Dallas</td>
<td>D.F. Farkas</td>
<td>9,102</td>
<td>533</td>
<td>453</td>
<td>940</td>
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<tr>
<td>1987</td>
<td>Las Vegas</td>
<td>R.L. Shewfelt</td>
<td>10,417</td>
<td>573</td>
<td>475</td>
<td>1,063</td>
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<tr>
<td>1988</td>
<td>New Orleans</td>
<td>E.W. Underquirer</td>
<td>10,233</td>
<td>682</td>
<td>525</td>
<td>1,211</td>
</tr>
<tr>
<td>1989</td>
<td>Chicago</td>
<td>D.B. Lund</td>
<td>15,082</td>
<td>770</td>
<td>636</td>
<td>1,416</td>
</tr>
</tbody>
</table>

*Registration represents professional registration (excluding family members)

<sup>b</sup>Not available
<sup>c</sup>No Annual Meeting held because of the war; papers presented at Regional Section meetings instead
<sup>d</sup>IFT took over responsibility for exhibits; previously handled by host section
<sup>e</sup>IFT took over registration and employment bureau
### Table 3—Winners of IFT’s Achievement Awards

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</tr>
</thead>
<tbody>
<tr>
<td>Babcock-Hart Award</td>
<td>Fred C. Blanck*</td>
<td>Clarence Birdseye*</td>
<td>Carl R. Fellers*</td>
<td>Samuel C. Prescott*</td>
<td>Fred W. Tannen*</td>
<td>Charles N. Frey*</td>
<td>Edwin J. Cameron</td>
<td>William V. Cruess*</td>
<td>Gail M. Dack*</td>
<td></td>
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</tr>
</tbody>
</table>

*Deceased
Food Technology
Industrial Achievement Award

1959—Eastern Utilization Research & Development Div., ARS, USDA
1960—Merck & Co. and American Meat Institute Foundation
1961—Swift & Co.
1962—Sunkist Growers, Inc.
1963—Swift & Co.
1964—Whirlpool Corp.
1965—C. J. Patterson Co.
1966—Swift & Co. and Trenton Foods, Inc.
1967—Foremost Dairies
1968—Hoffmann-La Roche
1969—Thomas J. Lipton, Inc.
1970—General Foods Corp.
1971—Central Food Technological Research Inst. (India)
1972—Western Regional Res. Lab., ARS, USDA
1973—Armour and Co., Food Research Division
1974—KeCo and Northern Regional Research Laboratory, ARS, USDA
1975—Clinton Corn Processing Co., Div. of Standard Brands Inc.
1976—Bishophric Products Co. and Purdue University
1977—Mississippi State University and Dacus Packaging Corp.

1979—Grumman Corp. and Armour Research Center of Armour & Co.
1980—General Mills, Inc.
1981—Award not given
1982—Oregon State University and Galloway West Co.
1983—Fundacion de Estudios Alimentarios y Nutricionales and Productos Alimenticios Delicias
1984—Research Branch of Agriculture Canada and ABCO Manufacturers Ltd.
1985—G.D. Searle Co.
1986—Award not given
1987—Western Regional Research Center, ARS, USDA, and Lactaid, Inc.
1988—Award not given
1989—Award not given

Carl R. Fellers Award
1984—Emil M. Mrak*
1985—Bernard S. Schweigert
1986—Edwin M. Foster
1987—Roy E. Morse
1988—Owen R. Fennema
1989—Frederick J. Francis

Calvert L. Wilely Award
1989—Ben F. Buchanan

Donald K. Tressler Award
1985—Jasper G. Woodroof
1986—Fergus M. Clydesdale
1987—Award discontinued
Table 4—Fellows of IFT

<table>
<thead>
<tr>
<th>Year</th>
<th>Fellows</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>Charles J. Bates, Charles A. Becker, Dee M. Graham, Robert C. Lindsay, Robert J. Price, Edmund A. Zottola</td>
</tr>
</tbody>
</table>

*Deceased
History of the Institute of Food Technologists (continued)

Publications and Editor of Food Technology, and Bernard J. Liska replaced Walter Urbain as Scientific Editor. Prior to that time, JFS had included basic research papers, and Food Technology had included applied research papers and other types of articles. In 1971, the applied research articles were transferred from Food Technology to JFS, and the abstracts of all the research papers in JFS began to be published in Food Technology.

Anna May Schenck joined the JFS editorial staff as copy editor in 1970, later becoming Associate Scientific Editor, and Stanley J. Kazeniac became another Associate Scientific Editor in 1974. Aaron E. Wasserman replaced Bernard Liska as Scientific Editor in 1981. He plans to retire from that position as soon as a new editorial system for JFS, including a scientific editor and a number of associate editors, is put into effect.

The editorial staff has expanded over the years and now consists of seven people in the headquarters office in Chicago and one in the office in Fairfield, N.J., plus the Scientific Editor and two Associate Scientific Editors of JFS.

Changes that have taken place in JFS over the years include instituting page charges of $50 per page in 1969, increasing them to $60 in 1987 and $70 in 1989; dropping the summary section of papers; phasing out the publication of series papers; and publishing the abstracts of the papers individually at the beginning of each paper rather than as a group at the front of each issue. Changes in Food Technology include the addition of various departments, as well as the addition, in 1977, of a new section called Overview, presenting "outstanding symposia in food science and technology" from the Annual Meetings.

Changes in logo, layout, and content have also been incorporated into both journals over the years to improve readership (Fig. 7), and the growth in circulation—now more than 23,000 for Food Technology and more than 10,000 for JFS—attempts to the success of these changes.

- Directory. Although membership directories had been published periodically since IFT's inception, it was not until 1967 that an expanded directory, called The IFT World Directory & Guide, appeared. It contained IFT information, a membership directory, and a select buyers' guide to food industry equipment and supplies. In 1987 it was changed to contain only IFT information and the membership directory; the Buyers' Guide section was discontinued, and the Classified Guide to Food Industry Services section was transferred to the December issue of Food Technology.

- Books. The Basic Symposium cosponsored by IFT and the International Union of Food Science and Technology at the IFT Annual Meetings have been held each year since 1976, with the exception of 1978, and all of them, with the exception of 1979, were published in book form through arrangements with commercial publishers. The possibility of IFT's becoming a full-service book publisher has been considered from time to time at least as far back as 1978, but so far the economics have not appeared favorable enough. The possibility is still under consideration.

Annual Meeting & Food Expo

The Annual Meetings (originally called Food Technology Conferences) have combined technical presentations with business and social events, scientific and industrial exhibits, and awards presentations since 1940. Table 2 lists pertinent information about the Annual Meetings, and the following discusses various aspects of the meetings.

- Program. One of the first actions the newly formed IFT Council took was to schedule a Food Technology Conference to be held in Chicago on June 16-19, 1940. Since that time, an Annual Meeting has been held every year except 1945, when it was canceled because of a transportation ban imposed by the Office of the War Mobilization Director. A business meeting of the Council was held for continuity, however.

The number of papers presented at the Annual Meetings has grown from 45 in 1940 to 770 in 1989. Poster sessions were introduced in 1976 and have since grown in size from 14 papers in one session to 286 papers in five sessions in 1989. The program now consists of technical sessions at which papers are presented orally, poster sessions, and Division, STG, and other symposia.

With the growth in size of the program, there has been increasing pressure to extend the length of the meeting and even perhaps have more than one meeting a year.

Some of the changes that have occurred in the Annual Meeting program over the years are as follows:

- The awards presentations were shifted from the awards banquet to the general business session in 1971.
- Poster sessions were added in 1976.
- An undergraduate student paper competition was added in 1974, and a graduate competition in 1977.
- Short courses began to be presented in conjunction with the Annual Meeting in 1971, and the Basic Symposium in 1976.
- An Intercollegiate College Bowl Competition was added in 1985.

Audio cassettes of all sessions were first sold in 1976 as a service to members who could not attend all the concurrent sessions.

In 1981, the Program Committee suggested establishing a forum for technical presentations on new commercial processes and products. This new product forum will be put into effect at the 1990 Annual Meeting.

- Exhibits. The first annual meeting in 1940 included 25 exhibits. That year G.S. Gorsline, an exhibit specialist, suggested that exhibits could produce considerable revenue for IFT, and he was put in charge of commercial exhibits for 1941. In spite of difficulties encountered as a result of unsettled conditions and strikes, the 1941 exhibit had a net income of $1,159.32, which was divided equally between the exhibit committee and Gorsline.

That year, Gorsline recommended that no exhibits in the future should be in the private rooms of exhibitors and that the organization of exhibits should be centered in one person to facilitate the business arrangements. He opposed commercial exhibits for the 1942 meeting and recommended holding exhibits only every other year. The Council decided not to sponsor an exhibit at the 1942 meeting because of conditions related to the war, but left it up to the discretion of the local section whether or not to hold an exhibit.

Prior to 1955, most of the Annual Meeting arrangements, with the exception of appointment of the program and exhibit committees and publication of the proceedings, were handled by the host section, including distribution of the proceeds. Beginning with the 1955 Annual Meeting, how-
Correction:

The first two paragraphs on page 44 contained several omissions. The following paragraphs are the correct version. — Neil H. Mermelstein, July 6, 2007

Publications and Editor of Food Technology, and Ernest J. Briskey replaced Walter Urbain as Scientific Editor. Prior to that time, JFS had included basic research papers, and Food Technology had included applied research papers and other types of articles. In 1971, the applied research articles were transferred from Food Technology to JFS, and the abstracts of all the research papers in JFS began to be published in Food Technology.

Anna May Schenck joined the JFS editorial staff as copy editor in 1970, later becoming Associate Scientific Editor, and Stanley J. Kazeniac became another Associate Scientific Editor in 1974. Bernard J. Liska replaced Ernest Briskey as Scientific Editor in 1971, and Aaron E. Wasserman replaced Bernard Liska in 1981. He plans to retire from that position as soon as a new editorial system for JFS, including a scientific editor and a number of associate editors, is put into effect.
History of the Institute of Food Technologists (continued)

ever, IFT took over responsibility for the Annual Meetings and limited the host section to $1,000 of the net proceeds. This arrangement continues to the present.

Since the early 1960s, an Exhibit Advisory Committee, headed by Hatton Rogers until 1987, annually conducted the assignment of exhibit space. The exhibits, called Food Expo since 1971, have grown in size from 25 exhibitors in 1940 to 636 in 1989, and they now account for a significant portion of IFT’s income.

- Locations. When IFT first began to hold Annual Meetings, there were many cities that could accommodate them. However, as the attendance, program, and exhibits grew, the number of suitable cities dwindled. Potential sites require hotels that have enough sleeping rooms for more than 15,000 people, have enough meeting rooms for the business meetings, are close together and close to the exhibit hall, and charge moderate rates. The sites also require a convention center that has a large enough exhibit hall, all on one floor, that has enough space for more than 1,500 booths and a sufficient number of meeting rooms for the technical sessions and that charges moderate rental rates. At the present, that leaves IFT with just about six suitable cities—Anaheim, Atlanta, Chicago, Dallas, Las Vegas, and New Orleans.

Awards

Awards for professional accomplishments have long been part of the Institute activities. At the beginning, the awards were sponsored by other groups and presented under IFT’s aegis at the Annual Meetings. Later, IFT took over or cosponsored some of the awards.

Because of the increasing size and complexity of the awards program, the Executive Secretary was designated in 1955 as the agent to represent the Institute in all financial and business transactions with award donors. The following year, the Council adopted a policy against acceptance of any award sponsored by an organization having interests conflicting with the business of the Institute or its professional integrity.

The following is a chronology of IFT’s awards program. All of the awards have been presented at the Annual Meetings. Table 3 lists all the recipients of the awards currently sponsored or administered by IFT.

- Nicholas Appert Award. The first of IFT’s awards, approved in 1941, was the Nicholas Appert Award, sponsored by the Chicago Section and given annually for preeminence and contributions in the field of food technology. Named in honor of the inventor of canning, the first Appert medal was presented to William V. Cruess in 1942. IFT took over sponsorship of the Appert Award in 1957, adding a $1,000 honorarium to the medal provided by the Chicago Section. The honorarium was increased to $5,000 in 1985.

- Food Industries Achievement Award. The second award, approved in 1948, was the Achievement Award sponsored by Food Industries magazine. This biennial award, consisting of a bronze plaque, was presented to the company in the food industry which had made the greatest achievement in food technology during the previous two years. The first of these awards given at the Annual Meeting was presented in 1949 to Florida Citrus Canners Co-Operatives for its frozen concentrated citrus juice process. The award was given four times.

- Babcock-Hart Award. Also approved in 1948 was the Stephen M. Babcock Award presented by the Nutrition Foundation, Inc., for a contribution in food science and technology which has been put into actual production and has resulted in an influence on better nutrition in the U.S. and Canada. Named in honor of the University of Wiscon-

The exhibits, called Food Expo since 1971, have grown in size from 25 exhibitors in 1940 to 636 in 1989, and they now account for a significant portion of IFT’s income.

sin biochemist, the award consisted of a plaque and $1,000. The first of these awards was given in 1948 to Fred C. Blanck. In 1954, the name was changed at the request of the sponsor to the Babcock-Hart Award to honor Babcock’s associate Edwin B. Hart. In 1957, IFT began presenting plaques to the awardees, and in 1989 the International Life Sciences Institute became a cosponsor of the award. The honorarium was increased to $3,000 in 1985.

- Monsanto Award. Approved in 1951 was Monsanto Co.’s award of $100 for the person judged to have the best technique in presenting a technical paper at the Annual Meeting. The award, first given in 1952 to Richard H. Forasyte, was presented each year for five years.

- Citations. In 1953, the Council established a citation to honor persons possessing an extremely outstanding record of performance. The only such citation was presented in 1953 to Samuel C. Prescott, IFT’s first president, “for his preeminent service in all phases of food science and technology and for his dedicated service in creating and building the Institute of Food Technologists.”

- International Award. In 1954, an International Award proposed by the two Australian Sections (later the Australian Institute of Food Science and Technology) was approved. The award originally consisted of an engraved silver salver from the Australians and a $1,000 honorarium from IFT. In 1984, however, the Australian Institute withdrew its support. The award, now sponsored by IFT, was changed to a bronze plaque and the honorarium, which was increased to $5,000 in 1985. The award was first presented in 1956 to Robert S. Schull.

- Poultry Award. In 1957, an award sponsored by the American Poultry Institute was approved. It was presented only once, to R.H. Forasyte in 1958.

- Food Technology Industrial Achievement Award. In 1957, the Council approved establishment of a Food Technology Industrial Achievement Award designed to recognize and honor an outstanding food process or application which represents a significant advance in the application of food technology to food production. The award consists of an engraved plaque and was first presented to the U.S. Dept. of Agriculture’s Eastern Utilization Research & Development Div. for its process for producing instant potato flakes.

- Advertising Excellence Citations. In 1964, IFT presented citations “for excellence in advertising” to five of the 100 companies which had advertised in Food Technology the previous year.

- Samuel Cate Prescott Award. In 1962, Council approved establishment of a Young Researcher Award for someone 55 years of age or younger. Consisting of a plaque and a $1,000 honorarium, the award was first presented in 1964 to Edgar Allen Day. It was renamed the Samuel Cate Prescott Award for Research in 1966, and that name was removed from the fellowship that had previously borne it. The honorarium was increased to $3,000 in 1985.

- IFT Fellows. In 1968, IFT established an award known
as Fellows of the Institute to honor those Professional Members of IFT who have made outstanding contributions to the field of food science and technology. Membership is limited to no more than 3% of the Professional Members, and not more than 20 people can be named to membership in any one year. The first group of Fellows was elected in 1970. To date, 273 IFTers from the U.S. and abroad have been so honored (Table 4).

- William V. Cruess Award. In 1969, IFT established an Award for Excellence in Teaching and named it after William V. Cruess, professor at the University of California-Davis. Supported by the Northern California Section with an annual stipend of $1,000 for a minimum of three years and a medal presented by the Northern California Section, the award was first presented in 1970 to Marcus Karel. The honorarium was increased to $3,000 in 1985.

- W.O. Atwater Memorial Lecture. In 1982, the IFT Annual Meeting was the site for the presentation of the U.S. Dept. of Agriculture's W.O. Atwater Memorial Lecture, delivered by E.M. Foster. Named in honor of the first director of USDA's human nutrition program, the annual award recognizes scientists who have made unique contributions to food science and nutrition. In 1988, IFT agreed to host the presentation of the award once every three years. Under this arrangement, the award was presented to John E. Kinsella that year.

- Carl R. Fellers Award. In 1983, an award sponsored by Phi Tau Sigma Honorary Society was approved. Named after Carl R. Fellers, Phi Tau Sigma's honorary president and a past-president of IFT, the award is given to members of both IFT and Phi Tau Sigma who have served and brought honor and recognition to the profession of food science and technology through their activities and achievements other than teaching, research, development, and technology transfer covered by other IFT awards. The award consists of a plaque from IFT and a $1,000 honorarium from Phi Tau Sigma and was first given to Emil M. Mrak in 1984.

- Donald K. Tressler Award. In 1984, an award named after Donald K. Tressler, an IFT founder, scientist, teacher, and publisher (owner and manager of AVI Publishing Co.), was approved. The award is given to honor an IFT member for preeminence in food science and technology and the ability to communicate with both the scientific community and the public. The award, a plaque from IFT and a $3,000 honorarium from the D.K. Tressler Memorial Fund, was given in 1985 to Jasper G. Woodroof and in 1986 to Fergus M. Clydesdale. It has since been discontinued.

- Calvert L. Willey Award. The Calvert L. Willey Distinguished Service Award was presented to Cal Willey in 1987 on his retirement after 27 years of service as Executive Director of IFT. Given to honor a long-time member of IFT or its staff for "meritorious and imaginative service to IFT," the award consists of a plaque and a $3,000 honorarium. It became a permanent annual award of the Institute beginning in 1989, when it was presented to Ben F. Buchanan.

- General Foods Chair. In 1983, General Foods Corp. chose IFT to establish a procedure for selection of the appropriate recipient for a new General Foods Chair in Food Science. The award—$100,000 per year for a five-year period—would be awarded once every five years to allow an individual who has shown distinction in his or her field to pursue research in food science that will be of significance to the food industry. The award was presented to John E. Kinsella in 1984 and to Larry L. McKay in 1989.

- Competitions. Several undergraduate and graduate research paper competitions are cosponsored by the Student Association, Phi Tau Sigma Honorary Society, and Procter & Gamble Co. In addition, the Food Microbiology Division sponsors the Z. John Ordal Competition for the best food microbiology paper presented orally at the Annual Meeting and the John C. Ayres Award for the best food microbiology paper presented in a poster session at the Annual Meeting.

In addition, in 1989 the Biotechnology Division sponsored a 50th Anniversary Competition for the best graduate research paper on food biotechnology presented at the Annual Meeting, and the International Relations Committee sponsored the George F. Stewart 50th Anniversary International Paper Competition for the best paper by a foreign author. Three other divisions currently have proposals for paper competitions.

- Journalism Awards. In 1987, IFT's Office of Scientific Public Affairs instituted an annual food science writing award. The award, consisting of a plaque and a $1,000 honorarium, was first presented in 1988 to Kathleen McAuliffe of USA Today and World Report. The following year, OSFA added an electronic journalism award, consisting of a plaque and a $1,000 honorarium. The award was first presented in 1989 to Bruce Cramer and Stephen Hill of WMAR-TV, Baltimore, Md.

Scholarships and Fellowships

In 1954, the Awards Committee completed rules for the administration of fellowships and accepted a $500 grant from FloraSynth Laboratories, Inc., and three $4,000 grants from the General Foods Foundation. The FloraSynth fellowship for graduate students was first presented to John E. Shade in 1954 and was increased to $1,000 the following year. The award was given four times. The first General Foods fellowship was given to Harold C. Rich in 1954. In 1955, a $6,000 postdoctoral fellowship was provided by the Gerber Baby Food Fund, Inc., and awarded to J.C. McDonald. This award was changed to six $1,000 awards for undergraduate work beginning in 1957.

In addition, in 1955 IFT took over responsibility for the Samuel Catz Prescott Award, a graduate fellowship (later transferring the name to IFT's Award for Research) which had been established in 1952 by the Northeast Section, and increased the honorarium from $100 to $1,000, supplementing a $2,300 grant from the section. The fellowship was first awarded by IFT to Robert E. Hughes in 1957.

In 1960, IFT established ten $300 scholarships to stimulate interest in food science and technology at the undergraduate level. The number of scholarships was increased to 15 for 1963, with provision for ten second-year awards, making a total of 25 $300 scholarships.

In 1964, IFT began work to establish a uniform procedure for administration of scholarships. The Committee on Awards and the Committee on Education were asked to work together to determine whether there was a possibility of establishing a standard or minimum requirement for recipients of the scholarships. The minimum standards for undergraduate curricula, established in 1966, were eventually used for this purpose.

In 1964, IFT increased the number of undergraduate scholarships to 30, of $300 each, to be divided equally between freshmen and sophomores. In 1967, the amount for each scholarship was increased from $300 to $500, and the scholarships were allowed to be allocated without a set ratio of freshmen to sophomores.

In 1985, the Student Association instituted a $1,000 freshman scholarship to honor George R. Foster for his many years of service and help to the students.

Over the years, IFT has administered scholarships and
History of the Institute of Food Technologists (continued)

fellowships sponsored by many other companies and organizations, as well as sponsored its own scholarships and fellowships. A total of 108 such awards were presented in 1989 alone. Although there have been no followup studies to determine how many of the recipients remain in the food industry, one thing that is obvious from the list of recipients is that there has been a definite trend toward more female recipients over the years. This matches the enrollment pattern of students in food science and technology programs.

Education and Continuing Education

Education of food technologists has long been a major concern of IFT and is reflected in IFT's activities not only in developing undergraduate curricula but also in providing continuing-education opportunities.

- **Curricula.** In 1941, IFT held a symposium on education of food technologists, and authorized a committee to explore the proper curricula for teachers in food technology. A 1944 report stressed the importance of the basic sciences in the training of food technologists.

In 1948, George Stewart, chairman of the Committee on Education & Curricula, reported that 22 institutions of higher learning were offering a curriculum in food technology. The committee had studied the problems involved in establishing food technology educational standards and was undertaking a long-range effort to provide guidance to educators interested in developing food technology courses.

IFT sponsored a Conference on Food Technology Teaching in 1958, at which industry employers and university teachers developed a recommended curriculum for food technology. This was followed in 1962 by a conference on undergraduate education in food science and technology.

In 1966, IFT established minimum standards for undergraduate curricula in food science and technology. These are intended as guidelines for selecting universities for eligibility for IFT's scholarship/fellowship program and not as a form of accreditation. The minimum standards were revised in 1977 and are again under review. IFT decided against establishing standards for two-year programs but is considering developing standards for graduate programs.

In his keynote address in 1985, Peter Barton Hutt stressed the need to provide more coverage of food laws and regulations in the training of food technologists. As a direct result of his remarks, the Education Committee in 1987 developed a tentative syllabus for a course on food laws and regulations, and in 1989 a Food Laws & Regulations STG was formed; it will complete the development of the syllabus.

- **Short Courses.** In 1969, a task force was appointed to consider the feasibility and desirability of conducting an intensive short course to update the knowledge of food technologists. The resulting short course, "Fundamentals of Protein in Foods," was presented in conjunction with the 1971 Annual Meeting. To date, one or more short courses have been presented at each Annual Meeting, and some have been repeated elsewhere following the Annual Meeting. The short course papers are published in manual form as a text for the participants and for sale to others after the course. Consideration is being given to increasing the number of short courses presented during the year.

- **Basic Symposium.** IFT and the International Union of Food Science and Technology have cosponsored the Basic Symposium at the IFT Annual Meeting every year since 1976 except 1978.

Career Guidance and Employment

IFT has also been involved in career guidance and employment-related activities.

- **Career Guidance.** In 1955, a food technology career brochure was prepared for distribution to high school and undergraduate students. In 1961, the Education Committee recommended that IFT not initiate accreditation but that efforts be directed toward attracting greater numbers of students for undergraduate and graduate training.

Career information available from IFT today includes a film, "Food: Its Science, Your Future"; a booklet of elementary food science experiments and a teacher's guide for use in high school science classes; "How to Get Your First Job," a brochure prepared by the IFT Student Association; and a brochure, "World's Largest Industry."

- **Employment.** IFT has always been willing to help its members and others find employment in the food industry. As early as 1941, a committee on employment and personnel changes was authorized. In 1950, the Executive Secretary was given responsibility for developing an Institute employment service. In 1960, the Northern California Section requested that IFT establish a centralized employment service, but IFT's attorneys pointed out that such a move could jeopardize IFT's tax-exempt status.

IFT currently provides a number of employment-related services, including an employment referral service which operates year-round at the headquarters office, and an employment bureau which has operated at the Annual Meeting since the 1950s. Copies of the résumé forms and position description forms are kept on file and also sent to the Regional Section employment committee chairmen for use by section members. The forms are provided as a service to the IFT membership and the profession, and no fees are charged to members, nonmembers, or companies.

A Workshop on Employment Transitions has been held at the Annual Meetings since 1987. IFT also offers classified ads in Food Technology at low rates for members. In 1989, IFT offered a free position-wanted ad and complimentary registration for the 1989 Annual Meeting (to utilize the employment bureau) to any five-year or more member of IFT who was unemployed or underemployed as a result of a merger, acquisition, or cutback.

The employment bureau at the Annual Meeting has grown in size over the years. At the 1989 Annual Meeting, a total of 1,254 résumé forms and 770 job-description forms were distributed, and representatives from a record number of 80 companies conducted interviews.

Other Organizations

IFT has been actively involved with other organizations in a variety of ways—including a dues-paying member of some, establishing liaisons with others, and cosponsoring activities with others. The following is a description of some of them.

- **Phi Tau Sigma.** The food science honorary society has played an important role in a number of IFT's activities re-
IFT has been actively involved with other organizations in a variety of ways—being a dues-paying member of some, establishing liaisons with others, and cosponsoring activities with others.

lated to students. It was organized in 1953 by seven people at the University of Massachusetts who were interested in keeping abreast of different disciplines and their influence on food science. An interdisciplinary symposium led to the formation of the society, whose purpose became the recognition of creative effort among food scientists and encouragement of the pursuit of excellence in their daily work. During its first year, Carl R. Fellers was its honorary president and G.E. Livingston its president. Beginning with 260 charter members, it has held its national meetings in conjunction with the IFT Annual Meetings since 1955. The first chapter was formed in 1954 at the University of Massachusetts, and today there are 26 chapters.

In 1976, the society established the Carl R. Fellers endowment fund to support its activities, including cosponsorship of the IFT graduate and undergraduate paper competitions (initiated by the IFT Student Association and later involving Proctor & Gamble Co.), the Student Association's Intercollegiate College Bowl Competition, the Longtimers and Fellows Receptions, and the Carl R. Fellers Award.

- International Union of Food Science and Technology. The formation and growth of IFT inspired the formation of associations in other countries. In the early 1960s, a group headed by Emil Mrak of the University of California-Davis began informal discussions about the foundation of an international union of such groups. As a result, an International Congress of Food Science and Technology was organized in London in 1962 by the Food Group of the Society of Chemical Industry. Immediately after the congress, an International Committee of Food Science and Technology was set up, and a second congress was planned to be held in Warsaw in 1966. IFT hosted the third congress (called SOS/70 for “Science of Survival”) in Washington, D.C., in 1970 under the chairmanship of Richard L. Hall, and at that time the committee became a permanent International Union of Food Science and Technology (IUFoST), with 20 member nations and George Stewart as its first president. IUFoST now has 40 member nations. The General Assembly, consisting of the delegates from the member nations, meets every four years at the International Congresses. To date, nine International Congresses have been held.

The organization's goals are to encourage international cooperation among food scientists and technologists, support international progress in basic and applied food science, advance technology in the preservation, processing, and distribution of foods, and stimulate education and training in food science and technology. The organization also has various committees and sponsors symposia in addition to the International Congresses. IUFoST cosponsors with IFT the Basic Symposium at the IFT Annual Meeting.

- International Food Information Service. One of IFT's major accomplishments has been in the area of information retrieval. In 1962, the Ad Hoc Committee on Food Science Abstracts sponsored a special meeting to explore the problems involved in abstracting the food science literature. In addition, IFT's delegates to the First International Congress on Food Science and Technology, held in London that year, were authorized to explore ways of setting up an international food science abstracting service. Over the following years, discussions were held with a number of other groups. By 1965, a pilot study to publish a computerized abstract journal was formulated, and the committee was authorized to determine if industry and government agencies would support the system.

However, in 1966, the ad hoc committee was reorganized, and in 1967 George Stewart, chairman of the committee, discussed the possibility of publishing an abstract journal with the British Commonwealth Agricultural Bureaux (CAB). A proposal tentatively accepted by CAB in conjunction with the Gesellschaft für Information und Dokumentation (German Institute for Documentation, GID) appeared to be the most economically favorable. Stewart and Cal Willey raised more than $80,000 in donations to help establish the service.

As a result, the International Food Information Service (IFIS) was formed in 1968, with IFT, CAB, and GID as cosponsors. The first issue of the monthly journal, Food Science and Technology Abstracts (FSTA), was published in January 1969. It was also made available on magnetic tape in 1972. In 1977, IFIS signed an agreement with Lockheed and System Development Corp. in the U.S. for on-line retrieval of data from FSTA through their Dialog and Orbit systems. FSTA can also be accessed on-line through similar companies abroad. To date, FSTA contains abstracts of more than 345,000 articles, patents, standards, books, and reviews.

IFIS, now also cosponsored by the Centrum voor Landbouwpubliekations en Landbouwdocumentatie (PUDOC) in the Netherlands, later began publishing two additional abstract journals—Packaging Science and Technology Abstracts and VITIS-VEA, covering viticulture and enology. IFIS also has sponsored several international symposia on food science and technology information retrieval, one scheduled for October 1989 in Budapest. It is also developing a system to provide the entire FSTA database on CD-ROM (compact discs with read-only memory) for use on personal computers in the developing countries.

- League for International Food Education. This organization was formed in 1968 as a consortium of six scientific and professional societies to provide technical assistance to developing countries. It began with a two-year initiating grant from the Agency for International Development and by the end of the year had nine member societies. IFT was a member until 1987.

In 1975, because it was considered "the foremost professional society of food technologists in the world," IFT was One of IFT's major accomplishments has been in the area of information retrieval. . . . The International Food Information Service was formed in 1968 [and] the first issue of . . . Food Science and Technology Abstracts . . . was published in January 1969.
chosen to administer a $100,000 grant from AID to LIFE for an 18-month study of the available resources in Latin America and an evaluation of how to implement them for improved nutrition. Ben Buchanan and George Stewart were appointed coordinator and assistant coordinator, respectively. The study was successfully completed in 1976.

- Council for Agricultural Science and Technology. This consortium of 28 food and agricultural scientific societies was formed in 1972 to supply the scientific background needed for the government, media, and general public to better understand food and agricultural issues. IFT joined CAST in 1977 and has participated in such of its activities as the Food Day telephone dial-ouges.

- National Nutrition Consortium. In 1972, representatives from IFT and three other nutrition-oriented societies drew up a draft constitution and by-laws for a consortium whose purpose was to provide the government, public health officials, and eventually the consumer with facts about the proper use of foods for health. Among other things, NNC prepared guidelines for a national nutrition policy and nutrition labeling guidelines for communicators before it disbanded in 1985.

- Canadian Institute of Food Science and Technology. In 1972, IFT and CIFSFT decided to have joint representation on each other’s Council without voting powers, beginning in 1973. CIFSFT also participates in IFT’s Public Information Program.

- Liaison. IFT has also had liaison and/or cosponsored symposia, workshops, and conferences with many other organizations over the years. Currently, IFT has liaison with the American Oil Chemists Society, Association of Official Analytical Chemists, Canadian Institute of Food Science and Technology, Codex Alimentarius Commission, National Inventors Hall of Fame, Phi Tau Sigma Honorary Society, and Society of Toxicologists.

Speaking Out

One of the earliest examples of speaking out occurred in 1958, after publication of the Food Additives Amendment to the Federal Food, Drug, and Cosmetic Act, when the IFT Committee on Food Additives supplied to the Food and Drug Administration a list of IFT members believed qualified to express opinions on the safety and acceptability of certain food additives. In addition, the committee pointed out to the Executive Committee that “there is a need to inform the public of the important and essential role of food additives in safeguarding and improving our foods” and recommended that local sections provide speakers on that subject to groups in their community.

In 1972, with impetus from Richard L. Hall, IFT instituted a Public Information Program, consisting of an Expert Panel on Food Safety & Nutrition which would prepare Scientific Status Summaries on specific topics; a Committee on Public Information, which would provide advice on dissemination of these documents; and a network of Regional Communicators, who would serve as contacts with the media. There are now 89 Regional Communicators who alternate throughout the U.S. and in Puerto Rico and Mexico. Nine communicators from the Canadian Institute of Food Science and Technology are also affiliated with the program.

To date, 45 Scientific Status Summaries have been published. They have received widespread dissemination and have been used for countless articles and programs on food science and technology in the popular media.

IFT’s Office of Scientific Public Affairs (OSPA) was established in late 1985 as an expanded Public Information Program, building on the work of the Expert Panel and Regional Communicators, and the Committee on Public Information was disbanded. OSPA functions under the direction of a policy board reporting to the Executive Committee. Its objectives are to establish IFT as the authoritative voice on food science and technology, establish IFT as the knowledgeable and influential resource to decision-making bodies, improve public understanding of food science and technology and IFT, and promote the need for excellent food science research, education, and training.

IFT formed a Foundation in 1985 to provide funds for IFT’s projects in education, communication, and research. It has functioned primarily in support of OSPA and IFT’s scholarship/fellowship program. The OSPA program has been funded about 40% from a grant from the general IFT funds and 35% from grants to the foundation, plus donations from individual IFT members and miscellaneous income.

OSPA is authorized to speak for IFT on matters of science and public policy relevant to the profession of food science and technology and the academic, industrial, and governmental committees it serves, where IFT policies and positions have been prepared. It has established a mechanism for issuing position statements on fast-breaking news. To do this, it established a public information committee (PIC) in each Division and STG. OSPA then requests a single-page statement from the appropriate PIC for each position statement on fast-breaking news. To do this, it established a public information committee (PIC) in each Division and STG. OSPA then requests a single-page statement from the appropriate PIC for each position statement on fast-breaking news. To do this, it established a public information committee (PIC) in each Division and STG. OSPA then requests a single-page statement from the appropriate PIC for each position statement on fast-breaking news. To do this, it established a public information committee (PIC) in each Division and STG. OSPA then requests a single-page statement from the appropriate PIC for each position statement on fast-breaking news. To do this, it established a public information committee (PIC) in each Division and STG. OSPA then requests a single-page statement from the appropriate PIC for each position statement on fast-breaking news. To do this, it established a public information committee (PIC) in each Division and STG. OSPA then requests a single-page statement from the appropriate PIC for each position statement on fast-breaking news. To do this, it established a public information committee (PIC) in each Division and STG. OSPA then requests a single-page statement from the appropriate PIC for each position statement on fast-breaking news. To do this, it established a public information committee (PIC) in each Division and STG. OSPA then requests a single-page statement from the appropriate PIC for each position statement on fast-breaking news. To do this, it established a public information committee (PIC) in each Division and STG. OSPA then requests a single-page statement from the appropriate PIC for each position statement on fast-breaking news. To do this, it established a public information committee (PIC) in each Division and STG. OSPA then requests a single-page statement from the appropriate PIC for each position statement on fast-breaking news. To do this, it established a public information committee (PIC) in each Division and STG. OSPA then requests a single-page statement from the appropriate PIC for each position statement on fast-breaking news. To do this, it established a public information committee (PIC) in each Division and STG. OSPA then requests a single-page statement from the appropriate PIC for each position statement on fast-breaking news. To do this, it established a public information committee (PIC) in each Division and STG. OSPA then requests a single-page statement from the appropriate PIC for each position statement on fast-breaking news. To do this, it established a public information committee (PIC) in each Division and STG. OSPA then requests a single-page statement from the appropriate PIC for each position statement on fast-breaking news. To do this, it established a public information committee (PIC) in each Division and STG. OSPA then requests a single-page statement from the appropriate PIC for each position statement on fast-breaking news. To do this, it established a public information committee (PIC) in each Division and STG. OSPA then requests a single-page statement from the appropriate PIC for each position statement on fast-breaking

OSPA has distributed Scientific Status Summaries, audiovisual materials, and responses to government proposals on issues relevant to IFT, using the established approval mechanism. It has also cosponsored workshops and symposia with appropriate groups, sponsored "hot-topic" symposia at the Annual Meetings, and held press conferences. It sponsored food/nutrition policy conferences in 1986 and 1989 and inaugurated a public policy newsletter in 1989.

In addition, it publishes an annually updated Directory of Information Resources in Food Science and Technology for the public and has available for the public Quick Answers to Commonly Asked Questions About Food. It established an annual food science writing award in 1988 and an electronic journalism award in 1989. It jointly sponsored a conference on new developments in food technology with the American Medical Association in 1988 and a symposium on food biotechnology with the American Society for Microbiology in 1989. OSPA has also issued Scientific Perspective statements to the media on newsworthy topics, using the "three-presidents" approval mechanism. It organized a workshop on food safety with representatives from 18 professional societies in 1988 and issued a scientific community consensus report in 1989, concluding that microbiological and natural toxicants are far more significant to the public health than are pesticide residues and "chemical additives."

The Future

It is appropriate to end this historical review of the Institute of Food Technologists with a discussion of OSPA because in many ways it illustrates the increasing stature and importance of IFT.

During his term as 1988-89 IFT president, Theodore P. Labuza conducted a "Mission 2000" study to determine what IFT will need to do in the next ten years to maintain and improve its professional stature. The future of IFT will depend not only on the outcome of that study but also on the continuing efforts of IFT members and staff. To quote Robert Browning, the best is yet to be.
On June 10, 1984, a group of members and staff of the Institute of Food Technologists met at IFT headquarters to begin planning appropriate activities to celebrate IFT's 50th anniversary during 1988-89. Over the ensuing five years, the committee members, under the chairmanship of André Bolaffi, expended a great deal of time and effort, culminating in the 50th Anniversary celebration at the 1989 IFT Annual Meeting, and it is appropriate to recognize their contributions by listing the committee members in this special anniversary issue of Food Technology.

Chairman and Cochairman
Subcommittee
André Bolaffi, chairman
Howard W. Mattson, cochairman
Dean Duxbury
Daniel Rosson
Roberta Salerno
Roy E. Morse, ex-officio
John J. Flowers, ex-officio
Theodore P. Labutta, ex-officio

Fellows Activities, Executive Committee, and Office of the President Subcommittee
Gilbert A. Leveille, chairman
John W. Erdman Jr.
David R. Lineback
Bernard J. Liska
Daryl B. Lund
Hamilton W. Putnam
Aaron E. Wasserman
Howard W. Mattson, IFT staff liaison
John B. Klis, IFT staff liaison
Jeffrey A. Kramer, IFT staff liaison

Program Subcommittee
Mary K. Wagner, chairman
Ben F. Buchanan
Paul A. Carroad
Daniel F. Parkas
Owen R. Fennema
Daryl B. Lund
Lowell D. Satterlee
Robert L. Shewfelt
Edward W. Underriner
Kenneth J. Wohlpart
John B. Klis, IFT staff liaison

Student Association Subcommittee
Leslie J. Herzog, chairman
Thomas Davis
Marie G. Harrington
Ann C. Hollingsworth
LeeAnne Jackson
O. Robert Noyes
Joe M. Regenstein
John H. Rupnow
Chris J.B. Smit
Timothy O. Taylor
George R. Foster, IFT staff liaison

Past Presidents, Founders and Charter Members Subcommittee
Ben F. Buchanan, chairman
Edward E. Anderson
Charles J. Bates
Philip K. Bates
Hugh T. Griswold
Robert C. Pearl
Neil H. Mermelstein, IFT staff liaison
Pamela Pierson, IFT staff liaison
Bernard Schukraft, IFT staff liaison
Calvert L. Willey, IFT staff liaison

Publicity Subcommittee
R. Coe Barnard, chairman
Lawrence M. Brickman
Miriam Saltmarch
Charles W. Wixom, IFT staff liaison

Awards Subcommittee
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Larry R. Beuchat
Gloria Brooks-Ray
Robert G. Cassens
Peggy M. Foegeding
Frederick J. Francis
Pamela Pierson, IFT staff liaison

Sections, Divisions, and Specialized Technology Groups Subcommittee
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Edward E. Burns
Jack L. Cooper
Richard Dougherty
Dee M. Graham
Leslie J. Herzog
Peggy Hinkhaus
Alan J. Post
Barbara A. Rainey
Isabel D. Wolf
Pamela Pierson, IFT staff liaison

Membership Affairs Subcommittee
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Patricia F. Edwards
Susan K. Harlander
George M. LoPresti
Toni Ruth Manning
Robert J. Price
Daniel E. Weber, IFT staff liaison
John S. Lane, IFT staff liaison
Joan Nolan, IFT staff liaison

Industry Recognition Subcommittee
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James J. Albrecht
Howard Bauman
Walter L. Clark
Paul F. Hopper
James R. Kirk
Gilbert A. Leveille
Blase T. (Ben) Messina
Roger D. Middelkauff
John H. Nelson
Charles H. Pyne
Anthony J. Re
Harvey J. Reiter
Howard W. Mattson, IFT staff liaison
Through the Looking Glass Brightly: My 27 Years as IFT Executive Director

Calvert L. Willey

My long tenure as Executive Director of the Institute of Food Technologists had its beginning in early 1959 when I received a phone call from Ray Wakefield, Chairman of an ad hoc committee, inquiring if I would be interested in a position with IFT. I was relatively happy in the position I held, but like most 40-year-olds, I indicated that I would like to talk about it.

My first meeting with Wakefield, a past-president of IFT; George Garnatz, another past-president; I.J. Hutchings, president at that time; and Harold Schultz, president-elect, produced very little except the knowledge that they weren't sure what they wanted other than a replacement for Colonel Charles Lawrence, a crusty veteran of the Bataan Death March in the Philippines during World War II who was about to retire as Executive Secretary of IFT. We did, however, agree to meet again after I could obtain further information about IFT, of which there seemed to be none, at least of particular relevance.

I later went to the public library, where I found a copy of Food Technology containing a report on the Annual Meeting. This was not particularly helpful. I still could not find out what a food technologist was, and to this day I'm not really sure I know! I decided I was not interested in the job and so told Wakefield when he called me for a second interview. However, the committee was determined, and Wakefield called me again late in December. So I once again met with the committee, determined to let them know that I was not interested but wanting to be at least cordial and willing to walk. I suggested plans for growth, but they were skeptical; so I left again with no information. The next morning, Wakefield called me early at home and invited me for breakfast, at which time we discussed salary and other important matters. He then invited me to join the Executive Committee for lunch, where I agreed in writing to come to work for IFT as soon as possible, but not later than May 1, 1960.

Enlarging the Staff

I went to New York City in early May 1960 for my first IFT Annual Meeting. I saw a lot of things that amazed me. The local section handled the meeting and kept the income; IFT handled the exhibit, such as it was. I met Hatt Rogers, who was in charge of the exhibits, essentially working for IFT for nothing. A splendid relationship developed between us that continues to this day. Later, the Executive Committee decided that subsequent exhibits and registration would be handled by IFT, and all funds and financial obligations would be the responsibility of IFT.

As the staff, consisting of only 4 or 5 people, began to be responsible for the exhibits, a period of considerable growth set in. One IFT officer later calculated that in a period of more than 25 years IFT had an income growth of 12% per year, which had a considerable impact on IFT's ability to better serve members. One of IFT's first staff acquisitions was Dan Weber, who was hired as administrative manager, and grew into larger areas of responsibility, eventually becoming Director of Marketing & Meetings. Dan and his department now account for about 65% of IFT's income.

IFT began to grow quite rapidly as additional staff came on board and new positions were filled. Over the past 25 years, IFT's membership has grown from approximately 6,000 members to 23,000 members, and income has grown from $200,000 to $5 million. Think back to 1960 when dues were only $7.50, and you can easily recognize that we couldn't do much for that amount of money. Increased dues, advertising revenue, and exhibit income all combined to make the IFT of today.

In early 1959 . . . I received a phone call . . . inquiring if I would be interested in a position with IFT. . . . I decided I was not interested [but] the committee was determined [and] late in December . . . I agreed in writing to come to work for IFT . . . .
unpaid, staff member of IFT. Claude was also the early organizer of the IFT employment bureau, a valuable service to any unemployed member. Our friendship continued until his death a few years ago. His family still has the original desk that I acquired from Col. Lawrence decades ago.

Reorganization

As new programs were crowded into an already understaffed organization, the Long Range Planning Subcommittee, with the late I.J. Hutchings as Chairman, recommended that a management study of the Institute be initiated to look into the staff organizational structure, methods, procedures, and equipment, and the total operations of IFT. After receiving several bids for this assignment, the subcommittee selected Fairbanks Associates in 1965 to do the study. John Evans, the principal of that firm, handled the assignment. The study produced a lengthy, exhaustive report, about two inches thick.

The following recommendations (and others) of the study were designed to increase the vitality of the service to members and further the cause of IFT:

IFT began to grow quite rapidly as additional staff came on board and new positions were filled. . . . Increased dues, advertising revenue, and exhibit income all combined to make the IFT of today.

- An organizational structure that meets the current requirements of the Institute and allows for expansion for future needs and requirements.
- Consolidation of editorial and production operations to improve cost relations without affecting services to members.
- Systems and procedures where proper investment
Through the Looking Glass Brightly (continued)

return can be achieved to operate the Institute's needs on a timely basis.

- A system of record maintenance, addressing methods, accounting records, and other operation facilities at a favorable cost to produce the quantity and quality of results required in a simple manner within a reasonable time.
- A long-range base for staff development that would enable the Institute to increase its service to the Regional Sections and the membership.

About 99.9% of the recommendations were instituted, and the report provided a working document for the staff and me. I can't forget the recommendation that IFT install its own list maintenance on an IBM-Scriptomatic operation for later conversion to a totally mechanized, in-house system (computer) under IFT's control. Dan Weber and I locked ourselves into a hotel room for many weekends to get this into operation, and since we couldn't do it during regular working hours.

Editing and Advertising

One of the first areas that we attempted to reorganize, in addition to the member services records, was the publishing operation. We began to organize an editorial staff that would in effect replace the operation that we had in Davis, Calif. We hired an editor to be on the staff in the IFT office, then hired John B. Kils as Director of Advertising; after a few years, John became Director of Publications and Editor of Food Technology.

John has functioned well in that position and has been able to expand the editorial office to a present total of eight persons in-house to handle publication of Food Technology and the membership directory and three individuals on an outside basis to handle Journal of Food Science. This has brought about a considerable improvement in communications and costs, and we are now handling a volume of technical papers and advertising that was only a dream just a few years ago.

John began building an editorial staff, among the first of whom was Neil H. Mermelstein as Associate Editor (later Senior Associate Editor), then Barney Schukraft was hired as Associate Editor (later Managing Editor) to plan and lay out each issue of Food Technology, accommodating all of the editorial as well as the advertising. Later, John also hired field editors to obtain stories related to food science and technology that were not presented at the Annual Meeting. This was a worthwhile effort. The readership of Food Technology has considerably improved, and the staff now handles a very large volume of papers.

Relocation

In 1966, we moved from our antiquated headquarters at 176 W. Adams St. in Chicago to our present building at 221 N. LaSalle St., which at least had alternating current! Rent then was $4.75 per sq ft compared to $19.26 per sq ft now—which is still a bargain in downtown Chicago.

Member Survey

One of the things that initially bothered me was that it was difficult to understand what a food technologist really was and did. This was of paramount importance to me, because of our need to know what kind of individuals we had as IFT members. One of the first things I did in early 1961 was to conduct a rather simple, yet extremely helpful survey of the 6,000 members. From the results, I prepared a filmstrip entitled "Portrait of a Food Technologist." This was shown at many Regional Section meetings and was helpful in determining advertising and exhibitor potential. It cost about $2,000 but recovered untold thousands of dollars.

Strangely enough, the only thing that most members had in common was that they all had something to do with food. They were chemists, engineers, microbiologists, product development people, quality assurance individuals, sensory evaluation specialists, production personnel, and on and on. Likewise, they ranged from Ph.D.s to nondegreeed individuals, with a few M.D.s, J.D.s, and L.L.B.s thrown in. Most worked for corporations, but there were a few academics, some consultants, and some government employees. Student membership then was quite low.

This gave me, on a percentage basis at least, something to start with. Later, with refinement of these percentages into buying and specifying influences regarding ingredients, laboratory instrumentation, supplies, machinery, etc., we were able to define a market for advertising and exhibits that produced some revenue that we desperately needed. The response to that first questionnaire was about 75%, which is truly astounding! Perhaps no one had ever asked IFT members such questions before!

After gathering such information, we put it to good use to sell the audience to the suppliers. Of course, we didn't have too many people to help sell anything—just one lone advertising sales representative in the East, Duncan McPherson, bless his heart, who put up with me when I became the "expert salesman" from IFT. I visited him several times a year for weeks at a time, and was constantly "on his back" daily by telephone.

We began to hire advertising sales representatives to support and supplement McPherson, who had a very large geographic area to cover. We began by hiring our first Midwest representative and continued with this operation for a considerable length of time, and eventually under the direction of Dan Weber, who had become the Director of Marketing & Meetings, we hired Jeffrey Kramer as Director of Advertising, reporting directly to Dan. Jeff has
Through the Looking Glass Brightly (continued)

assembled a sales staff that is quite capable, replacing the advertising representatives who were difficult to administer. We now also have a sales office in the East, with two staff persons to handle East Coast sales, and two staff persons in the Chicago office to handle Midwest and Western sales.

Advertising and exhibits constitute an enormous portion of the IFT income, and attention is going to have to continue to be paid very carefully to these operations.

Field Services

One other area that had been neglected for want of staff was attention and assistance first to the Regional Sections and later to the Divisions and the newly formed Specialized Technology Groups. This task was begun in 1968 when I hired George R. Foster as Director of Field Services. He has done a yeoman’s job in working with these groups. Additionally, George has been responsible for the career development of student members, who will be IFT’s future leaders. Pamela Pierson has been appointed as the Associate Director of Field Services to oversee the Divisions and STGs, and she will take over the Director’s position when George retires later this year. This appears to be an area that will need even further expansion, as the Sections are asking for greater assistance in their programming, scheduling, and administration.

Three Highlights

As IFT continued to grow and prosper, many other activities were undertaken that were both interesting and stimulating, and a bit outside the normal operations of a scientific and professional society. Three highlights that

As IFT continued to grow and prosper, many other activities were undertaken that were both interesting and stimulating, and a bit outside the normal operations of a scientific and professional society.

will remain with me for many years occurred during my tenure with IFT: the formation of the International Food Information Service, the hosting of the Third International Congress of Food Science and Technology, and the establishment of IFT’s Public Information Program.

• IFIS. One of the activities that was exciting and interesting was the formation of the International Food Information Service. IFIS was formed in 1968, under the leadership of George F. Stewart, by a consortium of British, German, American, and later Dutch organizations. The purpose was to bring together the world’s scientific and technical information in a computerized fashion so that it could be retrieved in the most efficient manner. The result is the database called Food Science and Technology Abstracts, as well as two others—Packaging Science and Technology Abstracts and VITIS-VEA. The databases are available in journal form as well as electronically through several information-retrieval “hosts” worldwide, including Dialog Information Retrieval Services, Inc. IFIS’s services are constantly advertised in IFT publications, as many of the subscribers are industries and universities in the United States. As a matter of fact, the U.S. makes up a major portion of the subscribers to FSTA. The databases are available not only to members of the sponsoring organizations but to the general public as well.

Today, IFIS has a worldwide reputation and a budget that closely approaches IFT’s. It continues to operate, and I am pleased to say that I was the senior founding member of the management committee which runs the organization, meeting on an annual basis in one of the founding countries.

• SOS/70. The Third International Congress of Food Science and Technology (dubbed “SOS/70” for “Science of Survival”) was sponsored by the International Union of Food Science and Technology and hosted by IFT. It was held in Washington, D.C., in 1970 and was a resounding success under the brilliant leadership of Richard L. Hall. It was a highlight of my life to have been a part of it and to head up the operations committee. Many longtime friends were made during that occasion. I truly believe that it was a model congress for any future host country to follow.

In heading up the operations committee, it was my responsibility to arrange for simultaneous interpretation. I hired a master at his trade, Vladimir Pojičioff, who had held previous positions as the chief interpreter at the United Nations. He had many acquaintances throughout the world, and he organized the simultaneous interpretation that was provided at the Congress in English, French, German, Russian, and Spanish. He estimated that this group of interpreters was larger than the normal working staff of the U.N.!

The operations committee had responsibility for just about every activity that could be imagined, except for the programming, which was handled by the late Harold Holcott. Certain activities were a resounding success, especially a memorable concert by the National Symphony Orchestra at the headquarters hotel. We also had a very large reception with entertainment at the State Department building and a banquet which was a wonder to behold, with the international gathering that was on hand. Our attendance was far in excess of any other congress that has been held.

What else can I really say about an activity that was so overwhelming that it still leaves an impression in my mind when I think about the early stages of IFT?

• PIP. The third highlight was the formation of IFT’s Public Information Program in 1973—another important undertaking for an educational scientific organization such as IFT. Howard W. Mattson, the current IFT Executive
Through the Looking Glass Brightly (continued)

Director, was chosen from numerous candidates to head up this activity.
The reason for this activity was the growing criticism of the food supply by consumerists in the public media. The intent was not simply to "rebut" specific charges but rather to present an overall view of the contributions of food science and technology to yield a safe, nutritious food supply, available at all times of the year in all parts of the country.

With this aim, a committee of experts was designated to produce background publications called Scientific Status Summaries on topics of public concern, such as sulfites, MSG, caffeine, and home canning. These were distributed to national and local media, with the name of a local IFT "Regional Communicator" who could be contacted by the writer or editor for additional information on that or any other food-related topic.

The program grew slowly, but with good credibility, since all the participants were university based and had no apparent axe to grind. As it grew and the effectiveness of the approach was demonstrated, the program was expanded into an Office of Scientific Public Affairs in 1985 and Richard A. Greenberg was hired as Director. Howard Mattson was simultaneously appointed Associate Executive Director as my ultimate successor, and he became Executive Director when I retired in 1987.

The program is unique among scientific societies, and has expanded substantially in a number of directions, with activities far beyond its original parameters.

Financial Responsibility

IFT is now becoming a much more complicated organization, not only because of the size of its membership services and budget, but also because of the desire of the Council and the Executive Committee for more complete and detailed financial information relative to the onset of each program. Obviously, if these bodies are to govern IFT, more information is needed. But it seems to me much of the expense involved in obtaining this detailed information comes about because of a lack of trust and understanding between the governing bodies. To obtain the degree of costs involved in a particular program, a highly sophisticated computer operation is needed which requires personnel and sophisticated equipment and causes a very large expenditure of funds. Of course, some cost systems need to be developed, but the detail required I consider to be in excess of what is needed or desirable. A strong "hands-on" control should be able to provide sufficient information to determine whether a program is cost-effective or not. The rub seems to be between the governing bodies, who need to be reminded of the Section 11 (Budget) of Article XII (Fiscal Procedures) of the IFT Constitution and By-Laws:

The Treasurer shall cause to be prepared for the Executive Committee a proposed budget for the ensuing fiscal year. This budget shall be considered, adjusted and adopted by the Executive Committee at its meeting next preceding the beginning of the

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For information circle 142
ensuing fiscal year. Budgeted funds over and above those required for the operating expense of the INSTITUTE and its publications and the maintenance of its reserve funds shall be reported to the Council at its annual meeting for such allocation as the Council may determine. Recommendations for specific allocations of such funds shall be made to the Council by the Executive Committee.

Therefore, in my opinion, it is not necessary for the Council to vote on every item in the budget. Maybe what is needed is to prepare two budgets—one to control financial information operations, and one for information purposes. The Council needs a budget to be informed, and the Executive Committee needs the detail to control expenditures. This should bring about a more harmonious relationship between the two bodies. An audited statement by a certified independent public accountant would detail for the members and Regional Sections the complete operating financial position of the society.

Reaching a Pinnacle

In many ways, IFT is reaching a pinnacle. It has come through more than a generation of perfecting its organizational and administrative operations. It has fine-tuned many of the activities and has gained a high degree of capability. It has broadened its base of communications both internally and externally and has achieved its present

I am proud to have played a part in taking IFT to its current position as the premier scientific food organization in the world.

level from modification of the past.

Perhaps I have been operating for too long on "intuitive judgment"—as I have been accused—for I like to keep things as simple as possible. I am reminded of a quote from T.S. Eliot's poem "The Rock" that represents my philosophy:

Where is the wisdom we have lost in knowledge? Where is the knowledge we have lost in information? As cycles of heaven in twenty centuries bring us farther from God and nearer to the Dust.

I am proud to have played a part in taking IFT to its current position as the premier scientific food organization in the world.

—Edited by Neil H. Mermelstein, Senior Associate Editor

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66 FOOD TECHNOLOGY—SEPTEMBER 1989
Mission 2000: 
IFT’s Future

Theodore P. Labuza

This issue of Food Technology commemorates the 50th anniversary of the Institute of Food Technologists. The current leaders of IFT, in reviewing the past history of food science and technology, and how IFT has been part of this science, decided in 1988 that we must begin a process to examine where we have been, what we are currently doing, and where we should be as a professional society in the next 50 years. More specifically, since we are closely approaching the new millennium, the IFT Executive Committee asked a group of its members to embark on a study to be called “Mission 2000,” the purpose of which was to accelerate the development of an action plan to bring IFT into the 21st century.

This article outlines the initial steps in that process. IFT’s Long Range Planning Committee held a preliminary meeting to review the areas to be addressed. Then six meetings were held in Minnesota during the summer of 1988 to focus on some of those key issues. Each meeting included 6–8 IFT members from different orientations, including research, education, IFT Regional Sections and Divisions, past-presidents, and staff.

Key issues to be discussed included how the industry is changing, what its new needs might be; professionalism within IFT; education at both the member and university level; public outreach to the consumer, media, and government leaders; IFT’s governance organization (Council/Executive Committee/staff); and the structure of IFT’s Sections, Divisions, and STGs.

During these discussions, a number of issues were raised that needed to be dealt with immediately or in the near future, and these have been passed along to appropriate bodies for immediate action or action in the near future.

Of course, any discussion of IFT’s long-range future must consider its charter, or mission statement, the basis of IFT’s tax-exempt status, as stated in the IFT Constitution:

The purpose of IFT is to support improvement of the food supply and its use, through science, technology, and education.

In all IFT’s deliberations, this statement must be kept in mind. Do new programs correspond with our mission? Should IFT consider altering its mission statement, or even consider giving up its tax-exempt status to achieve some new, essential member service? In this evaluation, we must also consider whether our mission should continue to orient to the discipline of food science and technology, or should orient to its practitioners or even (if IFT were to opt for trade association status) the industry?

Prior to the meetings, each attendee brought these issues to his or her respective committee or organization, and made a summary of key points for discussion and action. It became obvious that because of the diverse nature of the membership and their needs and desires, no one person could (or should) set the tenor for the future of IFT. The Mission 2000 report had to be a document which would address current issues, as well as longer-range issues which could be referred to other committees to focus on specific changes needed to strengthen IFT and its membership.

Composition of Membership

A critical issue facing IFT is the on-going, relatively lower rate of growth in number of members in the “Professional Member” class, compared with those in the “Member” class. Professional Member status requires additional years of technical education and professional work experience. Professional Members are the only ones who can vote or hold office. Some of this shrinkage in the ratio between

We must begin a process to examine where we have been, what we are currently doing, and where we should be as a professional society in the next 50 years.

Professional Members and Members may have resulted from the change in new member acceptance procedures, in which all applicants are accepted for Member class, and a “change-of-status” request form is included with the notice of acceptance. It is possible that some new members who are otherwise eligible for Professional Member status simply don’t bother to apply.

One result of this changed ratio is that almost every year, some IFT Regional Sections propose for chairman Member class members who are ineligible. This shift could also result in a perception by outsiders that IFT is less professional than it really is.

This aspect of Member/Professional Member qualifications also bears on where we look for new members, if IFT is to reach out to professionals who need the kind of information present IFT members produce but who are not “just like us.” This would include people like nutritionists, dietitians, food lawyers, or regulators. Should they somehow be granted Professional Membership, or should there perhaps be additional classes of membership? Would their membership increase IFT’s strength and allow us to do things we can’t do at present, or would it dilute our mission somehow?

We could, of course, tightly limit membership to avoid changing the traditional character of IFT. Many scientific societies have done just that, and maintained their membership and programs must as they were ten years ago. But if

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68 FOOD TECHNOLOGY—SEPTEMBER 1989
IFT were to limit membership, where would money for new programs come from?

IFT recently created a new staff position of Director of Market & Membership Development. Among his priority tasks will be to convert eligible Member class members to Professional status; increase the percentage of renewals among members who drop out each year; convert Student Members into full Members when they graduate (instead of losing some to other fields or while their earning potential is low; and reach out to professionals in closely related disciplines.

It may well be necessary or helpful to change the name of our society, if we are to reach out successfully to practitioners in related disciplines. If our name limits the effectiveness of our outreach, and if we want to reach out, changing the name may be the least we can do. Although there is tradition associated with our name, many of those in the Mission 2000 meetings felt that it was perhaps time to change.

One major need in this consideration is a thorough survey of job markets and salaries. Given the merger mania and leveraged buyouts that have occurred during the late 1980s, the whole food industry has changed. In many ways, we do not know what its personnel needs will be by the year 2000, nor the salary levels that will be paid. We need a better "fix" in order to plan knowledgeably.

Another question that might be answered by a good survey is whether the ever-increasing number of women entering the food science field will convert the industry into one which is "female-dominated," like nursing or teaching, and reduce the salary levels in the process. What can be done about this? Should more males be recruited into the field? Or should effective actions be mounted to increase salaries across the board? Only with data from a thorough survey can we know where to place our efforts.

We also need to know more about students, the basic foundation for continued growth of IFT. Currently, there are about 600 faculty members in food science and technology, graduating about 1,000 bachelor-level students and the same number of graduate students each year. (These numbers are not as solid as we would wish, and we need better data even on the most basic question of "What happens to the students?") IFT's Student Association has provided an excellent focus on the activities of students while they are.
in school, and the Phi Tau Sigma Honorary Society has played an important role in that function as well. A major break comes when the student leaves the campus at graduation, however, or earns an advanced degree. Starting salaries may not (in the ex-student's mind) be sufficient to pay an IFT membership dues bill, or the first job may be a little outside the field. What does the student do then? The conversion rate for IFT student members is respectable, but is it the best we can accomplish? What does an emerging adult food scientist/technologist expect from IFT? What does he or she have a right to expect?

**Education and Continuing Education**

IFT's by-laws stipulate a variety of objectives in the field of education, related both to the university world and to individual practitioners throughout their lives. Individuals in several of the Mission 2000 meetings identified areas of specific concern with respect to educational needs and possible changes in these areas, and talked about how IFT's Divisions, Specialized Technology Groups, and Regional Sections could be utilized to help fulfill these objectives.

Among the areas in education needing resolution are the following:

1. What do the "clients" of the university (industry, government, academia) want in the training of university students?
2. What is an appropriate balance between applied and basic research in the educational program?
3. Should an internship program be required?
4. How should food-related educational programs (nutrition, dietetics, home economics, etc.) be related to or integrated with traditional food science/technology training?
5. How (if at all) should IFT aid the university recruitment process? Can our scholarship/fellowship program be improved in this regard?
6. Should IFT be involved in course development programs? Should it continue or expand its involvement in curriculum evaluation/assistance?

In the area of continuing education, IFT's present involvement (other than the important one performed by its journals) is in running one or two short courses and a Basic Symposium at the Annual Meeting. As more and more of our members face changes in their job situations, should IFT upgrade its efforts in these areas? Should the short course program be expanded to a full catalog, covering not only new developments in the field but repeating basic courses which are inadequately covered (if at all) in university programs? Should it offer nondegree programs or courses?

If IFT were to expand significantly in areas such as these, it probably could not depend solely on volunteer effort. What kind of staff and staff structure would we need, and how would such activities be funded? Should they be subsidized, self-supporting, or even make a profit?

And what about career guidance and recruitment into colleges and universities? At present, few university students declare a food science/technology major as freshmen or sophomores—they generally don't even know that such a major exists. Does IFT have a role to play here, with junior high school students and their counselors? There is a dearth of minority students in our field; is there a function IFT can or should be filling to help correct this situation?

And, of course, there is the whole question of education of the general public. Consider questions as to more formalized programs for the general public, such as seminars during a "Nutrition Week" or at science fairs or even through service clubs and churches. Should IFT be pursuing an active role in these areas, and if so, through what structure and with what financial resources?

The variety of questions raised during the Mission 2000 meetings was tremendous, but formulating postures or appropriate IFT attitudes is an essential activity if we are to set priorities on how we spend IFT funds, and raise additional money.

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**Publications**

In its earliest days, Food Technology magazine was designed to carry reports of on-going original research being done by IFT members. Later, papers on basic research were transferred to a newly acquired publication, Journal of Food Science, and the more applied articles were to be published in Food Technology. All papers in JFS, as well as most volunteer-by-lined papers in Food Technology, are peer-reviewed.

Many more papers are received than can be published, and many papers are volunteered in scientific fields considered outside IFT's own. Many others are considered inadequate in scholarly content, too commercial, or too narrow in coverage. Papers which are strictly "cook and look" or compendia of nutrient data are also rejected or referred to other publications. There is sometimes an "excessive" number of papers in one field and relatively too few in another.

The Mission 2000 study groups were concerned about all these issues, about timing, and about the mass of pages presently being published. Suggestions were offered to increase publishing frequency from once every two months to monthly (which would be more costly). Another suggestion was to "categorize" issues by disciplinary content (an issue on muscle foods, a second on nutrition, and a third on food engineering, for example), but this was recognized as reducing the benefits of "browsing" through related fields, and even of losing out to "competition" from more narrowly focused, related...
Mission 2000 (continued)

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One of the primary benefits of IFT membership is (and will continue to be) the subscription to Food Technology. Will this be as attractive to potential new members in related fields...?

(which it is) and less appreciation for IFT member involvement in other major areas. Since advertisers make decisions on essentially commercial, non-scientific grounds, this leads to a conundrum. Should IFT provide more complete editorial coverage in fields which are important to only a minority of its readers (such as heat transfer, materials handling, pollution control, etc.), even if such issues become relatively less attractive to advertisers? We have to remember that journal advertising brings in about 35% of IFT's annual revenue, and without it, many member services simply would not have funding. (Similar considerations apply to the IFT Food Expo.)

Also, one of the primary benefits of IFT membership is (and will continue to be) the subscription to Food Technology. Will this be as attractive to potential new members in related fields who are not strong "purchasing influences" in our traditional areas, and hence affect their interest in joining the society?

There is a need to look at other publication possibilities for the coming years. The fact of long lead times for publication of news and meeting notices would seem to favor production of some kind of fast-breaking newsletter or other medium. Or perhaps electronic publishing, something like electronic mail, would be appropriate for informal, nontechnical issues.

One last issue related to publishing that surfaced in the discussions was whether IFT should become a book publisher. An ad hoc committee of the Publications Subcommittee was asked to prepare a report on this issue. The committee met with several publishers, as well as with scientific societies that publish books, to get background. The initial findings were that with the high cost of books today and their low volume of sales, IFT should not engage in the process, especially considering the

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Mission 2000 (continued)

need for added staff and space.

There were also suggestions, however, that considering how rapidly things are changing in electronic publishing, there may still be an important book-publishing niche for IFT in the next 10 years or so. The same can be said for the question of the need for new publications within IFT to solve needs yet unperceived.

Meetings Present and Future

The other major area of educational involvement for IFT members is meetings, both national and regional. The Annual Meeting technical program is a major focus for information transfer,

The Annual Meeting has grown in popularity to the point where it is becoming difficult to find geographic sites where sufficient meeting rooms are available for presentation of as many as 14 sessions at once. Both through the technical sessions and Food Expo and through publication in IFT journals. In fact, the Annual Meeting has grown in popularity to the point where it is becoming difficult to find geographic sites where sufficient meeting rooms are available for presentation of as many as 14 sessions at once. This year, more than 750 papers were presented.

Introduction of “poster sessions” several years ago did little to stem the flow. Such presentation provides a valuable alternative method of communication, but it does not reduce space requirements.

Beginning next year, a new type of presentation, the Divisional Lecture, will involve an hour-long distinguished lecture at the beginning of a divisionally oriented technical session. Although it is unlikely, if all IFT Divisions and STGs were to present such lecturers at any given Annual Meeting, they would consume the same number of “time slots” as 68 volunteered technical papers, enough to fill about 12 concurrent half-day sessions! There will also be a change in the final (Wednesday) afternoon’s orientation from standard volunteered papers to a new product session and a variety of forums on late-breaking topics of concern to smaller groups of IFT members. The effect of these changes on the program remain to be seen.

What can be seen already, however, is that the Annual Meeting & Food Expo is becoming a huge operation requiring critical examination. Obviously, IFT needs the revenue brought in by the increasing number of exhibitors and attendees. Also, the attractiveness of the technical platform permits many members to attend who might not be able to come if they were not presenting a paper.

One result of this growth is that the number of cities appropriately equipped to hold our annual events has shrunk to about a half dozen. There are several approaches to “solving” this (if, in fact, it needs solving). Surveys show that individual IFT members spend about the same number of hours “on the floor” as they do listening to technical papers (about 9 hours in each), and that they regard both such educational experiences as about equally valuable.

The number of concurrent sessions continues to be a problem, however, since even with the availability of audiotapes, many members feel frustrated over having to choose which to attend. A number of suggestions have been made, none perhaps an ideal solution. First, of course, would be to simply separate the two functions—hold a free-standing Food Expo and a major technical session separately at different times. This would obviously not solve the problem of concurrent sessions, if the same number of papers were volunteered. It would also have a dramatic effect on overall attendance. Another suggestion would be to limit the technical sessions to organized symposia and plenary sessions, while keeping the Food Expo hours as they are now. This might provide the same kind of “draw” to the Food Expo that the present technical sessions now provide, but would reduce the number of choices required to a more reasonable number.

This method would leave a decision as to how to provide a platform for the volunteered papers, both oral and posters. One solution would be to open the programs of the present multi-Regional Section meetings to such volunteered papers, or to create a new semiannual meeting, with no exhibits, which could be held in any of a number of smaller cities around the country, perhaps in the fall. This could allow many members to attend who cannot travel the distances now involved.

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Mission 2000 (continued)

to reach the Sun-Belt cities.

Inherent in all this is the question of the kind and source of support needed to operate these alternative meetings effectively. The IFT staff should be available to support activities such as the multi-Regional Section meetings, but the Sections (appropriately) wish to maintain control. For the IFT membership at large to get full advantage of such meetings, however, coordination must be effective—this year, two of the three existing meetings were scheduled head-to-head, so attendance at both was impossible. Also, attendance at all three has “plateaued” at a comfortable level of about 200-700 members, which may be about as large as most volunteer efforts can handle. Larger meetings, say 1,500-2,000 registrants, would probably require more professional staff help in site selection, hotel arrangements, room scheduling, etc.

Another approach that should be evaluated is the holding of specialized free-standing symposia by Divisions or STGs, or perhaps several cooperating Divisions/STGs. A number of these have been done in the past, with varying degrees of success. If given national support and coordination in planning, they could be very effective. This approach would also be in line with the Executive Committee’s commitment to making Divisions and STGs IFT’s “centers of technical excellence.” In several recent instances, IFT’s Office of Scientific Public Affairs (OSPA) has worked with individual Divisions on successful workshops on important topics, some in conjunction with other scientific associations involved with the same issues.

There are undoubtedly a number of other suggestions which should be evaluated. For example, it might be possible for IFT to hold joint meetings with another association with comparable or comparable aims; the staff is currently examining such a possibility with the Federation of American Societies for Experimental Biology (FASEB). The Executive Committee would appreciate hearing member input on all the matters discussed so far.

Outreach/Communications

About 15 years ago, recognizing the fact that consumer knowledge of science had fallen to an all-time low in the United States, IFT decided it had to do something to help the consumer understand how to safely use processed foods, and how to properly select products for a balanced and satisfying diet. Thus was born IFT’s Public Information Program.
kind of activity. Other projects within IFT, and its deficit financial position last year, make it imperative to move in a direction which has member support.

The original plan for financing OSPA was that the IFT would contribute about half of its operating expenses, and the second half would come from grants from food-related corporations and individual IFT members. Corporate grants were received in sufficient quantities to get the program off the ground, and member contributions have been gratifying. Now, however, corporate grants are diminishing and no other source has been identified to increase them or take their place. We have not yet developed an effective method for gaining foundation grants, nor have we been able to tap into more corporations than the two dozen which financed the original effort. IFT’s own finances are sufficiently meager this year that it had to cut its own contribution back by about $50,000.

International Issues

An issue which IFT must face over the next ten years is its role in international affairs. IFT has four Regional Sections outside the U.S. (Japan, Mexico, the United Kingdom, and British Columbia) and 19 Affiliate Organizations. About 15% of the present IFT members reside outside U.S. boundaries. These international sections have all the privileges of domestic sections in terms of votes in the Council, while

An issue which IFT must face over the next ten years is its role in international affairs.

Affiliate Organizations have (at most) one vote.

Several years ago, IFT established a policy of discouraging formation of new international sections, since it is so difficult to maintain the specific requirements involved in the by-laws. Instead, it chose to encourage the establishment of other national food science and technology organizations, and offer Affiliate Organization status.

Most international members appear to join IFT to receive its publications, while a minority express an interest in deeper involvement. During this past year, a number of international members have been appointed to committees of the Institute, and qualifications

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As in all volunteer organizations, specific functions grow to the point where volunteers are no longer able to fulfill the needs, and paid staff is added. In IFT’s case, there are now some 45 paid staff members. . . . They support the officers and committees, and provide needed detail and resources.

IFT’s Divisions and STGs are organized along topical lines, and attempt to deal with subjects with a disciplinary or commodity orientation. Their main function in the past has been to produce one or more symposia for the Annual Meeting. More recently, they have been invited to form Public Information Committees to develop statements on topics of potential consumer concern which are useful to OSPA in dealing with the media. A few years ago, the Executive Committee designated Divisions and STGs as IFT’s “centers of technical excellence,” but mechanisms for carrying this out have not been fully developed. This goal must be addressed in such a way that Divisions and STGs work together under IFT’s unique “umbrella,” without splintering off into separate organizations which could lose their effectiveness or uniqueness.

Geographically, IFT is organized into Regional Sections, to provide a local focus for meetings and sharing common regional interests. These vary tremendously in size and commonality of interest, and in their “success.” Sections are also the focus and source of IFT’s voting Councilors, who help shape IFT policies.

Is the present Regional Section structure appropriate in today’s economy? Does it supply representation (through the Councilors) in the most effective way? What sort of headquarters staff support should sections expect? At present, they are insured for liability under IFT’s umbrella policy, they can apply for Scientific Lecturers, and they can get help in questions of by-laws development, but are there other services that would lead to more effective communication or organization?

Institute committees fill another role, usually meeting three times a year and often performing specific duties during the intervening times. They deal with the operating functions of the member services, with their members being appointed for three-year rotating terms. Their effectiveness varies from year to year, of course. Sometimes this is a result of inadequate communication as to what is expected of the volunteer in terms of time and commitment at the time he or she is invited to serve. In other cases, there is conflict of goals between chairmanships, or, again, simply inadequate communication of goals and on-going programs.

This year, we instituted a general rule that chairmen remain on the committee for a year after their term, to help provide the new chairman with continuity. Also, the staff is developing better documentation for the president-elect to use in the annual selection process (and for the “invited” to use in deciding whether to accept an appointment or not). Also, the new documents will help orient the new committee members and chairmen as to what has been going on in the recent past, and will ask him or her to commit to goals for the upcoming year. These commitments then can be used to evaluate progress over the year.

Also, the Executive Committee has asked the Executive Director to reorganize staff-committee liaison to provide for more intensive and continuous staff support throughout the year. Many times, a committee will decide at a meeting that something should be done, but the action “falls through the crack” because of poor delegation or lack of followup.

The final structure within IFT is perhaps most pervasive, the staff. As in all volunteer organizations, specific functions grow to the point where volunteers are no longer able to fulfill the needs, and paid staff is added. In IFT’s case, there are now some 45 paid staff members handling functions as diverse as publication editing and design, meeting arrangements, member/subscriber relations, field service support, advertising and booth sales, finances, and general administration. The staff members are governed by the policies of the Council and Executive Committee, but are experts in their own right, and function as such in their assigned duties under the direction of the Executive Director. They support the officers and committees, and provide needed detail and resources.

For example, last year an IFT ad hoc
committee did a study to see if there were ways to reduce the time burden of the presidency. Although few areas were uncovered that could be eliminated (since most of the committee chairing functions and ceremonial duties cannot be delegated), the staff suggested furnishing the president and president-elect with a "floating" fax machine, so correspondence chores could be reduced and time lapses minimized in communications between these officers and headquarters.

Routine major mailings of committee meeting notices, production of Institute printed matter, mailing of dues notices, and the whole accounting function underlying a $6 million budget are also handled by staff, along with the myriad details involved in keeping the routine needs of 25,000 members.

Occasionally the staff may get carried away with a project, perhaps because of inactivity of a committee or misunderstanding of approvals, or by the very success of the project that is underway or being close enough to see how something can be done better. The new Executive Director and the officers have discussed methods for working together more closely, especially regarding continuity between successive presidents and committee chairmen, and are working toward better communication at these levels. More formalized procedures for periodic reporting of staff activities, performance evaluation, and compensation are also being developed. The budgeting and auditing process involves sophisticated accounting methods for allocating costs among the various functions performed within IFT have been developed, and will be applied to future cost control efforts and evaluation of ongoing and proposed programs.

Sources of Revenue

The great bulk of IFT's revenue comes from three major sources: member dues, advertising in Food Technology, and the Annual Meeting & Food Expo. Member dues account for about 20% of total revenue. About half of that is allocated to a subscription to Food Technology, the other half to support member services in general.

Ads in Food Technology and income from registration and booth rentals each provide about 35% of IFT's total revenue. Revenue from the Food Expo has been specifically exempted from taxation (by Congress) as part of the educational mission of organizations designated 501(c)(3) under the Internal Revenue Code. (This category includes IFT.) Revenue from advertising is taxable, but the expenses of producing the magazine and the direct sales expenses are deductible business expenses; during most years, IFT's expenses in this area have exceeded its revenue, and no taxes have been due.

Over the years, questions have been raised as to whether a larger share of IFT's income should come from dues, whether the present proportion makes us look like a trade association. There is also a question as to whether the IRS might change our tax-exempt status from 501(c)(3) to (c)(6)—trade association—if the unrelated proportion gets too large (no real danger yet, according to IFT's Executive Director). If we need to develop greater income for the future, how much should come from member dues, and how much from non-dues sources (related or unrelated)?

For a half-dozen years, IFT's Executive Committee has been dominated by a trigger mechanism (the so-called Evans Formula) which permits it to institute an annual dues increase of up to $10 in any year (up to a maximum dues of $75 per year) the so-called Institute Operations Center shows a deficit. (In this formula, the Institute Operations Center receives its revenue only from the 51% dues allocation, plus 100% of investment income; expenses attributable to member services are deducted from this.) The $10 dues increase this year was based on this trigger, although it had been ignored for several years. It has become apparent that this trigger mechanism is inadequate in today's IFT, and the Executive Committee has asked the Finance Subcommittee to examine other possibilities, as well as possible benefits of changing IFT's fiscal year for the future. In the process, it will examine policies of other scientifically oriented societies, as well as the emerging governmental policies on tax-exempt organizations.

Headquarters Relocation?

Another study that has been put in place because of its implications for the future is being done by the ad hoc Headquarters Committee chaired by Mary Schmidl. This committee is looking at the question of the appropriateness (for the future) of a downtown Chicago location in rented space (our present situation). Many considerations besides geography and financial aspects must be considered, of course, and IFT's probable future activities must also be factored into any recommendations.

Executive Director Howard Mattson is presently evaluating the current staff interactions and needs, as well as those of the types of potential member services to be offered. A number of other technical societies who have recently moved will be queried also.

Fortunately, there are no factors on the immediate horizon which make a decision imperative, so the study can be done at the appropriate level of detail.

The Future

More complete and timely communication and a genuine spirit of cooperation and interaction are the key to increasing IFT's effectiveness in the coming years. IFT has done wonders for its members since its beginnings in 1939. It has been the dedication of the volunteer members and the IFT staff that has brought IFT into the solid position it now occupies.

This document should not be looked on as a criticism of past activities in any way, but rather as a bridge to the future. As we deal with the issues raised, and answer the questions posed, we will be prepared to enter the 21st century with new goals and a more efficient structure to serve our membership.

I want to thank all those who participated in this study and helped generate the ideas discussed. Much more needs to be done, as separate documents will be developed, containing specific ideas for appropriate committees.

Twenty-five years from now, IFT members will look back at this event in IFT's history. Hopefully, those who work on the process will see it not as a milestone, but as a milestone in IFT's many accomplishments.

—Edited by Neil H. Mermelstein, Senior Associate Editor
50 Years of Progress in Food Science and Technology: From Art Based on Experience to Technology Based on Science

Samuel A. Goldblith

Actorem Memores simul affectamus agenda—"Memories of acts in the past in similar fashion affect those things which are to come." This motto of the Newcomen Society in North America, whose purpose is the study of business, industrial, and institutional history, presents the basic reason for reviewing the progress in food science and technology which has occurred during the first 50 years of existence of the Institute of Food Technologists. The 50th Anniversary of IFT affords us a unique opportunity not only for stocktaking and review of progress but also for looking to the future.

The 1937 Conference on Food Technology, held at Massachusetts Institute of Technology, provided an opportunity to examine the developments which had occurred in food manufacturing over the previous 50 years as well as the vast changes in the food supply which had taken place—all of which had occurred, to paraphrase IFT's first president, Samuel C. Prescott (1938), within his own lifetime. Changes of equally vast proportion have taken place since IFT was founded in 1939 at the Second Food Technology Conference, also held at MIT.

This article will examine not only the developments in food science and technology which have occurred since then, but also the contributions of IFT in four basic areas—research and development, education, the scientific literature, and public service, the "common good."

Factors Affecting the Development of Food Science and Technology

A number of factors affected the development of food science and technology during the past 50 years. While the following list is not complete, it is indicative of the external forces which have had a major influence:

- **Food Marketing.** The metamorphosis that has occurred in food marketing over the past half century is simply mind boggling.

  Retailing of Foods. The developments in retailing have been enormous. Compare today's supermarkets and hyper-marches, with their 7,000-10,000 items, to yesterday's corner grocer or fishmonger or vegetable and fruit merchant or baker. These developments have occurred, at least in part, as a result of advances in refrigeration and transportation; knowledge of consumer needs and desires; knowledge of demographic trends; developments in food preservation, packaging materials, and methods; know-

Changes of . . . vast proportion have taken place since IFT was founded in 1939. . . .

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alternative products to purchase. Private-label brands have also afforded important positions in management, quality assurance, new product development, and many other areas for newly educated food technologists.

Foodservice. Developments in processing technology, packaging, and materials have made possible the development of a whole new foodservice industry. Food manufacturers recognized the needs of a peripatetic population with double incomes per family. As a result, a new foodservice industry has emerged, supplied by food manufacturers with high-quality, specially developed products packaged in large containers, refrigerated, thermally processed, or frozen. Obviously, all of this required the development of new processes, packaging materials, and systems.

- **Legislation.** Probably the single most important piece of legislation dealing with foods that was passed during the past 50 years was the 1958 Food Additives Amendment to the Federal Food, Drug, and Cosmetic Act of 1938. The Delaney clause in that amendment has affected the course of food research and technological development since it became law.

  Other legislation of a similar nature followed, namely, the Color Additive Amendments; they, too contained the Delaney clause. The food industry has had to invest large amounts of money in equipment and personnel to meet the requirements imposed upon it by this clause, which has had great implications in limiting much new product and process development.

  The Delaney clause deals with matters of "zero tolerance," although zero does not exist in the biological
The early 1940s were a period of ferment for the genesis and development of food science. . . .
With the beginnings of food science as a discipline and the development of true food engineering based on basic principles of mathematics and physics . . . food technology itself began a metamorphosis.
status summaries on particular subjects and conducted educational programs on these and other timely scientific issues of the day.

- Developments in the Canning Industry. The National Canners Association (NCA), later renamed the National Food Processors Association (NFPA), was perhaps the major organization conducting research related to canned foods and processes thereafter when IFT was founded. It was industry-organized and -supported and grew out of a need to establish processing parameters to ensure the safety of various types of canned foods packed in all types of containers.

Out of its work grew a series of NCA Bulletins. The first edition of Bulletin 26L, "Low Acid Canned Foods," was published in 1930; by 1966, it had reached the tenth edition (NCA, 1966). NCA published the book on the then-known knowledge on the nutritive value of canned foods (Cameron and Esty, 1950). Meanwhile, the American Can Co. published the then-famous Canned Food Reference Manual (Pilcher, 1947) as a service to the food processing industry.

Thus, the major food canners and their suppliers, both directly and through their associations, have made major contributions to the fundamental knowledge of thermal processing, enabling the oldest commercial processing technology to produce vast quantities of healthful, safe, and nutritious canned foods.

In addition, the canning industry, its suppliers, and NCA did a great deal of work on minimizing loss of canned foods due to non-botulinal spoilage, e.g., that due to Bacillus stearothermophilus. The field of materials science and engineering, combined with the developing field of food science, made for interesting and exciting years for young food scientists . . . during the late 1940s and '50s.

Bacillus stearothermophilus. The food canners' technical laboratories worked on new product development and quality control.

In the late 1940s and the '50s, the food canners themselves began to manufacture cans, and the technical support of the can manufacturers and (concomitantly their laboratories and number of personnel) decreased greatly. Also the unparalleled increase in the size of the frozen food industry led the can manufacturers to diversify into supplying films and laminates for frozen food packaging. Thus, a great deal of main-line research for the food processing industry passed from the container manufacturers and their associations to the food processors themselves.

- World War II. Wars are great stimulators for the development of food preservation methods (Prescott, 1919). World War II not only served as a great stimulator for improving dehydration and thermal processing and developing new methods of food preservation, but also was a catalyst to the development of the field of food science. It also served to integrate the then-budding field of nutrition into food technology.

The U.S. Army Quartermaster Corps (QMC) began a new research and development program at the Quartermaster Food & Container Institute for the Armed Forces, located in Chicago. The QMC effort was under the direction of Brig. Gen. George Doriot, who was responsible for the totality of the Army research effort, which consisted of a large-scale external effort as well as an internal one. This external research program was really the beginning of the major external R&D support at universities throughout the country, with federal government funding. A number of leading lights (and others who would become leading lights) in food technology were on temporary duty spearheading the QMC R&D effort. These men, who were then in their forties, included such luminaries as Bernard Proctor, Emil Mrak, W. Ray Junk, Samuel Lepkovsky, Roland Isker, and M.L. (Tim) Anson, to name but a few.

QMC's R&D effort was important per se, but it also assumed long-range importance by being an important catalyst to the emergence of food science as a discipline in the United States, as will be discussed later. Moreover, it served as an additional vehicle to really involve the food and container industry in food research and to join with universities in these research efforts.

- Materials Science and Engineering. World War II was also the catalyst in the development of materials science and engineering. This new field was to become of tremendous importance in the development of acceptable and nutritious rations for the Allied Armed Forces. It also was important in the development of tinless cans and inhibition of container corrosion during the long ocean voyages and storage of foods in the tropics.

Additionally, the development of synthetic rubber led to the development of the whole new field of polymer chemistry, which in turn led to the development of tailor-made, nonrigid, plastic packages which protect foods from oxidative rancidity and loss of moisture vapor.

Materials science and engineering led to the development of semiconductors, which in turn led to the information revolution following the discovery of the transistor. Additionally, studies on the dielectric properties of foods made possible, in part, the development of microwave radar for the heating of foods and the later development of foods designed for heating specifically in microwave ovens (or in microwave as well as conventional ovens) which have become today an important segment of the packaged food products in the marketplace.

The field of materials science and engineering, combined with the developing field of food science, made for interesting and exciting years for young food scientists such as I during the late 1940s and '50s.

- Federal Government. A great deal of food and food-related R&D was carried out or supported by federal agencies such as the U.S. Dept. of Agriculture, primarily through its four regional laboratories; the National Institutes of Health, through its extramural research and training grant programs; and the Food and Drug Administration and the National Science Foundation, both to a lesser extent.

USDA's work during and after World War II on frozen and dehydrated foods at the Western Regional Research & Utilization Laboratory (now Western Regional Research Center) in Albany, Calif.; on penicillin at the Northern Regional Laboratory in Peoria, Ill.; on cottonseed at the Southern Regional Research Laboratory in New Orleans, La.; and on dehydration processes and dewatering processes at the Eastern Regional Research Laboratory in Philadelphia, Pa., was far reaching. The scientific merit of this work is attested to by the many publications that resulted and by the practical accomplishments visible by the variety and quality of products on the supermarket shelves of the world today.
Development of Food Disciplines

It is important to realize that it was not until the past 50 years that food science, food technology, and food engineering developed into separate and meaningful disciplines. This is reflected by the publications in the field.

Food Research first began publication in 1936 in the U.S. It was taken over by IFT in 1950 and renamed Journal of Food Science in 1961 in recognition of the fact that food science, as a discipline, was coming into its own and that a large number of papers being published in Food Research were actually quite basic in nature, in contrast to those being sent to and published by Food Technology, which IFT began publishing in 1947.

The Journal of the Science of Food and Agriculture first appeared in the United Kingdom in 1950, followed in 1953 by the establishment of the Journal of Agricultural and Food Chemistry in the U.S. by the American Chemical Society.

In the late 1940s, a number of British scientists felt that the time was ripe to establish in the U.K. a journal and an organization devoted to research on foods at a basic and fundamental level (i.e., "food science"). A symposium, actually a short course, on the subject of food science was held at Cambridge University in 1948. At that symposium, Bate-Smith stated that "Food science was concerned with the 'understanding' of knowledge whereas 'technology' was concerned with the 'exploitation' of that knowledge" (Bate-Smith and Morris, 1952). A second symposium on food science was held in the U.K. in 1961 (Hawthorne and Leitch, 1962a; b; Leitch and Rhodes, 1963).

In 1964, the Institute of Food Science and Technology was established in the U.K. In 1966, that organization began publishing the Journal of Food Science (re-launched in 1987 as the International Journal of Food Science & Technology).

- **Food Science.** The development of food science as a separate discipline epitomizes the Biblical proverb (4: 7), "... and with all thy getting, get understanding."

  Food science became vital in World War II for the Allied Powers to obtain an "understanding" of deterioration in foods (e.g., the browning reaction in dehydrated foods) in order to correct the problem.

  The nonenzymatic browning (or Maillard) reaction was of importance because it affected the taste and appearance of dehydrated foods being sent overseas to tropical climates and therefore the acceptability of the products by the soldiers in the field. Rather than try to solve the problem by "Edisonian approaches," as had been done before, "cures" based on careful chemical analysis of the browning reaction and the mechanism thereof were utilized, with great success.

  An important paper on the technical basis for blanching was published by Sizer and Josephson in 1942.

  The early 1940s were a period of ferment for the genesis and development of food science. It was the right time for the development of food science because many problems had emerged in the large-scale development of large quantities of processed foods for the armed forces and because knowledge, equipment, and techniques had been or were being developed within the previous 5-10 years which would enable analysis and solution of some of these problems; these developments involved the separation, identification, and detailed chemical investigation of active compounds.

  Much of this work was also based on the then-recent discoveries by Sir N. Haworth who first laid out the basic foundations for an understanding of carbohydrate chemistry; C. Ziegler and G. Natta who first made polyethylene and polypropylene in 1963, for which they received a Nobel Prize; H. Staudinger, who received the Nobel Prize for this work in 1953 on condensation of polymers; and W. H. Carothers who discovered nylon in 1923. These are but a few of the many outstanding examples that can be cited.

- **Food Engineering.** The ferment in food technology was extended to food engineering as well. In a manner similar to chemical and mechanical engineering, food engineering was transformed from a descriptive "state-of-the-art" discipline a half-century ago to a quantitative discipline based on "engineering sciences" (Seltzer, 1964).

  Articles began to appear in the IFT journals, dealing with the understanding (scientifically based) of such diverse subjects as the rheological properties of non-Newtonian fluids; prediction of thermal processing requirements for aseptic canning of foodstuffs; storage predictions of foods under various conditions of storage and packaging; and dehydration and dewatering of foods. In fact, many of the...
exploitation of that knowledge” no longer applied. Over the past four decades, in particular, food technology research has dealt increasingly with both the understanding and the exploitation of that knowledge. In all of this, IFT has played an important part.

Moreover, IFT has played an important role in another manner, in that much of the work dealing with the development of new processing techniques was presented at the Annual Meetings of the Institute and/or published in its journals. Examples of such processes include freeze drying; dewatering of foods; importance and applications of water activity; instantizing and agglomeration; microwave heating and processing of foods; and use of ionizing energy (irradiation) in food preservation.

Thus, IFT itself has served as the single most important vehicle for the development and dissemination of knowledge in food science, technology, and engineering.

Education
Education has long been a concern of IFT. At the start, in 1939, IFT established four goals related to education:

1. Emphasize fundamental science and technology aspects and identify their application to commodities.
2. Create a discipline of food engineering on a quantitative rather than qualitative basis.
3. Ultimately develop a model curriculum with educational standards that would need to be met for accreditation.
4. Have the new field of food technology recognized as being on a par with other existing fields of scientific and engineering enquiry.

There has been a trend in food technology education away from commodity orientation to consideration of basic principles. Commodity-type departments such as dairy technology and animal science have been combined with or merged into departments of food science and technology.

More important than the name changes per se has been the level of sophistication of the research and teaching in these new departments. The emphasis has shifted from “show-and-tell” education to education based on scientific principles which may be applied appropriately to many problems. As mentioned elsewhere in this article, the development of food science has had a major effect on the food and container industries themselves and have contributed greatly to the food supply in industrialized countries. Some of these are described below:

- **Instantized Milk Powder.** Peebles (1958) developed the first instantized milk powder, which was the basis for a host of new processes for producing beverage powders “instantly” rehydratable in cold water or cold milk. This process increased the surface area of the powdered product by partially rehydrating spray-dried milk powder. This process has since become known as “agglomeration.” Today, the bulk of the dried milk powders, whey products, cocoa beverages, strawberry milk beverages, etc., are produced by this technique.

The process has been extended to powdered, instant, spray-dried coffee and tea, both of which are being manufactured on a commercial scale in large volumes. It has been said that the new process developments which have taken place in instantizing have made it possible to produce spray-dried products with the same degree of rehydratability and quality as freeze-dried products but with far lower costs of water removal.

- **Extrusion Cooking.** Extrusion of protein and carbohydrate foods is also a development mainly of the food and equipment industry. Since about 1973, extrusion processing has made possible a whole new generation of pre-cooked, ready-to-eat cereals, snack foods, candy bar fillings, breadings for fish sticks that does not require baking, and dried vegetable and animal protein products manufactured on a continuous scale (Harper, 1978; Altschul, 1958; 1965; 1974; Inglett, 1972; 1975; Smith and Circle, 1972).

Some products can be produced by extrusion cooking which cannot be made by other means; these include multilayered products with different compositions/colors in the several layers (coextrusion).

- **Freeze Drying.** The first real industrialization of freeze drying probably took place with pharmaceuticals (Florsdorff, 1949). However, the greatest “tour de force” in freeze drying was an accomplishment of the food industry. This was the development of equipment for the continuous freeze drying of coffee on a large industrial scale.

By this means, the delicate volatile aroma compounds of coffee are preserved, since from the time the coffee is roasted until the final filling operation into glass jars, the
Coffee is not touched by any air at all. Thus, the product retains all the flavor and odor of the original product.

The so-called jumbo freeze dryer and the entire process were developed by a company in the food industry from its own designs and specifications. Today, this equipment is used in a number of countries to produce the highest-quality instant coffee by continuous freeze drying.

This is indeed a result of the ingenuity of food engineers, backed by a critical mass of chemists and food technologists supplemented by large investment capital. This is something that a university would be unable to do, even if individuals there had the original ideas.

- Thermal Processing Advances. Almost all, if not all, of the advances in thermal processing over the past half century have been the result of creative food engineers in food-equipment or container-manufacturing companies.

Chief among the first rank of such novel ideas which have been taken to commercial reality well within this time frame has been the development of high-temperature short-time (HTST) processes. These processes, for the most part, are characterized by rapid heating and cooling, holding for an ultra-short time at a relatively high temperature, and filling "aseptically" into sterile containers (Hersom, 1985).

Among the HTST systems which stand out as innovative and creative and are used extensively are the Martin-Dow system, which is mainly used for particulate liquid foods (Martin, 1948; Anonymous, 1951; Havighorst, 1951); the flame sterilizer, which is used for conduction-heated products such as peas and mushrooms (Beauvais et al., 1961; Richardson, 1987); the Sterilmatic rotary pressure sterilizer, which achieves induced convection heating instead of conduction heating for products such as cream-style corn—it was the first application of HTST in products sterilized in containers (Havighorst, 1953); the Orbitort, which produces rapid HTST sterilization of foods in No. 10 Cans (Anonymous, 1968); the hydrostatic sterilizer and cooler, which is designed for continuous processing (Lawler, 1960); the Jupiter process, which was developed for aseptic processing of products containing particulates (Manvell, 1987; Hersom and Shore, 1981); and the Flash-18 process, which processes, fills, and closes containers in a room-sized chamber under pressure (Urbain, 1964; Ziemba, 1964).

While these systems were created by industry, they are based on knowledge, discovered after the development of many of the above, which explained the reasons why HTST processing produces foods with the highest nutritional quality and better color and flavor. Here the work of Esselen and associates at the University of Massachusetts stands out as one of the pioneering and most successful efforts in food science. Simply stated, it showed that whereas the reaction rates for chemical changes generally double for each 10°C rise in temperature, the destruction rates for bacterial spores increase approximately ten-fold for the same temperature change (Esselen and Anderson, 1956; Feliciotti and Esselen, 1957; Livingston et al., 1957).

The inventors of the equipment and processes mentioned above had tremendous "gut feelings" and intuition. When the scientific rationale was published, even better and more innovative processes were developed.

- New Methods of Can Manufacture. The development by the container industry of two-piece cans using draw-redraw techniques and the development of welded cans came about as a response to the need to remove lead from cans (and thus from the environment), as well as to produce lighter-weight tinplate.

- Hazard Analysis and Quality Assurance. The hazard analysis and critical control point (HACCP) system was jointly developed by the Pillsbury Co., the National Aeronautics and Space Administration, and the U.S. Army Natick Laboratories (Wodicka, 1973; Jackson and Shinn, 1979; Baum, 1974; Kaufman, 1974) as an important step in assuring the safety and quality of processed foods.

- Decaffeination of Coffee and Tea. New nonorganic-solvent techniques have been developed for the decaffeination of coffee and tea products. These techniques include using such natural substances as water and vegetable oils as well as supercritical carbon dioxide. All three of these methods have been developed by the food industry within the past decade and are in commercial use today.

- Other Activities. The above represent an important though not complete list of processes and equipment which have originated, by and large, in industry. In addition to these process, equipment, and product developments, the industry has contributed its help in teaching as adjunct faculty at universities, participated in many activities for the public good, and contributed monetarily to the advancement of teaching and research at universities.

In addition to . . . process, equipment, and product developments, the industry has contributed its help in teaching as adjunct faculty at universities, participated in many activities for the public good, and contributed monetarily to the advancement of teaching and research at universities through fellowship and scholarship programs. These additional activities have been extremely great in scope and value.

Other Significant Developments

Space permits but brief mention of a number of other developments in food technology and related disciplines which have been highly significant or should prove to be of great importance in the foreseeable future:

- Dehydration. Great advances have been made in the scientific knowledge relating to spray drying and freeze drying, particularly over the past 30 years.

In spray drying, knowledge of the important variables which can be controlled and modified have permitted new design of spray dryers, better control of the dehydration, and thus better-quality products at lower cost per weight of water removed.

In freeze drying, advances in theoretical knowledge relating to color and aroma losses have made possible better-controlled dehydrators with shorter cycle times. The tremendous achievements in the development of continuous freeze dryers have reduced process times by four orders of magnitude and thus have improved product quality tremendously as well as reduced operating costs greatly.

- Freezing. The frozen food industry has grown greatly
over the past half century. This has been made possible by combined industry, university, and government R&D. In particular, the contributions of USDA's Western Regional Research Center in what is now known as the "time-temperature tolerance" studies (Van Arsdel et al., 1969). These have made it possible to predict optimal freezing and storage conditions for various types of foods.

The use of liquified (cryogenic) gases for freezing as well as for storage has now been applied commercially. New equipment for contact freezing of foods in novel shapes is also commercial reality, as are systems for efficiently freezing fruits and berries in fluidized beds.

- Refrigerated Prepared Foods. Knowledge of microbiology, raw material quality, good manufacturing practices, the role of temperature control near 0°C, proper packaging, and superb gastronomy have all made possible the development of refrigerated prepared main courses on an industrial scale. This is now a rapidly growing market in the U.K. and is spreading to continental Europe as well as to the U.S.

- Water Activity. As Duckworth (1975) so well pointed out, it has been only in recent times that "a scientific basis has been laid for our understanding of the conditions and properties of this most ubiquitous substance—water."

Bound water, sorption isotherms, water activity, and intermediate-moisture foods have become commonplace today. Recognition of the importance of water activity in foods and its availability for physical, chemical, and biological changes in food systems has revolutionized our thinking regarding food spoilage and its prevention and has played an important role in modern flexible packaging material design.

- Modified-Atmosphere Storage. The development of modified and controlled gas atmospheres has become important in the improvement in quality of fresh and processed foodstuffs packaged in flexible films (Kader, 1986).

Additionally, the development of packaging films and systems that are selectively permeable to specific gases has extended the storage life of many products under refrigeration (Sneller, 1986; Huntlien and Hotchkiss, 1986).

These developments, which may be said to be derivative to the discovery of polyethylene and polypropylene by Ziegler and Natta, have provided new means of improving storage of foods under refrigeration and offer even more promise for the future.

- Microwave Processing. Since the end of World War II and the development of the first microwave heating ovens for institutional feeding, there has been a dramatic increase in the use of these ovens. New developments in oven technology and in continuous processing devices for microwave heating of foods have resulted in a dramatic increase in the utilization of this World War II technology. Microwave ovens are becoming commonplace in many kitchens in the U.S., U.K., Sweden, and Japan as well as other industrialized countries.

Food packages and the foods themselves are being designed today for microwave oven heating in the home and workplace. In addition, few indeed are the restaurants and fast-food chains in the U.S. whose kitchens are not equipped with microwave ovens.

The fact that microwaves affect foodstuffs solely by the heat induced therein has been conclusively demonstrated and has served as a premise for applications of microwaves for processing of foods on a continuous basis in food factories. Such operations as continuous thawing of frozen foods for subsequent slicing and further processing, as well as preheating of foods on a continuous basis, are now commonplace in the food industry (Goldblith, 1966; Decraeneau, 1985).

- Computers. The computer revolution has made its mark in food technology, as it has in other fields. It has been used to study such things as reaction kinetics (Labuzka and Kamman, 1983) and storage prediction based on reaction kinetics (Mizrahi et al., 1970; Saguy, 1983).

As manufacturing processes have become more complicated, e.g., the Jupiter process for aseptic canning of foods containing particulates (Herson and Shore, 1981), with tighter specifications in terms of time and temperature, computer control of these processes is the only means to achieve safe and wholesome products.

Durham (1982) reviewed the applications of microelectronics in the food industry, including research and development, inventory control, manufacturing process and engineering operations control, sales forecasting, storage and handling of data, and decision making. To these, I would add the use of microelectronics and computers in supermarkets to scan the Universal Product Code and thereby improve efficiency of distribution and marketing, as well as pricing and inventory control; and the more recent use of "expert systems" techniques in food processing (Weiss and Kulikowski, 1986; Overview, 1989).

- Other Areas of Activity. There are many other areas of food technology activity where great progress has been made over the past 50 years, but limitations preclude an adequate discussion of each. Suffice it to say that great progress has been made in the following areas: dewatering of foods, or food concentration (Thijssen, 1974; Michaels, 1974; Madsen, 1974)—this includes freeze concentration, reverse osmosis, and ultrafiltration, as well as other membrane processing techniques; food microbiology, including foodborne diseases and their prevention; food chemistry; food safety and toxicology; sensory properties of foods, including flavor, color, odor, and rheology, as well as food acceptability; and fabricated foods.

The Changing Scientific Literature

We can examine the scientific literature as a means of assessing the progress in the field of food technology as well as the role that IFT has played.

While this article examines primarily literature in English, it should be noted that the findings are the same for other major languages, both Western and Far Eastern. There are basically three types of literature that might be examined:

- Journals. There has been a great improvement in the nature and scope of the journals in this field. There has been an increase in the breadth of coverage, as well as in the depth. The journals have become less descriptive and more analytical and quantitative. They have grown in stature as new understanding of the nature of the observed phenomena has emerged. In all of this, IFT has played a large role through its publication of Food Technology and
Journal of Food Science. The Committee on Publications of the Institute has been one of the most active committees and has been instrumental in improving the standards of its journals.

- Books. There has been an equally great metamorphosis with books. They, too, have become more analytical and less descriptive. Most of the books are multiauthored because the tremendous increase of knowledge in the field precludes a single individual from authoring such a volume.

Table 1—A Chronology of Some Major Books in food science and technology

<table>
<thead>
<tr>
<th>Year</th>
<th>Title</th>
<th>Authors</th>
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<tr>
<td>1923</td>
<td>Canned Foods in Relation to Health</td>
<td>Savage, 1923</td>
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<td>1932</td>
<td>The Microbiology of Foods</td>
<td>Tanner, 1932</td>
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<td>1939</td>
<td>Food Technology</td>
<td>Prescott and Proctor, 1939</td>
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<td>1944</td>
<td>The Chemical Senses</td>
<td>Moncrieff, 1944</td>
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<td>1948</td>
<td>Advances in Food Research, Vol. 1</td>
<td>Mrak and Stewart, 1948</td>
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<td>1949</td>
<td>Freeze-Drying (Freezing by Sublimation)</td>
<td>Florisvand, 1949</td>
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<td>1950</td>
<td>Canned Foods in Human Nutrition</td>
<td>Cameron and Esty, 1950</td>
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<td>1952</td>
<td>Food Science: A Symposium on Quality and Preservation of Foods</td>
<td>Bateman-Smith and Morris, 1952</td>
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<tr>
<td>1953</td>
<td>Foodstuffs: Their Plasticity, Fluidity and Consistency</td>
<td>Scott Blair, 1953</td>
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<td>1956</td>
<td>Food Poisoning</td>
<td>Dack, 1956</td>
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<td>1957</td>
<td>Sterilization in Food Technology</td>
<td>Ball and Olson, 1957</td>
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<td>1958</td>
<td>Processed Plant Protein Foodstuffs</td>
<td>Altschul, 1958</td>
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<td>1959</td>
<td>Sensory Communication</td>
<td>Rosenblith, 1959</td>
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<td>1962</td>
<td>Chemical and Biological Hazards in Food</td>
<td>Ayres et al., 1962</td>
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<td>Fundamentals of Food Engineering</td>
<td>Charm, 1962</td>
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<td>1963</td>
<td>Olfaction and Taste</td>
<td>Zotterman, 1963</td>
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<td>Introduction to the Biochemistry of Foods</td>
<td>Braverman, 1963</td>
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<td>Food Processing Operations: Their Management, Machines, Materials and Methods, Vol. 2</td>
<td>Heid and Joslyn, 1963</td>
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<td></td>
<td>Recent Advances in Food Science, Vol. 3. Biochemistry and Biophysics in Food Research</td>
<td>Leitch and Rhodes, 1963</td>
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<td>Global Impacts of Applied Microbiology</td>
<td>Starr, 1964</td>
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<td></td>
<td>Microbial Inhibitors in Food</td>
<td>Molin and Erichsen, 1964</td>
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<td></td>
<td>Principles of Sensory Evaluation of Food</td>
<td>Amerine et al., 1965</td>
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<td></td>
<td>The Freezing Preservation of Foods, in Four Volumes, 4th ed.</td>
<td>Tressler et al., 1968</td>
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<td>Recent Advances in Food Science, Vol. 4. Low Temperature Biology of Foodstuffs</td>
<td>Hawthorne and Rolfe, 1968</td>
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<td>Quality and Stability in Frozen Foods</td>
<td>Van Arsdel et al. 1969</td>
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<td>Report of the Secretary's Commission on Pesticides and their Relationship to Environmental Health</td>
<td>Mrak, 1969</td>
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<td>Principles of Enzymology for the Food Sciences</td>
<td>Whitaker, 1972</td>
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<td>The Microbiological Safety of Food</td>
<td>Hobbs and Christian, 1973</td>
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<td></td>
<td>An Introduction to Food Rheology</td>
<td>Muller, 1973</td>
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<td>Food Science, 2nd ed.</td>
<td>Potter, 1973</td>
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<td>Food Dehydration, Vol. 1. Drying Methods and Phenomena</td>
<td>Van Arsdel et al., 1973</td>
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<td>Food for Thought</td>
<td>Labuza, 1974</td>
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<td></td>
<td>Advances in Preconcentration and Dehydration of Foods</td>
<td>Spicer, 1974</td>
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<td></td>
<td>Water Relations of Foods</td>
<td>Duckworth, 1975</td>
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<td></td>
<td>Freeze Drying and Advanced Food Technology</td>
<td>Goldblith et al., 1975</td>
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<td></td>
<td>Fabricated Foods</td>
<td>Inglett, 1975</td>
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<td></td>
<td>Enzymes in Food Processing</td>
<td>Reed, 1975</td>
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<tr>
<td>1976</td>
<td>Microbiology in Agriculture, Fisheries and Foods</td>
<td>Skinner and Carr, 1976</td>
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*See references for publisher
Books that are illustrative of both the standard of excellence as well as the breadth and depth of coverage include those by Karel et al. (1976), Fennema (1976), Whitaker (1972), Reed (1975), Tannenbaum (1979), Davies et al. (1976), and Saguy (1983). These and many others

(Table 1) demonstrate the improvement in text material in the field and are relied on by faculty and students alike for education in food technology at the graduate as well as the undergraduate level.

During the past half century, a new phenomenon has appeared—that of the “Advances” series of books. A response to the tremendous explosion of knowledge in the field, these books, generally authored by one or two experts in a particular area, fulfill the need for in-depth reviews of a given subject. In 1953, Mrak and Stewart began a series of volumes, published more or less annually, known as Advances in Food Research, which have reviewed a number of topics in food research in a timely manner. These volumes, which have covered specific areas in food science, food technology, and food engineering, have been of high quality and extremely useful in updating one’s knowledge in a given field.

Another series of a related type is Critical Reviews in Food Science and Nutrition. These are more limited in scope but offer valuable teaching and research aids.

- Symposia Proceedings. IFT has for a number of years been publishing in Food Technology an “Overview” series of symposia in food science and technology. These are usually proceedings of outstanding symposia held at the Annual Meetings of the Institute.

Examples of timely topics that have been published in this series during the past decade include extending the shelf life of fresh foods by combining controlled atmosphere and refrigeration (Overview, 1980); computers in the field of food technology (Overview, 1981); optimization theory and techniques (Overview, 1982); bacterial spore resistance in food systems (Overview, 1983); membrane technology (Overview, 1984); diet and immune function (Overview, 1985); postharvest storage of fruits and vegetables (Overview, 1986); industry/university cooperative research programs (Overview, 1987); food and agriculture in a global economy (Overview, 1988); and artificial intelligence and expert systems in the food processing industry (Overview, 1989). All were presented in a timely manner by workers active in the particular field. IFT has done a unique public service by publishing these proceedings.

Thus, the literature in the field of food science and technology has increased in quantity as the level of knowledge has increased, and in quality as our level of understanding has increased. It reflects the improvements in the education of food technologists that have occurred over the past half century. In all this, IFT has played a significant role.

**IFT and the Common Good**

One of the criteria whereby an organization such as IFT may be judged over a period of time relates to its contributions to society, i.e., “the common good.”

Food science and technology have played an important
role in the improvement in feeding and nutrition of our society in the Western world (as well as in the developing countries) and in the provision of an abundance of food which is immense in variety, wholesome, and safe. Life spans in the industrialized world have increased. In all of this, IFT has played an important and central role. The Institute has provided forums for important symposia on timely topics; it has served as a central source for providing expertise in the various areas constituting the broad field of food technology; and it has provided journals for dissemination of new knowledge and ideas.

The Institute has been an important catalyst in mankind’s achieving the level of knowledge relating to foods. Were there no IFT today, it is doubtful that such levels of knowledge would have been reached; moreover, a similar organization would need to be invented to carry out its function.

The developments in food technology in the industrialized countries illustrate well Pasteur’s immortal comments. (Dubos, 1950) that “Science is the soul of the prosperity of nations and the living source of all progress—what really leads forward are a few scientific discoveries and their applications” and “Science knows no international borders; and is the basis of a universal community of thought . . . .”

I am proud to have been a witness to and participant in some of the advancements I have described. It is an exciting time to be alive, and I look forward to further developments in food science and technology for the benefit of mankind.

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—Continued on page 104
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For information circle 145

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Food Science and Technology in Developing Countries During the Past 50 Years

Ricardo Bressani

Anniversaries are usually happy occasions, particularly when they commemorate an event which, in one way or the other, is contributing to the well-being of mankind. Anniversaries are also appropriate moments to look back on what has been accomplished, to correct things which may not have turned out as expected, and to plan for the future. Thus, the 50th anniversary of the founding of the Institute of Food Technologists is an appropriate time to review the history of food science and technology in the developing countries.

This topic, however, is difficult to present, since it should discuss and be representative of all the Developing World, which consists of some 95 countries and about 75% of the world population. The content could be presented in a variety of forms, depending on how developing countries are defined and what aspects of the food system are discussed.

Economists define developing countries as countries with a low gross national product (GNP), high unemployment, low income, and poverty; demographers see them as countries with a high annual population growth and high population density; public health officials see them as countries with high infant mortality, disease, and malnutrition; educators see them as countries with a high illiteracy rate; and others see them as countries where food problems are a major concern.

Without an abundant, diverse, safe, and wholesome supply of foods, individuals and entire nations forfeit a life of hope and dignity. But production by itself is not enough; food must be available and accessible to every person in nutritious, safe, and appetizing forms. This means that every consideration must be given to the entire food chain, from production to processing, distribution, consumption, and biological utilization.

The scope of this article is therefore very broad, and it would be difficult to cover advances made in all links of the chain for all developing countries. I apologize for the omissions which I have unwittingly made.

The Supermarket vs the Open Market

The most significant representation of the achievements in the field of food science and technology worldwide in recent years is possibly the supermarket.

For those people not familiar with them, it is simply fascinating to walk aisle after aisle admiring the variety of attractive cartons, cans, and many other fancy containers with all kinds of foods. Aside from the beauty, diversity, and abundance of food items, the supermarket has many implications not evident to the consumer. It implies a very efficient agricultural production, to be used for feeding people and as raw materials for the food industry or other production systems. It implies making seasonal production available throughout the year. It implies many years of research in food science, nutrition, and other allied disciplines. It implies the use of food science research results to develop and implement food technology activities, also the result of research and a close association between research centers and the food industry. It implies the availability of knowledge in packaging, marketing, and quality control. It implies food security and food safety to the consumer. And it implies a receptive population with the knowledge to appreciate the foods, and with the economic capacity to purchase it.

Nevertheless, it is also fascinating to walk through the narrow passages of the colorful open markets typical of developing countries (Fig. 1). There, however, the variety of foods is low, mainly cereal grains and food legumes in burlap bags. Occasionally, baskets full of foods, mainly vegetables and fruits, are also to be found, but their availability is dependent on seasonal production. These foods come from poor and inefficient agricultural production systems, not good enough to supply the demand, deteriorating under the sun, dust, or rain, with flies and other insects as constant visitors. Those foods not sold by the end of the day go to waste. People marketing the foods do not look healthy, and they earn little for their effort because those who purchase do not have sufficient income to purchase more and in a continuous way. Even if they could, the food would be wasted because of the lack of refrigeration and other preservation techniques. Food products such as meat and eggs are in short supply and expensive. Only dry staples are sold, mostly cereal grains. The full benefits of processing, of engineering, and of food science and technology are still not reaching most people in the developing countries. Nevertheless, food science and
technology has evolved and has contributed to the alleviation of some nutritional problems as well as food needs and to the economies of the countries. Together with other factors, it is also changing the dietary habits of people.

The picture of the open market in the developing country today is very similar to the one which could have been seen 50 years ago. The difference between the two scenes lies only in the greater number of people today. Their appearance, however, is the same—they are malnourished, poor, unhappy persons, and this is more evident in children who go to market with their parents. Between 75 and 80% of a total world population of more than 5 billion live in the developing nations, and their nutritional status definitely is only slightly better than 50 years ago. Because of the significant number of people, low and variable agricultural production, poor economies, low food availability, higher costs, poor-quality foods, and the effects of adverse environments, diseases, and low socioeconomic condition, however, the possibilities for rapid improvement have been very slim.

Obviously, this picture has been the result of many factors acting simultaneously. No one corrective measure by itself will result in the kind of scenario represented by a supermarket. Still, during the past 50 years, food science and technology in developing countries has advanced and made some contributions which could have been more important and effective if other factors had concomitantly existed. It would seem that food science has advanced
Food Science and Technology (continued)

much more than food technology, because the first concerns the research laboratory, while the second concerns the application of research results for the benefit of people who for a number of reasons are not ready as yet to take advantage of the outcome of food processing and of food technology as a whole.

A number of problems have taken place in the world, particularly in the developing world, which in one way or another have stimulated the development of food science in the developing countries. But the factors which will stimulate food technology have not yet been attained for all people in the low-economy areas. The factors responsible for the development and increased activity in food science, as well as those which are constraining the faster development of food technology, are discussed below.

Problems Stimulating Food Science and Technology

It is difficult, and even dangerous, to state that events which took place during the past 50 years were solely responsible for the initiation of an interest in developing a capacity for food science and technology in developing countries. With this limitation in mind, several factors can be identified as probably playing a significant role. First is the malnutrition problem affecting all low-income groups but mainly children and pregnant and lactating women. Although at first it was felt to be a medical problem, it soon became apparent that quality and quantity of food were important. While efforts were beginning to be made to increase food production, it was felt that availability of what was produced could be increased by activities in postharvest technology. On the other hand, great losses of grains and of many other foods were recorded, and much interest developed to find ways to reduce such losses through simple but effective technologies.

Nevertheless, nutrition and food problems were not the only events which stimulated the development of food science and technology. Others include the need to produce and preserve more foods required by an increasing world population. Likewise, for some time now, all developing countries have been experiencing a migration of people from rural to urban areas. The economies of developing countries have reached such low levels that they have made it essential for their survival to process foods which before were imported.

On the other hand, the relatively high capacity to produce agroindustrial crops such as sugarcane and oilseeds led to the development of sugar and oil extraction and refining industries, to meet specific needs for sugar and oil and oil-based food products. Realization also came that in the developing countries problems such as those listed could be solved by strengthening local human resources, in spite of the fact that much help came from the developed world. In addition, much if not all of the technologies being utilized came from countries with knowledge and information. It was and is felt that knowledge and information must be produced locally to effectively develop food science and technology in developing countries.

It is of interest to point out at this time that the Institute of Food Technologists and the League for International Food Education (LIFE) conducted a study in Latin America in 1976 to identify actions which might be taken by governments of developing countries and donor agencies to stimulate the application of local food technology resources to the solution of malnutrition problems in Latin America (Buchanan and Stewart, 1977).

The study found a wide range of food technological resources in Latin America, from very good and modern to very poor and primitive. The authors also found that malnutrition conditions among the population were relatively similar throughout Latin America. They recognized that the conditions were more serious in the fringe areas of large cities caused by the influx of poor people from rural areas, and that many other factors were responsible, such as illiteracy, food habits, low income, poor communication, inadequate processing, handling, storage, and distribution technologies, poor water supplies, ineffective and/or inadequate government nutritional policies, disease, and inadequate agricultural production. They reported serious postharvest losses and identified a number of constraints which hindered food technology resources from being more effectively used in contributing to the solution of the problem.

- The Malnutrition Problem. Some 50 years ago, evidence was being obtained on the nutritional status of people in the underdeveloped world. Some factors associated with this malnutrition problem that gave rise to food science and technology were protein/calorie malnutrition; specific nutritional deficiencies such as iodine, iron, and vitamin A; lack of information on nutrient intake from local food consumption during pregnancy and lactation; nutritional problems during the weaning process; diarrhea; and infection. The relation of some of these factors to the development of food science and technology is shown in Table 1.

The nutritional deficiencies known as marasmus and kwashiorkor, however, attracted the attention of medical scientists, who concluded that the former was due to low intakes of both good-quality protein and calories, while the latter was due to a deficiency in the intake of good-quality protein accompanied by deficiencies of other nutrients.
However, between these two extremes, a great many children suffered from some degree of malnutrition (Scrimshaw and Behar, 1961). This problem gave rise to two important activities involving food science. The first was related to obtaining information on the nutrient composition of foods, and the second to the search for vegetable proteins which could provide a good balance of essential amino acids, since animal food products were too high in cost and not readily available. Other resources such as fish protein concentrate and single-cell protein became better known.

Knowledge of food composition was almost mandatory in order to understand and interpret food intake data and nutritional adequacy. Thus, many native foods were analyzed, and the information was published as early as 1943 in a number of scientific journals, one of them being Food Research, now known as IFT’s Journal of Food Science. The data from a relatively great number of researchers were finally compiled into food composition tables, which led to the appearance of a table for Latin America in 1961 (INCAP-ICNND, 1961). Similar information for Asia also became known in the early 1950s (Rand et al., 1984) and possibly for Africa as well. The data published in scientific journals and in tables served a useful purpose. However, it is necessary for food composition tables to be upgraded in quality of the analytical data, in quantity of foods, and in nutrients, since many changes in food production, storage, and processing known to affect composition, as well as changes in analytical techniques, have taken place over the years.

With regard to the search for products containing good-quality protein, significant amounts of research were carried out on local resources. Knowledge was thus obtained on a number of oilseeds such as sesame in Mexico and peanuts in India (CFTRI, 1974; Parpia and Subramanian, 1966), cottonseed in Central America and Peru (Bressani et al., 1966), and soybeans in Asia (CFTRI, 1974; Parpia and Subramanian, 1966). Oilseed flours from such products were developed and incorporated into mixtures with cereal grains, giving rise to products known as high-quality foods. Simultaneously, these foods were tested in human subjects with relatively good results, which encouraged their industrial production. Products such as Multipurpose Food and Bhal Ahar in India, Incaparina in Central America (Fig. 2), Maisoy in Bolivia, Protina, made from Incaparina and Maisoy (Fig. 3), Faffa in Ethiopia, Superamine in Algeria, Laubina in Lebanon, and many others were produced (Bressani and Elias, 1973). Quite often, little life expectancy was given to them, but many have survived. Furthermore, food industries to produce such foods were developed, setting in motion other activities such as processing and refining of basic ingredients, acquisition of modern technologies such as extrusion cooking, development of human resources to run the industries, and establishment of the quality control laboratory.

All of these developments yielded significant amounts of scientific information. This information has served a useful purpose and built a base for the research now being conducted. Interestingly enough, the search for high-quality food proteins still occupies the time and effort of scientists all over the world, including the developing countries. The search for solutions has continued. The development of fish protein concentrate, to be used as a supplement, was a significant contribution. Other kinds of fortification of foods were studied, and some implemented;

The lack of implementation of food research findings is one of the more disturbing factors which somehow must be solved.

Table 1—Malnutrition Problems and the application of food science and technology in developing countries

<table>
<thead>
<tr>
<th>Malnutrition problem</th>
<th>Food science and technology research</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein/calorie malnutrition</td>
<td>Vegetable proteins, fish protein concentrate, single-cell protein</td>
<td>High-nutritive-value foods</td>
</tr>
<tr>
<td>Poor nutritional status of people and low nutrient intake</td>
<td>Food analysis</td>
<td>Food composition tables</td>
</tr>
<tr>
<td>Iodine deficiency</td>
<td>Potassium iodate addition</td>
<td>Iodized salt</td>
</tr>
<tr>
<td>Vitamin A deficiency</td>
<td>Vitamin A stability in sugar</td>
<td>Fortified sugar</td>
</tr>
<tr>
<td>Iron deficiency</td>
<td>Heme iron from animal blood</td>
<td>Fortified bakery products</td>
</tr>
<tr>
<td>Low food intake in children</td>
<td>Increasing caloric density</td>
<td>Partially hydrolyzed food products</td>
</tr>
</tbody>
</table>
Food Science and Technology (continued)

autochthonous technologies; reduction of seasonal variation in food availability; introduction of the grain quality concept; food quality improvement through fortification, supplementation, and complementation; development of new sources of foods; and demand for specific food items, such as oils.

The low agricultural production of basic staple foods prompted the establishment of the International Agricultural Research Centers in developing countries in Asia, Africa, and Latin America. An event which was fundamental in their recognition was the Green Revolution, and undoubtedly they have made significant contributions in increasing food production worldwide. Soon, these institutions, besides increasing production, introduced into their objectives concepts in the area of food science, particularly grain quality characteristics of the staples and other foods of their particular mandate. The institutions also promoted food and utilization research activities; e.g., research by the International Rice Research Institute on rice (IRRI, 1979); research by Centro Internacional de Agricultura Tropical (CIAT) on use of cassava as a substrate in biotechnology (Cook et al., 1976); and research by the International Potato Center (IPC) on potatoes as a component in high-quality foods (Valle-Riestra, 1984). Food legumes also came into focus as potential sources of complementary protein; this not only induced increased research efforts for these foods, but also stimulated the agricultural sectors, national and international, to increase their production and utilization in food product development.

The malnutrition problem was also responsible for the finding that it was possible to select cereal grains of better nutritional quality; the classical example was opaque-2 corn, now known as quality protein maize, QPM (Anonymous, 1972). Likewise, triticale was developed and became famous, on the one hand because it was manmade and on the other because it has a higher content of high-quality protein than other cereal grains (Hulse and Laing, 1974). Other higher-quality cereal grains were found, such as high-lysine sorghum and Hiproly. Many studies were conducted on cereal grain supplementation with amino acids and/or small amounts of protein of both vegetable and animal origin (Scrimshaw and Altschul, 1969). Food complementation studies were also published, showing the significant improvement attained when two food sources mutually supplied each other’s deficiencies, resulting in a product of better nutritional quality than either component alone (Bressani, 1974a). All of these solutions were sold in terms of their potential nutritional benefits; nevertheless, it is difficult to cite examples of their technological application in the developing countries.

The malnutrition problem also influenced other areas of food science research. One of the best examples is the study of the lime-cooking process for corn to make tortillas. The technology, as described in the early 1950s with all the chemical data supporting it (Bressani et al., 1958; Bressani and Scrimshaw, 1958), has been very well used in the developed world, particularly in the United States. Likewise, chappaties made in India were extensively studied, as were other autochthonous technologies, like those used in Asia to process soybean (Steinkraus et al., 1983). The need to improve the biological utilization of local grains promoted research in understanding of the native processes to convert them into edible products. An interesting example of this is the development of sorghum and millet that have been selected for improved nutritional quality (Olatunji et al., 1982). Other achievements, such as leaf protein concentrate, were attained, not necessarily in developing countries (Pirie, 1971). Nevertheless, leaf protein concentrate is a resource not yet extensively utilized.

Research carried out in developing countries on various aspects of the food system brought into the news and research areas the problem of developing postharvest technology, particularly to reduce losses of staple foods. Thus, the grain storage practices as conducted in developing countries were analyzed, and solutions to the problems found were provided and implemented to reduce food losses as much as possible (BOSTID, 1978). The problem of postharvest food losses still prevails, particularly with small farmers, who to a very large extent are responsible for the production of the basic staple foods.

A problem now receiving worldwide attention is the hard-to-cook condition in beans, which has not as yet been resolved (Vindiola et al., 1986). This condition induces difficulties in cooking beans, causing large expenditures in energy and, as a consequence of the prolonged cooking times, losses in nutritive value and acceptability to consumers. This problem is useful to indicate that, besides nutritive value, other attributes of the different commodities are also being recognized, such as functionality characteristics.

A relatively high number of surveys of foods consumed
in developing countries indicated that wheat, as wheat flour, was being consumed in increasing quantities. Since most developing countries located in the tropical belt of the world do not produce wheat, which must therefore be imported, the composite flour concept was born (Kim and de Ruiter, 1969). It received much publicity and research efforts in the early 1970s Cassava flour became better known as a product useful with wheat flour to make bread. Although much was done in the developing world, very little of that was placed into actual use. When wheat economics became lower in comparison with costs of locally produced grains, the program on composite flours lost interest. However, it is still very important and probably much more significant today because of the developing countries' poor economic situation and increasing population.

The food problem not only had to do with low quantity and availability but also with the quality, particularly that of protein; this induced food research on cereal grains in particular. Many studies were conducted showing the nutritional limitations of cereal grains; and many studies showed how they could be improved by a large number of supplementary foods. In all cases, the results were outstanding, and technologies were proposed. But, after so much good research, none, or very few, of those results have been implemented. The lack of implementation of food research findings is one of the more disturbing factors which somehow must be solved.

- The Population Problem. Significant changes in the quantity and quality of the human population have taken place in the developing countries during the past 50 years (IADB, 1987) years and will continue to take place. There is still a significant increase in the number of inhabitants of the developing world, and this will induce a higher demand for food. However, a problem which is possibly as serious is the change in the quality of the population. As Tables 2 and 3 show, while the developing countries had a greater number of people in the rural areas early in 1960, today urban populations are increasing at a very high rate. In all countries of Latin America, the number of people migrating to cities is greater than the number of people living in the rural areas. The change in quality also is evident in the development of a higher middle class, which, with a higher income and greater knowledge, is beginning to demand or development of a higher middle class, which, with a higher income and greater knowledge, is beginning to demand or

### Table 2—Change in Total and Urban Population in selected Latin American countries from 1960 to 1986. From IADB (1987)

<table>
<thead>
<tr>
<th>Country</th>
<th>1960 Total population (1,000)</th>
<th>1986 Total population (1,000)</th>
<th>% Urban 1960</th>
<th>% Urban 1986</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolivia</td>
<td>3,294</td>
<td>4,611</td>
<td>26.9</td>
<td>47.7</td>
</tr>
<tr>
<td>Colombia</td>
<td>15,557</td>
<td>29,058</td>
<td>48.0</td>
<td>66.6</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>1,320</td>
<td>2,530</td>
<td>31.1</td>
<td>49.5</td>
</tr>
<tr>
<td>Ecuador</td>
<td>4,429</td>
<td>9,647</td>
<td>34.2</td>
<td>52.7</td>
</tr>
<tr>
<td>Honduras</td>
<td>1,988</td>
<td>4,514</td>
<td>22.0</td>
<td>40.4</td>
</tr>
<tr>
<td>Mexico</td>
<td>37,073</td>
<td>79,504</td>
<td>50.8</td>
<td>69.7</td>
</tr>
<tr>
<td>Peru</td>
<td>10,385</td>
<td>20,208</td>
<td>44.6</td>
<td>67.7</td>
</tr>
<tr>
<td>Venezuela</td>
<td>7,963</td>
<td>17,914</td>
<td>64.1</td>
<td>81.3</td>
</tr>
</tbody>
</table>

### Table 3—Some Population Statistics in Latin American countries in 1987. From BID (1987)

<table>
<thead>
<tr>
<th>Country</th>
<th>Annual growth rate (%)</th>
<th>Urban population (%)</th>
<th>Life expectancy (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>1.6</td>
<td>84.7</td>
<td>69.7</td>
</tr>
<tr>
<td>Bolivia</td>
<td>2.8</td>
<td>47.7</td>
<td>50.7</td>
</tr>
<tr>
<td>Brazil</td>
<td>2.5</td>
<td>74.5</td>
<td>60.5</td>
</tr>
<tr>
<td>Colombia</td>
<td>1.6</td>
<td>66.6</td>
<td>62.1</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>2.6</td>
<td>49.5</td>
<td>73.1</td>
</tr>
<tr>
<td>Chile</td>
<td>1.7</td>
<td>84.0</td>
<td>70.9</td>
</tr>
<tr>
<td>Ecuador</td>
<td>3.1</td>
<td>52.7</td>
<td>65.4</td>
</tr>
<tr>
<td>El Salvador</td>
<td>2.1</td>
<td>41.8</td>
<td>63.3</td>
</tr>
<tr>
<td>Guatemala</td>
<td>2.8</td>
<td>32.7</td>
<td>62.0</td>
</tr>
<tr>
<td>Honduras</td>
<td>3.2</td>
<td>40.4</td>
<td>62.0</td>
</tr>
<tr>
<td>Jamaica</td>
<td>1.5</td>
<td>48.4</td>
<td>70.3</td>
</tr>
<tr>
<td>Mexico</td>
<td>2.7</td>
<td>69.7</td>
<td>66.1</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>3.4</td>
<td>56.9</td>
<td>59.8</td>
</tr>
<tr>
<td>Panama</td>
<td>2.2</td>
<td>51.5</td>
<td>72.1</td>
</tr>
<tr>
<td>Paraguay</td>
<td>3.2</td>
<td>43.9</td>
<td>68.0</td>
</tr>
<tr>
<td>Peru</td>
<td>2.6</td>
<td>67.7</td>
<td>60.8</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>2.4</td>
<td>53.3</td>
<td>64.1</td>
</tr>
<tr>
<td>Trinidad and Tobago</td>
<td>1.4</td>
<td>85.0</td>
<td>70.3</td>
</tr>
<tr>
<td>Uruguay</td>
<td>0.5</td>
<td>85.0</td>
<td>70.3</td>
</tr>
<tr>
<td>Venezuela</td>
<td>2.9</td>
<td>81.3</td>
<td>69.0</td>
</tr>
</tbody>
</table>

*E.g., 84.7% of the total population in Argentina live in urban areas*
the agricultural and economic problem within countries plus the lack of job opportunities in law and medicine or pharmacy, has stimulated the development of new professional disciplines, including food science, technology, and engineering. This is slowly creating a critical mass which, together with the needs of the industry and those of the countries, will result in developments of food technology in the developing world.

On the other hand, the food industry is beginning to contribute to development by, among other things, increasing food production and productivity of some agricultural crops, decreasing food losses, increasing food availability, reducing seasonality, providing employment and a higher income, making available high-nutritive-value foods, and, in general, increasing the economic situation. Marketing strategies are beginning to include nutrition information on the label, which together with nutrition education programs, is making the population aware of nutritional quality and safety. However, the limiting factor at present is the relatively small population with the economic means to purchase processed foods.

- The Economic Problem. Developing countries have always had economic problems of one kind or the other. They always sold by the kilogram at low prices, and bought by the pound at high prices. In addition, in recent years, the devaluation of the local currency and the low prices of the commodities produced in the developing countries have resulted in even greater economic problems than in the past. This situation—negative in nature—is in fact resulting in a positive measure in a number of areas, including food science and technology. The problem and actions being taken are shown in Table 4.

To decrease imports, create jobs, obtain added value, and increase food availability and variety throughout the years, food agroindustries are being created, particularly in the rural areas, with small producers and cooperatives (Bressani, 1974b; CITA-RETADAR, 1985). Although the development of such agroindustries is not an easy task, it is bringing into view such things as the need to consider them as systems with three main components—agricultural production, processing, and marketing; the quantity and quality of materials to be processed; the kind of technology to use; the quality of the product; the marketing and management problems; and the social quality of the people being benefitted. It may be safely stated that the technology to be used presents the least of the problems; in fact, the quantity and quality of raw materials, as well as of people, and marketing represent the most important constraints.

- The Human Resources Problem. Early in the past 50 years, the problems already discussed in general terms and in a qualitative manner pointed out a great deficiency in the developing world: the urgent need to develop human resources in all areas of the food system. It was felt that the problems in the developing countries could be solved by training local scientists to find local solutions. This need gave way to a program for training in the industrialized countries. Although it is far from meeting the needs, it has—together with a diversity of communications, congresses, foreign teams visiting developing countries, and postgraduate training—been creating the critical mass of scientists needed in the different areas of food science, technology, and engineering to put in motion the kind of
Food Science and Technology (continued)

activity required to solve a number of the problems which still remain.

As a consequence, a number of events have taken place. First, local universities have started building up academic programs to award professional degrees in food science and technology. Governments have created special institutes to undertake developmental and adaptive food research to serve the food industry, and have created laboratories for quality control with trained personnel. And institutes in nutritional sciences have incorporated into their structure technical groups in food science and technology to work on food problems with a nutritional content not greatly appreciated by the conventional food industry or government food research institutes.

The problem, at least in certain countries in the developing world, is that the conventional food industry has not responded as yet in employing the professionals in food science and technology who are graduating. Table 5 summarizes the number of institutions in Latin America involved in food science and technology in 1976 (de Visscher, 1976). The number was relatively large at the time and has probably increased since then. The variety of research topics which were being conducted, as described by de Visscher, was impressive, suggesting a high interest in developing food science and technology in the area.

Second, local students trained in industrial countries have, upon returning to their own country, been organizing food science and technology associations which are helping create this very much needed discipline. Examples are Asociación Latino Americana de Tecnología de Alimentos, founded in Brazil in 1982; Asociación Argentina de Tecnólogos Alimentarios, founded in 1968; Sociedad Chilena de Tecnología de Alimentos, founded in 1972; Asociación de Tecnólogos en Alimentos de México, founded in 1970; and Asociación de Tecnólogos de Alimentos de Guatemala, founded in 1987. Furthermore, these societies as well as other groups publish their scientific findings in a number of technical journals, including Alimentos (Chile), La Alimentación Latino Americana (Argentina), Industria Alimentaria (Brazil), Boletín do Instituto de Tecnologia de Alimentos, (ITAL, Brazil), Archivos Latinoamericanos de Nutrición, published by INCAP (Guatemala); Tecnología de Alimentos (Mexico); and Tecnología, published by Instituto de Investigaciones Técnológicas (Colombia). The information published is quite variable, ranging from descriptions of plant equipment to research articles, some of which are of a quality which would be acceptable in international scientific journals.

It is difficult to obtain statistics on the number of trained people in food science and technology in developing countries, and more difficult to indicate that the discipline is, in fact, advancing. An indicator, however, could be given by the number of articles now being published by food scientists from developing countries in internationally recognized, refereed scientific journals. Accepting that this analysis is not really representative, I screened three journals for papers in food science published by food scientists from developing countries; the results are shown in Table 6. Of the articles published from 1960 to 1986 in the Journal of the Science of Food and Agriculture, published in the United Kingdom, 8.4-20.1% were from developing countries, and the number of countries increased from 2 in 1960 to 12 in 1986. For the Journal of Food Science, published in the U.S., 5.3% of the papers were from two developing countries in 1961, while 11.2% were from 13 developing countries in 1985. The third journal surveyed is the Archivos Latinoamericanos de Nutrición, selected to show that 25-61% of the papers are

Food science and technology is increasing in the developing countries, and it is certainly expected that this trend will continue in the future. The important activity now and in the future is the transfer of the great many research findings into practical application.

<table>
<thead>
<tr>
<th>Item</th>
<th>Total</th>
<th>Percentage of total by size of industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishments</td>
<td>57,703</td>
<td>Artisanal</td>
</tr>
<tr>
<td>Employees</td>
<td>372,525</td>
<td></td>
</tr>
<tr>
<td>Salaried</td>
<td>12,756,115 pesos</td>
<td>1.3</td>
</tr>
<tr>
<td>Added value</td>
<td>34,654,144 pesos</td>
<td>2.2</td>
</tr>
<tr>
<td>Investment</td>
<td>30,470,861 pesos</td>
<td>2.6</td>
</tr>
<tr>
<td>Total production</td>
<td>109,814,760 pesos</td>
<td>1.6</td>
</tr>
<tr>
<td>Gross capital investment</td>
<td>3,933,000 pesos</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Efforts which were initiated some 50 years ago must be increased substantially if the developing countries are ever to have supermarkets with the quantity, quality, and variety of foods that exist in the industrialized countries.

Table 7—Structure of the Mexican Food Agroindustries in 1976. From DGE (1979)
Food Science and Technology (continued)

in the area of food science and technology, mainly from Latin America.

All these facts taken together suggest that food science and technology is increasing in the developing countries, and it is certainly expected that this trend will continue in the future. The important activity now and in the future is the transfer of the great many research findings into practical application.

### Table 8—Development of the Food Industry in Venezuela. From Morales Carroz (1987)

<table>
<thead>
<tr>
<th>Classification</th>
<th>1971</th>
<th>1984</th>
<th>1971</th>
<th>1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat processing</td>
<td>42</td>
<td>90</td>
<td>3,655</td>
<td>8,774</td>
</tr>
<tr>
<td>Milk products</td>
<td>95</td>
<td>108</td>
<td>4,579</td>
<td>8,291</td>
</tr>
<tr>
<td>Canned fruits</td>
<td>44</td>
<td>46</td>
<td>2,310</td>
<td>5,465</td>
</tr>
<tr>
<td>Fish products</td>
<td>16</td>
<td>14</td>
<td>3,170</td>
<td>3,228</td>
</tr>
<tr>
<td>Fats and oils</td>
<td>12</td>
<td>18</td>
<td>3,714</td>
<td>3,226</td>
</tr>
<tr>
<td>Grain milling</td>
<td>81</td>
<td>111</td>
<td>4,158</td>
<td>6,854</td>
</tr>
<tr>
<td>Bakeries</td>
<td>1,091</td>
<td>1,718</td>
<td>13,550</td>
<td>22,350</td>
</tr>
<tr>
<td>Sugar</td>
<td>44</td>
<td>28</td>
<td>4,804</td>
<td>5,619</td>
</tr>
<tr>
<td>Chocolate and candy</td>
<td>37</td>
<td>40</td>
<td>2,345</td>
<td>5,220</td>
</tr>
<tr>
<td>Diverse food products</td>
<td>131</td>
<td>160</td>
<td>3,247</td>
<td>4,096</td>
</tr>
<tr>
<td>Feeds and concentrates</td>
<td>17</td>
<td>44</td>
<td>1,333</td>
<td>3,175</td>
</tr>
<tr>
<td>Spirits</td>
<td>53</td>
<td>44</td>
<td>1,743</td>
<td>2,586</td>
</tr>
<tr>
<td>Wine</td>
<td>6</td>
<td>3</td>
<td>172</td>
<td>260</td>
</tr>
<tr>
<td>Beer</td>
<td>8</td>
<td>7</td>
<td>3,013</td>
<td>5,416</td>
</tr>
<tr>
<td>Nonalcoholic beverages</td>
<td>75</td>
<td>73</td>
<td>4,195</td>
<td>6,352</td>
</tr>
</tbody>
</table>

### Table 9—Development of the Food Industry in Peru. From Lajo Lazo (1986)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat processing</td>
<td>33</td>
<td>38</td>
<td>864</td>
<td>1,067</td>
</tr>
<tr>
<td>Milk products</td>
<td>52</td>
<td>78</td>
<td>3,868</td>
<td>3,102</td>
</tr>
<tr>
<td>Fruits and vegetables</td>
<td>36</td>
<td>66</td>
<td>1,642</td>
<td>2,497</td>
</tr>
<tr>
<td>Fats and oils</td>
<td>42</td>
<td>43</td>
<td>2,436</td>
<td>2,352</td>
</tr>
<tr>
<td>Grain milling</td>
<td>164</td>
<td>199</td>
<td>2,963</td>
<td>4,275</td>
</tr>
<tr>
<td>Bakeries</td>
<td>875</td>
<td>905</td>
<td>12,033</td>
<td>12,497</td>
</tr>
<tr>
<td>Sugar</td>
<td>37</td>
<td>43</td>
<td>6,480</td>
<td>5,628</td>
</tr>
<tr>
<td>Chocolate</td>
<td>53</td>
<td>84</td>
<td>2,848</td>
<td>3,017</td>
</tr>
<tr>
<td>Diverse foods</td>
<td>191</td>
<td>243</td>
<td>3,726</td>
<td>3,799</td>
</tr>
<tr>
<td>Feed and concentrates</td>
<td>28</td>
<td>38</td>
<td>1,333</td>
<td>1,786</td>
</tr>
<tr>
<td>Spirit beverages (distilled)</td>
<td>104</td>
<td>248</td>
<td>1,827</td>
<td>2,398</td>
</tr>
<tr>
<td>Wine</td>
<td>81</td>
<td>99</td>
<td>1,069</td>
<td>1,214</td>
</tr>
<tr>
<td>Beer</td>
<td>11</td>
<td>12</td>
<td>3,570</td>
<td>5,970</td>
</tr>
<tr>
<td>Nonalcoholic beverages</td>
<td>122</td>
<td>141</td>
<td>4,498</td>
<td>4,405</td>
</tr>
<tr>
<td>Alcoholic beverages</td>
<td>13</td>
<td>13</td>
<td>3,057</td>
<td>3,038</td>
</tr>
</tbody>
</table>

### Table 10—Possible Reasons for the Lack of Interest of the Food Industry in developing countries in using local food science and technology research findings

<table>
<thead>
<tr>
<th>Multinational industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>No credibility of national research results</td>
</tr>
<tr>
<td>Lack of competence in the market</td>
</tr>
<tr>
<td>Small markets and revenues</td>
</tr>
<tr>
<td>Products being marketed have been patterned by food industry in developed countries</td>
</tr>
<tr>
<td>No interest in developing or marketing foods to meet local food habits</td>
</tr>
<tr>
<td>Strong control by head office in developed country</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Small and medium-size industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Little or no communication between food science and technology centers with the food industry</td>
</tr>
<tr>
<td>Lack of understanding and common interests between research groups and industrial personnel</td>
</tr>
<tr>
<td>Lack of government stimulus to industry for the utilization of national technology</td>
</tr>
<tr>
<td>Difficulties in supporting research costs in food science and technology</td>
</tr>
<tr>
<td>Research results not related to industry problems</td>
</tr>
<tr>
<td>Small earnings</td>
</tr>
</tbody>
</table>
ously, these enterprises do not absorb food science and technology professionals nor utilize local research findings; but much could be learned from them, and much could be done to optimize their production.

In Latin America, the food industry represents a high percentage of all industrial activity. For example, in Central America in 1968, the food processing industry accounted for 30.6% of industrial establishments, 24.8% of the industrial labor force, 25.3% of the value added by industry to the region, and 35.9% of the value of the fixed capital investment for five countries (FAO, 1972).

The food industry in Latin America is evolving slowly. Some industries are progressing more than others, not only within a given country, but also between countries. Data for Venezuela are presented as an example in Table 8. The meat processing, milling, and baking industries have shown significant increases from 1971 to 1984 (Morales Carroz, 1987). Data for Peru are shown in Table 9, with trends very similar to those shown for Venezuela (Lajo Lazo, 1986). Data from various countries reveal that two industries increasing in size and number are grain milling and baking. One of the best examples is the development of the lime-cooking process applied to maize to produce tortillas. The native technology as practiced by Mayan and Aztec civilizations in the past, and even today (Figs. 4 and 5), has been developed into small industries (Figs. 6–8) and even highly sophisticated tortilla flour industries in some countries in Latin America, as well as in the U.S. The same can be indicated for arepa flour in Colombia and Venezuela (Rooney and Serna-Saldívar, 1987).

---Continued on page 130

Table 11—Problems Partially Responsible for the development of food science and technology in developing countries, and actions taken

<table>
<thead>
<tr>
<th>Constraint</th>
<th>Year</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein/energy malnutrition</td>
<td>1940</td>
<td>Food analysis, search for high-quality protein sources</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iodine fortification of salt</td>
</tr>
<tr>
<td>Food availability</td>
<td>1950–60</td>
<td>Increase in agricultural research</td>
</tr>
<tr>
<td></td>
<td>1960</td>
<td>Development of autochthonous processing technologies</td>
</tr>
<tr>
<td></td>
<td>1965</td>
<td>Food quality improvement</td>
</tr>
<tr>
<td></td>
<td>1970</td>
<td>Composite flours</td>
</tr>
<tr>
<td></td>
<td>1976</td>
<td>Reduction of postharvest losses</td>
</tr>
<tr>
<td>Population</td>
<td>1960</td>
<td>Increase in food availability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increase in food processing</td>
</tr>
<tr>
<td>Economics</td>
<td>1970</td>
<td>Agroindustries</td>
</tr>
<tr>
<td>Human resources</td>
<td>1960</td>
<td>Foreign training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Development of food science and technology</td>
</tr>
</tbody>
</table>

Fig. 4—Washing of Maize after lime cooking for traditional tortilla making

Fig. 5—Traditional Preparation of tortillas in Guatemala
Food Science and Technology (continued)

Because of many of the problems referred to above, the role of the food industry in the development of food science and technology is very small, although this may not be the case in all developing countries. It is possible that there are many reasons for this state of events, and that it will change in the future. However, the participation of the food industry would have helped it evolve more rapidly in the developing countries. Some possible reasons for the food industry's lack of interest in promoting national food science and technology research in the developing countries and in using research findings are listed in Table 10 for the multinational food industry and the medium and small food industries. Some of these were identified by the LIFE-IFT Nutrition-Food Technology Study.

The agricultural production capacity of the countries must be reinforced to be able to develop stronger food industries. In most countries, there is an inability of the agricultural sector to provide the raw materials in the quality and quantity required by the food industry, with the possible exception of conventional agroindustrial crops such as sugarcane. The same may be true for the edible oil industry. All these crops are in the hands of the agricultural sector with a high capacity (economic resources, knowledge) to invest in technology. On the other hand, cereal grains, fruits, and vegetables are in the hands of farmers with a low capacity to invest and to absorb and utilize technology; this is also the case for the small- and medium-sized industries.

But agricultural productivity by itself will not stimulate the development of the food industry in Third World countries. The distribution and marketing aspects must also be increased, both internally and for export—internally by increasing the purchasing capacity and socioeconomic condition of the population, and for export by manufacturing products with the high quality standards required by foreign markets.

Efforts Must Be Increased

Figure 9 illustrates the multidisciplinary approach that must be taken to deliver food and nutrition to consumers in the developing countries. With the many problems facing the developing world (Table 11), there is no doubt that food science and technology will have a greater and more responsible role to play in the future. One must bear in mind, however, that efforts which were initiated some 50 years ago must be increased substantially if the developing countries are ever to have supermarkets with the quantity, quality, and variety of foods that exist in the industrialized countries.
References
BOSTID. 1978. “Postharvest Food Losses in Developing Countries.” Board on Science and Technology for International Development ad hoc advisory panel, Natl. Acad. of Sciences, Washington, D.C.

Fig. 9—Multidisciplinary Approach for delivering food and nutrition to consumers in the developing countries

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Activity</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural sciences</td>
<td>Production</td>
<td>Productivity (quantity and quality)</td>
</tr>
<tr>
<td>Food science and technology</td>
<td>Storage, processing, and marketing</td>
<td>Increased food availability and consumption diversity</td>
</tr>
<tr>
<td>Nutrition and health</td>
<td>Improved biological utilization</td>
<td>Acceptable physical, mental, and socioeconomic development</td>
</tr>
<tr>
<td></td>
<td>Adequate environment and socioeconomic conditions for consumers</td>
<td></td>
</tr>
</tbody>
</table>

Adequate ecological conditions

Agricultural sciences ➔ Production ➔ Productivity (quantity and quality)

Food science and technology ➔ Storage, processing, and marketing ➔ Increased food availability and consumption diversity

Nutrition and health ➔ Improved biological utilization ➔ Acceptable physical, mental, and socioeconomic development

Adequate environment and socioeconomic conditions for consumers

SEPTEMBER 1989—FOOD TECHNOLOGY 131
Food Science and Technology (continued)

and Panama (INCAP), Guatemala, C.A.

Based on a paper presented during the plenary session, "The Progress of Food Science and Technology Over the Past 50 Years," at the 50th Anniversary Annual Meeting of the Institute of Food Technologists, Chicago, Ill., June 25-29, 1989.
—Edited by Neil H. Mermelstein, Senior Associate Editor

For information circle 169

8th WORLD CONGRESS OF FOOD SCIENCE AND TECHNOLOGY

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Telex: 0668723
FAX: (416) 678-1229

For information circle 204
This is the future: On-line testing for the presence of microorganisms by genetic probes. Biosensors built into packaging materials to give consumers a digital readout of the degree of freshness, the presence of pesticides, and the relative risk of the food compared to others. Stable colors and flavors developed within the plant or animal by genetic engineering, and putrid, fishy, or rancid flavors eliminated through an understanding of the molecular basis of such events. Computer models in the home to provide consumers with a diet customized to fit their genetic individuality, which will have been predetermined by simple diagnostic tests.

More foods will be nutritionally complete, and a vast array of similar foods with differing caloric contents will be available. Plants and animals will be grown or raised with customized profiles of fat, fiber, carbohydrate, protein, vitamins, and minerals and will never have been subjected to a pesticide or antibiotic, since resistance will be built in. Robotics and superconductive materials will be commonplace in manufacturing, to allow the speed and flexibility necessary to produce a variety of product extensions, for both foodservice and the home.

The food scientist will be the individual to provide regulation, inspection, and the ethical technology transfer of molecular biology, genetic engineering, microbiology, computers, robotics, nutrition, chemistry, processing, engineering, and the rest of the sciences needed to create this futuristic scenario.

However, to reach that point we are going to have to deal with a host of scientific, ethical, and educational problems that will provide some of the greatest challenges the profession of food science has ever met. This article will discuss the current status and future of some of these problems.

The discovery and utilization of scientific principles in food technology . . . have provided a supply of safe, wholesome, and nutritious foods unknown before in history.

Techology and Health

Life expectancy is increasing, the death rate from heart disease over the past two decades is down by 20% and from stroke by more than 30%; fewer people are dying of cancer, infant mortality is decreasing, and childhood infectious diseases have nearly disappeared—a scenario which we can all be thankful for. Unfortunately, there are some who are not reaping the benefits of this trend, but, overall, the situation is positive in the industrialized world. Most of the credit for these advances is often given to medical technology, but in truth, the greatest impact has been from food technology. The discovery and utilization of scientific principles in food technology, culminating in the preparation, packaging, and distribution of processed food, have provided a supply of safe, wholesome, and nutritious foods unknown before in history.

In spite of this, the public continues to treat food and nutrition issues like fashion rather than science. We are eager to seize upon each new idea, no matter how bizarre, and carry it to some illogical conclusion. There are many reasons for this behavior, including fear, boredom, scientific illiteracy, and uneasiness about technology. These produce perceptions on health issues which often bear little resemblance to reality, and if technology is utilized to cater to them, disturbing ethical questions arise. There must be firm agreement, now and in the future, that technology should not be used to produce and market food under a false umbrella of health maintenance or disease prevention simply because consumers can be misled into believing that benefits exist.

Examples of appropriate responses of technology to legitimate needs of consumers are numerous. Convenience foods, low-calorie products, fortified foods, elimination of antimetabolites, changes in basic composition, gene probes for microbiological detection, inventory computerization to aid in maintaining quality, development of new colors and flavors, and refinements in processing and process control—all of these have a role in the diet of some or all segments of our population.

Unfortunately, we have seen some inappropriate responses as well, such as the marketing of "natural foods" with the implication of superior health benefits and the "creative advertising" used to take advantage of the sugar and food additive controversies. Of course, professionals always knew the claims were untrue, but that didn't stop them.

These examples pale, however, in comparison with the challenge we will have in developing appropriate labeling and advertising claims for diet and health in the future. Technology has an incredible ability to produce and/or
alter foods to meet a particular health need. Unquestionably, within the next two decades, we will see foods being produced that do have therapeutic as well as nutritional value. The challenge will lie in defining the particular health effect and then deciding how much and what kind of evidence will be required prior to advertising and labeling foods as therapeutic. We owe it to the public and to science to resolve this issue in an ethical and professional manner.

Educating the Consumer

Humans have no natural right to the bounty of nature. We have to fight for it against all the other children of nature—the weevils, cockroaches, rats, mice, locusts, molds, blights, viruses, eelworms, and whatever . . . . It is war . . . . (Crone, 1986).

Consumers must understand this essential fact and that only technology can win the war. Unfortunately, consumers too often think of science and technology as creating unsafe, non-nutritious, or unpalatable products, with the level of such thinking increasing in direct proportion to the availability of food. This occurs even in the USSR. A recent response to technological changes in breadmaking, as reported in Izvestia, was "the quality of bread in terms of taste, standard of baking, and shape has deteriorated . . . we now get huge pancakes of half-raw, unpalatable bread of unpleasant appearance" (Anonymous, 1987a). Such comments are due not only to "glasnost" but also to the fact that the Soviets have been producing enough food to allow their consumers to become more selective.

Education is really the critical component in spawning scientific achievement, and it will only flourish with support from a scientifically literate population. The environment for technology is better today than it was a decade ago, but new, poorly understood applications of technology still create tremendous emotional responses. Low-level radiation treatment is a prime example of a safe, tested technology which is being held back because of such emotion. And the potential uses of biotechnology will create great consumer concerns, as evidenced by the uproar that has occurred over the patent granted to Harvard University for a genetically engineered mouse.

Unfortunately, people learn from our modern communications network that technologies, about which they may know little, pose hazards which they may only dimly understand, and they respond by rejecting such technologies.
Industrialized Countries: Present and Future (continued)

consumer believes the technology will alleviate disease or, better still, promise immortality. In this case, the consumer will utilize the technology or its products in an excessive and almost compulsive manner. Illustrative of that point are the cyclical nature of various exercise regimens and costly equipment which consumers are willing to purchase, and the quest for the perfect food or food supplement, which is sold at exaggerated prices.

Fortunately, we are beginning to see exciting and innovative educational approaches in nutrition, safety, and technology which the consumer can understand. Perhaps the best examples are in the area of food safety, where efforts at prioritizing food-related hazards in a consumer-oriented framework began with the classic papers of Richard L. Hall. More recently, Ames et al. (1987) attempted to quantify and thereby compare the possible hazards from various carcinogens ingested by humans. They developed a measure of potency called the TD50, which is the daily dose rate (mg/kg/day) required to halve the percentage of tumor-free animals by the end of a standard lifetime. The lower the dose that achieves the same number of tumors, the more potent is the carcinogen. They then used the TD50 to calculate an index of possible hazard by expressing each human exposure (daily lifetime dose in mg/kg/day) as a percentage of the TD50. They called this percentage the Human Exposure dose/Rodent Potency dose (HERP) index. A higher HERP value indicates a greater hazard. A few arbitrarily chosen examples are shown in Table 1.

A natural continuance of these efforts to communicate

The products of nature’s bounty are garbage unless they are
preserved in a form which is acceptable to the consumer.

the concept of risk in life will in the future undoubtedly
give rise to biosensors for use in food which will not only detect and quantify carcinogens but also provide a risk-assessment analysis so that consumers may judge the degree of risk for a particular food in relation to other foods. Obviously, the interpretation of such data will require a sophisticated consumer, and it will be up to individual food scientists and the Institute of Food Technologists to promote the teaching of the “Science of Food” (rather than the “Art of Cookery”) by accredited teachers in primary and secondary schools, as well as to ensure the expansion of IFT’s public information program.

If such educational efforts are to be successful, the food
industry and its marketing component must stop taking advantage of the consumer paranoia concerning manmade chemicals to sell their products, and scientists must stop frightening the public to ensure adequate financial support. Too often, the hype and cry set up by individuals causes the public to assess the experimenter and not the experimental results. This is dangerous, since

In our culture, the scientific method is the paragon of
all impartial knowledge. Exaggerated claims based on
inconclusive data and distorted theory, and designed to
advance a political or social agenda, could easily break that trust and destroy scientific credibility. With a public numbed by man-made “disasters” that are here today and gone tomorrow, scientists have a responsibility to be voices of reason, not of alarm. . . . (Singer, 1987).

Table 1—Comparison of Selected Human Exposure
× Rat Potency (HERP) Values for various
materials. From Ames et al. (1987)

<table>
<thead>
<tr>
<th>Compound</th>
<th>HERP value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tap water (liter)</td>
<td>0.001</td>
</tr>
<tr>
<td>Well water (liter) contaminated with TCE, Silicon Valley</td>
<td>0.004</td>
</tr>
<tr>
<td>Well water (liter) contaminated with TCE, Woburn</td>
<td>0.0004</td>
</tr>
<tr>
<td>Swimming pool, 1 hr</td>
<td>0.008</td>
</tr>
<tr>
<td>Home air</td>
<td>0.6</td>
</tr>
<tr>
<td>Mobile home air</td>
<td>2.1</td>
</tr>
<tr>
<td>PCB</td>
<td>0.0002</td>
</tr>
<tr>
<td>EDB</td>
<td>0.0004</td>
</tr>
<tr>
<td>Comfrey herb tea</td>
<td>0.03</td>
</tr>
<tr>
<td>Brown mustard</td>
<td>0.07</td>
</tr>
<tr>
<td>12 oz beer</td>
<td>2.8</td>
</tr>
<tr>
<td>250 mL wine</td>
<td>4.7</td>
</tr>
<tr>
<td>Phenobarbital (one)</td>
<td>16</td>
</tr>
<tr>
<td>Formaldehyde (worker)</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Great care must be taken, both now and in the future, to recognize that scientific conclusions can be drawn only from data and not from a popular vote—science is not consensus. Unfortunately, today’s scientific conclusions are often drawn from “consensus panels.” These conclusions are interesting, but they often prove to be inconclusive, since data obtained in a well-designed experiment are oblivious of democratic principles.

Educators should emphasize that the major goal of
technology is to better utilize nature. The products of
nature’s bounty are garbage unless they are preserved in a
form which is acceptable to the consumer. Nature does not
provide food which is commercially sterile and/or pack­
aged in a form to guarantee extended shelf life. However,
we can use natural products in technological processes if a
beneficial effect is achieved. This applies not only to foods but also to the resolution of food-associated problems, such

Educational efforts which show
the clear advantages of
technology along with the risks
involved will . . . create a
consumer who will make
informed decisions. . . .

as contaminants of water, food, and packaging materials. Work is progressing on finding “natural ways” (e.g., use of bacteria) to degrade and render harmless such contaminants as polychlorinated biphenyls (PCBs), chlorophenol, and creosote which can contaminate soil and water (Roberts, 1987). There is no reason that such work cannot be expanded to many other problem chemicals, both natural and manmade.

Funding Food Science

Educational efforts which show the clear advantages of
technology along with the risks involved will in the future
create a consumer who will make informed decisions not only on regulation but also on sponsorship of science. In the words of Senator Albert Gore Jr. (1987),

If we are to manage the fruits of this unprecedented explosion of knowledge in virtually every scientific field in our generation, we have to stimulate and create... a much deeper and more profound, more involved and sustained dialogue between science and the public about the meaning of science, the meaning of new discoveries and the implications of those new discoveries for the society in which they take place, and for the civilization which allocates resources for the continuation of such discoveries...

This allocation is essential, not only for the continuation of an industry which provides food but also for the existence of academic programs in food science. Unfortunately, support of these programs is declining at the federal, state, and industrial levels. Such a trend, if it continues, will cause a further decline in the technological pre-eminence of the United States. Many consumers now feel that imported goods are superior to those made in the U.S.

Is this scenario going to occur in food research, or has it already? The Japanese are ahead in fermentation technology, and industrial and government support of their food-related research is expanding. Certainly, the support that food science receives in much of Europe and Great Britain far surpasses the minuscule support in the U.S. Who will be training future leaders in this field? How will universities attract the brightest young minds to research in food if it is clear that research funding is almost nonexistent? Will university food science departments become repositories for those who "can't make it" elsewhere? If this turn of events comes to pass, the U.S. will be giving away still another technological area, and it will be of little comfort to know that our major contribution to the food delivery system of the world may be to train waiters!

I don't think that any one person, whether an executive vice-president of research or an assistant deputy director of a government agency, has the answer. However, I do believe that the answer lies in dedication and cooperation. First, we must have unanimous agreement by government and industry that food science research and training are not only worthwhile but also critical to the continued well-being of the country. . . .

We must have unanimous agreement by government and industry that food science research and training are not only worthwhile but also critical to the continued well-being of the country. . . .

Ensuring Food Safety

Frank E. Young, Commissioner of Food and Drugs, was quoted (Anonymous, 1987b) as saying that the resources of the Food and Drug Administration are limited and the problems we face in protecting the consumer are many and varied. As a physician, my outlook on public policy issues such as Proposition 65 is guided by the oath I took many years ago, "Above all, do no harm." What is just as important to me, as an administrator who makes decisions based on sound science, is to be able to make distinctions between actions that cause harm and those that don't... and concentrate our remedial efforts on the former. I act with the knowledge that, although we have some control over the health risks we face, safety can never be absolute or guaranteed.

This philosophy, which stresses the concept of relative risk discussed previously, is particularly important in light of consumer concerns about food safety. Consumers are reported to rank food safety as their Number 1 concern, according to a survey by the Food Marketing Institute (UFFVA, 1987). However, their concerns are often centered on relatively low-risk categories such as intentional additives (food colors, flavors, preservatives, and functional aids) and unintentional additives (pesticide residues) rather than on the higher risks posed by microbial contamination.

The industrialized world is producing more than enough food to prevent widespread hunger within its borders and has come to terms with many of the problems involving foodborne illness. Its successes in both of these areas have been quite spectacular. Unfortunately, we cannot rest on our laurels. Future concerns resulting from new technologies should cause us to walk with care in a minefield of potential microbiological hazards.

Salmonella, Staphylococcus, Clostridium, and Shigella have represented the major microbiological concerns of the industrialized countries. However, we are now identifying other foodborne pathogens, such as Campylobacter, Listeria, Yersinia, at least four types of Escherichia coli pathogenic to man, and strains of the others which have unexpected resistance to classical control techniques.

Both Listeria and Yersinia are intracellular pathogens in cows and as such may have increased heat resistance. Antibiotic-resistant strains of Salmonella are showing up, and a strain of E. coli which was once considered to be relatively benign has been isolated from patients with hemolytic uremic syndrome, which can lead to renal failure and death.

Is it any wonder that E.M. Foster warns, "forget all the dogmatic truisms" (Anonymous, 1987c)?

Obviously, our work is cut out for us now and in the future. However, the increasing use of molecular biology
by the food technologist will provide a vast array of new tools to help ensure the safety of our food supply. The use of gene probes for the detection of bacteria, viruses, and toxins will be routine in the future, and the use of "gene machines" to synthesize the probes will become an undergraduate laboratory exercise in 20 years.

Since future problems in food may be virally based, it is essential that methods for rapid detection and control of viruses be in place. Without such protection, the bacterial plagues of the past could become the viral plagues of the future.

It also should not be forgotten that foodborne illness is a serious economic issue as well as a serious health issue. Todd (1987) has estimated the possible worldwide economic impact of foodborne illness at $20 billion/year, a sum which demands attention.

Nature, with its fickle mutations, is not the only culprit we must watch for in an ever-changing microbial world. New technologies in the future will have to be instituted with great care. For instance, does the demand for ever-lower levels of salt for the entire population produce health benefits that justify increased microbiological risks? One might successfully argue that in a product where salt is not involved in preservation, the potential benefits may be greater than the risks, which are zero in that case. However, in many products, salt is either a major factor or a cofactor in preservation.

The consumer demand for ever-longer shelf life will continue in the future and may require the utilization of "safe" microorganisms to provide competitive exclusion of pathogens. It will also require increased knowledge of packaging materials used with extended-shelf-life products.

As we enter into an era of global economics, more and more quality standardization of imported foods will be necessary, as well as constant vigilance with novel foods and foods new to the Western world. Again, biotechnology

Technology has contributed not only to the quality, safety, convenience, and reduced cost of food but also to the nutritional status of the industrialized world.

The Need for Technology

It is interesting to note the consumer resistance to a synthesized food preservative such as citric acid but the absolute acceptance of lemon juice to lower the pH of tomato sauce prior to home canning.

The American Indian added cranberries when making pemmican, undoubtedly for color but also, I'm sure, because they observed over the years that the final product was better preserved. This, of course, was due to cranberries' high content of benzoic acid. Such interpretive observations, along with intermittent creativity, has led scientists to the development of most food preservatives. When scientists noted that a particular food had a preservative effect, they separated and identified the active component, then added it as a single entity to other foods to confer the same beneficial attributes as were apparent in the original food. Thus, a food preservative was born.

Obviously, nature has many secrets of this kind, and it is the job of the food scientist to observe, test, and develop the compounds responsible.

We have seen the development of not only antimicrobials but also antioxidants, colors, and flavors—both those of natural origin and those synthesized exactly as they appear in nature. Undoubtedly, we will see more of these compounds isolated and identified, as well as an entirely new group of "natural" compounds produced by modifying the genetic code of a plant or animal. Such modification may increase production of a specific compound or subtly alter it while still producing it naturally. Genetic engineering will produce nutrients, colors, flavors, sweeteners, and preservatives, as well as increase yields of plants and animals by building in factors such as herbicide resistance.

The future of the food supply will rely on technology, judiciously used and judiciously regulated. However, we must heed the words of Milton Russell, former Assistant Administrator for Policy Planning and Evaluation at the Environmental Protection Agency (Abelson, 1987):

Real people are suffering and dying because they don't know when to worry, and when to calm down. They don't know when to demand action to reduce risk and when to relax because health risks are trivial or simply not there. I see a nation on worry overload. One reaction is free floating anxiety. Another is defensive indifference. If everything causes cancer, why stop smoking, wear seat belts or do something about radon in the home? Anxiety and stress are public health hazards in themselves. When the worry is focused on phantom or insignificant risks it diverts personal attention from risks that can be reduced.

Technology's Response to Health Concerns

Technology has contributed not only to the quality, safety, convenience, and reduced cost of food but also to the nutritional status of the industrialized world. We have developed techniques to reduce or eliminate natural anti- metabolites and antinutrients. Restoration, enrichment, and fortification have contributed to the demise of many nutritional deficiency diseases. And changes in the basic chemical nature of food ingredients have allowed the formulation of low- or modified-fat foods for the population that requires them. However, many challenges lie ahead.

As we genetically modify plants and animals to attain specific ratios of macronutrients and fiber and specific amounts of micronutrients, we will be faced with both scientific and ethical questions. The scientific questions may be the easier to answer, since they will be directed by
Research data. The ethical questions, on the other hand, will involve decisions on the creation and/or elimination of a species. We have been doing just that for years with selective breeding, but the power and potential spontaneity of genetic engineering have raised issues which may be somewhat different from those created by selective breeding practices. However, the risk is extremely low compared to the potential benefits.

As a society, we may have to conclude that we cannot recommend one diet for all people of all ages. Flexibility will be the key to providing many foods with differing proportions of fats, proteins, and carbohydrates, along with appropriate fortification of vitamins and minerals, in a biologically available package. "Customized mass production" must be our aim in the 21st century. We have reached the point where it has become feasible to foresee widespread genetic testing to establish those at risk for cancer, heart disease, and other disorders, who would benefit from a particular diet high or low in specific nutrients. Such testing is where tuberculosis testing was 50 years ago, but the rate of development of technology has increased so much that I doubt we will have to wait 50 years before we have tests for disease susceptibility as commonplace and simple as tuberculosis testing is today.

The Joint Nutrition Monitoring Evaluation Committee Report (1986) has outlined several food components of varying health priority, as shown in Table 2. Although these components are not universally agreed upon, the following will surely continue to have a high priority (HHS, 1988; NAS/NRC, 1989):

- Low-Calorie Foods. The obsession with the caloric content of food is recent and geographically limited to certain segments of the industrialized world. Since this obsession is driven both by a concern for appearance and by science, the population segments and the number of countries in which it exists probably grow.

Couple this with a greater concern over both the nutritional and pharmaceutical effects of nutrients, and we have the greatest challenge which food technology will face in the next several decades—the production of high-quality, low-calorie, fortified foods. The challenge will be not only in developing such foods but also in agreeing on the level of nutrients required. The difficulty of the latter challenge has been foreshadowed by the incredible set of events touched off by the Food and Nutrition Board's Recommendation for the 1986 Recommended Dietary Allowances (RDAs), which were not accepted by the National Academy of Sciences. Any food that is created with a lowered caloric count will have to provide increased or equal intensity of pleasure, increased or equal satiation, and increased sensory stimulation in one area to compensate for a decreased stimulation in another area. Some of the technology to achieve these principles is in place, while further research is necessary in other cases.

The development of low-calorie or non-nutritive sweeteners has a good technological basis but still has some functional, philosophical, and regulatory barriers to overcome. With these products, some consideration will have to be given to the appropriateness of their widespread use by groups such as children, pregnant women, and adolescents, as well as their effects on dietary choices and behavior for the population in general.

In cases where the sweetener has a peptide structure, it could be genetically introduced into a plant. This would be the ultimate in a presweetened product. There is a need for more low-calorie fat substitutes which will be formulated from fat, carbohydrate, and proteins. The use of computers in molecular modeling to engineer these molecules will be an important step in the future. Techniques to complement these developments should include the use of high-intensity flavors and odors, along with encapsulation procedures or chemical modification of solubility to allow controlled rates of release while chewing. Of course, the processing procedures selected would be of great importance in creating and maintaining the greatest sensory impact. All of this could be copped with colors developed to intensify the particular flavor desired. We will have to remember that we will be dealing with unconventional processes while trying to develop sensorially conventional foods. The lessons we are currently learning from microwave processing should provide us with a good technological basis.
Industrialized Countries: Present and Future (continued)

with a valuable map to follow in future technologies. After all, who can withstand the criticism leveled in Newsweek (Anonymous, 1987d) that decried some of the advertising for microwavable “homemade” dishes as an “Orwellian description for a dish that has been fully prepared in the factory . . . plainly centered on people who grew up on fast food and see its microwaveable counterpart as a form of upscale domesticity.”

Finally, appetite suppressants could be added, along with repartitioning agents to change protein:fat ratios in the human body to provide a truly futuristic diet food.

- Customized Fatty Acids. Consumption of lipids, i.e., fats, oils, cholesterol, etc., has become an issue not only of avoidance but also of selectivity. We now have an array of products, such as margarine, imitation cheeses, and other substitutes, with a particular polyunsaturated:saturated:monounsaturated ratio, to replace conventional products and meet the moment’s demand for selectivity.

Once the science is complete and the fatty acid profiles are known, we will be able to employ continuous culture selection to isolate lipases, desturases, and other enzymes to convert inexpensive and perhaps undesirable fats and oils from animal and plant sources into customized fatty acids in whatever proportions are required. It is also possible that genetic modification of plants will produce large amounts of omega-3 fatty acids or increased amounts of omega-6 monounsaturated fatty acids. Undoubtedly, new advances in artificial intelligence will assist us in such genetic changes, so that exactly the right metabolic sequences are selected. Techniques such as supercritical extraction will be necessary to remove oils in a stable form, and antioxidants and packaging will become even more important if the chemical integrity of the fatty acids is to be maintained.

- New Carbohydrates. Increased carbohydrate consumption seems to be at the top of the list of most health recommendations. However, both digestible and undigestible carbohydrates provide incentives for development by the food industry beyond health concerns, because their functional properties allow innovation in food formulation and processing. Products such as polydextrose and modified starches are indicative of that potential. In the coming years, genetic engineering could be used to modify the carbohydrate profile of plants, but a simpler approach is to use available fibers to more advantage. For instance, technological extensions of techniques such as freeze concentration, reverse osmosis, and ceramic filtration could be utilized to provide fiber concentrates as well as other ingredients from fruits and vegetables which would otherwise be underutilized.

Chemical changes in starches and/or fibers could be induced to alter their relative rate of digestion, which would ultimately affect their absorption or nonabsorption. It may prove important, as our knowledge of the relationship between carbohydrates and disease progresses, to modify starches so that they are digested at different locations in the intestine.

Finally, if fibers are to be used as major food ingredients, they must be made more palatable. Encapsulation, cocrystallization with sugars, or use of more intensive flavors might provide a means of accomplishing this.

- Mineral Fortification. Of the four nutrients identified by the Joint Nutrition Monitoring Evaluation Committee Report (1986) as having low dietary consumption and warranting “priority status” (Table 2), three are minerals—calcium, iron, and the trace element fluorine. As a result of such recognition, combined with some educational promotion and creative advertising, we are seeing the development of what might be termed a calcium frenzy among consumers. In response, the food industry is beginning to fortify more food with more minerals. This trend disturbs some scientists, although the record for fortification is very good. Arguments can be made that fortification was not solely responsible for the decline of deficiency diseases but was, at least, coincidental with their decline. Recent studies among high-risk children who have participated in the government’s Women-Infants-Children (WIC) feeding program showed a decline in the prevalence of anemia from 7.8% in 1975 to 2.9% in 1985 (Yip et al., 1987). This is probably due to several factors, but fortification has obviously played some role.

Although there is potential for ingesting an overdose of minerals or vitamins in fortified food, the danger is clearly not of the magnitude which exists for pills. In fortification, the dose is self-limiting, since food must be eaten with the nutrient and a point of discomfort would be reached. Obviously, if every food and beverage were fortified, this restriction would be less effective, but we should not aim for universal fortification, anyway.

In the future, however, we are going to be faced with more, not less fortification if present public health concerns, as noted in the Surgeon General’s report (HHS, 1988), are to be met. Recommendations for diets lower in calories, higher in fiber, lower in animal products, and higher in fruits, vegetables, and grains will create a situation where traditional foods, in these diets, may not contain enough minerals and those that they do contain may not be absorbed effectively because of the presence of natural inhibitors.

This will place greater responsibility on the food technologist to ensure that the nutrients added will be of known bioavailability maintained throughout processing and storage. The day has long passed when a mineral or mineral salt alone can be added to the food solely on the basis of isolated bioavailability studies or effects on quality. In the future, we will require the development of “nutrient delivery packages.” Thus, a mineral might be added in a ligand-stabilized complex so that it is unreactive within the food environment, does not chemically interfere with the absorption of other minerals, and maintains its bioavailability throughout storage.

To develop such nutrient delivery packages, we will have to develop a greater understanding of nutrient interactions within the food, not just at absorption sites or within the body. This will make it imperative that we isolate and identify the factors in food which enhance mineral absorption.

Such isolation of the “meat factor” for iron and zinc, the “milk factor” for calcium and iron, or the “yeast factor” for chromium, for example, will provide a basis for either designing nutrient delivery packages or genetically engineering such components into other foods. Imagine building into the genetic structure of plants the ability to produce the peptides in meat responsible for enhancing iron bioavailability. We would be able to conquer worldwide anemia with grains containing such a factor.

The food scientist must develop and utilize new techniques. . . . to create the flexibility and innovation required in the 21st century.
Industrialized Countries: Present and Future (continued)

- Food for the Elderly. I would be remiss if I didn’t mention the role of technology in meeting the nutritional, social, and psychophysical needs of the elderly. With the demographics of our population, the elderly “are us” and we must develop a better understanding of their unique requirements and how to meet them.

It is disturbing to realize that we have not studied RDAs for those over 50 years of age, nor do we deal effectively with the social and economic problems which surround their eating behavior.

The anorexia of aging is multifactorial, being due to both physiological and pathological causes (IFT, 1986; Morley, 1987). Obviously, food technology can’t address all the causes, but certainly we can do something with high-intensity flavors, odors, and colors to stimulate the hedonic appreciation of food which is being lost because of atrophy of gustatory papillae and olfaction receptors. Research on texture might lead to a design which provides the sensation of crispiness but ease of chewing to compensate for problems in dentition.

We will have to examine successful aging, rather than just average aging (Rowe and Kahn, 1987), and then reproduce the successful aging patterns. This might mean changing caloric and nutrient density as well as sensory considerations, possibly adding behavior modifiers, and providing appropriate easy-open packages and easy-to-read labels while keeping the price affordable.

Real Challenges Ahead

Food technology has been an integral part of society for eons but has received relatively little credit for its contributions. One can follow its development through the industrial revolution, through the dark times of war and famine when it was forced into incredible creativity, and more recently through the technological revolution we are now witnessing.

Its achievements have been awesome, as evidenced by the variety and amount of food available in the industrialized world as well as by the health of its people. However, the real challenges are in the future, where the food scientist must develop and utilize new techniques, ranging from molecular biology to sophisticated communications systems, to create the flexibility and innovation required in the 21st century.

References


Based on a paper presented during the plenary session, “The Progress of Food Science and Technology Over the Past 50 Years,” at the 50th Anniversary Annual Meeting of the Institute of Food Technologists, Chicago, Ill., June 25–29, 1989.

Paper No. 2920, Massachusetts Agricultural Experiment Station, University of Massachusetts at Amherst.

—Edited by Neil H. Mermelstein, Senior Associate Editor
Present and Future of Food Science and Technology in Developing Countries

Agide Gorgatti-Netto

It is almost impossible to make an analysis of the agroindustrial sector in developing countries without looking into the economics of those countries. Although Latin America is the focused region of this article, most of the concepts discussed are applicable to all developing countries.

Food and People

No study of the economics of food production, processing, marketing, and consumption could be accomplished without studying the relationship between food and people. The purchasing power of a country's population is the determining factor of the kind of food products demanded and consumed within the limits of production potentials.

What happens in Latin America, and may also be very true in most of the developing countries, is that income distribution is very poor, with the richest 20% of the people having 50-60% of the total income. So, the vast majority of those countries are ruled by principles and policies that take into consideration the needs and priorities of only part of the population, with the great majority being apart from the fruits of development. In its 1980 report, the Independent Commission on International Development Issues (the Brandt Commission) described the gap between rich and poor nations, saying it is so wide that at the extremes people seem to live in different worlds. The report mentioned the extreme differences that exist between the "rich North and the poor South"; but within the developing countries, the gap between rich and poor people is even greater and seems to be widening every year.

More than 25 years ago, it was said that "One hundred different travelers to Latin America would write one hundred different reports," referring to the many faces of Latin America, its swift changes, its bearing the modern and the ancient at the same time, and the different geographic, economic, social, racial, and political structures of the 20 countries of the region.

The contrast in lifestyles is quite evident when we analyze their diets, with the large majority of the population spending an average of 60-70% of their income in buying basic foods and the privileged being able to buy, in up-to-date supermarkets and food stores, the most sophisticated food products produced locally or imported from abroad.

Within this framework, we may say that as a general rule in almost all of those countries, we have the modern with the bizarre; well-nourished people living side-by-side with the hungry; and states with both high technological and living standards struggling to find the ways and solutions to diminish those insupportable conditions. Science and technology are some of the tools that government and entrepreneurs are trying to use to minimize those incongruous circumstances.

In Latin American countries today, we can find groups of food scientists carrying out projects at the most advanced frontier of modern technology. Biotechnology in many countries has been given a top priority, not only to improve existing raw materials but also to develop better and new plants or animals through genetic engineering.

Inter-regional programs in biotechnology are also being started, fostered by the initiative of government-sponsored research organizations associated with private groups in the participating countries. Laboratories are also doing research to produce recombinant insulin locally and studying the synthesis of many organic and inorganic components such as amino acids, vitamins, and various hormones.

Robotization and the use of computers in industry and some universities are commonplace. Also, part of the local manufactured computer production is exported—proof of the very high quality standards and level of competitiveness. Computer science is a compulsory discipline in most universities in Brazil.

Improvements are being made in manufacturing techniques and labeling for engineered food specially developed for dietetic requirements, providing the consumer with...
alternatives with desired nutritional composition, taste, and dependability.

Worries about cholesterol are also evident, and through embryo transplant and genetic engineering, various cross-breeds are being developed to provide a lowfat beef, thus contributing to an improved diet for those belonging to the high-risk groups. The food industry segment of the economy, at least in a few countries, is modern, efficient, and market oriented.

However, while industrialized countries have grown by an average of 3.0-3.5%/year in gross national product in the past decade, the average economic growth in Latin American countries was zero. So, in general, the 1980s are being called the lost decade for Latin America.

Although food scarcity is one of the most acute problems, it is not the major component of malnutrition. Malnutrition in developing countries is a phenomenon resulting from a series of geographic, cultural, historical, biological, economic, social, and political factors that mingle together, as shown in Figure 1.

Industrialized countries have received an immense contribution to their physiological, economic, and social well-being through food science and technology, which contributed definitively to improve standards of living of those wealthy countries.

The difficulty is to find the ways (not only financial resources) and political willingness to implement programs in a long-term perspective in which food science and technology will be a substantial part of the adopted strategy.

—Continued on next page
Developing Countries: Present and Future (continued)

This is not the case for the majority of the population living in the poor areas of Latin America, Africa, Asia, and the Middle East. In these countries, the underprivileged struggle to find food sufficient for survival, and malnutrition is a condition close to starvation, impairing the work output of the laborers, lowering resistance to infections, and increasing the amount of disease. This circle can only be broken through an increase in personal income, thus providing the means for an adequate diet.

Food problems do exist in today's world, and both past and present technologies have failed and are still failing to reduce human misery—not because they are inadequate technologies but because the technological factor is only part of the solution. Maybe we should ask ourselves the following question: "Is the actual situation a stalemate?"

Food Production and Technology

Thomas Malthus, in his 1798 "Essay on the Principle of Population as it Affects the Future Improvement of Society," said that population was, in the long run, determined by the amount of food available.

Today's world population is increasing at a rate of 220,000 people per day—an average of 150 births per minute—bringing continuous pressure to the potable water supply, air quality, and all other natural resources, which are fiercely defended by all sorts of environmental organizations because these resources are becoming scarce and by definition are finite.

The "State of the World Population Report—1988," a publication of the United Nations, says that today's 5 billion people will be 6 billion in the year 2000. According to Najla Sadik, Executive Director of the World Population Fund of the United Nations, in various regions of the world the underground water supply systems are being drawn out at a speed faster than they are being replenished.

Malthus, of course, had not foreseen a very rapid increase in technology perspectives, but his statement that population would press on food supply is still valid.

The question today is, "How fast can food production expand, or how long can it keep up with a population growth rate of 2% per year or even more?"

It is highly costly to produce food, and demand for food is increasing constantly. In 1982, the average annual world output of major food crops reached an estimated 1,830 million metric tons (Table 1). The developed economies, with 26% of the world's population, produced 51% of the basic food staples in that year. Thus, the world's distribution of population and food production was such that the developing countries, which had more than 3 billion people or about three-fourths of the world's population, accounted for less than half of the world's output of these commodities. The Third World per capita food production of 260 kg in 1982 was only one-third of that in the industrialized countries.

Food production in the developing countries expanded
by 3.1%/year during 1961-80, significantly faster than the population, which grew by 2.4%/year (Table 2). This rate of increase in Third World output was, however, largely influenced by the rapid production growth in China, which accounts for about 30% of the population and 35% of the food production of the developing countries. With China excluded, production grew just slightly faster than the 2.5% annual increase in population in Third World countries. Increases in the output of major food crops outpaced population growth in Asia and Latin America but lagged behind population growth in North Africa/the Middle East and especially in Sub-Saharan Africa. For the Third World as a whole, more than three-fourths of the population lived in countries where food production growth rates exceeded the population increase during 1961-80. Increases in food production outpaced population growth in large countries such as Brazil, China, India, and Indonesia. When China is excluded, the ratio is reduced to slightly less than 70%.

Recent United Nations projected population data for the developing countries show that the number of people in the Third World may increase from 3.3 billion in 1980 to 4.8 billion by the end of the century. Projected population growth rates are shown in Table 3. The assessment of the population estimates and projections that was made in 1978 indicated that, under the medium-variant assumption, Third World population would probably increase at an annual rate of 2.1% until the year 2000.

Among the developing regions, population growth is projected to decelerate in Asia and Latin America, remain unchanged in North Africa/Middle East, and accelerate in Sub-Saharan Africa, compared to growth rates during the past two decades. The slowest population growth is projected for Asia, with an annual rate of 1.5%. This would bring its population to 3.2 million in the year 2000, about two-thirds of the projected total for the developing countries. When China is excluded, the ratio is reduced to slightly less than 70%.

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Population-growth projections show a faster rate of

### Table 1—World Population and food production, 1982. From Paulino (1986)

| Country group | Population (million) | Major food crop production (
| | | million metric tons) | Per capita (kg) |
|----------------|----------------------|---------------------|
| World          | 4,605               | 1,830               | 400          |
| Industrialized | 1,185               | 925                 | 780          |
| Developing economies | 3,420 | 905                 | 260          |

### Table 2—Population and Major Food Crop Production by region and subregion, 1980, and average annual growth rates, 1961-80. From Paulino (1986)

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<tr>
<td></td>
<td>No. (million)</td>
<td>%</td>
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<tr>
<td>Developing countries (excluding China)</td>
<td>3,273</td>
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<td>Asia (excluding China)</td>
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Developing Countries: Present and Future (continued)

expansion (1.8%) for the other countries in the region when China is excluded. About three-fourths of the 40 million average annual increase in Asia’s population until 2000 would come from these countries. Even with the exclusion of data on China, projected population growth in the rest of Asia shows a decrease of 2.5% from the 1961–80 rate.

The projected population increase in Latin America, as in Asia, reflects a significant deceleration compared to population growth in the region in the trend period. Latin America’s projected 1980–2000 growth rate of 2.1%/year would mean an average of more than 9 million additional people every year over the two decades; the region’s projected population by the end of the century is about 540 million (Paulino, 1986).

Table 4 shows some social and economic indicators occurring in developing economies in Latin America. It is worthwhile to mention at this point that Latin American countries are among the most indebted countries in the world; the foreign debt, a sword over their heads, amounts to something around $400 billion, without a solution in the short run.

As Hungate and Sherman (1979) said in their food and economics studies, surely in countries with an annual per capita income of less than $100 (U.S.) the style of eating cannot be considered dignified. However, even in the so-called middle-income-lower-middle economies—the segment embodying all Latin American countries—with an annual per capita income ranging from $300 (U.S.) to $3,000, it is not easy for the vast majority of the population to have access to sufficient food to satisfy body requirements.

Comparing the indicator data in Table 4 with values prevailing in the industrialized countries, we find that the average annual population growth in industrialized countries ranges from 0 to 1%, infant mortality from 7 to 10/100,000 live births, maternal mortality from 5 to 15/100,000 live births, and per capita GNP from $5,000 to $17,500 (U.S.). So differences between those two groups of nations are enormous.

It is fully agreed that countries that are technologically independent and mature also are conscious of their sovereignty. The popular jargon “technology is power” is largely used, and in recent years has proved its validity, as in the case of the emergent rich economies, particularly those in Southeast Asia.

In the mid-1960s, there was a rush in Latin American countries, as well in other parts of the world, to organize research institutions. Since food was always a first priority, emphasis was given to this area. As a result, food science and technology research organizations flourished.

Considerable financial help was given by international agencies such as the Food and Agricultural Organization, Agency for International Development, International Bank for Reconstruction and Development, and InterAmerican Development Bank, contributing not only funds but also consultants with broad and recognized experience as well as scientific background. It was common understanding that simple transfer of food technologies from rich nations to recipient nations could prove to be very limited.

Hundreds of millions of dollars was spent on equipment, laboratories, and all types of facilities, to train technical personnel to work efficiently in both local food industry and government. Food science and quality control types of agencies were considered imperative for further development of Latin American food industries, and the introduction of new techniques absolutely necessary to improve food processing and thus manufacture more nutritious and safe food products.

Multinational companies joined in installing new factories or expanded existing ones, providing substantial knowhow and helping upgrade the quality level of many food products.

Universities were called to be part of this initiative. Soon many courses at both graduate and postgraduate levels were implemented, and human resources for the educational system and for the food industry in general were provided.

Having recognized the importance of the role of science

A nutritionally adequate diet for all mankind can only be achieved if politicians and policy-makers, helped by the community of scientists, decide to develop together actions to take care of the entire population of the nations.

Table 3—Projected Growth Rates of population, production, and domestic use of major food crops by region, 1980-2000. From Paulino (1986)

<table>
<thead>
<tr>
<th>Country group</th>
<th>Projected annual growth rate (%/yr)</th>
<th>Domestic use</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Population</td>
<td>Production</td>
</tr>
<tr>
<td>Developing countries</td>
<td>1.9</td>
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</tr>
<tr>
<td>(excluding China)</td>
<td>(2.2)</td>
<td>(2.9)</td>
</tr>
<tr>
<td>Asia</td>
<td>1.5</td>
<td>2.9</td>
</tr>
<tr>
<td>(excluding China)</td>
<td>(1.8)</td>
<td>(3.0)</td>
</tr>
<tr>
<td>North Africa/Middle East</td>
<td>2.7</td>
<td>2.9</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>3.3</td>
<td>3.1</td>
</tr>
<tr>
<td>Latin America</td>
<td>2.1</td>
<td>3.0</td>
</tr>
</tbody>
</table>
and technology in the development of nations and that transfer of technology is the most economical way of achieving their national goals, many developing countries have established their research institutes in the hope that such attempts would automatically bring about effective technology transfer in a short time, but the results have often been disappointing. Not the least of these difficulties is the discovery that there is no automatic harvest of benefits just because a growing research and development organization becomes established. Sadly but frequently it was discovered that "fertilizing" an R&D group with top people does not ensure a bumper crop of technical productivity. Like all groups of people working together, R&D organizations must be effectively managed.

Managing such creative professional groups requires, first of all, an understanding of the organization dynamics that underlie the technical effectiveness of the group. Effective management was not continuously provided to many of the food research institutions. Because of this, combined with the decreasing financial support that started occurring as a consequence of the oil crises in 1973 and 1979, after a 10- to 15-year period the problem of aging of such organizations became quite visible in many Latin American countries.

In developing countries, particularly in Latin America, R&D organizations in the field of food science started with a bright future ahead. After a relatively short period, many constraints were imposed on these organizations. They were unable to enlarge their R&D teams, thus reducing their chances for greater marketing activities. They soon became unattractive to well-qualified professional outsiders, being unable to improve recruiting ability and selectivity of staff. Losing their attractiveness, they minimized their chances to hire top graduates and people from competing organizations.

The aging circle was completed when very promising R&D organizations, which began with the spirit of innovation and creativity to transform scientific knowledge into technologies but were unable to break these impeding

| Table 4—Some Social and Economic Indicators in Latin American countries. Adapted from BIRD (1988) |
|-----------|-----------------|-----------------|-----------------|-----------------|
|           | Average annual population growth, 1980–86 (%) | Infant mortality/100,000 live births | Maternal mortality/100,000 live births, 1980 | Per capita GNP ($U.S.), 1986 |
| South America | | | | | | | |
| Argentina | 1.6 | 58 | 33 | 85 | 2,350 |
| Bolivia | 2.7 | 160 | 113 | 480 | 600 |
| Brazil | 2.2 | 104 | 65 | 154 | 1,810 |
| Chile | 1.7 | 107 | 20 | 55 | 1,320 |
| Colombia | 1.9 | 96 | 47 | 126 | 1,230 |
| Ecuador | 2.9 | 112 | 64 | 220 | 1,162 |
| Paraguay | 3.2 | 73 | 43 | 469 | 1,000 |
| Peru | 2.3 | 130 | 90 | 314 | 1,090 |
| Uruguay | 0.4 | 48 | 28 | 56 | 1,900 |
| Venezuela | 2.9 | 65 | 37 | 65 | 2,920 |
| Average | 2.18 | 95.3 | 54.0 | 159.2 | — |
| Central America | | | | | | | |
| Costa Rica | 2.4 | 72 | 18 | 26 | 1,480 |
| El Salvador | 2.2 | 120 | 61 | 74 | 820 |
| Guatemala | 2.9 | 112 | 61 | 105 | 930 |
| Honduras | 3.6 | 128 | 72 | 82 | 740 |
| Nicaragua | 3.4 | 121 | 65 | 65 | 790 |
| Panama | 2.2 | 56 | 24 | 90 | 2,330 |
| Average | 2.78 | 101.5 | 50.1 | 73.7 | — |
| North America | | | | | | | |
| Mexico | 2.2 | 82 | 48 | 92 | 1,860 |
| Caribbean | | | | | | | |
| Cuba | 0.9 | 38 | 14 | 31 | — |
| Dominican Republic | 2.4 | 110 | 67 | 56 | 710 |
| Haiti | 1.8 | 178 | 119 | 367 | 330 |
chains, became analytical laboratories and a training facility for industry personnel and university students.

At the same time, i.e., in the beginning of the 1970s, a major change was brought about in the agricultural sector with the creation in Brazil of the Brazilian Agricultural Research Corporation (EMBRAPA)—a modern and very agile structure prepared to face existing problems through research and skilled management. Although it is a public corporation, EMBRAPA was conceived like a private corporation. It could use all types of financial and human resources and sell its services to, buy from, and collaborate with all kinds of clients.

Within the first few years, more than 2,500 fellowships were granted by EMBRAPA for graduate study at Brazilian and overseas universities. Salary levels were established at international levels, and an active recruiting effort was undertaken to attract foreign scientists into the Brazilian system. An attempt was made to strengthen the connections among Brazilian and foreign universities and with the international agricultural research centers.

This well-organized research infrastructure had the responsibility of developing and improving existing technologies. The end result was that average yield of major basic crops, based on 1984-86 field data obtained from skilled farmers who adopted technologies generated by EMBRAPA, was 4,000 kg/ha for hybrid corn, 6,000 for irrigated rice, 3,000 for beans (virus-free seeds), 2,500 for wheat, and 2,000 for soybeans.

If we compare these data with the world crop productivity shown in Table 5, we see that the modern technologies generated by EMBRAPA were not adopted by the majority of small farmers in Brazil. We can also see enormous discrepancies between productivity of major food staple crops largely consumed in developing countries and those of the world and the industrialized countries.

It seems that as a general rule in developing countries, skilled farmers who have easy access to land, subsidized credit, sufficient buying power to purchase fertilizers, good seeds, and defenses (insecticides, fungicides, etc.) have adopted modern technologies and elected to grow crops with an internationally fixed price for export. Small farmers who have difficult access to land and use poor technology—defined by the use every year of their own contaminated seeds and small quantities of fertilizers—have become responsible for producing up to 70% of the basic food staples for their own subsistence, with the remaining sold to feed a population that is increasingly moving to urban areas.

The first products selected preferentially to grow in Brazil were soybeans, wheat, citrus (oranges being used in modern plants to produce concentrated frozen products), coffee, and sugar cane. The later ones were rice, corn, beans, and cassava. After the second oil crisis in 1979, a fallacious argument was widespread, that the alternative liquid energy program adopted by Brazil, based on ethanol production from sugar cane as a substitute for gasoline, would in the short run displace basic food staple crops. That did not occur, as shown in Table 6.

Table 6 shows that despite all adversities, grain production in Brazil has been increasing, reaching a record total of about 64 million tons in 1988, with an expected production of 70 million tons in 1989.

What is valid for some countries may not be valid for the majority. However, without taking into consideration the soil quality and other prevailing natural and weather resources, it can be seen from Table 7 that part of the success in increasing productivity is achieved by the use of fertilizers, which for most of the developing countries are imported in hard currency, with the final harvested productivity being sold at unsatisfactory prices in both internal and international markets.

**Food Losses and Energy Waste**

From tilling soil to baking bread, every step in producing food requires energy. To feed rapidly expanding populations, most developing nations needed to move beyond the limitations imposed by human and animal muscle to the scale of mechanized agriculture. Fuel is expensive, so the same principle is applied to food processing, where energy-saving practices should be looked upon to achieve an ever more economical process.

Energy in one form or another—solar, human, animal, fossil, or biomass—is a component of every step in food production and processing. Fertilizer represents a large energy expenditure, and when it is imported, it depletes foreign exchange. When energy and fertilizers were cheap, there was little incentive for energy-saving technologies. Rising energy costs, predictable for the next decades,
may again exacerbate this issue. Thus, we need to find ways to make sure that the highest percentage of all food, produced on a raw or processed basis, reaches the stomach of the consumer.

Overall assessment of the commodity movement system means a search for the points where the most acute food loss occurs. In developing countries, it is common to have losses of 5–15% of grains, 10–20% of vegetables (sometimes reaching 40–50%), and 10–30% of tropical fruits. The “food pipeline” concept (Fig. 2) visualized by Bourne (1978) is as valid as ever. One cannot accept that after all the effort spent in labor, equipment, fertilizers, chemicals, and energy to produce food crops, a large part is wasted because of a lack of proper technology for harvesting, handling, transportation, and storage.

A trend scenario of the food situation in the year 2000, based on 1961–80 data on production and 1966–80 data on consumption, projects a Third World production shortfall in basic food staples of about 70 million metric tons. This gap represents about 5% of the Third World’s projected shortfall for basic food staples in 2000 and is one-third larger than the food deficit of developing countries in 1980.

Scientific principles are universally transferable; many technologies are not. Technologies based on biological principles, whether they relate to the cultivation, raising, transformation, preservation, and distribution of plant and animal products, are intensely influenced by the physical, social, cultural and economic environment.

It is in many instances impossible to transfer crop technologies, and there is a need to adapt processing systems from countries where temperate climates prevail to those developing countries mostly located in tropical, subtropical, or semi-arid areas.

For instance, refrigeration is undoubtedly an important means of prolonging the storage life of high-quality fresh and processed produce in tropical countries. But besides the cost of refrigeration systems, there are some limitations for reducing food losses in developing countries: many tropical horticultural products are susceptible to low-temperature injury; many commodities are currently too low in unit cost to bear the cost of mechanically refrigerated storage; and many poor countries do not have a well-organized cold-distribution chain, so the capital cost associated with inefficient and poorly maintained refrigeration systems are major limitations.

<p>| Table 6—Production of Some Brazilian Crops. Based on Anonymous (1988b) |</p>
<table>
<thead>
<tr>
<th>-------------------------------</th>
<th>---------------------------------</th>
<th>----------------</th>
<th>----------------</th>
<th>----------------</th>
<th>----------------</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>2,159</td>
<td>2,885</td>
<td>2,314</td>
<td>1,671</td>
<td>2,428</td>
</tr>
<tr>
<td>Rice</td>
<td>9,027</td>
<td>9,024</td>
<td>10,374</td>
<td>10,425</td>
<td>11,816</td>
</tr>
<tr>
<td>Potatoes</td>
<td>2,171</td>
<td>1,946</td>
<td>1,835</td>
<td>2,342</td>
<td>2,303</td>
</tr>
<tr>
<td>Cocoa</td>
<td>329</td>
<td>430</td>
<td>458</td>
<td>329</td>
<td>347</td>
</tr>
<tr>
<td>Coffee</td>
<td>2,840</td>
<td>3,821</td>
<td>2,082</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Sugar cane</td>
<td>222,317</td>
<td>247,199</td>
<td>239,178</td>
<td>268,584</td>
<td>276,592</td>
</tr>
<tr>
<td>Beans</td>
<td>2,625</td>
<td>2,548</td>
<td>2,209</td>
<td>2,006</td>
<td>2,930</td>
</tr>
<tr>
<td>Cassava</td>
<td>21,466</td>
<td>23,124</td>
<td>25,620</td>
<td>23,499</td>
<td>21,418</td>
</tr>
<tr>
<td>Corn</td>
<td>21,164</td>
<td>22,018</td>
<td>20,530</td>
<td>26,786</td>
<td>24,714</td>
</tr>
<tr>
<td>Soybeans</td>
<td>15,540</td>
<td>18,278</td>
<td>13,330</td>
<td>16,978</td>
<td>18,060</td>
</tr>
<tr>
<td>Sorghum</td>
<td>312</td>
<td>268</td>
<td>365</td>
<td>453</td>
<td>318</td>
</tr>
<tr>
<td>Wheat</td>
<td>1,983</td>
<td>4,320</td>
<td>5,689</td>
<td>6,099</td>
<td>5,479</td>
</tr>
</tbody>
</table>

aNot available.

<p>| Table 7—Growing Area and Amount of Fertilizers used by selected countries in 1985. Based on Anonymous (1988a) |
|---------------------------------|----------------|----------------|----------------|----------------|----------------|</p>
<table>
<thead>
<tr>
<th>Country</th>
<th>Area (1,000 ha)</th>
<th>Nitrogen</th>
<th>Phosphorus</th>
<th>Potassium</th>
<th>NPK</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>58,792</td>
<td>823</td>
<td>1,228</td>
<td>1,061</td>
<td>3,112</td>
<td>53</td>
</tr>
<tr>
<td>Canada</td>
<td>46,780</td>
<td>1,225</td>
<td>707</td>
<td>401</td>
<td>2,333</td>
<td>50</td>
</tr>
<tr>
<td>China</td>
<td>100,883</td>
<td>13,437</td>
<td>2,996</td>
<td>349</td>
<td>16,782</td>
<td>166</td>
</tr>
<tr>
<td>France</td>
<td>18,928</td>
<td>2,408</td>
<td>1,466</td>
<td>1,821</td>
<td>5,695</td>
<td>301</td>
</tr>
<tr>
<td>Holland</td>
<td>892</td>
<td>496</td>
<td>82</td>
<td>120</td>
<td>689</td>
<td>783</td>
</tr>
<tr>
<td>India</td>
<td>168,950</td>
<td>5,815</td>
<td>2,068</td>
<td>854</td>
<td>8,737</td>
<td>52</td>
</tr>
<tr>
<td>Italy</td>
<td>12,200</td>
<td>1,065</td>
<td>725</td>
<td>403</td>
<td>2,193</td>
<td>180</td>
</tr>
<tr>
<td>Japan</td>
<td>4,758</td>
<td>694</td>
<td>741</td>
<td>613</td>
<td>2,048</td>
<td>430</td>
</tr>
<tr>
<td>Mexico</td>
<td>24,750</td>
<td>1,310</td>
<td>413</td>
<td>89</td>
<td>1,812</td>
<td>73</td>
</tr>
<tr>
<td>England</td>
<td>7,077</td>
<td>1,572</td>
<td>434</td>
<td>510</td>
<td>2,516</td>
<td>356</td>
</tr>
<tr>
<td>United States</td>
<td>189,915</td>
<td>9,470</td>
<td>3,774</td>
<td>4,561</td>
<td>17,825</td>
<td>94</td>
</tr>
<tr>
<td>USSR</td>
<td>232,187</td>
<td>10,950</td>
<td>7,615</td>
<td>6,822</td>
<td>25,387</td>
<td>109</td>
</tr>
<tr>
<td>West Germany</td>
<td>7,453</td>
<td>1,516</td>
<td>737</td>
<td>932</td>
<td>3,185</td>
<td>427</td>
</tr>
</tbody>
</table>
Postproduction systems need to be studied comprehensively and in their entirety before change is proposed. New or improved postharvest technologies tied to sound scientific principles are best developed where they are to be used, with the help of competent food scientists who are fully aware of the existing constraints and the needs of both producers and food industries.

Sound conservation practices range from a variety of commonsense measures, such as better hygiene, shading, and ventilation, good handling, use of appropriate packaging materials, correct transport procedures, and use of simple equipment (such as thermometers and hydrometers) to control physical conditions.

The loss-reduction activities, particularly those using postharvest technology, are basically dependent on well-trained technical personnel. Food science and technology courses in both academic and extension institutions are the most important instruments for bringing knowledge to those who have the responsibility to improve communication among farmers, government, educational agencies, and planning organizations and thus help to disseminate information and learning materials.

Education and Malnutrition

In developing countries, where the level of illiteracy is commonly around the 30% figure and is maintained at this high figure for many reasons, it is very difficult to expect that this situation of underdevelopment associated with poverty can be changed rapidly. Here also we have a vicious circle, with the children, the pillar population of the nations, being the principal losers. It is estimated that in the United States, investment in education exceeds $25,000 (U.S.) per capita. Poor countries spend much less, and the level of education is very unsatisfactory.

In general, industrialized countries spend 2-3% of their GNP on science and technology, while in developing countries the average expenditure is 5-6 times smaller.

As a general rule, we may sadly say that in most developing countries, education does not come first. Since education is overlooked, the high level of illiteracy greatly impairs the efficiency of the people engaged in food production, as well as their knowledge regarding improved diets.

New or improved postharvest technologies tied to sound scientific principles are best developed where they are to be used, with the help of competent food scientists who are fully aware of the existing constraints and the needs of both producers and food industries.

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**Fig. 2—The Food Pipeline, showing areas where more research is needed to decrease food losses in the developing countries. Adapted from a figure by M.C. Bourne in NAS (1978)**

**PRODUCERS**

- Preprocessing
  - Broken grain
  - Excessive dehulling
  - Trimming
  - Spillage
  - Bruising
  - Breakage
  - Leakage
  - Heat
  - Frost
  - Rain
  - Humidity
  - Contamination

**Transport**

- Insects
- Molds
- Bacteria
- Rodents
- Birds
- Sprouting
- Rancidity
- Overripening

**Storage**

- Inefficiency
- Excessive peeling, trimming, and polishing
- Unsafe foods
- Quality losses

**Processing and Packaging**

**Marketing**

**CONSUMERS**
Developing Countries: Present and Future (continued)

It is sad to realize how slowly things move in developing countries, particularly in Latin America. The findings of a 1977 world food and nutrition study by the National Academy of Sciences (NAS, 1977) are still valid, showing that the causes of hunger and malnutrition have hardly changed. Developing countries still face the problem of high population growth (Table 4), poor income distribution, and, consequently, hunger. The major immediate cause of hunger is poverty, the lack of resources with which to buy or produce enough food. Insufficient food in turn combines with disease, apathy, and other effects of poverty to foster malnutrition and lower human productivity.

The Green Revolution introduced high-yielding food crop production technologies in the developing countries, increased per capita food supplies, and created a surge of optimism about reducing world hunger problems.

In the past several decades, we have also seen important demographic change. In Latin America, urbanization has been the dominant force in this change, and in some countries, such as Brazil, it has been dramatic. Currently 70% of the Brazilian population live in cities, with the remainder living in the countryside. In São Paulo, the most industrialized state of Brazil, 91% of the population is urban and 9% is rural, causing a tremendous demand on the state capital and medium-sized cities for better living conditions, such as housing, transportation, water, and sewage treatment. Food prices increase at an incredible rate.

The urbanization movement is irreversible and will continue in the future, as indicated in Table 8.

Expectations for a better life in the cities are the chief motivation for millions of people to live in crowded areas.

<table>
<thead>
<tr>
<th>Period</th>
<th>Urban</th>
<th>Rural</th>
<th>Ratio of urban/rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961-70</td>
<td>5.50</td>
<td>1.50</td>
<td>3.7</td>
</tr>
<tr>
<td>1971-80</td>
<td>5.70</td>
<td>1.50</td>
<td>3.8</td>
</tr>
<tr>
<td>1981-90</td>
<td>5.80</td>
<td>1.50</td>
<td>3.9</td>
</tr>
<tr>
<td>1991-2000</td>
<td>6.00</td>
<td>1.50</td>
<td>4.0</td>
</tr>
<tr>
<td>2001-25</td>
<td>6.20</td>
<td>1.50</td>
<td>4.1</td>
</tr>
</tbody>
</table>

While ... the occurrence of malnutrition is largely determined by the socioeconomic circumstances of the individual or family, specific intervention measures can alleviate or even solve some nutrition problems without the time and resources required for social change.

The lack of consistent rural development policies is the force that detracts people from staying in the villages and other small agricultural settlements.

The marginal segments of the population of cities do not satisfy their needs for food, housing, health, sanitation, water, employment, recreation, and education, and the standard of living is preposterous. Under those conditions, all sorts of diseases occur through different pathogens—viruses, bacteria, helminths, and protozoa—causing acute respiratory diseases and mainly diarrhea. Children are the most vulnerable group, with infant mortality reaching numbers that are unacceptable in a world that is preparing to enter the year 2000 (Table 4).

Some improvements have been achieved in recent years. However, the problem is far from having a reasonable solution. Maldistribution of income is the key word in this phenomenon, so nutritional problems and their consequences are also grossly maldistributed. Lack of money to buy food is the main reason for existing discrepancies.

Protein-calorie malnutrition, anemia, xerophthalmia, hypovitaminosis, endemic goiter, and rickets, all related to nutrient deficiencies, coexist with obesity, diabetes, and atherosclerosis in the urban centers of Latin America.

While it is true that the occurrence of malnutrition is largely determined by the socioeconomic circumstances of the individual or family, specific intervention measures can alleviate or even solve some nutrition problems without the time and resources required for social change. The classic example is the elimination of endemic goiter by the use of iodized salt in many countries. Iron deficiency anemia also should be amenable to direct intervention if suitable staples and methodologies for iron fortification can be identified.

Other types of direct intervention programs include nutritional rehabilitation centers, food-distribution or supplementary feeding programs, breastfeeding, homemade liquid serum to combat diarrhea, and nutrition education.

Many intervention programs may not have been very cost-effective and in many instances for economic reasons have not reached more than a small proportion of the vulnerable groups for which they were intended.

Policy discontinuities and budget cuts, which are commonplace in many countries, show that intervention programs are very far from being a reasonable solution for the nutrition problem. The merit of having them, however, is to avoid increased infant mortality rates, serious anthropometric deviations, and all kinds of diseases related to insufficient ingestion of food.

The World Bank has estimated a mean per capita energy gap of 119 kcal for Brazil as a whole, 210 kcal for the urban population, and 2 kcal for the rural sector, and that 17% of the Brazilian population show a daily energy deficit greater than 400 kcal (Gray, 1982).

Although city dwellers may be, on the average, better off than the rural population in terms of food availability and satisfaction of needs, the marginal urban poor potentially live under worse conditions than their rural counterparts.

For the next decade and beyond, prospects for a minimally adequate diet among the world's poorest people appear grim indeed.

Food science and technology have played a significant role in developing countries. However, it is still a new scientific field in almost all existing universities. Graduate courses in Brazil started in the mid-1960s and postgraduate courses only after 1968. Through the sponsorship of the
Organization of American States, students from all over Latin America were enrolled in postgraduate courses in the State of São Paulo in 1969. That was the beginning of an educational training program that was followed by many grants offered by regional and international organizations interested in fostering initiatives in food science. Emphasis was given to nutrition programs, fortification of foods, and development of indigenous technologies.

However, while food science and technology can be a fundamental instrument to find ways to minimize losses, better preserve foods, and improve nutritional and quality values, it cannot by itself be even a partial solution to such a burdensome problem.

A nutritionally adequate diet for all mankind can only be achieved if politicians and policymakers, helped by the community of scientists, decide to develop together actions to take care of the entire population of the nations.

Through a more equitable system in which the maxim "A hungry man is not a free man" may prevail, perhaps in the future malnutrition may be eliminated or minimized. In poor countries, access to food is the most important thing in many people's life, and this should be of universal understanding to construct a better world for us to live in.

Food Research and Food Availability

The agrifood business represents, as a rule, the largest sector of most developed and developing countries. Nevertheless, food production in the developing countries must increase at an unprecedented rate at least to the end of the century.

Eight food sources—rice, wheat, corn, sugar, cattle, sorghum, millet, and cassava—provide most of the nutrients for people in the developing countries. They account for about three-fourths of calories and two-thirds of the protein consumed, and in the case of the poorest population may account for as much as 85–90% of calories and protein.

The first priority is to increase the food supply. Through plant breeding, genetic engineering, and more recent biotechnology procedures, gains have been obtained, mainly with fruits and vegetables, sugar cane, and oilseed crops (soybeans and palm oil).

Because of enormous variations in weather conditions due to man's interference in the environment, it is impor-

---Continued on next page---
Developing Countries: Present and Future (continued)

tant to give priority to varieties of hybrids that are resistant to environmental stresses such as drought, temperature extremes, salinity, and acid soils. Improved techniques for predicting weather and climatic changes, using information to help farmers try to avoid crop losses, are essential.

Pest-management techniques through integrated control systems and improved management of tropical soils to increase crop productivity using biotechnologically improved seeds, nitrogen-fixation techniques, and adoption of rational irrigation systems to adapt farming to water availability are efforts that should become routine in developing countries to overcome the projected famine perspectives in the poorest part of the world.

Postharvest technologies also should be given attention to avoid losses, primarily of grains, which provide more than 60% of the calories consumed in developing countries and perhaps 70% in the poorer countries, and which are the principal food commodity in world trade. Storage policies at both farm and warehouse levels, regarding what to store, how much to store, who should hold the stocks, and at what price stocks should be acquired and released, should be implemented.

In most developing countries, because of the duality of income, we find, side by side, some industries using very modern processes to produce high-quality and sophisticated products, with the majority using routine processes and technologies to make products which are affordable to those with medium or low income.

Dairy products; processed meats; aseptic and frozen fruit juices and pulps; frozen, canned, and dehydrated vegetables; coffee and tea products; and cocoa and its derivatives are examples of products that are manufactured using up-to-date technologies in some developing countries. They contribute to progress and the improvement of GNP and per capita income.

In modern chains of super- and hypermarkets, all sorts of raw and processed items are sold. The paradox is that the very poor people do not take any advantage of this technological progress in marketing. Living in suburban areas where large supermarkets are nonexistent, low-income people usually pay for their basic food staples a higher price than those with high income who have the means to pay cash for what they buy in food chain stores. So improved marketing strategies are a must to make possible better distribution channels for food commodities in developing countries.

While this ideal situation may not be reached, many developing countries face the implications of food subsidization. Wheat, for example, has been a commodity that is largely subsidized in non-wheat-producing countries, meaning most of the developing countries. The costs and distortion brought by this procedure have been enormous.

Gray (1982) conducting studies on food trends in Brazil, found that “If increased calorie intake among calorie-deficient households is the goal, results indicated that wheat was not the proper commodity to subsidize. Not only is actual calorie intake likely to decline when wheat prices fall, due to substitution of wheat for higher-calorie foods, but calorie intake may well fall the most for the most severely malnourished sector of the urban population. The most effective and efficient subsidy for nutritional purposes would be a rice subsidy. It would have a substantial effect on calorie intake of the calorie-deficient population. Moreover, only the rice consumption of the poor would rise, not that of the wealthiest portion of the population.”

In a world where famine, misery, illiteracy, and all kinds of illness live side-by-side with the modern and the beneficiary of the affluent societies, it is easy to visualize how high a priority research is. The difficulty is to find the ways (not only financial resources) and political willingness to implement programs in a long-term perspective in which food science and technology will be a substantial part of the adopted strategy.

Future Perspectives

According to 1980 data, the developing countries are having an average annual deficit in the 1980s of about 50 million metric tons of major food crops. By the year 2000, with a trend of income growth, the deficit should increase to something around 70 million metric tons. Latin America will be in a balanced situation, able to produce all major basic foods to feed its population but showing no surpluses.

Sub-Saharan Africa as well as countries in North Africa/ the Middle East certainly will be in an even worse situation both industrialized and developing countries ... will need the expertise of food scientists and technologists to win the fight against ... foodborne diseases and ... contaminants and to search for safer ... and even more nutritious [food products].
making a large amount of food products available to the population.

Although some companies have lost interest, many food industry leaders have accepted the nutrition challenge, convinced that solutions to malnutrition problems can be partially provided by private enterprise.

Famine and deterioration of the purchasing power of national currencies may also impose constraints on the normal operation of programs such as fortification of salt and sugar, since the additives are imported.

Agroindustry entrepreneurs will find the way to produce raw and processed products to meet buyers' demands for high quality.

Impediments to importation of goods from tropical countries should be eliminated, opening space for processes like food irradiation to become fully accepted by countries, and no doubt it will be only a matter of time until these technical advances will be transferred to the industrial marketplace.

We are beginning to see technical contributions in food science and technology from the scientists of the Third World countries, and no doubt it will be only a matter of time until these technical advances will be transferred to the industrial marketplace.

need the expertise of food scientists and technologists to win the fight against outbreaks of foodborne diseases and the presence of contaminants and to search for safer food products free of toxicants and even more nutritious.

Much of modern food science and technology has been recognized and is being practiced by the scientific community in developing counties. But adaptation of more advanced techniques, such as genetic engineering, irradiation sterilization, freeze-dehydration preservation, refrigerated distribution systems, etc., to the production, processing, distribution, and storage of food products in the developing countries will come slowly, but surely. We are beginning to see technical contributions in food science and technology from the scientists of the Third World countries, and no doubt it will be only a matter of time until these technical advances will be transferred to the industrial marketplace. However, there will remain an untold lag period of years between their application in the industrialized countries and that in the developing countries.

We live in a world of contrasts, concentration of riches in a few countries or hands, a world of imagination and opportunities. Let us hope, without being naive, that science and technology can be used to bridge the gap between the rich and poor. There is a strong need to believe in it.

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—Edited by Neil H. Mermelstein, Senior Associate Editor