

# Seventy-Five Years of Food Science

## 1918 - 1993

### at the University of Massachusetts

(updated to 1997 with an addendum)

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#### **The Department of Food Science Historical Development**

##### **F. J. Francis**

The inspiration to develop a Department of Food Science started in January, 1913 when Dr. Frank Waugh, Head of the Department of Horticulture, asked Walter Chenoweth to give a paper on Horticultural Manufactures to a group of fruit growers. Dr. Chenoweth had been hired the year before as a pomologist, and since fruit was a major item for preservation, he was a logical candidate. He answered "But, Prof. Waugh, I know absolutely nothing about that subject". "Fine", said he, "then you won't have any prejudices to overcome".

In the summer of 1913, Prof. Sears, Head of the Pomology Department, provided funds to purchase a gas plate, pots and pans, etc. and a laboratory was set up in the basement of Wilder Hall. A second lab was opened in the basement of an old Grounds Service building, and they were used to make grape juice, grape butter, plum jelly, plum butter, cider, vinegar, boiled cider, and apple butter. The Dept. of Pomology was teaching and demonstrating food preservation. The timing was perfect

since World War I pointed out the problem with food shortages. The staff of the College was mobilized to engage in food production and conservation. In 1917, Prof. Sears asked for a budget to expand the program. Prof. Waugh sensed that the timing was appropriate and, in 1917, petitioned the trustees to found the Dept. of Horticultural Manufactures. The request was granted on April 27, 1918 and Prof. Chenoweth was appointed as Department Head. The Dept. started with two laboratories in Flint Laboratory, and the staff consisted of Walter Chenoweth and William Martin - the all round handy man. William R. Cole joined the staff in 1919 followed by William Robertson in 1920. A budget for a new building was submitted in 1919 and every year thereafter until 1928. President Thatcher took it on as a personal crusade and after 12 years the new building was opened in 1930. Shades of *deja vu!* I recall being shown the plans for a new building when I was being recruited in 1953. The present building was opened in 1965.

The 1920's saw the buildup of a research faculty. Dr. Carl R. Fellers was hired on December 1, 1925. He already had considerable research experience at the USDA, National Canners Association

and the Univ. of Washington. Francis P. Griffiths, a graduate of the Univ. of Washington was hired on September 1, 1927. Cecil R. Rice and John A. Clague came on board in 1929 and 1930. The Department had four graduate students, Maurice Cleveland, Paul Islam, Michael O'Connor and Ernest Smith and the research program was in full swing. Professor Chenoweth and Fellers proceeded to build a research and teaching department second to none

Professor Chenoweth retired in 1941 and Dr. Carl R. Fellers was appointed Head, in which capacity he served until his retirement in 1957. In the 1940's and the 1950's, the Department dominated research at the University of Massachusetts, regularly producing more than half of the total number of Ph.D.'s. In the 16 year period from 1945 to 1960, the university graduated 140 Ph.D.'s and 75 of them were in Food Technology. In 1954, the Department founded Phi Tau Sigma, the Honor Society for Food Science. It was largely through the efforts of Guy Livingston, on faculty at the time, and 6 graduate students, M. P. Baldauf, R. V. Decareau, E. Feliciotti, W. D. Powrie, M. A. Steinberg, and D. E. Westcott. These seven are the founding members of Phi Tau Sigma. I was a student at U. Mass in 1952 and came back on faculty in late 1954 so I missed this honor. G. E. Livingston was the first President, F. J. Francis was the first permanent Secretary Treasurer, and later President (1979-80).

The two decades from 1940 to 1960 saw a rapid expansion of the Department and the establishment of a number of food science programs in other parts of the U.S. A number of the graduates of the University of Massachusetts program

were instrumental in founding and staffing these programs. In 1944, the name was changed to the Department of Food Technology, in order to reflect a much broader emphasis. In 1962, the name was changed to the Dept. of Food Science and Technology, in order to reflect the changes in the Department itself and the recognition of the importance of the basic sciences to the food industry. In 1964, the College of Agriculture programs and staff in Dairy and Meat Technology were added to the Department of Food Science and Technology. In 1960, a state appropriation of \$1,650,000.00 was made for the construction and equipping of a new four story addition plus the renovation of the original Chenoweth Laboratory. In addition, a \$265,000 Graduate Level Research Facilities Grant was awarded to the Department by the National Science Foundation. The 48,000 square foot addition to the original 10,000 square food building enabled the Department to expand its undergraduate and graduate programs.

Dr. W. B. Esselen was appointed Department Head in 1957 and served until 1971. Dr. F. J. Francis served as Department Head from 1971 to 1977 and was succeeded by Dr. Glen R. Brown who served until 1988. Dr. Fergus M. Clydesdale, the current Department Head, was appointed in 1988. In 1972, the Department of Foods and Nutrition was merged into the Department of Food Science and Technology and the new Department was called Food Science and Nutrition. In 1988, the Department was split into the Department of Nutrition and the Department of Food Science. In 1990, when the Department of Food Engineering was discontinued, part of the staff and facilities were

merged into the Department of Food Science.

The Department of Food Science has organized a number of short courses and programs through the years. One of the most successful is the current Department of Hotel, Restaurant and Travel Administration which was nurtured for 32 years in the Department of Food Science. In 1935, a campus committee recommended that a two-year program in Hotel Stewarding be organized in the Department of Horticultural Manufactures. This program was established in 1937 and later became the Food Management option. In the 1940's the program started to expand and a four year program was instituted in 1955 in the Department of Food Technology. In 1969, the program was separated from the Department of Food Science and Technology and became the current Department of Hotel, Restaurant and Travel Administration. A new concept, initiated in 1992, is an off-campus M.S. program in Eastern Massachusetts. This effort is just one of the innovative programs designed to serve the needs of our off-campus constituents.

The Department of Food Science is proud of its tradition of being one of the first Food Science Departments in the U.S. It has succeeded through 5 name changes, over 75 years of progress, and has graduated over 1500 alumni. With this foundation, the Department looks forward to an even more promising future as one of the premier centers for food science in the U.S.

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## **Personal Recollections**

### **Roy Morse**

My contribution to the history of the Department can best be described as the "early middle" years. I actually spent three different periods at the Department -- my MS work, 1940 fall to spring '41 and awaiting Army call, fall '42 to late spring '43 and post war period, fall 1946 to spring 1948. With this in mind I'll try to recall the events and people of those eras.

#### **Phase I, 1940-41**

In this time I was working on my MS in Food Technology under Art Levine. The project had to do with inhibitory effect of short chain fatty acids on molds and yeasts. Those in attendance at this period were the faculty consisting of Prof. Chenoweth (I took his candy course!), Carl Fellers, Art Levine, Bill Esselen, Walt Maclinn (who was just starting the Hotel Restaurant Program) and Jack Clague. The Department was in transition in name from Horticulture Manufactures to Food Technology. The highlight of the program was the Friday Afternoon conducted by Carl Fellers, which was a tour de force of the Fellers depth and fascination with the chemical and microbiological attributes of foodstuffs.

Other graduate students in the area that I can remember included Fred Wenzel (a southern gentleman from Sauer Spices in Virginia), Glen Boyd (Carl's nephew who spent his entire career at Campbell Soup), Ed Moore (who went on to work on citrus in Florida), Bob Messier (who went on to Chem. Abstracts in Columbus Ohio), John Bernotavicz (who

went on to head up research on dog food for GF-Gaines Division in Kankakee, IL), Bud Lacey (who went on to canning in South Jersey, as did Ed Morin, an Amherst boy), Jim Moyer (a Canadian who spent his career at Geneva Experiment Station), Abdulah Sedky (an Egyptian who returned to Egypt), Bill Fitzpatrick (who did some of the early work on microbiological determination of amino acids in mushrooms, and kept us fed with them) and one other we called the mystery man, Fred Theriault (who appropriately went on to work for the government as a cryptographer). It should be pointed out that at this time there were only four Universities in the United States offering a major in Food Science. Several schools offered courses, but only Mass State, Massachusetts Institute of Technology (M.I.T.), Oregon State and the University of California-Berkeley offered a major. Also, at this time there was an affinity between Oregon State and Mass State. Walt MacLinn did work there and Tom Onsdorff did work at Mass State. After a stint at Hills Brothers, Inc. in Brooklyn, a Fellers consultant, I too went on to Oregon State to start my Ph.D. program, which the war interrupted.

### **Phase II, 1942-1943**

When the war broke out, John Stewart and I were graduate students, instructors in Food Technology at Oregon State at Corvallis. We both enlisted in the Air Corps and awaited the call to active duty, which didn't come and didn't come. We finally returned to Amherst and were still not called. We went to Maine, Fort Kent to run a potato dehydration facility, producing products for the armed forces. When still not called I decided to go back to Amherst to pick up on the Ph.D.

program again. At that point (1943 spring) Carl Fellers had been recalled to active duty and the Department was being run by Francis Griffiths, "Griff", who was incidentally the first graduate student in the Department. He was an old friend to Carl Fellers from his days at the University of Washington, both were interested in fisheries. This was pretty much the beginning of the Carl Fellers "pied piper" exercise. He attracted young followers wherever he went.

In the Department at that time were graduate students such as John Powers, Pete McConnell, Celeste DuBord, Angie Filios (one of the many Filios kids at Mass State), Bob Tischer (Who later went to the Natick Laboratories), Charlie Rogers and Jose Franco-Betancourt. To my knowledge he was the only Cuban the Department has had until Mike Jimenez graduated in 1959. Also in graduate school was Nick von Guggenberg, whom Stu and I had known at Oregon State. Nick originally came to the States as a Mussolini Fellow at which time he was di Guggenberg, which he then shifted to von and finally, as the allied sides showed up, he became de Guggenberg. He was a charming gent who finally settled in the Washington area. Fellers, called to active duty, moved him into the then Quartermaster Corps. His principal duty was the establishment of a laboratory in Australia to help the Australians where needed and oversee food supplies for the allied troops. He took over the recently constructed Tooth's Brewery laboratories and was soon an operating entity.

### Phase III, 1946-1948

The final stay was 1946-48; the post-war period was in full sway. Fellers was back from the army and the campus was full of returning GI's on the GI Bill, including me. The Department was filled to overflowing with graduate students including Ed Anderson, Norm Desrosier, Ricardo Millares (Mexican), Tony Lopez (Chilean), Andre Patron (French), Vic Lewis (Australian) and two Turks, Kemal Gokce and Omer Kosker. Also Ottilio Guernelli (Brazil), Ramamurti Reddi (India), Mohammed Ishag (Pakistan), also Hormoz Broumand (super salesman), Ted Calianos (Greece), who returned home and has not been heard from since. The local boys included Bill Hart, Jack Crimmins, Charlie MacCormack, along with Matt Highlands of the University of Maine, Milt Howe, Norm Vanasse, Mike Papparella, a Yale graduate who worked in the Australian Lab under Carl. One of the few ladies was Edith Weir, a Canadian who later went with the U.S.D.A. Also, Ed Nebesky, on to Cornell, then Rutgers and finally at Natick, Jack Krum at various places including French's, Roy Moser, who confounded my mail for years from Amherst who went on to Oregon State and finished at Hawaii, Don Westcott, Irving Pflug (recent IFT Awardee at Minnesota) along with sister Ione, Don Seely who wound up at Pfizer in Connecticut and worked on antibiotics. We must not forget Cy Garvey who kept the building operative through all these phases and was friend and helper to every graduate student who went through Food Science.

The Ph.D. when I finished had not yet become simply Food Science or Food

Technology. Rather, it was a granted degree from a consortium from four departments, Food Technology, Dairy, Nutrition and Microbiology. My class (1948) was the last to attain this degree.

An important aspect of the Carl Fellers saga was his keen involvement with the graduate students, though he taught the undergraduate course in Food Technology. For example, he arranged for graduate students to live in what was then called the "Hatch Annex". He also arranged for students to live at his house. My own tale is equally fascinating. When I had finished the MS degree he approached me one day out of the blue and told me he had arranged an interview with Hills Brothers (Dromedary Products). I was taken aback because I had no funds to meet such a date--graduate pay then was \$30 per month. He assured me all was well and provided me with a ticket and return. Also, on the day of the meeting he drove me to the train station in Northampton, Mass. but stopped en-route at his house to put together a lunch for me to take along. Standing there in his hat and overcoat he put together a sandwich, some sweet stuff and a banana, quite a sight! By the way, I got the job, but left later to go back to school at Oregon State. I was succeeded by "Bud" Chenoweth who stayed with Hills Brothers through a Nabisco acquisition and with Nabisco for the rest of his career.

During this period George Hucker of the Geneva Experiment Station was Secretary Treasurer of the IFT -- a volunteer position -- because the IFT probably only had a few hundred members. In 1947 or so he resigned and Carl Fellers was chosen to carry on. For

actual work he hired Mary Morse. Mary and I went to Geneva to pick up the records in a not too trustworthy vehicle. Hucker was not that great as a record keeper, but the total IFT records were contained in 2 shoe boxes! Mary kept up the good work until she could no longer reach the typewriter because of a midsection protrusion, which Carl considered highly secondary and allowed she could continue until just before leaving for the hospital.

On another matter, it would be easy to misread Carl Fellers, for in spite of his tenderness with graduate students he was a fierce competitor. Anyone who played badminton with him, a game he loved, would testify that he fought every point and close calls were a problem. When his mother died in New York State he and Joe went to the proceedings, while Mary and I stayed with the Fellers clan. We were about to try ping pong one evening and I suggested we just volley rather than a game (I wasn't very good) and the kids were delighted. "Dad never let's us just volley, we must play a full game." An interesting insight.

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## **Personal Recollections**

### **John Powers**

This account is intended to add additional details to Roy Morse's recollections, particularly in who was doing research in the 1940's.

First, Bill Fitzpatrick may have started to carry on microbiological analyses for amino acids in mushrooms in 1942, but in 1940 he was determining oxygen uptake by bottled orange juice. That was

the task Doc Fellers first set me to. It was a part of the Glass Container Manufacturers Association (GCMA) project, and both Bill and I worked on that plus the ascorbic-acid-as-an-antioxidant project. My recollection is that Bill Fitzpatrick left in 1942 to join the Office of Strategic Services. I have practically no recollection of him being there beyond that. He became an instructor when Walt Maclinn was called to active service. I became one in February 1942 when Doc Fellers was called to active duty. Both our desks were in the same office, but I don't recollect him being an office mate very long; thus I think at best he barely got started on the microbiological phase before he left the Department. Fifty years later it seems to me that Angie Filios probably was the one who really commenced that work. Bill's main effort must have been the old GCMA project.

Speaking of the GCMA project and teaching, first to the GCMA phase. One of the great things about Doc Fellers was that he intended for his "boys" to participate in all forms of scientific endeavor, and he went out of his way to introduce them to the leaders in the field at that time. Dr. Fellers was a former chairman of the AGFD division of ACS. Fitzpatrick was the senior author of a paper given on ascorbic acid as an antioxidant at the ACS meeting in the fall of 1941; I was second, and Dr. Fellers, though the leader of the project, graciously made himself third. There was no real reason for me to be there, but Dr. Fellers took me to Atlantic City with him in his Cadillac, and while at the meeting he introduced Bill Fitzpatrick and me to several who were prominent in the field at that time.

He also made sure we attended the 1941 meeting of the IFT in Pittsburgh and the 1942 meeting in Buffalo. He took us to meetings of the GCMA Association in New York City to report progress made on the GCMA project. We really had nothing to do other than to speak briefly--and that was done really just as a matter of courtesy. Attendance for us was chiefly his way of promoting us in the field rather than for any real reason to attend.

Now to the teaching phase: I became an instructor literally overnight in February 1942. One afternoon about 4 o'clock, Dr. Fellers told me he had been over to see the President and that I was to be appointed an instructor effective that day and that I was to take over his classes the next morning at 8:00 AM since he was to depart for active duty. This all came out of the blue as far as I was concerned. I had never dreamed of teaching. I certainly was one of the "juniors" among the graduate students. Why he selected me I don't know. I do know he set my feet on a path which provided a lifework both challenging and intriguing.

I can add a few names to those Roy Morse mentioned as being students in the 1940-1946 era. One was G. Sherman (Bucky) Davis, another was Ruby Woodward, still another was Frank Yourga, Fred Voit was still another, and there was one more who was there in 1940 or 1941, but I can't think of his name. Leonard Parkinson who was the technician at the Hatch Lab was also a graduate student, I think. Roy mentioned Edith Weir. Maybe in 1946 she did become a graduate student in Food Technology itself; my recollection of her is that she was in Nutrition, but -- as Roy points out--Food Science was a joint

program among Chemistry, Bacteriology, Dairy, Nutrition and Horticultural Manufactures. In 1945 my Ph.D. was in Food Technology, I think the first year we got out from under the title Horticultural Manufactures. In mentioning whether Edith Weir was in Nutrition or Food Technology at the end, others who were in Nutrition could be mentioned because there were very close ties between Nutrition and Food Technology. We did our animal bioassays in the Hatch Annex, and Doc Fellers ran some of his industrial grant projects there, i.e., assaying Red Squill. We all thus got to know Dr. Anne Wertz well. I guess she was in the School of Home Economics, but she had a lot more to do with we Food Scientists than she did with anyone in Home Economics. The ones I remember in Nutrition are Marilyn Cooney, Faye Kinder (I think the spelling is correct), who I believe taught at Michigan State and was the author of a very successful Experimental Foods book; a Southern young lady named Hamilton whose first name I have forgotten, and either Robert or Joe Lubitz, but now I'm not sure which.

Oh, the one I'm about to name was an undergraduate. She was Ruth Kitson, who if she got a masters from UMass. went on later to get a Master of Nursing from Yale, married a doctor, I think, and she lived for many years in Red Creek, W. Virginia. She was around the building an awful lot, 1942-45.

Another "oh": Roy mentioned the Food Science staff in 1940. I never remember Jack Clague being on the staff when I was there, but that could be perhaps because Roy started right after he graduated in 1940 whereas I didn't come to Horticultural Manufacturers until just

before the start of the Fall semester in 1940. The one I remember is Lowell Tucker who was an instructor. He left I think at the end of the 1940-41 year to go back to the Mid-West. I have a feeling that Bill Esselen came to take Clague's place in the fall of 1940.

One recollection about Dr. Fellers was the effort he expended on behalf of married graduate students. As Roy mentions in his write-up, we graduate students got \$30/month. Maybe because Dr. Fellers had such a big--and fine--family himself, he had a special leaning toward married students. At \$30/month there weren't many married students, but there were a few. Doc Fellers always managed to find a job for the wife (Voit, Tischer, McConnell).

The Department carried on some activities which I'm sure it doesn't do today, such as tap the maple trees on campus to make maple syrup. When I became an instructor in early February, one of the first things I had to do was to manage the maple-syrup project. Cy Garvey would get a horse and wagon from the farm--on sleigh runners. Washington's Birthday (when it was really celebrated on February 22) was usually about the starting time. For two weeks a big maple syrup boiling tank would be set up in the commercial lab, and we'd boil syrup. Another thing the Department did was related to the War Effort. From 1942-1944, the commercial laboratory was used to can food for the dining halls. There were only two then, Draper and one in one of the "new" dorms on the hill. I was responsible for that operation too. In the summer months we had about 30 Smith College girls who were paid to be cannery workers. Most of them came from well-

to-do families with a sense of identity to do something on behalf of the War Effort. The work obviously was hot with retorts and kettles going, somewhat sloppy as one would expect, for we canned tomatoes, corn, green beans, made applesauce, and ketchup. The Olericulture Dept. was responsible for growing vegetables, and naturally Pomology furnished the apples. I might say several faculty wives also worked alongside the young college women. One I remember is Professor Lanphear's wife. Professor Lanphear was the Registrar, taught freshmen orientation, astronomy, and knew each one of the 1,200 student body by name.

Roy mentioned Nicholas von Guggenberg. Roy had a touring car, a Ford I think. Sometimes he'd let the top down, and Nick would stand up in the rear, strut like Hitler, scream in German--all to our enjoyment.

The carrying on of human experiments was entirely different in those days. Doc Fellers had a project with Quaker Oats to test levulinic acid as a by-product from its destructive distillation of corn cobs used to make charcoal briquettes. We graduate students were human guinea pigs. For a month or more we ingested several cc of levulinic acid dissolved in a pint of grapefruit juice. There were various clinical tests made before and after the test, but there certainly was no human experiment clearance. The same applies to some of Fran Griffiths' tests. Whenever I see my dog eat grass, I know it's because it has decided it needs a laxative. In the hey-day of chlorophyll being added to chewing gum, mouth wash, etc., Griff had worked out a new extraction procedure as part of an industrial project he had. We were the

guinea pigs to learn if his product has any untoward effects. It did.

One last thing about Doc Fellers. He left for the War in February 1942. I'm not sure whether it was a month later or a year later, but I do know it was during a very snowy period. Mrs. Fellers asked me to see about getting the oil changed in Doc's Cadillac. I often drove the Fellers family to church because I guess none of the Fellers family at home were old enough to drive. I've always remembered Doc's marvelous memory for things scientific. As a sometimes absent-minded professor, I can attest none surpassed him. Here it is either 1942 or 1943; the Cadillac was a 1939 or 40 model. In two years, Doc had never thought of having the oil changed.

Bill Esselen naturally also contributed greatly to the well being of the Department during 1940-46. While he was a straight Research Professor, his activities didn't impinge too much on the teaching side of the Department. When MacLinn and Fellers left, Fran Griffiths got Bill to teach some. He instituted a thermal processing course and one on glass breakage. Actually, throughout most of the War, he was at the University only one month out of two. He alternated between one month with the War Production Board (WPB) in Washington and one month on campus. When Germany capitulated, he went into the Army to survey German industrial might (what was left of it). I think Fran Griffiths left late in 1945 to get a job since his appointment was only temporary and Charlie Rogers became an instructor, but I won't attest to the last bit. Charlie did share the office with me for a while, I do know that.

Bill Esselen brought a lot of attention to the Department between 1942-45 because of his WPB activities. We gave short courses for managers of community canneries, he had a research project with the USDA on thermal processing of home-canned products, Karl Ford of Ball Brothers Glass Company spent a lot of time on campus, and I utilized him some in the teaching of the so-called commercial processing course because he was quite willing to oversee projects dealing with cannery layout.

Professor Chenoweth was of the old school. Friendly, gracious to all and, fortunately for him, home-food preservation was still very much in vogue, because that was his real interest. Carl Fellers was the one who brought the Department into the scientific age. I still remember Professor Chenoweth commenting that when he first began to teach food preservation (in 1916, I think), he could carry the entire resources of the library on food preservation under one arm. One could still do that pretty much in 1940; Cruess' book existed; so did Prescott and Procter and a few others. Bittings' Appertizing and the Complete Course in Canning were mainstays. Tony Lopez of course has kept the Complete Course in Canning to the fore.

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## **The 1950's and 1960's**

### **F. J. Francis**

The early 1950's embraced an upbeat outlook due to the pent-up demand for goods and services after World War I. It was a era of expansion. The Department

of Food Technology expanded under the very extroverted personality of Carl (Doc) Fellers. Decision making at the Department Head level was easy. Doc would make a decision then and there or sometimes he would walk down the hall and consult with Bill Esselen and Art Levine. The younger faculty members learned not to walk past his office or you would get an assignment. I remember in 1955 walking past his office. Doc called me in and said "Jack, I have a request from a group in Gardner for a speaker on the dangers of processed food. I told them you would go". I went to Gardner, dismissed the topic with one sentence saying that there were no dangers and proceeded to talk on the safety of processed food. In the question and answer period, I felt as welcome as a bastard at the family reunion - but a thick skin helps. I recall in 1952, being constantly amazed at Doc's detailed knowledge of the research literature. I learned later that he personally wrote every food-related abstract that appeared in Chem. Abstracts. Despite the free-wheeling and sometimes autocratic Department administration, there was a real sense of camaraderie. As one example, Doc had negotiated a contract with Consumers Union to do all the food-related testing for Consumer Reports. The program was administered by Irv Fagerson and later together with Ed Anderson and some of the proceeds were used to fund dinners for the whole faculty and their wives. I was not involved in the testing but the fallout was much appreciated.

In the 1950's, with a small department there was much collaboration and the names of Fellers, Esselen, Fagerson, Levine and Anderson appeared on many research papers. The main research

grants were Hatch and USDA funds, Glass Container Manufacturers Association (now the Glass Packaging Association) and state grants for cranberry research. The research had a very practical approach on commodities such as apples, pickles, cranberries, blueberries, broccoli, etc. combined with studies on processing and vitamin retention. One project on preservation of caviar was very popular but I understand that after eating so much caviar, no one in the Department would even look at it. Art Levine and Carl Fellers directed the caviar project with graduate student Dick Barton. Carl Fellers directed research on eggs, fish and wine with students Jack Krum, Tony Lopez and Ed Anderson.

Cranberries loomed large in the early days of the Department. Production of cranberries had started in the early 1900's and was well established in the 1930's. Marketing was primarily as fresh fruit but Marcus Urann, founder of the Urann Canning Co., which later became Ocean Spray, Inc., had a vision. Fresh cranberries had to be sorted to remove soft berries by dropping them on thin boards. Each berry had seven chances to bounce over a board. Those berries which did not bounce were rejected, and large piles of culls appeared by the screening sheds. Marcus Urann looked at those piles and said, "The future of the cranberry industry lies in those piles of rejects". These cranberries were suitable for processing but they could not be stored for merchandising as fresh fruit. Research on processing cranberries was encouraged and the Department of Food Technology became the research arm of Ocean Spray. The University of Massachusetts Cranberry Experiment Station had already been the research

arm for cranberry production for many years. In the 1930's to the 1950's research on packaging, storage, processing, composition, nutritional aspects and quality control began. The 1950's to the 1980's saw the development of colorimetric quality control methods, pigment identification and degradation. In the 1960's Ocean Spray developed its own research and development facilities which are well known today. Marcus Urann was right -- today the tonnage of cranberries used for processing is far larger than that in the fresh fruit category.

The Department of Food Technology had a real edge in the claim for new faculty members because it dominated the research efforts of the University. To put this in perspective, in the sixteen years from 1945 to 1960, the Department of Food Technology graduated more than half of the Ph.D.'s produced by the entire university (75 out of 140). In my opinion, this is an amazing accomplishment for one small department. In the 1950's and 60's the faculty consisted of Carl Fellers (1925-1957; Dept. Head, 1941-56), Bill Esselen (1936-75), Arthur Levine (1937-1967), Irving Fagerson (1949-1987), Ed Anderson (1948-1956), Kirby Hayes (1951-1987), Guy Livingston (1952-1958), Len Parkinson (1952-1958), Jack Francis (1954-1990), Miles Sawyer (1957-1988), Ward Hunting (1957-1989), Warren Averill (1957-1960), Hamid El-Bisi (1958-1963), Wassef Nawar (1959-1992), Herb Hultin (1959-present), Charlie Stumbo (1963-1975), Bob Levin (1964-present), Fergus Clydesdale (1967-present), and Tom Mulvaney (1968-1971).

Four members of the former Department of Dairy and Animal Science were transferred to the Department of Food Science and Technology. They were Denzyl Hankinson (1968-1975), Frank Potter (1964-1988), Dave Evans (1964-1994) and Ernest Buck (1964-1990). There were also seven faculty members in the Food Management option, which later became the Department of Hotel, Restaurant and Travel Administration. They were Otto Kranz (1938-1952), Tom Culbertson (1953-1956), John Baker (1954-1962), Norman Cournoyer (1956-1969), Al Wrisley (1962-1969), Cliff Robertson (1963-1969) and Don Lundberg (1963-1969).

Bill Esselen had a large research program in the 1950's and 1960's, primarily on thermal processing, spore resistance, pickle technology, vitamin retention and packaging of cranberries. His students included R. Reddi, Art Kaplan, Norm Derosier, Omar Koskker, Joe Liciardello, Louis Ruder, Ed Nebesky, Marcel Labbee, Irving Pflug, Gaston Kohn, Enio Filiciotti, Ron Lompi, Mohamed Zoueil, Betty Elbert and Kioshi Tsuji. Bill Esselen was Department Head from 1941-1956. Art Levine joined the Department in 1937 primarily to teach the undergraduate courses in Food Processing and later a graduate course in Food Packaging. In the early days, with a small Department, nearly all research projects involved some aspect of processing or packaging so Art was involved with most of the students and faculty. He was particularly involved with the freezing, packaging, and roasting of frozen poultry and stuffed turkeys. His interest in packaging led to development of equipment for determining moisture equilibrium. Art taught nearly every student in the

Department so he was probably the best known faculty member.

Irving Fagerson joined the Department in 1949. His early research together with Ed Anderson, Art Levine, Carl Fellers and Bill Esselen was to take advantage of the large number of samples provided by Consumers Union. They were able to establish statistically reliable estimates of the nutritive value and general quality of a number of commodities such as frozen broccoli (a relatively unknown crop at that time), frozen peas, canned soups, frozen dinners, etc.

Irving's interests were primarily in chemistry and the analytical equipment applicable to this area. This obviously relates to a very wide spectrum. He was involved in moisture equilibrium apparatus, heat-transfer techniques, darkening in food purees, MSG as a flavoring ingredient, flavor changes due to pesticide contamination, gas chromatography, food irradiation, volatile products of lipid oxidation, volatiles from heated glucose, the chemical profile of cranberries, volatiles from soy protein, etc. His students included Bob Vilece, Mary Kearns, Mike Brodnitz, Reginald Walter, Rodney Croteau and Charles Manley. One visiting professor was Ron Edwards from Australia.

Kirby Hayes joined the Department in 1951 as an extension professor. He soon switched to a teaching professor but maintained his interest in extension by assuming responsibility for a number of extension bulletins. His major research accomplishment was the development of the beverage "Cran-apple" as part of his M.S. thesis.

Len Parkinson joined the faculty in 1952. His responsibilities were to run the animal colony since the Department at that time was doing considerable research on vitamins and toxicology of compounds with potential for the food industry.

Guy Livingston joined the faculty in 1952 and proceeded to develop a research program on the chemical aspects of food processing, particularly the discoloration aspects of thermally processed baby food. He worked on the mechanism of non-enzymatic browning, metal contamination, pigment destruction, etc. with the following students: Bob Vilece, Oddvar Solstad, Narayan Pandit, Perry Markakis, Arnold Roseman, Irving Lemack, and C.T. Tan. Guy Livingston also worked with Irving Fagerson and Jack Francis on a U.S. Army grant on gamma irradiation preservation of beans, broccoli, sweet potatoes, and squash with students Ted Wishnetsky, Ray Franceschini and Anand Naik-Kurade.

Jack Francis was hired in 1954 to develop a research program in post-harvest physiology. This involved studies on the effect of growth hormones on shelf-life of spinach, broccoli, and asparagus and the development of the technology for prepeeled vegetables such as potatoes, carrots, turnips and rutabagas. He worked with students Herb Brody, Bansi Amla, Art Kiratsous, Mike Jimenez, Mik Sanna, Gordon Fuller, Ben Alexander and Rosalita de la Mar. With the resignation of Guy Livingston in 1958 he took over the colorimetry area and developed a teaching and research area involving C.T. Tan, Sonia Yuson, Lorna Staples, I Lo Huang, Elizabeth Gullett, and Dick

Whelan. The Glass Container Manufacturers Grant funded research on conventional thermal processing and High Temperature - Short Time methods particularly on appearance and quality. Six students graduated in this area - Arthur Kiratsous, Shashi Gupte, Roberto Resende, Dan Fleishman and Fergus Clydesdale.

Jack Francis had been on faculty in the Department of Horticulture at the University of Guelph in Canada where he had developed a colorimetric method to measure quality of tomatoes for processing as an incentive for growers to provide better tomatoes. He was asked to do the same thing for the cranberry industry. The resulting colorimetric research, pigment identification and effect of processing on quality was done with the help of students Joe Servadio, Bonnie Sun, Charles Zapsalis, David Lees, Gabor Puski, Martin Starr, Carlos Chiriboga and Sadao Sakamura (visiting faculty from Japan). Tibor Fuleki developed the classical methods for quantitative analysis of anthocyanins based on paper chromatography which were universally accepted until they were replaced by HPLC in the 1980's.

Three faculty members joined the Department in 1957. Warren Averill served primarily as a teaching professor. Miles Sawyer had the charge to develop a program in sensory assessment. Ward Hunting handled teaching and research in food analysis. He worked with several other faculty to help with analytical problems and researched analytical methods for enzymatic activity.

Dr. Hamid El-Bisi described his first position in America as only Hamid could - "My glorious years at Chenoweth". He

had graduated from the University of Illinois and gone back to Egypt to remake the future of Egypt after the revolution by Nasser. Politics apparently were not Hamid's strong suit and he tells of a hair-raising escape from Egypt in 1957. He came to Amherst in 1958 to develop a program in microbiology. His research involved the mechanism of growth and control of psychrophilic and thermophilic organisms. Sterilization of food containers and space probes with ethylene oxide was all the rage at that time and his program was very well supported financially by government and industry. He designed equipment for sterilization of glass containers using ethylene oxide but it was never adopted possibly because food processors were reluctant to include an explosion hazard in a food plant. He worked with students Kyoshi Tsuji, Dick Vondell, Isaac Camber, Tom Ott, Tom Park, John Cohen, Spyros Sophianopoulos, Ernie Beltran, Gordon Fuller and Shashi Gupte.

Wassef Nawar joined the Department in 1969 and proceeded to develop a program in lipid chemistry. For the first year, he collaborated with Irving Fagerson to develop the methodology of analysis using the newer approaches of gas chromatography and mass spectrometry. For the next three decades, research projects involved 3 major areas: flavor chemistry, lipid oxidation and food irradiation.

Flavor research covered aspects of volatile identification in nutmeg oil, carbonated and alcoholic beverages, headspace analysis and vapor pressure relationships. The students involved were George Sammy, Jacqueline Fontaine, Ben Fernandez, Elizabeth

Mulley, Madeha Showhda, Sadik Al-Hakim, and Susan Bradley.

In his early work on lipid oxidation, Wassef first focused on investigating the basic mechanisms by which food lipids decompose when exposed to heat, oxygen, light, radiation etc. Systematic studies were done with relatively pure model systems, natural oils, and eventually complex foods. Students involved in lipid research were Louis Cancel, Charles Buziassy (Fulger), Ann Noble, Yao-Chi Lien, Carol Whitlock, Sema Guney, Jagadish Pai, Carol Paden, Susan Henderson, Leonard Johnson, Nancy Jewell, Elizabeth Shively, Gwen Richardson, Armand Paradis, Susan Lomanno and Chris Massaras.

Herb Hultin joined the Department in 1959 and his first efforts were directed towards revamping the existing courses to reflect an emphasis on food chemistry. He then proceeded to develop a large research program on enzymes related to maturation in bananas particularly those associated with mitochondria and proteins. He worked with graduate students Bonnie Sun, Dottie McCarthy, Bob Landers and Norm Haard. He enjoyed a post-doctorate appointment at the Institute for Enzyme Research at the University of Wisconsin and proceeded to develop a research program on myofibrillar and glycolytic enzymes and thus relationship to meat quality with students Jim Southard and Dave Stanley.

Charlie Stumbo came to Amherst in 1963 with considerable industry experience in calculation of thermal process times for commercial canning. He proceeded to develop the area particularly for High Temperature -

Short Time processes. He designed a thermoresistometer to control accurately the temperature and exposure time of microorganisms in order to calculate thermal death times. He studied the sterilization efficiency of ethylene oxide which earned him substantial funding from NASA. His favorite comment was "A space craft is just a big tin can". This was the time of the infamous vichyssoise episode of botulinum poisoning and the FDA decided to revise their oversight of commercial thermal processing. They established thermal process short courses to ensure that every factory had a qualified retort operator on duty at every shift. With a big contract from FDA, Charlie wrote the questionnaire to ask the right questions for a survey of the commercial retorting operations. Later he computerized the calculations and established the parameters for 250,000 process values ( $F_0$ ). These were later published with over 1000 pages in two volumes as a guide for the canning industry. K.S. Purohit, Dave Evans, T.V. Ramakrishnan and F.J. Francis were cooperators in this work. Charlie worked with students Robert Resende, Larry Kuzminski, Tom Blake, Reed Freeman, John Marletta, George Michael, Bob Savage, John Manson, Y. Jen, John Mann, Peter Snyder and K.S. Purohit.

Bob Levin arrived in 1964 with the charge to develop a teaching and research program in food microbiology. He concentrated on the purification and characterization of various enzymes in bacteria responsible for fish spoilage. Another important area was studies on the microbial production of gums. He worked with graduate students Remedios Silverio, Tsugi Chai, T.C. Chen, Alan Delisle, Arie Sadovski and Maria Cheng.

The transfer of 4 members of the Dairy and Animal Science Department in 1964 provided a welcome addition to the teaching and research program of the Department. Ernie Buck taught the meat courses and became the undergraduate advisor. Dave Evans became the Department resource person on food sanitation and taught Food Microbiology. His major research activity was a comprehensive investigation to determine the effect of rapid heating of milk, with very short holding times at process temperatures, on the thermal resistance of microorganisms important to milk pasteurization. These studies involved the determination of thermal death kinetics of vegetative pathogenic bacteria inoculated into milk using a commercial scale plate heat exchange pasteurization system. Employing this same equipment, additional research was done to evaluate the effects of thermal pasteurization processes on inactivating non-pathogenic milk spoilage organisms of concern to extending the shelf-life of fluid milk products. This work was in cooperation with Prof. Denzyl Hankinson and Warren Litsky. The results from this work were utilized, in part, by USPHS to establish legally defined pasteurization standards for fluid dairy products under the provisions of the Grade "A" Pasteurized Milk Ordinance.

Frank Potter became very involved in the undergraduate teaching program and a graduate course in Dairy Chemistry. Denzyl Hankinson was involved with the Dairy Technology program and particularly with extension activities. His research involved the Clean-In-Place (CIP) procedure for dairy processing equipment, the dye binding procedure

for analysis of milk proteins, and off-flavor development and control in milk. His students were Ken Gordon and John Beam.

Fergus Clydesdale joined the faculty in 1967 and initially worked with Jack Francis on the degradation of chlorophyll upon processing. Tom Mulvaney joined the Department in 1968 primarily to assume the responsibility for teaching food processing and the care and nurture of the pilot plant.

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## The 1970's and 1980's

### F. J. Francis

The prior three decades were the years of expansion, but the 1970's and 1980's could best be described as the years of retrenchment. There was also a marked change in approach at the university. The earlier years emphasized research and "Centers of Excellence" was an important theme. This Department was well-positioned because of its dominating activity in research with students at the Ph.D. level. However, around 1970 the emphasis, universitywide, changed to the importance of teaching and the "head-count" became very important. The Department reacted by developing large services courses. One introduced in 1971 by Fergus Clydesdale and Jack Francis, entitled "The Struggle For Food", enrolled about 3,200 students per year. Another, introduced by Miles Sawyer entitled "World Food Habits", enrolled about 600 per year. These courses together with a large graduate program placed the Department in the enviable

role of having a large teaching head count as well as a large research output. But the heady activist days of the 60's and early 70's were followed by the realistic economic problems of the late 70's and the 80's. The easy growth opportunities of the 1960's were essentially over.

The faculty in the 70's and 80's was Bill Esselen (1936-1975), Irving Fagerson (1949-1987), Kirby Hayes (1951-1987), Jack Francis (1954-1990), Miles Sawyer (1957-1988), Ward Hunting (1957-1988), Wassef Nawar (1959-1992), Herb Hultin (1959-present), Charlie Stumbo (1963-1975), Bob Levin (1964-present), Denzyl Hankinson (1964-1975), Frank Potter (1964-1988), Ernie Buck (1964-1990), Dave Evans (1964-present), Fergus Clydesdale (1967-present), Tom Mulvaney (1968-1971), Peter Bluestein (1972-1975), Ron Labbe (1976-present), Ray Mahoney (1977-present), Glen Brown (1978-1988, Dept. Head), Dick Mudgett (1983-present), Pavinee Chinachoti (1986-present), and Micha Peleg (1990-present). In 1972, the merger of the Foods and Nutrition Department into the Department of Food Science and Technology created the Department of Food Science and Nutrition and added eight faculty members. They were Peter Pellet, Virginia Beal, Mark Bert, Moktar Atallah, Carrie Johnson, Will Weatherholz, Dorothy Davis, and Harriet Wright. In 1988 the nutrition group was split off to form the Department of Nutrition. In 1992, the faculty of the Department of Food Science was Wassef Nawar, Herb Hultin, Bob Levin, Dave Evans, Fergus Clydesdale, Ron Labbe, Ray Mahoney, Dick Mudgett, Pavinee Chinachoti and Micha Peleg.

In the 1970's and earlier, Irving Fagerson continued to follow his interests in sophisticated methods of analysis using gel permeation, gas chromatography and mass spectrometry. Nearly all of his later research involved some aspect of GC/MS. These include oligomers of glucose, plastein protein products, carbohydrates in hard candy, volatiles in hydrolyzed vegetable protein, hydrolyzed soy protein, casein, and flavoring compounds in coriander. His students included Bob Vilece, Mary Kearns, Mike Brodnitz, Reginald Walter, Rodney Croteau, Charles Manley, Nabih Sabbagh, Mercedes del Rosario, Svend Erickson, S. Bunjapomai, Tom Szalkuchi, Paul Szalkuchi, Linda Letcher, Larry Freedman, Phil Palkert, Jean Lee, K. Mtebe, Janet Williams, Chin F. Lin, Kurt Klestadt, Avalina (Yu) Qua, Bill Fletcher, George Haloby, Marilena Uzelok, Shelly Numry, M. Yukota, Martin Cryan, Rigoberto Alvarado, Bill Draper, Hiro Toriomi, Joe Shore, Peter Thompson, John Yarmac, Tom Parliment and Mary Jane How. Tom Yasui from Japan and Ron Edwards from Australia were visiting scientists.

Jack Francis continued a large research program on pigment identification and degradation and particularly the effect on appearance, i.e. color. The work on cranberries involved effects of metals and processing on pigments and color and the development of analytical methods for determination of adulteration. The general studies on pigments involved paprika, cherries, roselle, onions, garlic, blueberries, grapes, pokeberries, raspberries, miracle fruit, mangosteen, pomegranates, and ornamental plants such as Cornus, Cotoneaster, Viburnum, etc. The later

years involved research on potential food colorants such as the pigments in blueberries, cranberries, red sweet potatoes, red cabbage and Tradescantia. The students involved were Carlos Chiriboga, Larry Freedman, Tom Philip, Peter Cansfield (Post-Doc), P.L. Wang, T.V Ramakrishan, C.T. Du, Anil Shrikande, Reginold Buckmire, Phil Calvi, Dick Metivier, Andy Moore, Mary Lee Hale, Yvette Bassa, L.S. Teh, Min Lin, Susan Gabriel and Zulin Shi. Jack Francis was Department Head from 1971-1977.

In the 1980's Wassef Nawar shifted his emphasis after it became clear that oxidative reactions in biological systems are greatly influenced by the presence of other lipid and non-lipid neighboring molecules. With support from several government and industrial grants, focus gradually shifted to lipid-protein interactions, oxidative-antioxidative balance, cholesterol oxidation and oxidative reactions of membrane lipids. The students involved were Lung-Bin Hau, Michele Bronstein, Frank Bunick, Vincent Donndelinger, Pei-fen Wu, Sheryl Hutchinson, Michael Bradley, Zhenhy Chen, Carol Wilhelm, Sunki Kim, Yong-Jing Li, A.R. Hammouda, Xua Xing, Joss Dore, and Wen Zhang.

After World War II, there was great interest in ionizing radiation as a means of food preservation. A major problem was the development of off-flavor. With grants from the Atomic Energy Commission, NIH, the U.S. Army and the U.S.D.A., Wassef proceeded to study the effects of irradiation on food lipids, worked out mechanisms for the radiolysis of fats, and developed methods for the detection of irradiation treatment in foods. His laboratory was

one of the very few in the world which were active very early in this field of research. Sponsored by the International Atomic Energy Agency, he was selected to coordinate international testing of detection methods with 20 laboratories in various Countries. Students involved in irradiation work were Milan Dubravcic, Paul Letellier, Joseph Champagne, John Balboni, Javad Meidani, Mehran Vajdi, Philip Handel, Stanley Kayser, Zhenrong Zhu, Hong Wan and Tom Aciukewicz. Wassef also hosted a large number of international students, researchers and scholars who spent various periods of time training in his laboratory.

During his tenure at the Department Wassef taught Food Chemistry, Lipid Chemistry, Seminar and part of the service course "Struggle for Food".

Herb Hultin continued a very active program in the study of the glycolytic enzymes during the first half of the 1970's. The emphasis in this program was in determining how the structures and conditions found in the muscle cells would affect the functioning of the enzymes. The students involved with this were Shawky Dagher, Ron Melnick, Grady Chism, Poedijono Nitisewojo, Bob Ross, and Sumesh Hirway. Joan Ehmann, working as a research assistant while husband Ed was a graduate student, also contributed significantly to this research.

Work on the solubility of myofibrillar proteins and their role in muscle properties was carried on ably by Ed Commissiong in the early 70's and has been picked up again in the 1990's by Jennie Wu, Krishnamurthy Ganesan, Gudmundur Stefansson and Hsin-Sui

Chang. To give some balance to the program, Donna Fafard (Anderson) determined protein extractability from alfalfa chloroplasts.

Two major areas of research began development in the early to mid 1970's. Interest was running high in the use of immobilized enzymes for food processing. Doug Chapman, Jim Bouin, Frank Bliss (tragically deceased at an early age) and Bruce Wasserman were instrumental in this work, ably supported at the time by undergraduate student Kirk Parkin and post-doctoral fellow Mokhtar Atallah. The second area was lipid oxidation. The interest in lipid oxidation began somewhat accidentally when Sundaram Govindarajan got some strange results while studying pigment and lipid oxidation in beef muscle that indicated that there was an enzymic system involved in the oxidation. This was shown by Tzong-Shin Lin to reside in the microsomal fraction of chicken breast muscle, a result contrary to the accepted dogma of the day. Tim Player then followed with a detailed study of the characteristics of the system. As of September 1, 1978 Hultin was assigned to the Marine Station to develop a program in marine foods. Thus, interest shifted to lipid oxidation in fish muscle. The students in this area included Rich McDonald, Rob Shewfelt, Marty Apgar, Shih-Wuu Luo, Barbara Halpin, Kathie Kramer, Joanne Osinchak, Chen-Huei Huang, Jia Tian-Dong, Eric Decker and Dave Petillo.

Another major area of interest in marine foods addressed at this time was the reaction of TMAO and its breakdown products with proteins and the impact on the texture of frozen fishery products. Lorie Landolt, Maria Banda, and Yaw

Owusu-Ansah were instrumental in defining the effect on fish muscle tissue while Kirk Parkin and Brian Phillippy made impressive strides on the mechanism and enzymology of the reactions. The students involved were Lorie Landolt, Maria Banda, Yaw Owusu-Ansah, Kirk Parkin, Brian Phillippy, Jit Ang, Stephanie Folger and Srinivason Subramanian.

These describe the major research thrusts of Hultin over the past three decades but several other ventures into the unknown were carried out for a variety of reasons. Dale Logsdon studied chilling injury in tomatoes while Ken Baseman evaluated changes in color of beef muscle post-mortem as it was affected by enzyme systems. Barbara Rasco and Bill Racicot looked at the recovery of fish enzymes (lipases and proteases) from fish processing waste with a view to evaluating their appropriateness for use in food processing. Jin-Der Kuo carried out a study of squid texture as related to collagen content and fiber orientation and was able to recommend some practical procedures for improving squid texture. Nelson Ferreira developed a process for reducing the viscosity of ground fish waste with the use of an acidic protease; this process is currently in commercial use.

Post-doctoral associate Manouchehr Borhan investigated the antioxidative components of fish muscle (and married fellow researcher Barbara Rasco). Marilyn Erickson was a post-doctoral associate who contributed to our understanding of the role of iron chelating agents in the oxidation of fish muscle lipids while post-doctoral associate Sajida Jafar worked on an

antioxidative system to greatly increase the shelf-life of mayonnaise prepared with fish oil. Practical applications of protein solubility and lipid oxidation studies were made by post-doctoral associates Hussain Bakir and Joshua Opiacha. Their work greatly expanded the number of fish gels and showed the practicality of using antioxidative systems in producing high quality, stable fish gels from fatty species. As part of the expansion of the marine foods program, Steve Kelleher was appointed as Extension Specialist and assigned to the Marine Station in 1987. Steve, a graduate of the Department with a Master's degree from Cornell University, has been instrumental in several research areas, but particularly in developing methodology for producing stable minced fish products from fatty fish species.

Bob Levin continued his research interests in microbiology, particularly in a broad-based teaching and research program in genetic toxicology. This involved the mechanisms of antibiotic activity with *Listeria monocytogenes* and the relationship between marine bacteria and the dinoflagellated algae responsible for the production of paralytic shellfish toxins and bacterial fermentations of fish hydrolysates. His work also involved a number of other microorganisms and also the toxicology of caffeine. His students included Richard Stevens, Camilla van Sickle, George Carmen, Susan Saxe, Candice Biggs, Matthew Zaya, Ibrahim Markarios-Laham, Karen Blom, Jung-Ho Kim, Lih Fang Lin and Radu Giurca. Padam Rastogi, Anwar Hamma and Robert Lucas were Post-Doctorates at that time.

Ernie Buck became an Associate Dean in 1969 and returned to the Department in 1976 where he became the undergraduate advisor. His research interests were in low temperature processing of beef, production of surimi, and hot dog analogs with students Keriakis Veraltsis (Post-Doc), Ann Hickey, Carole Hennigar, Jeanne Holmquist, Gary Wernstein, Rick Fafard and Mark Di Nardo.

Dave Evans continued his studies on evaluating thermal processes and factors relating to microbiological food safety issues and food quality. For example, he investigated the ability of selected chemical and biological indicators to monitor steam sterilization conditions and to determine the ability of these devices to determine that the time-temperature requirements for steam sterilization have been achieved. He extended studies initiated by C.R. Stumbo, following his retirement, on thermal death kinetics of *Clostridium botulinum* spores in various low-acid foods, under contract for the FDA. This involved evaluation of heat penetration and thermal process schedules for low acid foods in glass containers processed by still retorts. This work was supported by the Glass Packaging Institute and the data obtained were utilized in revision of the NFPA Bulletin 30-L "Processes for Low-Acid Canned Foods in Glass Containers".

Two innovative processes were studied. The first concerned the application of ultrasonic radiation as a mechanism for inactivation of vegetative microbial contaminants of foods. The second involved the utilization of gas plasma as a mechanism for inactivation of microbial surface contaminants of rigid

food container surfaces. Success was achieved, with limited applications, with both of these processes on a pilot scale. However, neither of these processes was found to be cost effective when compared to present technologies that achieve the same end result.

Graduate students included: Wen Chin Lou, Alicia Loffler-Ottino, Barbara Eckstrom, Peter Erickson, David Poust, Matthew Zaya, Andrew Welt, Deborah Yuu, Katayoun Ehsani, and Yolanda Jove.

Fergus Clydesdale's first research area in collaboration with Jack Francis was a continuation of his Ph.D. research on color measurement, chlorophyll stability and pigment degradation. This led to studies on the role of organic acid formation and total food quality. The students involved in this area were Jeff Main, Yi Do Lin, Linda Wisnowski, Donna Jara, Nai Chu, Brad Eagerman, Tom Bibeau, Len Johnson, Ed Ehman, Aurora Hodgson and Don Coffey. After a sabbatical at the University of California at Davis, Fergus returned to start a research program on the nutritional aspects of food processing. This evolved into studies on fiber and mineral availability with iron, zinc, magnesium, copper, calcium, etc. This led to attempts to develop complexes which would increase iron bioavailability and some of them were adopted commercially. Studies were started evaluating physiological effects of mineral-fiber complexes on bile acids which could lead to lower blood cholesterol and reduced risk of colon cancer. The students involved in this aspect were Steve Nojeim, Alex Camire, Steve Rizk, Steve Platt, Sheila Flynn, Doug Nadeau, Sandra Gifford, Helen

Roth, Christine Bonner, Mary Ghia, Noel Anderson, Ken Lee, Lee Anne Eyerman, Andy Taylor (visiting Prof. England), Theresa Desrosier (Post-Doc.), Tira Pandolf, Doug Philipsen, Kristen Barner, Liisa Holcombe and Takeshi Suzuki (Visiting Professor). Fergus Clydesdale was appointed Department Head in 1988.

Ron Labbe joined the Department in 1976 and proceeded to develop a research program in microbiology. This involved primarily the physiology of growth, sporulation, germination and the production of enterotoxin in *Clostridium perfringens*. His group studied the enzyme responsible for the above physiology and also those in the spore coat. They also characterized the extracellular and intracellular proteases produced by *C. perfringens* and suggested a role for each. Apparently, caffeine can dramatically stimulate sporulation and enterotoxin formation and a likely mode of action was identified. Later work dealt with the production of amylases and the effect of temperature on growth rate. The latter has implication for food sanitation since under some conditions, *C. perfringens* can grow faster than any other bacterium. The students involved were Tom Franceschini, Hsiao-ping Lu, Sangryeol Ryu, Dave Rey, Mary Dillon, Kyong-Bin Park.

Ray Mahoney joined the Department in 1977 and proceeded to develop a program in enzymology. His first project was to study lactase which transforms lactose into glucose and galactose. This reaction has implications for lactose intolerant individuals and also for whey disposal. His group isolated a lactase from yogurt and studied its mode of

action and stability. The lactase work was expanded to include a galactosidase to remove unwanted oligosaccharides from soy milk. Related areas in protein chemistry were peptides which inhibit pectic enzymes and those which enhance iron bioavailability. The students involved were Norman Greenberg, Byeong Chang, Sanjog Surve, Nancy Rawson, Michael Annunziato, Paul Howard, Li-Kuang Huang and Anahita Seth.

Dick Mudgett came to the Food Engineering Department in 1974. His interests were in microwave food processing and solid state fermentation. While in Food Engineering, he developed predictive models for temperature distribution for microwave heating with students Rupak Bajracharya, Sunil Swami and Mike Keenan. Other studies involved hydrolysis of soy sugars, leaf protein recoveries, fungal growth rates in solid state fermentations with students Richard Schuler, Krishnamurthi Rajagopalan, and Jeff Nash. He continued the same type of research after transferring to the Department of Food Science and Nutrition in 1984. These included lethality profiles for microwave pasteurization of apple juice, solid state fermentation for the breakdown of lignin, solid-state fermentation for chlortetracycline synthesis, pigment synthesis in *Monascus* in the solid state, synthesis of vitamin B12, and intracellular synthesis in food products. The students involved were Anne-Marie Foley, Armand Paradis, Mary Jane How, Chantaek Han, Maria Medina-Pizzali de Gates and Paramedav Supiramanian.

Dr. Chinachoti joined the Department of Food Science at the University of

Massachusetts in 1986. Her research area of interest is on water mobility and its relationship to food stability. She has developed a research group conducting studies in food textural quality and the role of water plasticization. The research activity mostly involves physicochemical changes in food such as starch gelatinization and retrogradation, glass transition, and moisture migration in food. The role of microbial food safety is also being investigated.

In collaboration with Professor Thomas Stengle of the Chemistry Department, she has developed a means to measure water mobility by NMR (nuclear magnetic resonance). The goal is to correlate NMR with various food properties, such as plasticization by water (texture), moisture migration, mold germination and bacterial growth. Many interesting results have been achieved. For instance, it was found that bread staling involves a certain degree of moisture migration not between amorphous and crystalline matrices only but also among amorphous components. This lab was the first to report the role of glass transition during bread staling by using DMA (dynamic mechanical analyzer).

Bread staling is related to a combination effect of starch retrogradation, glass transition temperature and the amount of freezable/unfreezable water. Water mobility plays a role in plasticization. Bread textural properties were studied by stress-strain analysis and recoverability measurements which allows one to understand the cellular (foam) properties of bread and the effect of anti-staling additives. When water NMR mobility was correlated with mold germination, mold was found to be less

important than water mobility. Current research is to correlate water mobility in wheat gluten with glass transition temperature and water permeability through gluten films. Applications of this work include bread staling, microwave toughening of dough systems, moisture migration problems, edible films, microbial food safety and ingredient technology (e.g., fat substitutes). Other research involves extraction of solids from ground fish by-products, pectinase enzymes in ultrafiltration performance, and stabilized dairy fat for the military. The students involved were Linnea Hallberg, Leah Lo, Amos Nussinovitch (Post-Doc), Matt Steffens, Pramila Rao, Mal-Shick Kim-Shin, Yang Kou, George Cherian, Sungmi Chung, Maria Rodriguez-Estrada, and Woraluk Ang.

Ward Hunting, Miles Sawyer, Frank Potter and Peter Bluestein maintained primarily a teaching program in this era. Denzyl Hankinson continued his teaching program and also the CIP (Clean-in-Place) program for the dairy industry. Charlie Stumbo continued to teach the course. Thermobacteriology and Food Processing which was later taken over by Dave Evans.

Micha Peleg, a former member of the Department of Food Engineering, joined the Department in 1990. His research interests involve the development or adaptation of objective methods for mechanical characterization of solid foods based on engineering principles. These include the following: The mechanics of "soft machines" have been analyzed as a means of elucidating the performance of the human sensory system in textural assessments. Mathematical and computer aided

methods have been developed for analysis of mechanical, morphological, sorption and kinetic data of foods. Lubricated squeezing flow viscometry has been introduced as a means of avoiding artifacts in rheological evaluation of semi-liquid foods. Objective methods have been developed to evaluate physical stability of food powders (caking and segregation). Models have been developed for analysis of particle size distributions in size reduction and enlargement operations.

### **Addendum**

The 1990's have seen a resurgence of Departmental activities and achievements. After undergoing the budgetary crisis of the late 1980's, along with every other institution in the U.S., we have emerged strong and more creative than ever.

This has been, in large part due to a faculty effort which created a strategic staffing plan for the future. We were able to finalize their plan in 1995 after hiring four outstanding young scientists who, along with our senior faculty, are focused on studies on the molecular basis of food and health.

In 1993 Dr. Eric Decker and Dr. Kalidas Shetty joined us. Dr. Decker's research involves the characterization of natural antioxidants, including the skeletal and neural tissue dipeptides, carnosine and anserine. He has also been involved in research involving lipid oxidation catalysis and antioxidants in muscle foods, development of methods to maximize the concentrations and stability of functional food ingredients in processed foods and fundamental

research on how lipid interfacial properties influence oxidative reactions. In addition, Dr. Decker has, and is, actively collaborating with other scientists to investigate the role of antioxidants, lipids and lipid oxidation products on the molecular basis of disease and the prevention of tissue damage during exercise.

Dr. Shetty's research is in food, plant and environmental biotechnology focusing on the molecular and physiological regulation of phenolic metabolites through the regulation of the proline linked pentose phosphate pathway. These studies are at the cutting edge of basic research while having important broad implications in food through the production of preservatives and functional ingredients, in tissue culture through the production of elite clones and in the environment by creating clean-up systems by optimizing phenolic aglycone synthesis. Dr. Shetty also has broad geographical interests, expanding our research network into the Asia/Pacific Area and bringing great new potential for comparative studies and economic development.

In 1994, Dr. D. Julian McClements joined the Department bringing a new and exciting focus in the physical chemistry of food. His research interests include the ultrasonic characterization of food materials, studies in food biopolymers and colloids which focus on emulsions, gels and micellar systems, protein functionality and physicochemical properties of lipids.

In 1995 we completed our staffing plan with the hiring of Dr. Lynne McLandsborough, a food microbiologist. Dr. McLandsborough's expertise is in

bacterial genetics and she is applying this knowledge to the area of food microbiology with an emphasis in food safety and pathogenesis of food borne bacteria. Current research interests include rapid detection of pathogens in foods and bacterial adherence mechanisms in foods and food fermentations. In the area of rapid detection of bacteria in foods she is developing detection methods using PCR, immunoassays and unique bacteriological media formulation for the isolation of food borne pathogens. She is also interested in the genetics of lactic acid bacteria, application of lactococcal bacteriocins as food preservatives and use of these organisms as human probiotics.

As a result of these new hires in combination with our more senior faculty we have developed a team approach to research, which is expressed in nine Centers of Excellence: Environment, Food Biopolymers and Colloids, Food Biotechnology, Food Safety, Health Science and Functional Foods, Physical Properties, Production and Process Development, Regulation and Seafood Processing. This focus has led to the development of a Strategic Research Alliance which boasts a membership of 10 major industrial companies within several months of its inception.

Concurrent with these events, Dr. Fergus Clydesdale, who assumed the Department Chair in 1989, appointed an Advisory Board of alumni who have top leadership positions in industry, government and academia. With their support the Department began a drive for a \$1 million dollar endowment to celebrate its 75th Anniversary in 1993.

This endowment was successfully concluded in 1996.

We are a Department with a proud history of successful alumni and we keep in touch with them through biannual Alumni weekends which began in 1990, a twice yearly Newsletter, personal visits and of course the Annual UMass IFT Breakfast.

Everything is now in place for a successful entry into the 21st century and we are all enthusiastic and highly optimistic about the future of this wonderful Department.

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### **The Undergraduate Program**

Many of our undergraduates who received a B.S. degree in the past 75 years have gone on to illustrious careers in the profession. Many have gone to graduate school at UMass. and other institutions while others pursued their professional career directly after graduation.

The Index (the student yearbook) and the University of Massachusetts Annual Reports provide some insight into the early years of the Department Walter Chenoweth, who joined the faculty in Pomology in 1912, was asked in 1913 to give a talk to the local fruit growers on preservation of horticultural products. He proceeded to develop short courses (2 and 4 weeks) on preservation, canning, fermentation, etc., and they became well accepted both with students in other options and in the extension program. The offerings were expanded primarily for students in the Pomology option until sufficient courses were

available to offer a four year undergraduate major. The name "Horticultural Manufactures" was adopted possibly because a similar program entitled "Dairy Manufactures" was already well established The Index of 1933 provides the first mention of this option. Two students, Walter Maclinn and Clifton Ahlstrom were listed as seniors. Walter Maclinn stayed on to get an M.S. in 1935 and a Ph.D. in 1938. He later became the Dean of Agriculture at Rutgers University. The years 1933 to 1940 produced 20 graduates, and the program gained momentum. The years 1941-1942 produced 20 more but the years 1943-45 had only seven graduates. The class of 1943 was the last of the "Hort Man" graduates since the class of 1944 graduated in the Food Technology option. The decade 1946-55 had 113 graduates and the organization of the IFT Student Chapter No. 1 with a charter granted in May, 1950. Enrollment decreased somewhat in the 1956-65 decade to 90 students. In the 1966-75 decade there were 130 graduates. The 1976-85 saw a further increase to 154 with a high of 35 in 1977. Then enrollment started to fall through the next decade with 46 students graduating. In 1994, two new options, Food and Environmental Safety, and Food Technology Management, were implemented in addition to the conventional food science option. Our student numbers began to rise. We currently have 41 undergraduates and we continue to grow

The Department was involved from 1937 to 1955 with the two year program in Hotel Stewarding, which then expanded into a four-year program. This option was separated from the Department of Food Science and

Technology in 1969 and later became the Department of Hotel, Restaurant and Travel Administration. Another two year program, Food Processing Technology, was started in 1965 when the Dairy and Animal Science Group was integrated with the Food Science faculty. This program was discontinued in 1975 due to lack of demand.

We have some indication as to where the graduates went after graduation, since the 1955 edition of Food Folks lists 131 graduates with a B.S. degree. This number, of course, does not include normal attrition, or those who obtained another degree, or left the profession for one reason or another. The 1955 edition actually contains 270 names. The 1977 edition lists 332 names with a B.S. degree only and 924 overall.

This brief account really does not do justice to the undergraduate program in view of its obvious importance to the activities of the Department. But our information is limited to events described in the Index and the Annual Reports of the University. Both are very sketchy.

succeeded by a long series of illustrious alumni. Abe Naoum, from Basrah, Iraq (M.S. 1934), was probably the first foreign graduate student followed by Vladimir Jancik (Ph.D., 1938) from Czechoslovakia. It is an interesting observation that the early research prowess by the faculty was attracting the attention of foreign students so soon after the formation of a graduate program. This interest remains today and over half of the Department's alumni have been from other countries. Currently we have 50 graduate students and just graduated another 16 M.S. students in the new off-campus program.

We have attempted to trace the graduate students through their association with the research program as described in the preceding sections, but certainly we have missed some and for this we apologize. The last issue of Food Folks, published by Jack Francis in 1977, contains 924 names. However, we still keep in touch with a Newsletter which began in 1989 and has been issued twice a year since then.

Content last updated: February 12, 1997

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## **The Graduate Program**

The enthusiasm for research instigated by Carl Fellers stimulated the development of a graduate program in 1930. The first M.S. candidates were Francis Griffiths and John Clague, both with an M.S. degree in Horticultural Manufactures in 1932. In 1933, the Index listed six graduate students, and the program was off and running. Francis Griffiths was the first Ph.D. candidate, awarded in 1935, and he was