

Mary Engle Pennington, Food Refrigeration Engineer

Karl D. Stephan
Dept. of Electrical and Computer Engineering
Univ. of Massachusetts Amherst
Amherst, MA 01003

One evening not long before the due date of this paper, as I pondered, weak and weary, over volumes of forgotten copies of *Ice and Refrigeration*, I put my head down on the library carrel and closed my eyes. I was awakened (or so I thought) by a touch on my shoulder, I looked up to see a woman of indeterminate age, slightly shorter than average, who was wearing a gray silk dress, a cloak, and a single string of pearls. She looked at me intently through rimless glasses, identified herself as Mary Pennington, and asked me if I was going to the ASEE conference in Washington next June. When I replied in the affirmative, she asked me to convey her greetings to all of you. I should explain that she is no longer able to attend in person, having passed away in 1952 at the age of eighty. But in the dream (for that it what it was), this fact troubled me not at all, and I proceeded to interview her for the next hour and a half.

During our conversation I found that I wasn't able to tell her much that she didn't know already about the current status of engineering in her field. In her former life she was an expert in the refrigeration of foods, but where she lives now it seems that decay is no longer a problem. So she spends much of her time talking with the recent arrivals and keeping up with progress in refrigeration around the world.

The recent development that pleases her the most is the fact that millions who live in the hottest parts of the world can now hope to benefit from the refrigeration of food, as electric utilities and home refrigeration spread throughout southern Asia and sub-Saharan Africa. Then she asked me how international compliance with the Montreal Protocol was going, and I had to admit I didn't know. It turns out that the Montreal Protocol is the international agreement to reduce and ultimately eliminate the production of chlorofluorocarbons which harm the ozone layer. She told me that she feels in some small way responsible for CFCs, and I asked her why.

“Well, as you may recall, Thomas Midgely, fresh from his discovery of the lead additive for ‘ethyl’ antiknock gasoline, developed the first chlorofluorocarbon refrigerant when he was working for Frigidaire in Dayton, Ohio, in 1930.¹ At the time ‘freon’, as it came to be called, was hailed as a triumph of modern applied research. Frigidaire and the other manufacturers soon began to use it in mechanical domestic refrigerators. My work made refrigerated foods more widely available. As the market for mechanical refrigerators grew rapidly, so did the use of CFCs.”

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 “By ‘mechanical’ refrigerators, you mean ones that run on externally supplied power, such as electricity or gas?”

“Yes.”



“Did the invention of CFCs make the household mechanical refrigerator possible?” I asked her.

“Heavens, no,” she replied. “People were tinkering with electrically-powered home refrigerators since before 1900. But the average housewife had neither electricity installed in her home, nor the expertise necessary to operate a small compression refrigeration plant filled with pure anhydrous ammonia gas as the refrigerating medium. You can imagine the consequences if your machine happened to leak. Later the manufacturers switched to sulphur dioxide, which is a substance scarcely less unpleasant than ammonia. The main drawback to all mechanical refrigerators before about 1935 was cost. They were much more expensive than the alternative.”

“Which was?”

“The old-fashioned icebox filled by the ice man. Every few days in the spring and summer, he would arrive at your back door with a twenty-five or fifty-pound cake of ice in his tongs. The natural ice trade made ice available to many Northern cities before the Civil War, and when steam-powered refrigeration machinery was invented not long afterward, ice manufacturing plants spread throughout the country. But back then the system, if you could call it that, was far from satisfactory. As late as 1925, the average home icebox was just that: a crudely constructed wooden container, often with no more insulation than a packing crate would provide. The uninformed housewife purchased a cake of ice every few days with the hope that food kept inside her icebox might stay a few degrees cooler than the ambient temperature in her kitchen. And all too often, even that hope was denied, with the result that lettuce or eggs which had traveled thousands of miles, perhaps, in refrigerated boxcars carefully maintained at the proper temperature, came to bad ends in an improperly designed and insufficiently iced refrigerator, and had to be thrown out.”

She was clearly speaking of something close to her heart. I had done a little reading on her career, so I was able to ask her next, “You had something to do with those refrigerated boxcars. You performed some of the first scientific studies of refrigerator car cooling efficiency, starting around 1910. Did you actually ride in the refrigerator cars to check on temperatures en route?”

“of course not. That misunderstanding came from an inaccurate news story filed by an inexperienced reporter. Once the thermocouples were in place and the car was iced and loaded, my staff and I retired to a private car just ahead of the caboose and monitored conditions from there.”

“What were your findings?”

“Many so-called ‘refrigerator cars’ of that era were not worthy of the name. For example, a car with less than three inches of insulation all around was practically useless in preserving a load of fruit. We published a series of circulars in which we described the specifications for a properly designed car, but the manufacturers were reluctant to change their ways. Widespread improvements came only when Uncle Sam, in the form of the U. S. Railroad Administration, tapped the railroads on the shoulder during the first World War and said in effect, ‘You WILL build according to these standards.’”²

At this point I began to wonder how a woman, even of Mary Pennington’s evident energy and talent, was able to attain such a position of responsibility and authority. So I asked her, “At that time you were with the U. S. Department of Agriculture. What was your title at the USDA, and how did you get the job?”



“I was the first Chief of the Food Research Laboratory, which was part of the Bureau of Chemistry under Dr. Harvey Wiley. At first I didn’t want the position at all. In 1898 I had founded the private Philadelphia Clinical Laboratory for the purpose of providing the city’s doctors with bacteriological analyses. A report we **furnished** on the condition of the city’s milk supply led to an offer to superintend the laboratory of the Philadelphia health department, which I accepted. So I had my hands full already when Dr. Wiley invited me to join his staff in 1907. But he was an old family friend, and very persuasive. Only the year before, he had succeeded in securing the passage of the federal Pure Food and Drug Act, and was eager to hire workers to help him do the research needed to enforce it properly. When I found out that he had put my name down on the list of applicants to take the appropriate civil service examination without asking me first, I was mad as wrath.”

“Why was that?” I asked her. “Were you afraid they would turn you down because of your sex?”

“As it happened, the examiners had no chance to be influenced by that particular factor. I simply signed the examination papers as ‘M. E. Pennington.’ And when Dr. Wiley received word that M. E. Pennington was the examining board’s first choice, he immediately set me up with an office and a stenographer right there in Philadelphia. By the time the people in Washington found out they were dealing with a Pennington named Mary, not Michael or Martin, I was already at work. ”

“So you were simply the most qualified candidate for the job.”

“In their estimation, yes.”

“What were your qualifications, if I may ask?”

“I received a doctorate in chemistry from the University of Pennsylvania in 1895. Then I went to Yale on a fellowship to study biological chemistry.”

“Women with Ph. D.’s in chemistry were not too common back then. How did you get accepted into the University of Pennsylvania?”

“Actually, it was not too difficult to obtain permission to take classes back then. There were always a few professors who would **allow** a woman to attend their lectures. A degree was another matter altogether. At the end of three years of study in biology and chemistry I had **fulfilled** all the requirements stated in the catalog for the degree of Bachelor of Science. But when the school’s board of trustees found out about it they **refused** to grant me the degree.”

“Simply because you were a woman?”

“I never obtained a satisfactory answer from them, but there was no other reason I could see for their refusal. At that juncture one of my professors discovered a disused college statute which empowered the faculty to grant certain degrees without the approval of the board of trustees.”

“So is that how you got your bachelor’s degree?”

“No, the only degree that could be so granted was the Doctor of Philosophy. I was only eighteen at the time, so my professors and I agreed that if I waited until I was at least twenty-one to apply for my doctorate, they would see to it that I was treated fairly. It actually took me four years after that. So without



really planning to do so at the outset, I received a doctorate in biological chemistry at the age of twenty-two."⁴

I said to her, "It was either that or write off your studies altogether."

"Precisely," she replied.

I knew that **after** her time of government service Miss Pennington had operated a successful private consulting business for the remainder of her career, I asked her, "This business of refrigerator cars, cold-storage warehouses, ice plants, and so on seems such a man's world, even today. Did you find that your status as a woman made your consulting work harder?"

"Not really," she replied. "It is a difficult question to answer, because at the time there were few people, either male or female, doing the kind of work I did. When I first developed an interest in refrigeration, many of the food transportation and storage industry's practices were based on nothing more substantial than tradition and guesswork. As you can well imagine, the excess spoilage, waste, and consequent needless expense was **frightful**. When someone came along who could show the shippers and warehousemen how to increase their proportion of marketable delivered goods, and thus raise their business volume and profits accordingly, the sex of the consultant was the last thing on their minds."

"Your consulting work also involved a good bit of public relations for the ice industry, didn't it?"

"You must be referring to my Household Refrigeration Bureau bulletins. The work of the Bureau was indeed funded by the National Association of Ice Industries."

"So the bulletins were a marketing ploy to increase ice sales, basically."

"Some individuals within the ice industry may have viewed them only in that way. But to me they were an opportunity to educate the public about the whole issue of food refrigeration, so that the wasteful and dangerous practices of the past could be replaced by methods of refrigeration based upon sound scientific principles. When I began my work for the Association I insisted upon substantial changes in that portion of their public relations under my control."

I asked her about what sort of changes she made.

"The **icemen**---they always called themselves that, so I might as well---as I say, the **icemen** were a curious lot. Their educational backgrounds were uneven. Some of them were quite advanced in their thinking and willing to adopt modern business methods, but others had a sort of mystical faith in the ice business and believed that if you just told the public romantic stories about ice, that this would somehow inspire them to buy more and everything would be fine. It was these latter ones that were mainly responsible for the motion-picture extravaganzas they were sponsoring about the time I began my work for them."

"What motion pictures?"

"This was in 1923. Their Trade Development Bureau had just paid a tidy sum for a film entitled 'The Romance of Ice.' It had such stirring scenes as the one in which the Muslim chieftain Saladin served the crusader King Richard the Lion-Hearted the first sherbet ever tasted by an **Anglo-Saxon**.⁵ Or so they



claimed. When I saw what they were doing with their money I told them I could help them spend it in a way better calculated to inform the public rather than merely entertain them. I showed them how, for the price of that picture, they could print thousands of neat, informative sixteen-page booklets that explained ice in a practical way that would be of use to the average consumer.”

“And they went for it.”

“Absolutely. From 1923 to 1931 the Household Refrigeration Bureau sent out about twelve million brochures in all.”⁶

I asked her how they were distributed---by direct mail?

“No. We never sent out a brochure unless we knew it was wanted. Instead, we compiled a list consisting of home economics teachers in the colleges and high schools, county extension agents, members of the American Dietetics Association, and others in the educational and medical professions who were likely to be interested in home refrigeration, amounting in all to some 17,500 persons.⁷ Each person received a letter containing a card that could be used to request any reasonable number of our brochures, free of charge. The response was amazing---in the peak years of 1926 and 1927 we were sending out many thousands of bulletins each month. The typical request was for dozens or hundreds for use in the classroom. I suspect that nearly every young woman taking a home economics course anywhere in America during that time received one of our brochures. As part of this work I conducted a one-week Home Refrigeration Bureau school at the University of Chicago, to train the staff of the ice companies about the basics of food preservation and refrigeration---the same matters covered in our brochures. ”

“With such a booming business, why did the Bureau close?”

“The Depression put an end to it all in 1931. But by that time most of the work had been done. Only seven years later, despite the terrible economic stresses of that time, four out of every five homes in the country had refrigerators.⁸ Unfortunately for the icemen, three-fourths of those were mechanical ones, that is, electrically operated. The icemen's domestic business went into a decline from which it never recovered.”

“Do you feel you contributed to that decline? It sounds to me as though your emphasis on science may have led many people to buy the most ‘scientific’ refrigerators of all, namely electric ones. But the icemen hired you to help their business, not ruin it.”

“I believe that our efforts postponed the inevitable, rather than hastening it. There is a phrase that some of you younger people use: ‘consciousness-raising’. Through the Household Refrigeration Bureau I raised the public’s consciousness of refrigeration in the home. And their consciousness, or rather, conscience, was fairly tender on some points.”

“Such as?”

“One of our most popular brochures was entitled ‘The Care of the Child’s Food in the Home.’ Mothers were desperate for information about how to keep their young ones healthy, and if keeping milk in a refrigerator would do it, a refrigerator they must have.”

“But did it have to be an ice refrigerator?”



“Either an ice refrigerator or an electrically-powered one was capable of keeping food cold enough, as long as it was properly designed.”

“If the electric ones were so much more expensive, why did they prove so popular?”

“Several reasons, I think. For one thing, the ratio of a good mechanical refrigerator’s purchase price to that of a good ice unit declined from ten-to-one to only about three-to-one. And money wasn’t the only factor. Convenience was important. An electric refrigerator meant no iceman tracking muddy footprints on your clean kitchen floor on his way to the icebox. Finally, there was the mystique of the modem. Mechanical refrigerators were the coming thing; iceboxes were perceived as a thing of the past.”

“Did you ever retire?”

“I stayed as active as my health and resources would permit, right up to the end. Although business slowed during the Depression, the second World War provided me some opportunities to serve Uncle Sam again. I advised the research and development branch of the Quartermaster General’s office, and also the Food Control Division of the War Shipping Administration.”

At this point I felt that Miss Pennington’s career had been reasonably well covered. Now was my opportunity to ask a question about her personal life.

“You never married. Why not?”

“You must understand what marriage meant back then. In the course of my work I had dealings with a few professional women, most of them younger than I. In almost every case the words ‘I do’ brought an abrupt end to their professional lives. Now mind you, I have nothing against the institution of marriage. But my interest in science, my desire to know how the world of invisible living things affected the world we see, and my hopes that somehow I could use this knowledge to make the world a better place---all that took precedence over such desires for matrimony as I may have had.”

“So as you saw it, marriage and your career were mutually exclusive?”

“Yes. I chose to enter my profession and to forego marriage, which decision I do not regret in the slightest.”

“Did you ever participate in what is now called the feminist movement?”

“I knew some suffragettes and other women active in progressive causes, and for them political activity was as all-consuming a passion as my own profession was for me. But I eschewed politics myself and considered it a distraction. That was one reason I kept the Department of Agriculture’s Food Research Laboratory in **Philadelphia**, away from the political intrigues in Washington.⁹ When the Nineteenth Amendment was adopted in 1920 I was glad at last to vote for representatives to the government for which I had worked. Other than that I took no active part in politics except to make annual requests for my laboratory’s appropriations, as long as I worked for Uncle Sam.”

“In closing, is there anything particular you wish to say to American engineering educators of the year 1996?”

“You must always keep in mind that engineering should be performed for the betterment of mankind. I am **grateful** that I was born at a time when I was able to teach the people of my native land some facts that enabled them to live safer and better lives. My work is done now, but there are millions more who need to learn the same lessons, and who can benefit from the same advances. I would leave you with a thought I expressed in a talk to the Massachusetts Ice Dealers’ Association many years ago. I was speaking about the ice business, but what I said then applies as well to engineering. It was this:

‘There must be service, service, service, unselfish, because the Bible was quite right when it said that as you lose yourself, you shall **gain**.’¹⁰

The author hopes that this imagined conversation with Mary **Engle** Pennington has communicated something meaningful about this most remarkable woman engineer. Since in this work of historical fiction I have mixed together many facts with a few suppositions, the reader interested in a strictly factual treatment is referred to the articles by **Heggie**¹¹ and **Pierce**¹² as well as mentions of her in the classic comprehensive work by **Anderson**.¹³ At the conference the talk will be accompanied by slides illustrating various aspects of her career and the engineering and social environment in which she worked. The author plans to offer a course on engineering for non-engineering majors in which the activities of engineering personalities such as Pennington will be a prominent feature.

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KARL D. STEPHAN

Prof. Stephan's career includes studies at Caltech (B. S.), Cornell (M. Eng.), and four years in industry. He obtained his Ph. D. from the University of Texas at Austin and is presently associate professor in the Department of Electrical and Computer Engineering at the University of Massachusetts Amherst.

