



A Half-Century of Research at the World's Largest Winery – A Personal Retrospective

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Sir Isaac Newton once remarked that if he had seen farther than other men, it was because he had stood upon the shoulders of giants. While I certainly don't claim to have seen farther than anyone else, I have certainly been privileged to stand upon the shoulders of giants. The shoulders of Ernest Gallo, Julio Gallo, and Charles Crawford were remarkably broad and strong, and they supported not only me, but hundreds of others as well. A look at the roster of past presidents of the ASEV will reveal almost a dozen who worked at Gallo at one time or another. It would be impossible to be surrounded by individuals of such talent and ability and not to have learned something.

It was as a fifteen-year-old high school student with an interest in chemistry that I first stepped into the small laboratory of the E. & J. Gallo Winery in June 1950. Although the facilities were relatively modest and primarily dedicated to winemaking and analyses, Charles M. Crawford and R.B. "Brad" Webb had already instituted a small research program. Displayed prominently on a wall was a floor plan for a new and expanded laboratory that would provide additional space for research work. The die had already been cast. When they founded the company, Ernest and Julio Gallo had determined that they would build the largest winery in the world and they understood that technology would play a pivotal role in that endeavor. Much of the technological expertise that had existed in the wine industry prior to 1920 was lost during Prohibition, and precious little research had been done in viticulture and enology in the United States from 1920 to 1933. The hiring of Charles Crawford in 1942 was the first step in building the kind of scientific capabilities the Gallos knew would be necessary if their dream were to become a reality. Crawford had graduated from the University of California, Berkeley, in the same class as a number of other individuals who would be technological leaders of the wine industry in the post WWII years. These included Louis M. Martini, Myron Nightingale, Ze'ev Halperin, and Aram Ohanesian. Until the viticulture and enology program at U.C. Davis became firmly established, the Food Science program at Berkeley was the training ground for many scientists who would ultimately go into the wine business. Crawford, a Charter Member, Past President and

Merit Award recipient of the Society, had a deep interest in research and the potential it held to help build the winery. Fortunately Ernest Gallo was of a like mind, and he told Crawford that he "considered research like savings. If you wait until you need it, it's already too late."

Ernest and Julio understood something else that would be of critical importance, not only to Gallo but also to the California wine industry as a whole. They realized that the most sophisticated winemaking techniques in the world could not produce a superior wine from inferior grapes. The early table wines they bottled came from Napa and Sonoma, and were of excellent quality. However, if their dreams and plans to become the world's largest winery were to be realized, table wine grapes of good quality would have to be available from the Central Valley as well. The grape acreage that had survived Prohibition in this area was generally less than ideal for table wine production. The Thompson Seedless variety was very popular with Central Valley growers because it could be used for table grapes, raisins, or dessert wine. It was clearly not suitable for any kind of quality white table wine. A similar situation existed for many red varieties that were not appropriate for good quality table wines. Despite the fact that dessert wines had commanded the greatest part of the wine market after prohibition, the Gallos knew that the real future lay with table wines, and they planned accordingly.

In the early 1940's the Gallos purchased 160 acres near Livingston; this was the first parcel of what would ultimately become a 5,000 acre ranch, of which 4,000 acres are now in vineyards. In 1946 a portion of that vineyard was set aside for the evaluation of various grape varieties. More than 400 selections were planted and experimental wines were made from each of the varieties for a number of years. Those that had acceptable viticultural characteristics and produced better wines in that region than the then available varieties were propagated. But having identified more suitable varieties, the task of convincing growers to graft over their poorer quality grapes was formidable indeed. It was only finally accomplished in 1967 by guaranteeing growers a minimum price for these grapes and contracts of ten to fifteen years. But the research that had been done for twenty years on selecting the best grape varieties for the Central Valley was now going to pay dividends. This experimental work was the beginning of an active viticultural research program that continues, in a greatly expanded form, to this day.

Although Crawford and the small group of winemakers carried out a number of applied research projects as time permitted, the addition

in 1951 of Dr. Ralph Celmer to the staff as a full time research scientist marked the beginning of the formal enology research effort at Gallo. I had started working summers in the laboratory as a high school student starting in 1950, and would continue to work every summer in the winemaking and research areas until I had completed my education. During 1951 and 1952 I assisted Celmer on a number of projects, including the construction of a small-scale continuous fermenter. Although continuous fermentation offered some theoretical advantages and Soviet researchers had published on the technique, we did not find it to be practical in our application. A good deal of work was also carried out on accelerated aging of dessert wines using oak chips, contact with granulated cork, controlled oxidation at very low levels of addition, and numerous other techniques.

In the summer of 1953, having completed my first year at UC, Crawford asked me to look at improving some of our analytical methods. It is axiomatic that it is imperative to be able to measure the effect of changes that are made by any kind of process if that process is to be properly utilized. Charles understood the need to improve the scope, accuracy, and speed of our analyses to provide our winemakers with more and better information upon which to make key decisions. Like everyone else, we had been analyzing titratable acidity by titrating wine samples in freshly boiled (and still extremely hot) distilled water to a phenolphthalein endpoint. Direct reading analog pH meters had only recently become available, and I saw no reason why such a device could not be employed for this very common and necessary analysis. I also adjusted the normality of the titrant so that the result could be read directly from the burette without the need for further calculation. By implementing this technique we achieved not only faster and easier analyses, but much more accurate ones as well. Over the course of that summer and the next several, I implemented the use of the microdichromate method for alcohol analysis, developed rapid procedures for aldehyde and fusel oil analyses, a rapid reducing sugar test for use in our fermenter laboratory and a multitude of others. Development of new analytical methods has continued to this day, and many of the procedures we devised have been published over the last 45 years or so.

Maynard A. Amerine had been a classmate of Ernest and Julio at Modesto High School. He would obtain his Ph.D. and go on to become, along with Albert Winkler, one of the pivotal figures in the Department of Viticulture and Enology at the University of California, Davis. The faculty and staff that were assembled in that

department laid the foundation for several generations of winemakers and viticulturists that were necessary to rebuild an industry that had been devastated by Prohibition. The department was built upon people like Amerine (who would remain a lifelong friend of Ernest Gallo), Winkler, Harold "Hod" Berg, James Guymon, A. D. Webb, Vernon Singleton, Cornelius Ough, Lloyd Lider, Mark Kliewer, Curt Alley, Amand Kasimatis, Harold Olmo, George Marsh, James Cook, Hank Nelson, Ralph Kunkee, and others. They initiated wideranging research programs and designed and taught courses that were responsible for educating an enormous percentage of the professionals in the wine and grape industries in the second half of the twentieth century.

These individuals did not operate in academic isolation or from a purely theoretical standpoint. A number had previous industrial experience, and all worked closely with the industry they were dedicated to improving. Much of the early research that came out of the department was focused on solving the numerous practical problems that were plaguing the industry. The evaluation of various grape varieties and rootstocks for optimum performance in different areas of California became an important element of the department's work, as did Olmo's efforts in breeding new varieties that offered valuable characteristics for certain regions and wine styles. The department educated the industry about the importance of proper sanitation procedures and the need for proper materials of construction to avoid product contamination with various trace materials or microorganisms. The effects of numerous factors on fermentation characteristics and wine composition were studied in detail, and the results immediately made available to the industry. Amerine's work laid the foundation for the sophisticated sensory analysis used in the industry today.

The industry also benefited enormously from a somewhat smaller but very vigorous viticulture and enology program at (then) Fresno State College under the direction of the indefatigable Vincent Petrucci. Some of the State's foremost viticulturists and enologists are graduates of that school, and many alumni of that institution matriculated to Davis and elsewhere for advanced degrees.

The technical people at Gallo always have had the utmost respect for the faculties and staff of these institutions and sought their advice and cooperation at every opportunity. The majority of our winemakers and a large number of our research staff were, and are, products of these schools. We have continued to actively interact with the research scientists at these institutions.

By 1957 the time had come to expand the laboratory and build an addition devoted exclusively to research. It was decided that the plans that had been on the wall prior even to my arrival were not suitable, and I was asked to design the new facility. This would be the first of three laboratories for which I would ultimately produce the specifications and work with ar-

chitectural firms and contractors to produce the final structure. It was, by our current standards, rather modest, but it provided us the basic space and equipment needed to move our research to the next level.

Ralph Celmer had left at this point, but Lewis Stern (an early ASE officer) had joined the company as the chief table wine maker in the mid-1950s as had Dimitri Tchelistcheff, who wore several hats, working as an enologist and in research developing new products in particular. Celmer had developed Thunderbird, our first flavored special natural wine, and Tchelistcheff would produce a number of others.

Stern was concerned about oxidation of our table wines, especially the whites and asked B. J. Williams, a microbiologist new to the company, and me to find a solution. Williams and I were able to locate ceramic diffusion tubes that could be attached to the end of a length of plastic tubing that would reach to the bottom of a bottling tank. When hooked to a cylinder of nitrogen, a stream of minute bubbles would sparge dissolved oxygen from the wine. Of course it was then necessary to measure the amount of dissolved oxygen to remove only the amount necessary and to avoid stripping desirable volatile compounds from the wine. Although the dichloroindophenol titration used to measure dissolved oxygen in water was tried, it was cumbersome and incapable of the accuracy we wanted. I was able to use a dropping mercury polarographic procedure for this measurement and this enabled us to expand our use of oxygen removal to include carefully controlled nitrogen stripping when transferring sensitive wines within the winery and from our Fresno facility to Modesto. A few years later the first Clark one-piece polarographic electrode became available, and we published a paper on its use for the measurement of dissolved oxygen in wine. It has since become the standard analytical tool for this measurement in the industry.

The principles of gas chromatography were just reaching the hands of analytical chemists, but commercial instruments were not readily available and prohibitively expensive. I was reasonably knowledgeable about electronics and fairly adept with a soldering gun and other tools. I was able to build a GC and, with numerous modifications over the years, it is still operational today. It enabled us to separate and quantify trace volatile compounds such as the individual fusel oil components of distilled spirits and thus to improve our distillation procedures.

A new Research Director, Robert J. Bouthilet was hired in 1958, shortly after the completion of the new research lab. Bouthilet brought on board a number of new scientists including Dr. Richard Peterson, Karl Popper, Dr. George Thoukis, and Masao Ueda, of whom the latter two are still with the company. The next decade would see commercialization of a number of processes new to the wine industry. The late 1950s saw a good deal of research on ion exchange, initially to achieve tartrate stability,

later to provide additional tools for winemakers in treating certain wines. Karl Popper became the resident expert on these processes and developed a substantial number of variations on the basic technology.

For wineries bottling wines with small amounts of residual sugar, pasteurization was commonly used to keep wines from undergoing fermentation in the bottle. This heating process inevitably had a deleterious effect on the product, and the industry had been in search of a viable alternative. Sterile filtration was being used by several wineries employing asbestos sheets in plate and frame filters, but the process was cumbersome and fraught with peril from a microbiological standpoint. Thoukis became aware of the fact that some brewing companies were using membrane filtration to achieve a sterile product and thought it might have an application in the wine industry. A project was set up in 1960 in conjunction with the Millipore Corporation to apply this technology to our wine process, and by 1961 all of the pasteurizers had been replaced with membrane filters. This resulted in another significant improvement in product quality.

In 1961 Cornelius Ough and John Ingraham had published a paper on the use of diethyl pyrocarbonate (DEPC) as a possible bottled wine sterilizing agent. This material rapidly decomposes to ethanol and carbon dioxide after addition to wine and it has no effect on the sensory properties of the product. Thoukis, Ueda, and I followed the decomposition rate using radioactively labeled DEPC and showed that over 98% of the compound hydrolyzed to ethanol and CO₂. Most of the remaining by-products could be accounted for as ethyl carbonate and carbomethoxy derivatives, within experimental error. Since only 100 mg/L or so of DEPC was needed to achieve sterility in properly filtered wine, it was the perfect complement to membrane filtration if added just before the bottle was filled. We had long ago found fermentations using indigenous yeast to be unpredictable, marked by variable sensory properties and the occasional stuck fermentation. We chose to inoculate juice with selected yeast strains, but were forced to propagate yeast from a slant to a small flask of juice and subsequently to larger vessels until a sufficient quantity was produced to properly inoculate a fermenter. Intermediate steps included 1 liter, 5 liter, and 5 gallon containers of sterilized juice before preparation of a 250 gallon starter tank. This was clearly inconvenient, time consuming, and expensive.

John Castor at UC, Davis, had demonstrated a number of years earlier that wine yeast could be produced in a 5 gallon aerated fermenter and harvested as a compressed cake. At about the same time, Adams in Canada described the collection of wine yeast in the form of small filter cakes that could be stored frozen and later used as an inoculum for wine fermentations. Baker's yeast was being produced commercially in a similar manner, and Thoukis was aware of this work. He developed a joint project with Dr.

Gerald Reed of Universal Foods Corporation to produce wine yeast, first as frozen cakes then later as a dried product. The dried form could be easily transported and stored and rehydrated just before use. Thoukis presented a paper on the production and use of compressed yeast at the 1963 ASE Annual Meeting and this material has become widely used in the industry to the present day.

The early 1960s saw the development and implementation of large-scale submerged culture production of flor sherry. Although Amerine and Ough, using pressurized vessels, had demonstrated the principle on a small scale, we were able to achieve the same effect at atmospheric pressure in production tanks. R.L. Nowlin, our chief engineer at that time suggested the hydrostatic head in the large tank would provide adequate pressure if a proper circulation system was designed. The system was constructed and worked perfectly. This period also produced evidence that temperature controlled fermentations produced wines of a higher quality, and enormous amounts of refrigeration capacity were added. With the increased use of stainless steel tanks insulated with urethane foam, wines could now be stored at optimal temperatures outdoors. The traditional cellar consisting of wood or concrete tanks in a fully enclosed building began to disappear.

With the introduction of low alcohol, lightly carbonated wines, it was necessary to devise techniques to reproducibly carbonate the wines to the desired level and to analyze the CO₂ content. By generating comprehensive CO₂ solubility data for various products and different temperatures, we were able to achieve consistent carbon dioxide levels in bottling tanks. A number of analytical procedures were devised, each faster and more accurate than the previous ones. Almost all were validated and published.

During this period the first experiments with mechanical harvesters of our own design were conducted at the Livingston ranch. Although some positive results were obtained, Julio Gallo felt the resulting wine was not as good as that from the same grapes that had been hand picked. As a result we delayed the acceptance of mechanically harvested fruit until the technology had become more refined.

The introduction of our first Charmat process Champagne was hugely successful, and it became necessary to produce larger quantities than our initial industry standard 2,000 gallon tanks could provide. Crawford and my father, who headed the company's maintenance and much of its engineering, had found a couple surplus 20,000 gallon liquid oxygen tanks from a decommissioned missile site. They felt these could be used as large Charmat fermenters. I was asked to perform some calculations to see if we could bottle from these large vessels isobarically without losing any significant CO₂ content. The calculations were favorable and the tanks were acquired, installed by my father, and performed flawlessly. Additional tanks of the same and even larger size were later added.

When Bouthilet left the organization in 1963, Richard Peterson and I assumed responsibility for the administration of the Research Department, and we prepared to move into a large new facility. I worked with an architectural firm on the design of a new building that would house the winemaking, analytical and research departments. We moved into the new quarters in May 1969 shortly after the departure of Dick Peterson. The Engineering and Personnel Groups initially were included in the structure as well, but, like the Company as a whole, the laboratory expanded rapidly in the 1970s, and those departments were soon displaced.

Tchelistecheff and Popper had left about the time of Bouthilet's departure as well, and we had to find new members of staff to carry on the work. With the move into the new laboratory, people like Dr. Richard Morenzoni from the UCD enology program, Dr. Thomas Wong from the Food Science program at UCD, and James Peck, one of Maynard Amerine's last graduate students, were added to the research staff. These individuals would be key contributors to the research done in the new building throughout the 1970s, 1980s, and into the 1990s.

Morenzoni had done his graduate work on the malolactic fermentation under Ralph Kunkee and continued his investigation of that process, but now on a commercial scale. He also worked with commercial suppliers of yeast to obtain various strains and select particular ones to optimize different fermentation needs. Procedures were developed and implemented to measure the viability of incoming shipments of dried yeast. Because many of our products were now being sterile bottled, it was necessary to put into place even more stringent sanitation procedures and comprehensive sampling and plating procedures to insure all bottled wines were microbiologically stable. These were all done with Morenzoni's advice and direction, as was the design of the microbiological facilities at all the company's production locations. An enormous amount of work went into optimizing protocols for production of fermentation starters. His group used DNA Karyotypes to follow the characteristics of yeast populations under various fermentation schemes. They demonstrated that the presence of excessive levels of fluoride caused increased amounts of volatile acidity and other by-products during fermentation.

Most recently, this group developed microbiological "fingerprints" for the wines being produced at our North Coast facility. A number of lots of wines were made using various combinations of yeast and malolactic bacteria and the resulting wines carefully evaluated. This has led to the current practice of using specific yeast and malolactic bacteria combinations for the wines produced at that winery.

Wong brought a strong background in enzymology, and he immediately went about identifying enzyme preparations that could improve juice yield, wine filterability, and optimum color characteristics. He has continued

to this day to evaluate new enzyme preparations and optimize their use. With the assistance of a number of other members of staff, Wong developed a cellulose fiber filtering material that was patented and employed in our filtration process for many years. His interest in filtration led him and his associates to explore and implement new membrane technologies such as ultrafiltration, nanofiltration, and crossflow filtration. As new materials and equipment became available, adoption of various uses for these processes continued throughout the 1980s and 1990s.

Although wine tasting had always been an important aspect of the Company's ongoing commitment to quality, until the construction of the new laboratory in 1969 we had no formal sensory evaluation program or tasting booths. A small sensory area was incorporated in the design and the booths were provided with filtered and conditioned air and red illumination to obscure differences in wine sample appearances. Jim Peck, who had extensive sensory training under Amerine, set up the first trained taste panels in the building as well as carrying out a variety of other research projects.

The balance of the 1970s and the 1980s were filled with a variety of projects, many dealing with regulatory requirements. New waste disposal techniques were developed and implemented at all corporate production sites. When the California Air Resources Board suggested winery fermentation emissions might be the source of unwanted ozone precursors, our staff worked with other wineries through Wine Institute to develop important data on this issue. A great deal of experimental work was carried out in conjunction with Professor Carlos Muller at California State University, Fresno to substantiate the industry's position on the unfeasibility of mechanically controlling these emissions.

In the late 1980s the U.S. Food and Drug Administration became concerned about the presence of traces of ethyl carbamate, a suspected carcinogen, in fermented foods and beverages. A comprehensive study was initiated (that continues to this day) in which Gallo scientists worked with academicians, principally C. S. Ough and Linda Bisson, to elucidate all the factors involved in the formation and control of the traces this naturally occurring compound. The first work implicating arginine as a precursor for urea was done by the Gallo microbiology group and brought to the attention of the Davis researchers who developed it further. These efforts are typical of the kinds of interactions that exist between the Gallo technical staff, academia, and the rest of the industry.

By the early 1990's it became clear that the technical needs of the organization had outgrown the facilities in which they were housed. Once again I was asked to draw up specifications for, and help design and staff a new research building. It was based upon an organizational structure that seemed logical at that time, but would be entirely modular in concept so that it could easily be modified when the need arose. A chemistry group, then under Dr. Jeff

McCord and now directed by Dr. Tim Ryan, was charged with the responsibility of investigating the volatile and non-volatile components of wine and establishing the sensory effect of each, singly and in combination. A portion of this group would develop both specialized analyses as well as automated routine procedures for the Analytical Department. A number of robotic procedures have been implemented for common analyses and capillary electrophoresis methods have been developed for the analysis of proteins, organic acids, specific amino acids, and numerous inorganic ions.

A microbiology function was incorporated to supplement the existing group and provide additional research capabilities for this critical aspect of the winemaking process. It has since been merged with the Genetics team to form a Life Sciences Group led by Dr. Nancy Irelan. A major thrust has been the physiological characterization of wine microorganisms using the BIOLOG microplate system that measures the growth of microorganisms on various carbon sources. The pattern of growth is compared to the patterns of type strains in the database and the degree of similarity calculated. We have constructed our own custom databases of wine microorganisms including *Saccharomyces cerevisiae*, *Hanseniaspora (Kloeckera)*, and several others. These databases are being used to build up a picture of the microbial ecology of wine fermentations at Gallo, which will hopefully lead to a better understanding of the process. A member of the group, Dr. Roy Thornton, has a strong background in classical breeding techniques and has used these techniques to improve the winemaking properties of one of our preferred wine yeast strains. The group has collected over 70 *Dekkera (Brettanomyces)* strains from California and around the world. They were characterized by BIOLOG were found to separate into several distinct physiological groups with a wide range of physiological/biochemical activities.

A Molecular Biology/Genetics Group was included to study both plants and microorganisms at the molecular level. A number of achievements have already occurred in the area of molecular diagnostics for vineyard, wine, and juice related microorganisms. The team has developed robust, rapid, PCR-based, plus-or-minus molecular identification tests for a wide range of vineyard pathogens and wine yeasts, such as *Eutypa*, *Botrytis*, *Brettanomyces*, *Zygosaccharomyces*, and *Torulasporea*, to name only a few. Tests for 6 vineyard pathogens have been patented, and tests for 13 yeast species are patent-pending. Because the tests are rapid, easy to perform, and produce plus-or-minus results, any technician can easily be trained to use them and interpret the outcome. The tests have already been successfully transferred to production microbiology laboratories in several locations, and implementation of the technology is continuing.

The team working on plant genetics has extensively studied *Eutypa*, a dieback disease of

grape, which affects grape production around the world. In grape, the disease is caused by a fungus known as *Eutypa lata*. The group obtained and collected 116 isolates of *Eutypa* species from grape, cultivated species, and native tree species. They used Amplified Fragment Length Polymorphism (AFLP) to produce genetic fingerprints of each isolate and analyzed specific regions of DNA sequence from each isolate. The results indicate that there are two species, *Eutypa lata* and *Eutypa armeniaca*, capable of causing this disease. Of equal importance is the finding that both of these species of *Eutypa* can grow on many of the native tree species in California. This means there is always a ready source of inoculum to further the spread of the disease. In addition, information from the DNA sequence analysis from this research was used to generate diagnostic tools for *Eutypa*. A Polymerase Chain Reaction (PCR) based method was developed that allows detection of *Eutypa* in woody vine material long before symptoms appear. This tool enables researchers to investigate the growth of the fungus in the vine and enables a better understanding of the disease process. This diagnostic method has been patented worldwide, and is currently being made available to academic researchers free of charge.

Some of the initial research within the Genetics program involved investigating the genetic diversity between a number of *Vitis sp.*, representing native species from North America, as well as other species from around the world. Wild *Vitis* species contain a wealth of germplasm that is a potential source of genetic material for improving existing cultivated species of grape. Breeders have used this genetic material via classical methods to develop rootstocks resistant to Phylloxera, and nematodes. In addition, rootstocks have been developed that perform well over a wide range of soil and climatic conditions. A detailed understanding of the genetic diversity, or relatedness between the wild species is an important starting point to utilizing this resource in a more specific and efficient manner. In our laboratories AFLP was used to analyze 66 *Vitis* accessions representing 18 wild species of grape and compared with *Vitis vinifera*. This was the first time this technique had been used to analyze a diverse group of *Vitis* species. The results of this research were presented at the Sixth International Plant and Animal Genome Conference in 1997. The genetic relationships observed in our analysis agree with the current taxonomy and indicate *Vitis vinifera* is genetically distinct from both the North American and Asian grape species. In addition, we were able to identify three major groups of *Vitis* species that will be useful in further investigations.

A professional flavorist, Leslie Norris, was added to the mix to not only work with the Product Development Department, but with the Chemistry group to determine if the various compounds they had identified as having sensory impact really were responsible for important tastes and aromas. Her understanding

of how flavor compounds interact and change their sensory properties with changes in concentration have been invaluable in this area of research.

The group that ties all of these efforts together is the Sensory Department headed by Dr. Isabelle Lesschaeve. Ten tasting booths are equipped with computers that are, in turn, linked to a central server utilizing specialized sensory software. Additional statistical software permits the construction of preference maps, PCA plots, spider web diagrams, and numerous other representations of statistically analyzed sensory results. The group can provide difference testing, preference evaluations, coordination with marketing consumer testing, and other services.

The small scale research winery that had existed in various forms since the 1950s was completely refurbished. It was equipped with small stainless steel tanks, many of which are jacketed and can be accurately temperature controlled by the circulation of chilled glycol. A computer controls and monitors the status of these tanks. Small-scale bladder presses operate under microprocessor control and can simulate the effects of full size devices. Over 500 experimental fermentations have been conducted in the research winery in a single year. The wines produced in this facility permit us to evaluate various viticultural and winemaking possibilities. An adjacent pilot plant provides the necessary environment and equipment for the process development group to explore new technologies or transfer techniques that have been effective in other industries and might work for our needs.

The research effort that had begun with a handful of people performing experiments when time permitted has now grown to a staff of over 60 people, including post-doctoral appointees, interns, and trainees. Virtually all of the major scientific disciplines are encompassed within the Research and Technical Services Department. Scientists have been recruited from all over the world to assist in this effort that is now directed by Dr. Terry Lee, who joined the organization after a distinguished career heading the Australian Wine Research Institute. All of the parts appear to be in place to move the research effort at the E. and J. Gallo Winery to the next level of excellence and to help fulfill the vision of the Company's founders.

As I put this presentation together, so many names came flooding back to me – Emil Mrak, Maynard Joslyn, Rose Marie Pangborn, Walt Jennings and dozens of others. Some of the people I have mentioned in this address may not be familiar to the younger enologists and viticulturists in the audience or may just be names in old publications they have seen in the literature. Many have retired; many more are no longer with us. But they were the pioneers who worked, often in anonymity, to lay the foundation for the industry we know today. These people and their work helped shape my career, and, whether you realize it or not, they have helped shape yours.

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