2nd symposium of

The Society of Flavor Chemists

"Flavors—Safety and Regulations"

The subject was Flavors—Safety and Regulations at the 2nd symposium of the Society of Flavor Chemists, held April 1, 1976. Dr. C. A. Vodoz, Firmenich, represented the flavor industry and Dr. H. E. Bauman, Pillsbury, represented the food industry. Dr. J. C. Kirschman, General Foods, moderated a panel which included Drs. Vodoz and Bauman, and representatives of academia, government, and the medical profession. Following cocktails and dinner, E. P. Grisanti, IFF, delivered the keynote address.

We are publishing the proceedings of this symposium which includes the presentations of Drs. Vodoz and Bauman, and Mr. Grisanti's keynote address and subsequent discussion.

Dr. Vodoz was born in Switzerland in 1922 and attended the Swiss Federal Institute of Technology in Zurich. He studied organic chemistry in the Department of Natural Sciences there under Professor Ruzicka in 1947.

Since 1948, Dr. Vodoz has been employed with Firmenich in Switzerland, initially in chemical production, later in flavor production. Dr. Vodoz is currently the head of the Department for Flavors and Perfumes Legislation and is actively involved in numerous European legislative organizations.

Flavors—Safety and Regulations

When I started my career as a flavor chemist, some 25 years ago, our industry was still living, as one might say, in the golden years of innocence or, if you prefer, of innocuousness. Flavors were hardly regulated at all so far as their composition was concerned. And how could they have been? There was little analytical knowledge of their composition and no possibility of their control through gas liquid chromatography, for instance, which had just been invented. Natural flavors, being extracted from natural edible materials and used at dosages inversely proportional to their factor of concentration, were obviously no more toxic than, or just as safe as, the original edible material. Artificial flavoring substances, on the other hand, were used at such low dosages that nobody thought they could endanger human health.

Perfumer & Flavorist Volume I, Number 4

August/September 1976

Founded in 1906 as The American Perfumer

From left: SFC officers Albert Venutolo, Fries & Fries, Chairman of the Board; Albert Saldarini, Norda, Vice President; and Klaus Bauer, Dragoco, President. Program Chairman of the Symposium Albert Goossens, Miles Laboratories.

At that time, the safety of flavors was hardly ever questioned. The only natural essential oil known to be toxic was wormwood or absinthe oil, which because of its thujone content was responsible for the rather bad poisoning caused by abuse of so-called absinthe (or wormwood brandy) which was consumed in large quantities at the beginning of this century. Absinthe was forbidden first in Switzerland, after an absinthe-drunken man killed his whole family and burned down his house, right in the village where I presently live. Later it was forbidden in France, Belgium, and Germany. Nitrobenzene, another aromatic material, whose toxic properties were well known, was forbidden practically everywhere, too. Such flavoring materials were not a cause for concern because their use could easily be avoided. The safety of flavors continued to be taken for granted.

The appearance of gas liquid chromatography, paper chromatography, thin-layer chromatography, and, later, of nuclear magnetic resonance and mass spectrography has given a tremendous impetus to analytical research in the flavor field. Due to the very low dosages involved, flavor analysis was previously restricted practically to essential oils and extracts available in quantities big enough for the macroscopic separation methods available. Knowledge of the actual composition of natural flavors was thus limited, but suddenly many publications devoted to flavor analysis began to appear, both in this country and abroad. These made us realize how complicated natural flavors are. They demonstrated the existence of gamma- and delta-lactones, of pyrazines, of thiazoles, and of many other compounds in natural food. Unsaturated aldehydes, for instance, were still unknown in the early fifties.

Then came 1952, with the discovery of the weak carcinogenic properties of coumarin in rats. This acted like an alarm bell for our industry because coumarin had been considered totally harmless before. This discovery, added to better knowledge about the complexity of natural flavors, leading in turn to much more sophisticated synthetic flavors, has been a major factor in calling the attention of toxicologists, physicians, and nutritionists to flavors in general and in encouraging authorities to deal with flavors that had been neglected before.

Objectives of national food regulations

All national food regulations have two objectives, the first of which is to protect consumers and trade against fraud. Foodstuffs must be what they claim to be. They must correspond to their denomination by having all the characteristics that everybody expects them to have. These characteristics are mentioned in food standards, generally incorporated in food laws or regulations, and are controlled by government chemists. Foodstuffs must be named and labeled correctly. This is, of course, a most important objective; this part of the law covers and directs the whole food trade.

The second objective, the subject of this symposium, is the protection of public health against poisoning and disease caused by foodstuffs. In this part of the law, the legislator has to set up rules ensuring the safety of food.

What is a safe food? What does "safe" mean? It must be clearly said that safety—absolute safety—simply does not exist. Safety, according to the Oxford dictionary, means "freedom from danger or risks"; it is a relative concept. A single food is never safe because, if somebody eats it exclusively for a long period of time, he will certainly show some more or less ill effect, due to a lack of balance in the different nutriments contained in that food—absence of fats in fruits, excess of carbohydrates in bread and potatoes, lack of vitamins in macaroni, too much saturated glycerides in butter, not enough vitamin C in preserved foods, and so on. In French, we say, "l'excès en tout est un défaut"; excess with anything is a fault. This statement seems to apply extremely well to foods. Safety is a relative concept in the sense that water is safer than wine, which is safer than brandy. One glass of wine is safer than one pint, which is safer than one gallon! A little nutmeg powder is very nice, but eating the whole nut will give you hallucinations for an entire day!

The safety of foods, then, depends essentially on judgment in choice, variety of diet, moderation of intake. This is something which seems to escape too many people; they think of safety as an absolute concept. According to the Report of the Panel on Chemicals and Health of the President's Science Advisory Committee, of September 1973, entitled "Chemicals and Health": "Perfect safety is not attainable. We must always live with some risks, both because nature forever confronts us with hazards, and also because the contributions of chemicals to human welfare are so vital. Our knowledge is never complete; as it increases, it will make us reconsider, and often revise, past decisions." The same report says further: "It is clear that nothing is wholly safe or dangerous per se; it is the quantity involved, the manner and conditions of use, and the susceptibility of the organism which determines degree of hazard or safety."

The protection of public health implies, then, the safety of foods. With the limitations mentioned before, it is generally assumed that our usual foods are safe, and obviously regulations have to cover the safety of everything added to them. How is safety defined in food regulations? Here are some examples:

In Switzerland, Article 6 of the ordinance on foodstuffs (1972) says: "Foodstuffs shall not contain harmful substances or organisms likely to endanger human health."

Left: John Kenneally of Pepsico with Earl Merwin of McCormick; Right: Jim Engle of Food Materials with Jim Rogers of Fritzsche.

The French food law (1905) says: "Those who will expose or sell products used for human or animal foods, beverages and agricultural or natural products which they know are falsified, adulterated or toxic will be punished."

In Germany, the food law (1974) says in paragraph 8: "It is forbidden a) to produce or to treat foodstuffs for other people in such a way that their consumption would damage the health, b) to introduce in the trade as foods, substances the consumption of which is likely to damage the health."

In Italy, the law on the sales of foodstuffs and beverages (1962) says in paragraph 5: "It is forbidden to use for the preparation of foods and beverages . . . foodstuffs which are . . . filthy, invaded by parasites, in a state of deterioration or otherwise harmful . . ."

The Food and Drug Act of Great Britain (1955) mentions in its first article: "No person shall add any substance to food, use any substance as an ingredient in the preparation of the food . . ., so as to render the food injurious to health, with intent that the food shall be sold for human consumption in that state."

In the United States of America, Section 301 of the Federal Food, Drug & Cosmetic Act says: "The following acts and the causing thereof are hereby prohibited: 1. The introduction or delivery for introduction into interstate commerce of any food, drug, device or cosmetic that is adulterated or misbranded." Section 402 specifies: "A food shall be deemed adulterated if it bears or contains any poisonous or deleterious substance which may render it injurious to health; but in case the substance is not an added substance, such food shall not be considered adulterated under this clause if the quantity of such substance in such food does not ordinarily render it injurious to health."

According to these few examples, the legislator has not defined safety but rather prohibits the presence, the use, or the sale of food products toxic in some way or another. What is a toxic product is not described either, but is instead left to the judgment and knowledge of the interested persons who are, primarily, the food manufacturers.

This is obviously not very satisfactory, because a little thinking quickly shows how limited are our knowledge and our capacity for judging correctly. Some limits must be put on the freedom of interpretation, therefore, in order to reduce the possibilities of errors by manufacturers and risks for the consumers.

Regarding additions to foods, in particular flavors, one possibility of reducing risk is by limitation of use, restricting it to some specific applications, to a limited dosage, or both. Another possibility is to regulate the composition or the nature of the additives, either by forbidding those known to be dangerous (system of abuse with negative lists), or by listing those deemed safe enough to be used, thus excluding from use all other additives (system of interdiction with positive lists). As a matter of fact, both systems are generally used in conjunction in developed countries.

Whatever the system, the food industry has to comply with it just as the flavor industry does. There is however, a difference between the industries in that the flavor industry generally exports a larger share of its production than the food industry. This means that the exporting flavor indus-

try is very often asked by foreign customers to certify that the flavors they buy conform with local regulations. Such certification cannot be given, of course, without knowledge of the local legislation that applies. This knowledge is very difficult to guarantee because: a) laws differ from one country to another b) modifications are frequent and sometimes quite important and c) excellent command of languages is necessary, but is inevitably insufficient.

Our industry must rely, therefore, on legal information services as supplied, for instance, by the British Food Manufacturers Industries Research Association (BFMIRA), the members of which regularly receive abstracts of the newest food legislation, both in Great Britain and abroad. Another source of information is the World Health Organization's excellent publication, "International Digest of Health Legislation" (published by the Health Legislation Unit in Geneva). There are also very useful information letters sent by the International Organization of the Flavor Industry (IOFI) to its member-associations. All these sources are most helpful, and could hardly be dispensed with. In addition, local flavor salesmen should be aware of the legal aspects of their businesses. Through contacts with their customers, they, too, can supply very useful information.

As to regulations concerning the use of flavoring substances, all legislation makes a distinction between artificial flavors composed of synthetic, chemically defined substances and natural flavors isolated from natural raw materials by physical means. In the German, Italian, Spanish, French, and Swiss regulations, an additional difference is made between nature-identical flavoring substances known to occur in natural flavors and foods, and artificial flavoring substances which have not yet been isolated from natural flavors or foods. It is quite striking to note that everywhere the use of natural flavors is far less restricted than is the use of artificial flavors.

Three classes of flavoring substances

Thanks to the patient and continuous work of the International Organization of the Flavor Industry and of the different national associations that are members of IOFI, the Codex Committee on Food Additives definitely recognized during its tenth meeting in 1975 the existence of three classes of flavoring substances, i.e., natural, nature-identical, and artificial. This will no doubt have a very important influence upon the declaration and labeling of flavors in general. European manufacturers consider it most unfortunate that in the United States the recognition of nature-identical flavoring substances goes no further than being just one more criterion for a safety evaluation. In Europe the concept of "identity with naturally occurring substances" (used at levels comparable to those found in nature) seems to help a great deal in leading consumers to understand that synthetic flavoring substances are just as acceptable as natural flavoring substances.

Flavors, we all know, are distinctive. Regulating

Chuck Grimm of IFF with Anne Prendergast and Bob Swaine, both of Canada Dry.

systems for flavors, therefore, must also be distinctive in order to allow for the special characteristics of each flavor.

What is a safe flavor in the legislator's mind?

First of all, quite obviously, natural flavors are classified as safe because all of them have a long history of use, locally or abroad, so that it can be claimed that nobody would use them should they have proved harmful. This firm belief in the harmlessness of natural foods and, therefore, of natural flavors has deep roots in everybody's mind and is reinforced by an innate reluctance to change one's food habits. Confidence in the safety of traditional, natural food and flavors is perhaps not scientific, but it is plain common sense. In the persistent lack of detailed, scientific knowledge of all the toxicological properties of flavoring substances in humans, it represents a provisional, and reasonable, basis on which to build flavor regulations, provided they are made so as to allow for adaptations to new scientific knowledge as it becomes available.

If traditional, natural flavors are considered safe, it is logical to consider their components, either isolated or reproduced by synthesis, as individually safe, at least as a first approximation in the absence of further knowledge about the behavior of the substance in the human body. Obviously, if such knowledge becomes available and shows that a substance may be harmful in one way or another, the regulations must provide for its interdiction or for its limitation in accordance with the first principle of food laws—that foods should not contain anything harmful. This may be done either with a negative list totally forbidding the use of the substance or, better, with a limiting list, in which a maximum safe level of use is specified. A regulation based on such a principle would thus allow the use of all traditional, natural flavors and their components reproduced by synthesis and would establish a limiting list for natural and nature-identical flavoring substances representing a risk for human health when used at too-high dosages. There remain, of course, the purely artificial flavoring substances, which have not yet been found in natural flavors or foods. For these substances, there is no long history of use; therefore, they must be regulated otherwise, i.e., they must be evaluated according to logical, well-adapted scientific criteria as to the safety of their use in foods, taking into account all available information. Such scientifically evaluated artificial flavoring substances, as the only ones permitted for food use, will be described in a positive list.

This system is known as the "mixed system." It features a positive list for permitted artificial flavoring substances, a limiting list for natural and nature-identical flavoring substances capable of endangering human health, and free use of nature-identical chemically defined flavoring substances. This system has been in force in Germany since 1958. Germany pioneered in introducing this system through legislation because the experts of the German *Bundesgesundheitsamt* (Federal Ministry of Health) were, and still are, of the opinion that they could not make a complete enough positive list of natural and nature-identical flavoring substances, thus officially taking the responsibility of their safety assessment. Had they decided to make such a list, they were conscious of the enormity of the work involved, which would have automatically led them to question the safety of practically all foods. They preferred to regulate flavors according to what they actually knew. Italy has applied this system since 1963, and Spain since 1975. Finland and the Netherlands are going to adopt it in the near future.

The many advantages of this "mixed system" include: 1) relative ease of enforcement through analytical control; 2) possibility of correcting the negative or the limiting list at any time for protecting public health; 3) control of artificial, non-nature-identical flavoring substances; 4) possibility of introducing new nature-identical flavoring substances without compulsory disclosure, an important incentive for flavor research.

IOFI advocates the "mixed system" to all countries intending to change their flavor regulations.

Safety of flavors

There is, of course, another answer which can be given to the question: "What is a safe flavor?" This is the "scientific answer" (one might say the scientist's dream): "No flavor is safe, unless its safety has been established." As all known flavoring substances would have to be evaluated to meet this standard, it presents, of course, a formidable, nearly impossible task.

The problem can be simplified, however, as in the Eastern countries under Russian influence, by means of extremely restrictive regulations. The Sov-

Satti Omar of Warner Jenkinson East with Mamoun Hussein of Life Savers and Paul Perry of Warner Jenkinson.

iet Union allows the use of some 55 defined flavoring substances and 35 natural spices and botanicals; coumarin, beta-naphtyl esters, acetaldehyde, and chloroform are forbidden (list prepared by the Ministry of Public Health, received in 1967).

In Bulgaria, 32 defined flavoring substances, 10 essential oils, and the extracts of commonly used kitchen spices are allowed (Recueil International de Législations sanitaires de 1973, tome 24, No. 3 pages 281 ss). Poland allows 42 defined flavoring substances, 24 essential oils, and extracts of edible plants and fruits (Recueil International de Législations sanitaires de 1973, tome 24, No. 2, pages 397-409). In Rumania, natural flavors, in general, seem to be allowed, but only five chemically defined flavoring substances may be used in food (Arrêté No. 846 of September 4, 1963, of the Ministry of Health & Welfare). Surprisingly enough the mentioned lists do not exactly correspond. It must be said, however, that in all these countries there is a way out of these restricted lists by means of registering with the proper authorities qualitative flavor formulations containing other, nonlisted flavoring substances.

It is further interesting to note that the Bulgarians are the only people in the world who rely on peritoneal LD_{50} on rats for their safety evaluations, in the sense that flavoring substances can only be used if they have such an LD_{50} of more than 1 gram per kilo, and at dosages not exceeding 50 parts per million (sanitary Regulations Nos. 0-36 of February 11, 1972). All substances mentioned in these lists are used very commonly. No wonder that these countries don't export any compounded flavor!

In order to be as scientific as possible, one has obviously to evaluate each flavoring substance per se. Considering the huge number of these substances, the work involved is tremendous, so that there has been up to now only one country with enough courage, people, and money to undertake it and that is, of course, the United States of America, under the Food Additive Amendments of 1958. And still, flavoring substances have had to be treated in a special way differing from that chosen for food additives proper. Food additives are regulated under the system of petitions requesting in particular "full reports of investigations made with respect to the safety for use of such additive" (Section 409 of the Federal Food, Drug & Cosmetic Act). This is why a "Generally Recognized As Safe" (GRAS) concept has been invented. Let me quote from the Report of the Panel on Chemicals and Health of the President's Science Advisory Committee, of September 1973: "The GRAS concept was a compromise which attempted to apply scientific judgment and, by implication, common sense to a modified 'grandfather clause,' so that the limited scientific and regulatory resources available might be directed toward those situations most needing them." Thus "any substance the intended use of which results . . . in its becoming a component or otherwise affecting the characteristics of any food . . ." is not a food additive if it is "generally recognized, amongst

experts qualified by scientific training and experience to evaluate its safety, as having been adequately shown through scientific procedures (or in the case of a substance used in food prior to January 1st, 1958, through either scientific procedures or experience based on common use in food) to be safe under the conditions of its intended use."

The criteria of evaluations applied by the FEMA experts are extremely interesting. To recall them: "1) Toxicity data; 2) Metabolic data; 3) Occurrence of the substance in natural foods; 4) Analogies with chemically related substances, the toxicity or metabolism of which is known; 5) The nature, level, and volume of use of the substance in foods; 6) The toxicologic significance of the levels in use.[1] If considered as a whole and combined together by knowledgeable experts, all these data, even if some of them are missing, give the truest possible picture of the substance considered from the safety point of view.

It is not very surprising that some legislation is built upon just one or two of these criteria. For example, legislation based on restrictions of use clearly rely on criteria 5 and 6. The general authorization of nature-identical flavoring substances (Germany, Italy, "mixed system") is based on criterion 3. The adepts of criterion 1 are to be found mainly among the toxicologists participating in the "Ad hoc working party on flavoring substances of the Council of Europe": in Chapter IX of their work entitled "Natural flavoring substances, their sources and added artificial flavoring substances," they demand a full set of toxicological tests for each new substance to be added to the list, including LD_{50}'s on three species of animals, short-term studies with two species (90 days with rats and one year with dogs) with at least two dosages, and, in principle, a long-term study of two years with rats, comprising reproduction studies on two generations. Biochemical studies of the substance and/or of its metabolism are recommended as well as observations on humans. However, flavoring substances which are used at less than 0.1 ppm would escape these demands, according to criterion 6.

In this respect, it is interesting to know that the joint Expert Committee on Food Additives of the World Health Organization—Food Agricultural Organization of the United Nations has taken a more moderate position with the toxicological evaluation of flavoring substances. In their 70th report, they say:

Toxicological evaluation

> In general, the Committee considered that the procedures adopted by the Council of Europe represent a useful and practical approach; the problem of evaluating flavouring substances is one that cannot be solved simply by adopting the processes traditionally used by the Committee to evaluate other types of food additive. While concurring with the concept put forward by the Council of Europe, the Committee wishes to draw attention to the following issues:
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> *(a)* In listing flavouring substances it is difficult to take into account the many indigenous materials, notably herbs, that are peculiar to specific regions. The Council of Europe lists are not comprehensive and are unlikely to incorporate all the flavouring substances actually used.
>
> *(b)* In the opinion of the Committee, the guide to the testing and toxicological evaluation of flavouring substances provided by the Council of Europe goes too far beyond the enunciation of principles, entering into detailed protocols that are not only unnecessary but also tend to create a rigid set of testing requirements. The Committee cannot emphasize too strongly the need to maintain flexibility at all times in the approach to toxicity testing since each compound presents an individual and unique problem.

These experts are studying the criteria to be used for the evaluation of flavoring substances. It is to be hoped, and it would be quite logical, that criteria similar to those of the FEMA Expert Panel will emerge from the discussions. The Codex Alimentarius Committee on Food Additives discussed flavoring substances in its tenth session last year. A subcommittee was formed to study flavoring substances and to recommend priorities for their evaulation by the joint FAO/WHO Expert Committee on Food Additives. It seems that a priority will be attributed to the study of purely artificial non-nature-identical flavoring substances, which are considered as food additives by practically all member countries. I think that our industry fully agrees with this procedure.

limitation of the possibilities of use, the more or less exclusive use of natural flavoring substances and of their synthetic equivalents, the evaluation of each flavoring substance according to scientific procedures, and, last but not least, the general possibility of forbidding the addition of anything toxic to foods. The different national approaches are never clean-cut. All are obviously converging toward the common goal of improving the relative safety of foods in general and of flavoring substances in particular. The guidelines to be followed are probably best described in the six criteria of the FEMA expert panel mentioned earlier. Opinions about their relative importance do, of course, differ. What kind of studies will have to be made? With what substances and with what order of priority? The flavor industry can certainly play an important role in helping to answer these questions.

Collaboration between flavorists and regulatory agencies

Flavorists know, and they are the only ones who do know, all the chemical, organoleptic, and practical aspects of flavors—and how complicated they are. Regulatory agencies, therefore, need the collaboration of flavorists. If they think they can totally or partly dispense with this collaboration, as did the Council of Europe experts with the first edition of their work on flavors, we have seen how poor the result is. Such a collaboration is our duty, as flavorists, because it is in the interest of the food industry, of the consumers, and of our own industry. This seems to be extremely well understood in this country and all non-American flavor chemists are grateful to the FEMA and to its experts for their remarkable job, as well as for their very collaborative spirit with their foreign colleagues. The International Organization of the Flavor Industry plays an ever-greater role in this respect and is more and more considered a valuable partner in discussions at the international level. This organization is now fully recognized as representative of the flavor industry, worldwide. As such, it can supply its national member-associations with well-studied documentation to be used for discussions with national authorities. The IOFI's policy of open information and discussions, either directly or through member-associations, has led to some remarkable results: intro-

In the European economic communities there is no unity of views about safety evaluation of flavoring substances. Great Britain is strongly in favor of a positive list which is due to be introduced in their national legislation soon. France, too, is theoretically in favor of such a list, but Germany and the Netherlands definitely prefer the "mixed system." A project for a "directive" is due to be issued soon, but nobody knows whether there will be a positive list for artificial flavoring substances only or for all classes. It may be noted, however, that in a few directives on commodities (for example, the directive of July 24, 1973, on cocoa products and chocolates, a proposed "directive" on oils and fats of 1974, draft-"directive" on condiment sauces of 1973), natural flavors and their identical snythetic equivalents are the accepted flavors. Artificial, non-nature-identical flavoring substances are thus excluded. In cocoa products, however, ethyl vanillin is the only artificial flavoring permitted, and flavors imitating cocoa or milk are not permitted. In confectionery products, all three classes of flavoring subtances are permitted, according to the proposed "directive" of 1971. In ice creams, only natural and nature-identical flavoring substances are foreseen (plus ethyl vanillin) in a proposal for a directive in 1970.

Among the Codex Alimentarius standards having reached the final step before adoption by the member countries, we find that natural and nature-identical flavoring substances would be permitted in canned peaches, grapefruits, plums, pears, and apple purées, in deep frozen peas, in margarine, and in edible fats and oils; in addition to natural and nature-identical flavoring substances, artificial flavoring substances are permitted, provided they are mentioned in the still unfinished list A 1, No. 9 of the document CACFAL 1-1973, list of Food Additives, of which the safety of use in foods has been evaluated. In the less advanced projects of norms for ice creams, the use of the three classes of the flavoring substances is foreseen; in the projected norms for cocoa and yogurt, natural and nature-identical flavoring substances would be permissible, the artificials being under discussion.

Whatever the approach taken by legislators in order to deal with the problem of the safety of flavoring substances, our industry must comply with the regulations. These approaches have included the

duction of the mixed system in the new Spanish flavor regulations, its future introduction in Finland, and spectacular last-minute changes in the new Danish food flavor regulations. At the international level, IOFI has now been consulted by the Council of Europe experts for the preparation of the third edition of their work, and it has established good contacts with the Commission of the European economic committees, as well as with the FAO, the WHO, and the Codex Alimentarius Organization, particularly with its Committee on Food Additives.

Our industry is fully aware of its insufficient knowledge of many physiological aspects of natural and synthetic flavors, but our conscience does not bother us because, after all, general knowledge of the physiological properties of all components of our daily foods is not much better. We are just used to them, that's all. For the moment, the only flavoring substances which have been forbidden in this country—coumarin, safrol, and beta-asarone—are all of natural origin, and we all know that there are many more toxic substances present in food.

Our industry is, of course, willing to devote more of its limited resources to the study of toxicological problems specific to flavors and of general interest to most flavor firms. IOFI has already started financing such studies, one on ester hydrolysis, for instance, and it intends to do more such work. It must be stressed, however, that our industry is relatively small. According to some estimations, its total annual turnover in the United States is about $0.3 billion, against a total turnover of $150 billion for foods and beverages, $12 billion for tobacco, and $8 billion for alcoholic beverages. It must be realized, too, that it would be foolish to demand a complete set of academically interesting toxicological tests costing in the neighborhood of $100,000 to permit the use of some newly discovered, very powerful nature-identical flavoring substance, the total, additional use of which would not exceed a few kilos per year, worldwide. Such unrealistic demands would, of course, kill, or at least strongly hamper flavor research, which would be most unsatisfactory. This is why we think that a gradual approach, taking into account all important elements for a safety evaluation, is the only possible one.

Such a gradual, stepwise approach is all the more justified in the light of the order of priorities set up by the FDA, in which food additives rank last, after food-borne infections, malnutrition, environmental contaminants, naturally occurring toxicants, and pesticide residues.

Flavors, which in this country are not even considered food additives, have never been proved seriously harmful to humans, in contrast to alcohol, tobacco, or drugs, in spite of the fact that certain poorly informed people consider them a very convenient scapegoat, much to the detriment of our industry.

The American flavor industry certainly will not be the only one to benefit from the remarkable work started on the revision of the GRAS lists. Such work is possible only in a country having at its disposal scientific and financial resources, which, at least at present, cannot be found elsewhere. Outside of the USA, and particularly in Europe, we are convinced that this work will represent for years to come the ultimate, the *nec plus ultra*. We certainly shall continue trying to convince our European experts of the validity of the American approach, should they want to establish positive lists of flavoring substances. By then, a great step forward will have been achieved in the direction of the harmonization of flavor regulations. While natural flavors have already reached a certain perfection, synthetic flavors may still make significant progress toward greater naturalness. Progress in the synthetic flavor field is important as such flavors will come into greater demand for flavoring new foods on account of the limited supply and high price of many natural flavors and of their technical limits of application. New flavoring substances, which remain to be discovered in natural flavors and foods, will have to be used. This will be possible only if their evaluation is made with a full, but subtle understanding of their very special nature. If this is done, we can expect a bright future for our industry.

Reference

1. Hall, R. L., and Oser, B. L., Food Technol. 15 (12), 20, 1961.

Dr. Bauman was born in 1925 in Woodworth, Wisconsin. He studied at the University of Wisconsin, where he obtained his bachelor's, masters, and, in 1953, his Ph.D. in microbiology.

In that same year Dr. Bauman joined the Pillsbury Company as a research bacteriologist, soon becoming the head of the microbiology section. Subsequently, he was promoted to associate director and then director of various research functions within the Pillsbury Company. Currently, Dr. Bauman is vice president of science and technology.

Food Additives

Most people, both consumers and producers, seldom think about where foods or the additives used in foods originated. They give little thought as to who was brave enough to use this or that food for the first time.

A point not generally emphasized in any discussion of foods is the impact that the domestication

of plants and animals has had on human history. We owe a fantastic debt to our ancestors for the accumulated knowledge they have passed on to us. Since the original food introductions, our main contribution has, for thousands of years, been genetic improvements to the many strains of crops our ancestors discovered and approved by their "FDA" systems. Today, most so-called new foods are merely combinations of or variations of old foods.

We might say, then, that the concept of a GRAS list for foods and food additives is not new. We have a list that could be millions of years old. This list is extremely valuable to us since it represents the only type of testing that can be readily related to humans—that is, thousands of years of human experience. This list is so valuable that it would be wise for us to expend a good deal of money, time, and effort on its development. As the world becomes more sophisticated, much of the information on this list could be lost for a good deal of it has never been written down, but has been passed on from generation to generation by word of mouth and experience. As the world gets more populated, we may need this broad spectrum of information in developing feeding systems for the future.

Early man, of course, experimented with the processing of foods. For example, he apparently started using fire for cooking foods about 360,000 years ago. The losses of nutrients during this process undoubtedly contributed to early man's adding greens and fruits to his meal. These fresh foods made him feel better. Cooking aided the process of civilization, but the process of cooking also obviously led to the development of food additives because of the effect on the food of the time and temperatures involved. Cooking encouraged the development of civilization because it shortened the time that had to be spent in eating. Very early man probably spent almost all day eating, chewing tough materials just as gorillas do today. Then, he learned that cooking made the food easier to chew and more digestible. Thus, the time spent in eating could be reduced to a few hours each day, allowing more time to be spent in other pursuits.

Another valuable source of information about the origin of food customs is the area of religion. Many taboos on foods are tied to religious beliefs, creating in effect negative GRAS lists. It is also important to understand the importance of preprocessing of foods because many products that are poisonous when raw are quite safe to eat after treatment. Raw cashew nuts, for instance, are poisonous, but if properly heat-treated are safe to eat. Cassava root is poisonous as dug out of the earth, but, with pounding and frequent washing, becomes good food. One wonders how our ancestors discovered these processing techniques.

The ancient GRAS list consists of thousands of items. We know, for example, that the Indians in Mexico and Central America were cultivating hundreds of plants and animals long before the Spaniards appeared. They had plants from which they obtained food, spices, flavorings, medicines, poisons, fibers, gums, dyes, and paints. At least 40 of these plants contribute today to improved living conditions all over the world. For instance, corn is a basic food for a large share of the world's population. The Indians also raised over 50 species of beans including lima, string, and kidney beans. Their peppers have a number of uses: they add a zing to food; there is evidence that they help control amoebic dysentery; and they are good sources of vitamins A and C. The pumpkin, too, was discovered and cultivated by these Indians, and squashes were an important part of their diet. Other foods developed by the Indians include tomatoes, several varieties of onions, chocolate, chicle, peanuts, popcorn, acorn meal, crabapples, persimmons, papaya, eggplant, blackberries, cranberries, raspberries, plums, cherries, sweet and sour sap, granadilla, and avocado. How would some of our food taste without lime or lemon, chili, oregano, coriander, vanilla or sage? These are but a few examples of the food experiences of man of just one continent. If we add all the knowledge that has been developed in Asia, Africa, Australia, and Europe, our ancient GRAS list could become a truly great document. It could afford us a means for adding new foods to our diet, foods that we might never consider for this modern age.

Another factor not mentioned very frequently is that certain physiological features of our bodies have resulted from the foods our ancestors ate. The most notable is the liver. The liver, besides being a tremendous storehouse, also performs a function

that is essential to life itself. That is its ability to detoxify various materials taken in by the body or, for that matter, formed by the body under certain conditions and to prevent these materials from accumulating and poisoning the body. It also has the ability to manufacture certain materials that the body needs and to change compounds to a form that the rest of the body can use. The kidneys too, perform an extremely useful function in that, besides causing excess water to be eliminated, they also cause other excess materials to be flushed out of the system, such materials as many types of salts, hormones, and even amino acids.

Nature, over many years, has designed a great protective system for man. In some ways, however, medical progress tends to offset many of the benefits nature has developed for us. In fact, we seem to have certain situations at the present time that could well result in the need for a great deal of adjustment in the food supply as well as a further use of additives. One of these situations is that because of technological advances in the fields of medicine, biochemistry, and food science, many people with genetic anomalies can now survive and, more importantly, survive through their reproductive years, a situation that could not have occurred many years ago. Thus, we find the number of diabetics rapidly increasing. The number of persons carrying the gene for cancer of the eye, retinoblastoma, has increased. Now, with special diets, persons with phenylketonuria (PKU) can live extended lives and even have children. There are probably many more metabolic anomalies of this type than we are aware of, and as they are discovered, it is most likely that solutions will be found. Many of these conditions will require not only medication, but also careful and strict control of the diet. Over the years, there will be an increasing need for special foods and diets. The implications for the food industry are tremendous. We are already experiencing the need for special foods and labeling for diabetics and for persons with heart disease, hypertension, and other abnormal conditions.

Also to be considered is environmental contamination of the food chain. Such contamination causes what might be termed incidental or accidental additives, but these "accidents" must be taken into account in any discussion of food additives.

It seems obvious that many quite vocal individuals have become politically and emotionally involved, but have not really stopped to consider the true impact of switching decisions about the use of food additives from a basis of science to one of legislation touched with emotionalism. It is very easy to cry: "Ban Food Additives!" "Ban Herbicides and Pesticides!" "Ban Power Plants!" "Ban the Internal Combustion Engine!"—but the consequences, particularly in the food area, could spell catastrophe. First of all, the problem has to be considered not just in connection with the needs of the United States, but with those of the world as a whole. Looking at the earth for what it is, we must conclude that the problems of survival here are no different from the problems of survival in a spacecraft. We must realize that even though the world is made up of many nations, we all share the earth's resources in common. Decisions can be made, and are being made especially by the more powerful governments, that will ultimately have an impact on an individual's life—regardless of where he lives.

The world food supply is most critical. Conservative estimates of the world's human population by the year 2000 range from about 5.3 to 7.4 billion, with 80% to 85% of the total living in the underdeveloped countries. This may double the present population of approximately 3.5 billion. At the present time, the world's land harvest is about 1,650 million tons of food each year; the sea harvest, about 56 million tons. It is easy to calculate that if 3.5 billion people are semistarving on the current production, 25 years from now we will have to harvest some 3,500 million tons of food per year just to keep the status quo. This means at least doubling our food production in the next 25 years. The possibilities of achieving this goal are remote unless a considerable amount of technological effort is expended by the lesser developed countries, where the greater population increases will occur. Our own country could probably survive the banning of a number of materials. If, however, we take action against particular herbicides and pesticides that are essential for protection of crops in the field from the ravages of insects and rodents and against certain food additives that preserve food in a more or less refrigeratorless society, we could doom a substantial portion of the world to starvation. We must recognize that many of the lesser developed countries follow the lead of the more developed; as the developed countries set up bans, the others follow almost immediately with the same bans.

It is probably true that many of today's problems are to some degree the fault of the food industry. We, food scientists and chemists, have for years blithely gone on our way formulating foods, using new additives, and finding new uses for old additives without really advising or telling the consumers what we were doing, why we were doing it, and what the benefits to them would be from the use of food additives.

Perhaps we should look at food additives in a new light. Consider, for instance, the MSG report by the National Research Council. A few years back, they set a precedent—they cleared MSG, but stated that since there was no good reason for it to be included in baby foods, it should not be. And today it isn't. The same philosophy might be extended to many other food additives. From now on, perhaps we should make absolutely certain that any food additive used in a product is essential in that particular product for the consumer who is going to use that product and that we can clearly demonstrate this need for the additive.

In order to deal with this problem, our firm has an internal system that requires full knowledge of all food additives that go into our products. Every additive must have a "326" form—a listing by the man-

ufacturer of the components of any item sold to us. Many of the flavor formulations are provided on a confidential basis, so the percentages of ingredients are not given, but the names of the components are listed. There certainly are times when the list of chemical compounds is extremely long, and that brings up the question as to whether all of these compounds are actually necessary in this particular flavor. Again, frequently flavors supplied to us contain artificial colors, not for their contribution to the final product, but merely to make the compounded flavor material look better. If it is an artificial syrup flavor, for instance, it may have a brownish tinge. In this instance, the food additive seems totally unnecessary since the finished product will carry its own color. Flavor chemists might keep this in mind when working on new formulations.

Our firm must keep track of the materials used in the products we buy also because we may use the particular material in an export product. We must be sure that product components are approved not only in the United States, but also in the countries to which we export.

Another area to consider in the matter of food additives is that of components that may be allergens. This is particularly important, again, with flavor products using carriers to dilute the flavor so that it can be properly mixed in an end product. In our corporation, if the flavor carriers are considered to be allergens, we include the items in the ingredient itemization, even though they may be present in very minute quantities. We feel it is better to do this voluntarily than ultimately to be legislated into it.

As to food additives, I believe that we should be able to justify the use of any material to the consumer or we should not be using it. This raises the question of the use of colors in food products. The standard answer from many activists is that food colors are not necessary—that people can do without them. Yet, we all know the story of the white maraschino cherries and how many of those were sold. This is another area in which the activists seem not to have thoroughly thought out the problem. I have no doubt whatsoever that color, texture, and flavor all play a role in adequate nutrition in that people tend to eat those things that are more appetizing, things that appeal to several senses, not just one. It might, indeed, be worthwhile for the industry to fund some studies on the importance of color and flavor in food products in relation to the nutrition of the population that eats those products.

In summary, then, food additives, important as they are today, can be expected to become truly essential in the future as an increased population puts added pressure on food supplies.

In response to the cries of the activists, we should insist on sound scientific data prior to the banning of any particular material, especially one that has had a long history of safe usage. An instance is Red No. 2, which was in use for well over 70 years.

We might also question whether the natural is always better than the synthetic or manufactured product. Flavor chemists should point out that many of the chemicals used in the flavor industry are nature-identical and that, in many instances, a flavor can be manufactured using fewer chemicals than are found in the natural product. This means that the public is exposed to less in the way of chemicals through the use of artificial flavors than of natural flavors.

Another factor to consider is that a dual standard of safety is built into our food and drug laws. Natural foods are essentially exempt from any considerations of safety and the requirements for their use are far less stringent than those for the use of any type of manufactured or additive-containing food. Yet, it is well known that many natural foods contain harmful chemicals that have nowhere near the 100:1 safety factor that is required for food additives. In many instances, natural foods may offer only a 1:1 or 1:10 ratio of safety.

It seems, then, that we should concentrate on publicizing the safety of our manufactured food supply since a great deal of care and effort have gone into making it the safest food supply anywhere in the world.

Following their talks, the speakers joined other panel members Dr. William J. Darby, Richard Ronk, Dr. Jan Stofberg, Dr. E. M. Foster, and Dr. David W. Fassett, to participate in a question and answer discussion period covering safety and regulations of flavors. The discussion was moderated by Dr. John C. Kirschman.

Members of the Panel: Dr. Stofberg, Dr. Fassett, Dr. Darby, Dr. Bauman, Dr. Kirschman, Mr. Ronk, Dr. Foster, and Dr. Vodoz.

Dr. William J. Darby received his medical degree from the University of Arkansas and his Ph.D. in biological chemistry from the University of Michigan. He spent a few years affiliated with Vanderbilt University Medical School. Dr. Darby is presently president of the Nutrition Foundation.

Richard Ronk is director of the Food and Color Additives Division of the Bureau of Foods of the Food and Drug Administration. He received his academic training at Creighton University, receiving a master's degree in chemistry in 1961. He has been with FDA since 1961, and in Washington, DC, since 1968.

Dr. Jan Stofberg, with Polak's Frutal Works for 24 years, is presently director of standards and regulations. He received his doctorate in chemistry from the University of Amsterdam, and is a research and flavor chemist by experience. He is presently chairman of the Expert Committee of the International Organization of Fragrance Industry, chairman of the Food Additives Committee of FEMA, and member of the Technical Committee of the Research Institute of Fragrance Materials.

Professor E. M. Foster earned his Ph.D. in bacteriology at the University of Wisconsin in 1940. He joined the faculty there after World War II and has since been a professor of food bacteriology. Currently, Dr. Foster is director of the Food Research Institute and chairman of the new Department of Food Microbiology and Toxicology.

Professor Foster has been president of both the American Society for Microbiology and the American Academy of Microbiology.

He has accepted numerous assignments for the National Academy of Sciences–National Research Council including member of the Agricultural Board, member of the Food and Nutrition Board, chairman of the Committee on Salmonella and chairman of the Committee on Food Protection. He is a member of the National Advisory Food and Drug Committee of the FDA, a member of the Expert Advisory Panel on Food Hygiene of the World Health Organization, and a member of the Expert Panel on Food Safety and Nutrition of the Institute of Food Technologists.

Dr. Foster is a Charter Fellow of the Institute of Food Technologists. He received the Distinguished Alumnus Award from North Texas State University; the Pasteur Award from the Illinois Society for Microbiology; and the Nicholas Appert Award from the Institute of Food Technologists.

Dr. David W. Fassett is now an industrial and environmental consultant, having retired after 25 years with Eastman Kodak, in the industrial toxicology laboratories. He is a charter member of the FEMA Expert Panel.

Dr. Fassett received his bachelor's degree in organic chemistry from Columbia in 1933, his M.D. from New York University in 1940 and for a while was acting chief of the Department of Pharmacology of the Food and Drug Administration. He has been serving on a number of subcommittees for the National Academy of Sciences, the Committee of Naturally Occurring Toxicants, Artificial Sweeteners, Subcommittee on Food Irradiation and others.

Dr. John C. Kirschman obtained his bachelor's degree in chemistry in 1948 from Muhlenberg College in Allentown, a master's degree in chemistry in 1955 from Oklahoma State University, and a Ph.D. in biochemistry from Vanderbilt University in 1960.

In his professional career, Dr. Kirschman held research positions with various U.S. government agencies in the United States and abroad, before joining Atlas Chemical Industries as supervisor of biochemistry in 1960. In 1967, Dr. Kirschman went to General Foods Corporation, where he is presently manager of regulatory sciences.

Eugene P. Grisanti has been president of International Flavors & Fragrances (U.S.) since April 15, 1974. He was previously executive vice president.

Mr. Grisanti joined IFF in 1960 and was for many years its secretary and general attorney. He holds a Master of Laws degree from Harvard Law School, and a Bachelor of Laws degree from Boston University.

Active in industry affairs, he is president-elect and a member of the Board of Governors of the Flavor and Extract Manufacturers' Association of the United States, a director of the International Organization of Flavor Industries headquartered in Geneva, and a member of the Board of Directors of the Essential Oil Association of the U.S.A. Inc. For several years, he directed the efforts of the government relations committees for both the flavor and fragrance industries.

Flavor Safety—Fact or Fantasy

Rather than the title "Flavor Safety—Fact or Fantasy," this paper should really be called "Food Ingredient Safety—Fact or Fantasy." On this subject, it is time to ask where we are going. We seem to have reached a cross-roads in this country on the issue of regulation of food ingredient safety. Industry can go from day to day, and year to year, engaged in rear-guard skirmishes, but we have now reached the point where the significance of the decision-making base must be appreciated. Make no mistake about for whom the bell tolls. Today's Red No. 2 may be tomorrow's saccharin or the next day's methyl salicylate.

First, let us address the Red No. 2 issue, although it is true that only a few companies in our industry manufacture colors. But Red No. 2 happens to be a good example of a point worth making.

It is now common knowledge that many responsible scientists considered the test data and the Gaylor report as insufficient to prove Red No. 2 harmful to man. The reports of the deliberations of the FDA Toxicology Advisory Committee bear this out. At the meeting of the Committee held on March 8 and 9, the majority opinion was that the FDA study presented no adequate evidence of carcinogenicity. Dr. George Mandel, chairman of the Pharmacology Department of George Washington University, was quoted as saying: "The material is insignificant. There is a tendency to consider this study as evidence, but we would be making a mistake if we did." Dr. Robert Squire of the National Cancer Institute agreed with this assessment. And pathology professor, Dr. Edward Smuckler concluded: "The experiment provides us with no data that can be used to assess the safety of this product or its potential hazard as a toxin or a carcinogen." In response to the Canadian government's statement that the FDA study had not altered the Canadian view that Red No. 2 was safe, an FDA spokesman stated: "The FDA cannot say that Red No. 2 is unsafe; neither can it say that the color is without hazard. In this situation, the FDA is convinced that its action to end further marketing is in the best interest of consumer health and safety." In the legal action, too, the FDA emphasized that its actions were based on the fact that the safety of Red No. 2 had not been proved, not that the testing data had shown it to be unsafe.

Once the FDA, after sixteen years of provisional color listing, took that legal position, it can be argued that a basic policy departure had occurred, recognized or not. There is, of course, a certain logic in the charge that industry had more than a dozen years to prove safety and the Commissioner had the right to pull the cord, ignoring for the moment that a questionable series of tests, after all that time, was the occasion for the cord-pulling. The real significance of the FDA action, however, is that it has, as a practical matter, shifted its own role of the past several years in judging the proof of safety burden.

Formerly, whether it was saccharin which was being questioned, or brominated vegetable oil, or any number of other substances, the FDA stance was to allow the testing to proceed systematically to a satisfactory conclusion before banning the substance—unless, of course, some significant adverse evidence showing possible harm developed during the course of evaluation.

The dilemma which this policy shift is causing is clearly exemplified in the recent Red No. 40 decision. By the government's own standard, has safety been proved for Red No. 40? And if the FDA is awaiting further data and analysis for proof of safety, was not this the same rationale on which Red No. 2 was banned? In short, why is interim life allowed to Red No. 40, but interim death dealt to Red No. 2? Toxicologists attempting to explain the distinction resort to the argument that random tumors observed in confused animal testing of Red No. 2 are more significant than lymphomas found in Red No. 40 test animals. But for the lawyers, that is not a relevant answer. The Federal Court upheld the validity of the government's position, i.e., not that Red No. 2 is harmful, but that it has not *been proved safe.* Would not the consistent application of that principle tend to create a domino effect on Red No. 40 and other provisionally listed colors? And what are the implications for ingredients now "generally recognized as safe"?

The responsible answer to that question seems to be that the Red No. 2 determination and any subsequent color determinations are made under the Color Additive Law's provisions requiring FDA's premarketing listing and certification, and are,

therefore, substantively different from GRAS determinations allowed by statute to be made by qualified scientific experts on quite another basis. That is, of course, a legal answer, but it is a very important one, containing a distinction which must be maintained to prevent a series of regulatory developments, the effects of which would be quite impossible for either the government or industry to handle without causing immeasurable difficulties and disruptions in our food supply chain.

Government scientists would surely agree that banning cyclamates in favor of saccharin—or Red No. 2 in favor of Red No. 40—and then spending years resurrecting the dead and the damned because of the inadequacies and inconsistencies of the original data base, does not promote consumer confidence in the safety of the food supply; it ultimately generates confusion and lack of confidence. For the longer term, the solution to the safety problem lies in quite another direction, requiring both government and industry leadership.

The answer must lie in a *realistically honest* concept of safety, steadfastly maintained by both government and industry. We are, each one of us, consumers. We should, each one of us, be concerned about the proliferation of chemicals, new and old, into our environment, and what their effects may be. Let's not, however, allow the alarmists to impede the adoption of a sane regulatory policy to deal with this vast and complex problem. The first step to such a program is education, and for this we must rely heavily on the scientific community. Let's tell consumers the facts.

Is the public aware that the normal components of natural food products constitute more than 99% of the weight of our daily diet? Intentional additives represent less than 1%, and most of that portion consists of either dietary supplements or materials present in natural food sources. By any reasonable standard, the toxicological consequencies of the naturally existing ingredients in food products must be the most significant safety factor of food consumption in a man's lifetime.

Today's urgent regulatory priority is to place the food additive safety problem in its proper perspective. Take, for instance, one of the staples of man's existence, the simple potato. It contains, as we know, oxalic acid, arsenic, tannins, and nitrates among other random toxicants. Isn't it time to face the fact that we can now take almost any natural food, isolate the several chemicals present in the food, test them according to the same safety margins now required by governmental regulations, and prove conclusively that it is no longer safe to eat—period? We can readily understand why the enormity of this truth may be best ignored: by industry, not to shake public confidence in the food supply; by government, not to unleash the unmanageable; and even by the consumer activists, not to distract from their singular vendetta against artificial additives.

But the consumer has a right to see the food safety problem in its rightful proportions. He has a right to know not only the *nature* of the toxicological criteria used to determine lack of safety, but the consequences of applying the same criteria to what he and his forebears have been eating for centuries.

Let us consider for a moment the nature of toxicology itself. It is only in the last several years that graduate training in toxicology has been available in this country. Even today, I am told, there are fewer than a dozen universities which offer a Ph.D. in toxicology. Dr. Arnold Lehman, a former head of the Pharmacology Department of the FDA, was said to have a sign in his office reading, "You, too, can be a toxicologist in two lessons—each ten years long."

Would that Dr. Lehman had been right! Today, some toxicologists have no hesitation in pronouncing sentence on an ingredient on the basis of any one of a wide variety of exotic testing procedures. The fact is, the more reputable the toxicologist, the more limitations he will impose on the conclusions to be derived solely from animal testing of food ingredients. And for good reason!

The number of enzymes in the body is limited and, therefore, the number of reactions that can occur in the body are limited. Obviously, this is the reason a lovely martini glow with increased consumption can become a vicious hangover. The metabolic pathways used by the body for the biotransformation of a chemical depend on the dose of the chemical. Further, different metabolites are formed at different dose levels. Dosage levels are extremely important in chronic toxicity testing. Gargantuan doses to achieve positive effects are probably self-defeating in proving lack of safety because of the grossly distorted impact on the system whether man or animal. In addition, there is the emotional factor which can produce disease as a result of repeated insult to the animal physiology with high dosage feeding. Finally, there remains the question of extrapolation—after all this, is the rat or the dog even comparable, in its response, to man?

Left: Cary Hutchinson of Universal Flavors with Mileta Kovacevic of Albert Verley; Right: Larry Henthorne of McCormick with Dick Schranz of Firmenich.

How aware is the public of the inherent limitations of present toxicological testing procedures to *prove or disprove safety of a food ingredient* that is consumed at low levels by man over a long period of time? Some would answer, "But this is the best we can do today; is any better approach possible, considering the present state of the science?"

There is a better way—the multidiscipline approach to safety evaluation. We can approach toxicology by *admitting* the limitations of animal testing, using such tests to the extent practicable, but integrating the results in a far broader process of evaluation. This is, of course, the rationale for the FDA's own Toxicology Advisory Committee.

Dr. Horace Gerarde, the late, distinguished member of the FEMA Expert Panel, used to say that toxicology was a practical science involving chemistry, biochemistry, pharmacology, physiology, pathology, and medicine. Intelligent decisions concerning the safe use of chemicals require an integration of knowledge in all these fields.

It was probably fortunate, in a way, that the flavor industry had so many hundreds of ingredients to contend with when the GRAS provisions were established. If the job had been easier, the pat solution might have been too tempting to resist. Reliance solely on animal testing provided no panacea, considering the number of ingredients, their natural presence in food products, and their levels of use (often at levels below 10ppm in the food). Instead, the monumental challenge required a sobering assessment of the nature of the safety problem itself. Once it was recognized that toxicology was multidisciplined, requiring the application of scientific judgment to the entire data base, the nonindustry expert panel was selected comprising these disciplines. The rest is history: the FEMA GRAS list, its acceptance and publication as a regulation by the FDA, and the present review of the list.

Today, safety evaluation panels, as rare as Sputniks when the FEMA Panel was begun, are commonplace satellites revolving around almost every safety issue. The mere proliferation of panels, however, has not served to make safety determinations easier.

What is needed is a well-defined safety program based in both conception and inception on educating the consumer to the true issues of food safety. It should be disseminated to the public by government on a broad and effective scale. It is easy to say this is a job for industry to do, but quite frankly, industry cannot do it alone, and for very good reasons. First, a public information program by industry is always considered suspect as self-serving. Second, and more importantly, we have reached a point where such a public information effort must reflect actual governmental policy. We are in need in this country of a national program on the safety issue.

If anyone doubts that this is so, he need simply consider the issue of the Delaney clause. Almost all reputable scientists agree that, with the present state of knowledge on cancer and toxicology, the Delaney clause is scientifically indefensible. Yet the same scientists will agree it is almost impossible politically to modify the clause. No other country has such a law. The inescapable conclusion is that we lack an adequate public information effort to provide support for a national food ingredient safety program that makes sense.

Such a program must be multidisciplined, calling upon the ablest scientific minds in the country; it must recognize the inherent limitations of present toxicological testing procedures and the need for judgmental interpretation by qualified experts; and finally, it must deal with the food ingredient safety issue, not on the basis of some unrealistic criteria of absolute safety, but in terms of the safety of the food supply as a whole. Once such a program has been established, with input from both industry and the consuming public, it must be allowed to operate on a systematic scientific basis to maintain its integrity. It must be free of undue pressures from politicians, from industry, and from consumer activists, gauged to trigger premature decision.

Our food supply, thanks to this country's food industry, and to the flavor industry, is the best, the most nourishing, and the tastiest in the world. It is also the safest. The public should know this, and be assured of the steps being taken to keep it that way.

Flavor Safety—Fact or Fantasy Discussion

Q: Will your presentation be published in the media, for instance in the New York *Times*, in order to counteract some of the less positive publications we have seen lately?

A: It will get into *Food Chemical News*, at least. It is available for publication and will be given to the industry trade press. Certainly parts of it might be helpful for further dissemination.

I don't think that the publication of this paper will particularly help in the present climate. I do think, however, that what I have been talking about does require an effort that must involve Washington. Perhaps, it should begin at the level of the White House. There has to be some administration policy on the National Food Ingredients Safety issue, and this will become ever more apparent as the months pass. It's true that the National Cancer Institute and several private groups are working behind the scenes, but nothing is being coordinated. There is, at the present time, a national leadership vacuum on the issue. This is one of the problems we face.

Q: Would you agree that, perhaps in addition to needing a definition of a "carcinogen," we also need a definition of an "expert"?

A: I think that part of any difficult definition is something that "is." Cancer is. Carcinogens are. And to a great extent, experts are. The problem, of course, is that we get into the question of political criteria as to who should be qualified to sit on a panel. This can impede any progress made by the panel, so convoluting it with cumbersome mechanism that it cannot reach a decision. Per-

haps, a commission on the safety of the food supply is needed. The President could appoint a number of the leading scientists in this field to design a program and to staff it with scientists qualified by national leadership reputations. I realize this answer somewhat begs the question, but I think the situation really requires leadership, and it requires somebody to appoint people in whom we can have confidence, and, to some extent, it requires a weeding-out process of the troublemakers on the fringes who are either not qualified or who do not act from credibly scientific motivation.

Q: Could you be more specific about what should be done about a program to educate the public on the safety of the food supply?

A: The primary lack today is that we don't have even the foundation for a program. The public lacks knowledge. People are frightened by the fact that chemicals are coming into the environment. There is no educational program putting the safety of the food supply into perspective.

The Commissioner himself had an opportunity when he appeared before the Kennedy hearing on the Feingold issue. He could have said, "Maybe Dr. Feingold has isolated some ingredients that have caused a problem, but the issue is not whether these ingredients are artificial or natural. If an ingredient is toxic or if it causes hyperkinesis, it is a chemical that is bad. Whether it is artificial or natural is not the issue. It is a scientific judgment as to whether this particular chemical entity causes harm." Now, just this kind of basic concept could have been put across in that hearing, but was not. Instead, it was simply a question of "I agree with you, senator, we haven't done enough and will do it as fast as possible. We'll start testing."

There is such a great lack of public information which could put the whole issue in perspective that it requires a vast governmental program. First, the problem has to be recognized, and then the program has to be designed to teach people what the issues of safety and of the food supply are. Along with this, a proper program of looking at ingredients in the food supply on the basis of their safety, whether natural or artificial, has to be set up on the support-base of that public information.

I think, quite frankly, that the whole effort of the government, and its whole budgetary allotment, should not concentrate on the fringes of incidental additives or artificial additives. The first concern should be the volumes of dietary components that we eat every day. Just as in industry safety programs, whether on fragrance or flavor, we first test the ingredients that are used in the largest quantities and the largest concentrations. For the past ten or fifteen years, this country has ignored the whole natural food supply and concentrated on a fraction of a percent of artificial additives. At a certain point, anybody who is truly thinking about the safety of the American consumer and what in his diet may cause cancer must sit back and say, let's look at this whole picture. What is he eating day in and day out? What does it contain? Why should we be concerned about this aspect and not concerned about that aspect? The perspective is just not there.

Q: On the question of who should conduct programs on the safety of our food supply, besides industry, should we also urge Capitol Hill and other legislative bodies to participate?

A: I think you're right. I agree that getting industry active in the programs is not enough. One of my business associates has pointed out that we constantly breathe each other's exhaust—that we are talking to one another when we should be talking to others. And to be realistic, we have to admit that industry cannot do the job alone. Government has to be involved in the recognition of the problem and in its solution. It's going to be forced into this sooner or later. The only question is how much damage is going to be done in the interim. And what industry should do is, yes, inform the legislatures and inform the public. But industry must also get busy working in Washington and through Washington to get a responsible program under way. The program must recognize the problem and have the leadership to stand up to, rather than be distracted by, politically motivated activists who snipe from the wings. It's gone beyond that.