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WATER QUALITY

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AWWA WATER QUALITY

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FOREWORD

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THE ADVISORY COUNCIL'S ROLE IN SHAPING EPA'S PROGRAM

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It is with much pleasure that I appear before the 1976 Water Quality Technology Conference. There are some of you present who will remember my days as a bureaucrat when I was not always in good favor with my colleagues in the water industry. During those days, in the late 1960's, it was my lot to call attention to the fact that some of our water facilities, particularly the smaller ones, were not always meeting the high standards of performance the industry had set for itself. In view of the illustrious history that attends the U.S. water supply industry, criticism by an outsider, that appeared to be self-serving, was difficult to take. Nevertheless, the industry survived this earlier evaluation, and I believe it has become stronger in the process.

Today, once again the water industry is under attack and this time for reasons for which it has little control. In addition, the answers to the problems it is being required to confront are not readily apparent. As a result of the billions of gallons of waste water that is discharged daily to our streams and onto our lands, together with the millions of tons of solid and gaseous wastes that are discharged to the environment, the safety and quality of our water supplies are threatened in a manner not previously considered significant. Now, you and I know that this is not a new subject area. Downstream communities have been treating and drinking diluted waste water discharges from upstream communities for a long while. What has changed is our knowledge of the character of the upstream discharges and our apprehension about the possible health significance of the contaminants being identified. Because of advances in laboratory technology, we are now able to discover and measure substances in our water supplies which we did not know were there before.

The situation we find ourselves in today is a good illustration of what an excellent environmental barometer our water resources are. As an environmentalist I will always be concerned about the manner in which we attempt to prevent degradation of all environmental mediums - air, land, and water. But I believe of these, our water resources, more perhaps than any other, illustrates the interaction of all parts of the environment and particularly the recycling process that characterizes every resource of the ecosystem. Everything that man himself injects into the biosphere - chemical, biological or physical - can ultimately find its way into the earth's water. And these contaminants must be removed, by nature or by man, before that water is again potable. When we learn to protect our water resources, we move a long way toward the protection of the other mediums of the environment.

The theme of this year's conference - "The Water Laboratory--Key to Process and Quality Control" - is a most fitting one to embrace the remarks I bring to you today. Because of what we have done, and are continuing to do by contamination of our water resources, the water laboratory is indeed a most significant member of the team required to assure the production of water that is safe for domestic purposes and other uses. The laboratory's role starts with the determination of the quality of the raw water to be treated so that the correct treatment processes can be designed, and continues by determining the effectiveness of each step in the treatment process, and finally evaluating the quality of the water delivered to the ultimate consumer. In view of today's changing scene with respect to laboratory technology and our non-knowledge as to the significance of the findings being reported in parts per billion and parts per trillion, the Water Technology Conference this year takes on broadened and significant dimensions.

Never before have the pressures been so great on laboratory, technical, and scientific persons in the environmental movement to justify their actions and give credence to their results. The demands that we make on the public for protection of our water resources, and on industry for water pollution control have reprecussions far beyond the costs of water supply treatment and distribution. They affect almost every aspect of our lives. While I believe you and I are of the opinion that the standards we set and objectives we seek are necessary for the protection of the public's health, satisfying ourselves may not be enough.

Today we are in a brand new ball game. No longer are we permitted to promote legislation, establish standards, and promulgate regulations based on the knowledge, experience, and judgment of a small committee or a few individuals. Through the administrative processes that have been established, everyone and anyone may exercise the opportunity to participate for the purpose of influencing the outcome of each deliberation and if needs be seek redress in the courts when it is felt the results should be other than what they are. While it sometimes places a heavy burden on all of us to justify our actions and our positions, I personally would not have it any other way.

It has been my honor and my pleasure to be involved in some activities that affect our evolving concerns about our environment Through my participation on the National Drinking Water Advisory Council I have had an opportunity to keep abreast of many activity areas which directly affect the quality of our water resources. From this vantage point it is readily apparent that nearly every grant, regulatory, technical assistance, research and developement program activity of the EPA has some direct impact on the quality of our community water supplies. In my opinion, one of the primary functions and indeed responsibilities, of the National Safe Drinking Water Advisory Council is to be sure that the EPA understands and appreciates this as they implement those specific programs.

For those of you who may not know, the Advisory Council is mandated by section 1446 of Public Law 93-523, the "Safe Drinking Water Act." It is an advisory body to the Administrator of EPA. There are 15 members representing State and local agencies concerned with water hygiene and public water supply; private organizations or groups demonstrating active interest in the field of water hygiene and public water supply; and members from the general public. The act instructs the Council to advise, consult with, and make recommendations to the Administrator on matters relating to activities, function, and policies of the agency regarding the safety of public water supplies. I believe it it fair to say we have attempted to do just that. Our concerns have been specific as related to EPA's regulatory responsibility under the act and general as related to a host of activities that support EPA's ability to effectively implement the act. The results of our first year's activity are recounted in the Council's annual report for 1975 which is available from EPA. Our second year's annual report should be available shortly after the first of the y r.

Rather than introducing matters contained in those documents l t me speak to three subject areas that illustrate the Council's role i shaping the EPA program - (1) concern for water supply sources, (2) an approach to standard setting, and (3) implementation of a laborator quality assurance program.

In prescribing national primary drinking water regulations, som assumptions must be made about the quality of the intake waters to be processed by treatment methods found to generally available. The House committee responsible for the act intended that the Administrator assume the intake water will sufficiently uncontaminated so that with application of the most effective treatment method(s) available, a public water system would be able to protect the public health. The validity of this assumption in large measure resides in the timely success of the Nation's water pollution control effort.

Today the United States uses water at the rate of about 500 b.g.d By the year 2000 it is estimated that our use will be 1.400 b.g.d. The supply of fresh water for these purposes is relatively constant. It follows then that we have been and will continue using the same water supply over and over again. If man is to be protected from the chemical and bacteriological hazards associated with water reuse, every effort must be made to control contaminants at their source. In the past, we the industry, the public, and the Government have tended to regard water supply as separate from water pollution control. Recognition of their interdependence is essential to an effective and rational approach to implementation of the Safe Drinking Water Act.

Close analysis of the Water Pollution Control Act will reveal a law that complements and supports the Safe Drinking Water Act in very significant respects. It is replete with requirements which when implemented will identify toxic and hazardous substances in water that are harmful to the public's health, locate the points of discharge of such substances to our water supply sources, establish maximum daily loadings of such toxic and hazardous substances so as to protect the water quality in the receiving streams and in every instance carrying out all of the foregoing activities in a manner that protects public water supplies and public health -- so says the law. I believe it is within the role of the Council to exert its influence to encourage the coordination of these two programs so that the resources made available for their implementation are wisely spent and the resulting programs complement each otherin reaching their common objective in protection of the public's health.

There is a national debate occurring at this time, accompanied by a court consideration of what to do about organics in drinking water. It is interesting to analyze just how this debate got started. First of all, we had the discovery of minute quantities (parts per billion) of a half dozen organic substances in the New Orleans water supplies. An epidemiological survey reported a correlation of these substances in the New Orleans water with increased cancer mortality in white males. A critical review of this study disputed the conclusions of the authors. Later, a survey of 83 U.S. cities confirmed the presence of some 300 organic compounds in very small quantities (parts per billion) including several known and suspected carcinogens. Chloroform was one of them. A study by the National Cancer Institute concluded that chloroform administered in very large doses, caused cancer in rats and mice. The question was then raised as to whether the interim primary drinking water standards should include a maximum contaminate level for chloroform and other organics. While there is much more to this story, the point I would like to make, one with which the Council has grappled, is what constitutes the basis for creating any standard. Is this done on the basis of the findings of one study? What would be the reactions if the level of the organics was parts per trillion rather than parts per billion or some other concentration? Does any detectible quantity of a substance that is considered carcinogenic under some test conditions unrelated to human exposure dictate the setting of an MCL for water supplies?

One viewpoint in the current debate recommends setting a standard of zero because of the widely accepted view of a no threshold level for known or suspected carcinogens. Another says it is too early to to establish a standard because available data do not allow an evaluation of the significance of trace amounts of such substances in water. Nearly everyone agrees that the source of most of these organic compounds of significance to health orginate with disposal of wastes by our industries. The ultimate solution of this problem can have far reaching and significant impact on both the American public and the economy of this country. Its resolution cannot be taken lightly.

If it could be determined that a threshold does exist for carcinogens, the establishment of a standard to protect the public health would be made considerably easier. The National Drinking Water Advisory Council has been pursuing this matter for some months now. Dr. Herbert Stokinger, a toxicologist with the National Institute of Occupational Safety and Health, presented a case for biologic thresholds at a recent meeting of the Council. Data were presented for several separate instances which indicated evidence that measurable and significant thresholds existed for eight suspected or known carcinogens He noted that the carcinogens were of widely differing chemical structures, producing many different tumor types, presumbly by different mechanisms. Further, he noted that thresholds were evident for all three major routes of entry and unrelated as to whether the carcinogens were of very high or low potency.

I understand that the Dow Chemical Company has conducted studies on several substances and has obtained results similar to Stokinger's. In a study of hexachlorobutadiene, the Dow Chemical Company found that a high dosage caused multiple toxic effects, including kidney cancer in test rats, while lower doses did not.

Thresholds for health effects when discernible are essential for the developement of sound environmental standards. In my opinion, it is incumbent on the scientific community to evaluate Dr. Stokinger's and the Dow Chemical Company's findings for the benefit of the public knowledge at the earliest possible time. Should it be determined that their work has merit and relevance, an entirely different approach becomes available for the establishment of effluent standards for many hazardous substances, and for the development of organic standards for water supplies.

The significance of the foregoing is readily apparent if one reads literally the words of the act [section 1412 (b)(1)] - "Each such recommended maximum contamination-level shall be set a a level which...no known or anticipated adverse effects on the health of the persons occur and which allows an adequate margin of safety." When we accept the prevailing opinion of a "no threshold level for corcinogens" then the recommended MCL has to be set at zero. We have to use "best technology" as no economical treatment process will produce an effluent meeting the zero tolerance limit.

To require a specific treatment process because a varying number of organic compounds are identified at different levels without knowledge as to the significance of the levels present; or following treatment without knowledge of the subsequent effect of the reduced levels on persons, or the significance of the organic compounds unaffected by the treatment process, is to require the expenditure of millions of dollars for unknown purposes or benefits. It is doubtful that the Congress intended to place such an enormous economic burden on the population in the absence of more definitive information justifying the need. It is like buying an insurance policy simply because you can afford to pay for it. We must ask ourselves, is this the wisest use of money?

On the other hand, there is little doubt that the Congress expected some type of regulations with respect to organics. In my opinion the fairest and most practicable regulatory philosophy for organics is the establishment of MCL's - either singularly or in groupings. The process allows maximum consideration of the quality of the water supply source, the ultimate quality of water desired or required, and the capability (technical and economic) of water utilities of all sizes to meet the required levels.

Since a zero level is impractical, a reasoned approach requires an assessment of risks to accompany the identification of contaminant levels in the treated water and the selection of an MCL dependent on the specific contaminant or group of contaminants and the available treatment technology taking cost into consideration. MCL's should be established whenever the weight of scientific opinion suggests a potential for harm and provides estimates of the degree of risks to the public health associated with the levels of the identified contaminant. The mere identification of a contaminant in water regardless of the concentration, without confirming evidence of the extent of its presence (geographical distribution) in water or the significance of the levels found should not trigger the establishment of MCL.

Under any conditions the setting of standards for purposes of the Safe Drinking Water Act requires the development of an environmental health research strategy and the implementation of an expanded health effects reasearch program that is coordinated to the maximum extent possible with other government and non-government health effect research efforts. Almost from its inception the Council has been encouraging the development of such a strategy to accompany implementation of the water supply program. At its last meeting the Council voiced its concurrence in the staff developed water supply research plan and recommended its approval by the Administrator. We will continue to work for and support its full implementation.

We have briefly discussed the Council's concern for the quality of water supply sources and the manner in which standards might be established. I would now like to spend a few minutes discussing the water supply national laboratory certification and quality assurance program from the Council's point of view.

The concern for laboratory approval, however, it not new. On a State basis, California has had a water laboratory approval program since 1950. Some other States have done likewise. EPA and its predecessor organizations have had the Analytical Reference Service, and now EPA has the Methods Development and Quality Assurance Research Laboratory that is concerned with both methods and laboratory evaluations in the field of water and waste water analysis. Initially, this Federal laboratory was involved only with methods development and the evaluation of EPA laboratories, but it is increasingly concerned with laboratories outside the Federal system. Within recent years, EPA has awarded several contracts to assist it in formulating policy with respect to laboratory approval and procedures under which such programs could operate. In the context of air pollution analyses, EPA has a sister laboratory, Quality Assurance and Environmental Monitoring Laboratory, that has been engaged in comparable activities.

Not only are Federal agencies concerned with the regulation of environmental laboratories but professional societies have expressed similar interests. The American Industrial Hygiene Association has had a voluntary accreditation plan operating for a number of years. Although the number of industrial hygiene laboratories currently accredited is relatively small, the combined interest of the Federal OSHA program and that of the association is likely to lead to more accreditation activities. I have read where the Committee on Environmental Improvement of the American Chemical Society has been investigating activities and interest in licensing chemists and certifying laboratories. That society has surveyed all the States and is in the process of tabulating the data and preparing a report. The American Water Works Association has expressed clear interest in water laboratory certification and included a full session on this subject at its Water Quality Technology Conference in 1974.

Early on the National Drinking Water Advisory Council recommended that a system of mandatory laboratory certification be established to assure the maximum degree of uniformity in the measurement and interpretation of laboratory results required by the national primary drinking water standards. In making this recommendation the Council desired the States to have maximum flexibility in building on existing programs and competemce. Accordingly, it was the Council's further recommendation that EPA provide an interim approval period for implementing certification of State principal water supply laboratories until 1977 and then begin formal certification under the revised final regulations. This approach allows an orderly evaluation aimed at full certification of most laboratories by 1979. Because all certification will not occur when the revised regulations are issued in September 1977, the interim approvals will need to continue until final certification occurs. In the Council's opinion this approach presents a workable plan which extends certification gradually, does not use the evaluation resources to duplicate work in two certification steps, and permits work on all procedures at once.

In the implementation of certification programs for local laboratories the Council prefers a State adminstrative approval system which uses the criteria and procedures manual developed by EPA or State equivalent standards for approval. certification should begin after the permanent regulations are in effect and would be completed by March 1979. In recommending this approach to the Administrator it was assumed that State administrative approval will be based on previous contact with laboratories either from State licensing laws or from administering the inter-State carrier program and that laboratories unknown to the approval agency will be given some type of comparable inspection in the administrative approval process.

In the Council's opinion it will be necessary for EPA to adopt an administrative approach which focuses on obtaining final certification of as many laboratories as possible by March 1979. To accomplish this the work plan must be simple and directed at final certification. Steps creating workloads which interfere with this, such as creating elaborate interim certification procedures, must be avoided. Interim approval should be based on guidelines rather than regulations and remain in effect until final certification based on final regulations is accomplished.

The question of reciprocity between State programs is always one demanding attention and some answers. Reciprocity takes on greater significance when Federal dollars are used to support such programs and minimum Federal standards govern their operations. The primary value of reciprocity is to the water suppliers making use of laboratory services. Required reciprocity with all States would be unnecessary for the efficient operation of water supplies in any one State. On the other hand, many States do have localities where water suppliers might best be served by a laboratory in an adjacent State. In such situation we understand that some States have voluntarily developed such relationships. In the Council's opinion, the important thing to the national program is not necessarily to require, but rather to permit reciprocity to take place. A recommendation embracing this concept, and encouraging such agreements when it is to the mutual benefit of water purveyors and the States, has been forwarded to the Administrator.

Equally important to obtaining certification is maintaining a level of performance that entitiles a laboratory to keep its certification. EPA proposes to check laboratory performance based on periodic reports on reference samples and submission of results from performance samples. The reference sample is a sample of known content and quantity which a laboratory can use to check its procedure and equipment. The performance sample is an unknown sample which the laboratory tests and returns its findings to the examining agency. The laboratory's continued certification would be dependent upon the results obtained when the reports on reference and performance samples are evaluated.

The Council expressed concern that certification could be lost on failure to pass on one performance sample. It was the Council's opinion that performance testing should not be use as a punishment but rather as another tool for evaluation and for training and upgrading the laboratory program. In any case, base approval should be determined on more regular scheduling of both reference and performance sampling than the quarterly and annual schedule then being recommended by the EPA. Two possible alternative schedules were suggested with the further recommendation that the regulations require a field inspection rather than decertification if an error is made on a single performance standard. Further, the Council believes each State should have the responsibility to develop and maintain quality assurance programs for the control of laboratories in their States. Minimum compliance monitoring within States should be the same as that applied to the principal State laboratory by EPA.

Finally, the Council believes that the compostion of the certification team should be determined by the certifying agency in consideration of the scope of the particular survey to be accomplished and the timing of the various components of the survey porcess rather than to have the team membership specified in the regulations.

I believe that much of the Council's thinking has been included in the current draft of the EPA guidelines. I understand that EPA will be reporting on that draft during the course of this seminar. It must be noted that EPA continues to involve to a large extent concerned and affected persons in the development and implementation of the regulations geverning the safe drinking water program. The implementation strategy for EPA's water supply national laboratory certification and quality assurance porgram is no exception. The extent to which you involve yourselves in this development process wil determine its ultimate acceptance and the ultimate success of the entire program.

There is no doubt in my mind that this year in this country we have embarked on a new voyage in our pursuit of environmental quality.

The Safe Drinking Water Act is one very important aspect of that voyage. The Toxic Substances Act, and the amendments to the Solid Waste Act add renewed impetus to the existing Air Pollution Control, Water Pollution Control, and other acts that comprise our legislative flotilla to combat emvironmental degradation. The implementation of programs, the development of standards, and the establishment of regulations in any of these legislative areas impact upon and interface with the maintainance of water quality. The National Drinking Water Advisory Council is keenly aware of this as we pursue our role of participation in the shaping of EPA programs. In large measure our knowledge of the water interface with the rest of the environment comes to us through the results that are obtained from the water quality laboratories. It occurs to me that the quality of those results is significant not just to the production of safe water, but to the Nation's confidence in a scientific system that is essential to human survival. I wish you well as you begin this conference and pursue the deliberations that place the water laboratories on board for this all important voyage.

WHAT THE WATER QUALITY LABORATORY CAN DO

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The role of the laboratory is a subject that provided impetus for having these Water Quality Technology conferences. The Association and its Water Quality Division have recognized the need to improve the image of the laboratory and emphasize that new responsibilities are coming up fast. Laboratory equipment and instrumentation are improving at an amazing rate - to the point where we speak of micro and nanograms per liter without wonder.

Using time as a comparison, one microgram per liter - or a part per billion - is equal to only two seconds in the life of a 63 year old man. A nanogram per liter is equal to one second in 31,700 years - or to put it another way one-tenth of a second in 3,170 years or since 1200 B.C. to now. Or try this for a volume comparison - Lake Michigan contains almost 1,200 cubic miles of water or about 1.21 X 10^{15} gallons. Just 5000 kilograms, or 5 tons of a chemical uniformly mixed throughout the lake would give one nanogram per liter. A picogram per liter - a part per quadrillion - would take only 11 pounds of the chemical in the 1,200 cubic mile lake.

The laboratory space allocated and the potential for sophistication probably come about under the influence of the utility's management. We've all seen water plants with nice little labs, some even with a fair amount of good equipment. It's an odds-on bet, however, that the laboratory will not be staffed with a qualified person. The plant operator may be trained to run chlorine residuals, hardness, iron concentration or other pertinent tests, but other than these routine, operation-oriented things, there is usually little capability.

Many systems which have invested capital funds in a plant laboratory claim that they cannot afford to hire a qualified person to run tests other than those absolutely necessary for some minimum level of quality control. The U.S. Drinking Water Regulations will add certain tests and require more careful reporting than has been the case for the majority of water systems. Parallel state rules and regulations will bring the requirements closer to reality and affect even the smallest water systems to some degree.

What size does a utility have to be to afford an acceptable laboratory? It's a tough question with many variables in the answer. As a starter, I'll attempt to set a base with my own utility. Chicago spends slightly over $1 million per year on all aspects of water quality surveillance - from sanitary surveys, through plant operations, distribution taps and final reports. Based on 4.5 million customers that is something over 22 cents per customer per year. This figure has been quoted by others and seems to be acceptable for a very large water utility. For the sake of simplicity, however, we'll use 20 cents per customer per year in this discussion (Fig. 1).

Let's assume that a population reduction of one order of magnitude doubles the cost per consumer - in other words, if a utility serving 5 million spends 20 cents per consumer on the water laboratory function, then a 500 thousand community should spend 40 cents, and a 50,000 population system should spend 80 cents per consumer. Thus, the 50,000 system would be spending approximately $40,000 per year as shown on the projected table. Is this a reasonable assumption? Can a town of 50,000, probably treating about 8 or 9 mgd, spend up to $40,000 per year to operate and maintain a water quality laboratory? (Fig. 2).

As shown on the table, reducing the community size to 25,000 raises the per consumer cost to about $1 dollar but only produces $25,000 per year - most probably not sufficient to operate a full-time lab without support from some other agency. We hope you'll have some comment on this attempt to establish a minimum level for a quality control oriented utility.

Can the water quality laboratory justify its existence? Can it produce data leading to better quality water and/or better operation? Yes, we firmly believe that a well-staffed and equipped laboratory can do even more. As an example, Chicago within the last few years has cut the cost of chemical treatment by as much as $1.25 per million gallons. Most of this savings is due to the use of polymers as coagulant aids, reducing the aluminum sulfate dosage. Ancillary cost benefits are reduced suppression of pH and a significant drop in the gelatinous portion of the settling basin sediment. Literally thousands of jar tests were run during the polymer evaluation work by laboratory personnel. These somewhat tedious tests provided good preliminary data that were the base for plant scale evaluations. The lack of a "standard" for the polyelectrolytes increased the amount of work necessary to satisfy the purchasing agent at the bid evaluation state. Chicago is using approximately $300,000 worth of polymers per year so you can believe that the bidding competition has been brisk. At an annual treatment plant pumpage of approximately 390 billion gallons, our chemical cost savings approach one-half million dollars - certainly not all credited to laboratory work, but the contribution was significant.

While on savings, we maintain extremely close control on the fluosilicic acid feed for fluoride - it's expensive. We're presently paying 15 cents per pound of fluoride. At the 390 billion gallons per year pumpage, one-tenth (0.1) milligram per liter would cost almost $50,000.

Despite the obvious advantages in such cost saving procedures, quality control should be one of the first considerations of the laboratory. Surface water treatment plants usually require some degree of monitoring, starting with the source water. If the raw water quality is rapidly variable in quality - as from a river or at our South plant which is near wind-blown industrial pollution - then alert and careful monitoring pays off. It pays off not only in the most efficient use of chemicals but in the community relations aspects. You'll recall that the AWWA sponsored gallup poll of consumers emphasized odor problems at the Las Vegas Conference in 1973. (As an aside, it's interesting to note that the use of powdered activated carbon has decreased dramatically as the cost more than doubled over the past few years. It would be great to think that pollution control efforts were responsible - we have not found this to be the case as yet).