

WATER POLLUTION

IN HAWAII -- 1969

**address at the Conference for
Clean Air and Water held on 7 November 1969**

by

DOAK C. COX

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**WATER RESOURCES RESEARCH CENTER
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Doak C. Cox, Director

Water Resources Research Center, University of Hawaii

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Conference for Clean Air and Water

One cannot read newspapers or magazines, or listen to the radio, or watch television, without being aware that the effects of water pollution are becoming increasingly apparent, here in Honolulu, in Hawaii nei, all over the United States, and indeed throughout the world. In many parts of the worlds there have already been some most unpleasant consequences, large lakes now stink, major rivers kill fish, streams burn, seas tar and kill the seabirds, and water supplies are poisonous untreated and noxious treated.

In Hawaii we have to some extent been lulled to complacency by the combination of an unusually beneficent natural environment and the results of the application of some really first-class water-quality technology. There are very few parts of the world where it is possible to obtain domestic water of a quality superior to that obtainable fairly generally throughout our State. I suspect, in fact, that no other urban supply of anything like comparable magnitude approaches the quality of our Honolulu supply, with its microbiological quality so impeccable that it cannot be improve by chlorination, entirely lacking in suspended sediment, of an overall salinity so low as to be unnoticeable, and with no ion present in concentrations of concern. In fact, if the water were much purer, it would in many ways be less desirable. Really pure water, of the sort produced by distillation, is a necessity in a chemists lab, but it is a rather unsatisfactory

flat-fasting beverage.

Although we are less fussy about the quality of the much larger supplies of water used for irrigation, even they would be considered of good quality in most parts of the world. Because many of them are drawn from ground-water bodies having the most intimate relation with sea water, we have had to be concerned with salinity in these irrigation water supplies, but through a highly developed technology have been able to produce quite adequate supplies even in many very dry areas.

And around us, of course, we have the entire Pacific Ocean, extending thousands of miles in all directions, with that depth of blue in our vicinity suggestive of a purity which, to the knowledgeable, is indeed all too real because it indicates a lack of nutrients, plankton, and hence fish.

Even those of us who have lived here in this euphoric environment for a long time, have however, been aware right along if we think about it of some polluted corners, murky canals and harbors, stinking tidal mudflats, overflowing cesspools, and that constant slick in the ocean off Sand Island.

Indeed certain pollution problems, admittedly of a natural sort, are a matter of old Hawaiian record. A mele, cited by Emerson, has this verse:

O Ewa, aina kai ula i ka lepo	Ewa's lagoon is red with dirt
I ula i ka makani anu Moa'e	Dust blown by the cool Moa'e
Ka manu ula i kalau ka ai	A plumage red on the taro leaf
I palahe'a ula i ke kai o kuhi'a.	An ochereous tint in the bay

More recently, we have become increasingly aware of other evidences of pollution, mats of cane trash floating offshore, pineapple cannery waste of pungent odor, dead fish in streams, tar coating our golden

beaches, and persistent plumes of red mud marring those blue seas.

In spite of the increasing evidences, I rather doubt that we would at this point have given much attention to the state of pollution of our waters, or its control, if the problems had not been much worse elsewhere in the nation and had not resulted in national legislation. The federal Congress passed in 1965 a Water Quality Act requiring the establishment of water quality standards for all waters subject to federal jurisdiction, namely coastal waters and interstate waters. Each state was encouraged to set its own standards for the waters within its boundaries or on its coasts, subject, however, to approval by the Federal Secretary of the Interior, and such state standards would then be accepted as federal standards applicable to those waters. If a state failed to take advantage of the opportunity, the Interior Department would establish standards for the waters in that state. Within about three years, all states complied.

The Department of Health which, in Hawaii, has jurisdiction in matters of water quality chose not to try to define closely which waters were federal, but to adopt standards applicable to all its surface and coastal waters (but excluding ground waters). A marathon series of public hearings were held, in 1966 and 1967, 17 in all, on the present state of pollution of these waters, and after considerable negotiation with the Department of the Interior, standards were adopted satisfactory to the Secretary. The negotiations were such as to make quite questionable subsequent disclaimers of responsibility by representatives of the federal department.

The records of the hearings make quite interesting reading, combining, as they do, fiction with the non-fiction. Besides establishing a base of sorts on which to erect the standards, they brought to wide-

spread public attention facts, and opinions, concerning water pollution in Hawaii that simply couldn't be ignored, and the attention has persisted since.

These standards make a good starting point for an examination of the actual pollution status of our waters, first because they indicate some of the pollutants thought to be of concern, and second because the limits of tolerance set represent levels which have, however, arbitrarily, been set as targets.

Under the standards, the surface waters and coastal waters of the state have been divided into 5 classes to which different levels of tolerance apply: Class 1, waters from which supplies are drawn for drinking water and food processing; Class 2, all other fresh water streams; Class AA, special coastal waters to be protected in essentially pristine conditions; Class B, the waters of commercial and small boat harbors; Class A, all other coastal waters.

The pollutants and indicators of pollution for which tolerances have been established are of several sorts. There are, for example, limits set for all waters as to certain microbiological concentrations, those of coliform bacteria and fecal coliforms. These are not disease-causing bacteria but bacteria which, especially the fecal coliforms, are considered to be indicators of the risk of contamination by pathogens. Maximum tolerances are set in the coastal waters for the nutrients, phosphorous and nitrogen. These nutrient elements are essential to the growth of plants, and for that matter animals too, but in overabundance they can cause ecological unbalances, such as algal blooms and resulting stagnation and fish kills. Minimum tolerances are set for oxygen in coastal waters. Maximum tolerable departures from natural conditions are set for turbid-

ity, temperature, pH, and salinity, in coastal waters. Maximum tolerances of radionuclides are established for all waters. And in addition, the standards say that all waters shall be free from such waste substances as will settle to form objectionable deposits; floating debris or oil; substances with objectionable color, odor, or taste; toxic materials; or materials causing undesirable aquatic life.

I won't pretend any knowledge concerning the degree to which either the surface waters or the coastal waters in the State in general meet the standards, but at the University of Hawaii we have recently completed a study of the pollution of estuaries in the state for the Federal Water Pollution Control Administration. The most intense work was concentrated in Kaneohe Bay, but a graduate student, Mr. Lawrence Gordon, and I combed through all records of pollution indicators that we could find pertaining to estuaries throughout the state. We found it was necessary to distinguish between stream-mouth estuaries, generally partly cut off from the sea and mainly fresh to brackish; and bay estuaries mainly open to the sea and salt. For most of the estuaries we found insufficient information for conclusive determination whether the water did or did not fall within the tolerances set by the standards. In general, the only water quality parameter for which records were available was total coliform concentration. Analyses of fecal coliforms, pH, nutrients, oxygen, dissolved solids, temperature, and turbidity were very rare, and reports of trash and oil sporadic.

For convenience, I will simply quote from some of the conclusions of the report, which is in press:

Some of the estuaries are still in essentially natural condition, others have been much altered, and many are demonstrably polluted. Sediment discharge occurs through even

estuaries in natural conditions.

For more than half of the stream-mouth estuaries, the analyses of water quality available are insufficient to provide any basis for judging whether or not the pertinent established standards (Class A) are met. In almost all of the fraction for which available analyses provide some basis for judgement, the water quality does not meet the established standards. Further, the water quality of none of the estuarine canals meets the pertinent established standards (Class A).

The water quality of the bay estuaries or portions of bay estuaries designated for maintenance of high quality (Class AA) probably meets the pertinent established standards in the case of most of the estuaries on Molokai and Maui, but not in the designated portions of the West Loch of Pearl Harbor, of Kahana, and Waialua Bays on Oahu. For nearly half the harbors, the available analyses are insufficient to provide any basis for judgement. In the rest, the water quality probably does not meet the pertinent established standards (Class B). In more than half of the other bay estuaries the water quality probably does not meet the pertinent established standards (Class A).

This sounds pretty bad, but in a few ways, at least, it may be the standards or the classification of the waters that are at fault. Consider for example the drainage canals, such as the Ala Wai and Kapalama, which are supposedly Class A waters but don't meet the standards for that class. Could these canals, intended to receive general overland drainage from urban areas, possibly be expected to meet the standards of this class which were intended to indicate suitability for swimming? If the canals had been designated Class B, like the harbors, more, perhaps even most, might meet the standards. Or consider the nitrogen tolerance level. We don't have many nitrogen concentration measurements, but we find that the tolerance is exceeded not only in bays like Kaneohe but well offshore in presumably unpolluted water. Isn't the tolerance set much too low?

The most intensive part of the estuarine study, that of Kaneohe Bay, to which oceanographers, microbiologists, marine zoologists, geo-

logists, hydrologists, sanitary engineers, and economists have contributed, turned up some surprises. The levels of concentration of pollutants were not as high as had been feared, and although the outfalls of the sewage treatment plants in the area were found to be sources of nutrients, and even on occasion of bacterial pollution, the major sources of such pollution as well as of sediments were found to be the streams. The economic studies indicated clearly that the value of the bay for fishing and recreation purposes would justify diversion of the sewage effluent elsewhere when it becomes an ecological menace, but we are still struggling to reconcile some of the conflicting evidence as to the degree to which the effluent has been or now is a menace. The studies also have indicated, however, the complete impracticability of impoundment and treatment of the stream waters.

This audience is, I realize, not particularly interested in highly technical problems, but I think I should discuss just a couple to indicate further how inadequate is our fund of knowledge with respect, not only to the judgement of the quality of our waters in relation to the standards, but to the judgement of the appropriateness of the standards themselves, and indeed to the appraisal of the whole approach to pollution control.

First, as to sanitary aspects and the pathological hazards. It is clear that fecal coliform concentrations, of which we have very inadequate records, are better indicators of pathological hazards than total coliform concentrations, of which we have many more records. Some microbiological research done a few years ago at the University suggests, however, that even the fecal coliforms, which are a standard indicator the world over, are a very poor indicator of the pathological

ards do exist and have the force of law. However, enforcement seems mainly to have been limited to a few cases where there were public complaints. Very little attempt seems to be made to locate discharges resulting in exceeding of the tolerances and, hence, in violation of the water quality control act, to penalize them, or even to grant the temporary permits or define the semi-permanent zones of mixture which are allowed by the regulations. The failure seems to be due to a lack of personnel in the Department of Health, but I am not sure whether this is due to a failure of the department to budget for them, a failure of the state administration in curtailing the budget, a failure of the legislature to make an adequate appropriation, or merely slowness in recruitment and inadequate salary levels.

The enforcement program cannot get far, however, and our understanding of the scope of our problems cannot increase without the establishment of a substantial program of monitoring water quality parameters throughout the state to determine what the existing situation is and keep track of changes. Such a program has been planned, and again the failure appears to be due to a lack of personnel.

But monitoring alone will not settle the graver questions. We need to know much more about the indicators to be monitored and where, what the sources of the various pollutants may be, what the real ecological effects are of the various sorts of pollutants in the various kinds of environment, what the economic consequences of these effects are, what effectiveness potential control measures might have, and what the costs of such control measures might be. In other words, we need a very intense and wide-ranging research program. It isn't clear where this research program should be funded or where it should be carried out. The University should be in a key position when it comes

hazard in sea water because of a rapid dieoff, and that concentrations of enterococci would be a better indicator, although non-standard. Yet we use only coliforms! We make the assumption, further, that bacterial concentrations are indicators of all pathological hazards, although very recent work, again at the University, has indicated that the larger viruses are transmitted at least through soils much more readily than the bacteria, and the smaller viruses are transmitted very readily indeed. Here we have a problem, because there are apparently no standard methods for viral analysis applicable to the concentrations to be expected even under fairly badly polluted conditions.

Second, as to ecological hazards, that is the risks of serious upsets of the natural balances of life. We assume that by measuring nutrient concentrations in solution we can gage the ecological hazard presented in a water. At least in the case of phosphorous, however, there may be very effective biological buffering of the water. Increasing discharges of phosphate may be made to the water without raising the level of phosphorous in solution, the phosphorous being tied up in plankton and other organisms, until suddenly eutrophication occurs, the oxygen is exhausted, the organisms die, the phosphorous is thrown back into solution and, only after the ecological catastrophe the phosphorous levels suddenly shoot up. The nitrogen levels adopted in the standards seem unreasonable.

Now, recognizing that we have a water pollution problem but can't evaluate how bad it is, what should we be doing? I can be quite clear about this really nitty-gritty question. What we need is a three-pronged program comprised of enforcement, monitoring, and research.

For all that I have my doubts about the appropriateness of some of the tolerances in the present water quality standards, the stand-

to planning the research and it will surely be involved to some extent in actual performance. I like to think that it would be appropriate for the University actually to assume some responsibility for such a pollution research as well as other research applicable to our island problems.

Most of all, what is needed is an intelligent concern on the part of the citizens of Hawaii, because only with this can the necessary legislative support and the necessary administrative push be generated.

The concern is, of course, necessary to develop the leverage required. The intelligence, however, is of equal importance. I am profoundly unimpressed by those who would attempt simply to ban pollution. We are all and cannot help but be polluters. Waste disposal is part of our biological make up. But we are polluters on a far greater scale than our fellow organisms because we are the developers and users of tools, tools which are themselves wastes when discarded, whose manufacture involves waste, and whose use in many instances involve more waste. By tools I mean not only spades and hammers, but automobiles, detergents, and insecticides. The standard of living which we enjoy and indeed the support of the present population of the world depends just as essentially on large scale waste disposal as do our individual lives on a small scale. We can choose to some extent where to dispose of the wastes, and what other advantages to trade off for the sake of controlling pollution, but we cannot just legislate it out of existence.

The matter of choice brings us to some special concerns here in Hawaii. I like to think that our goals in these Islands are not more tourists, not a greater GNP for the state, not a greater

individual income, not even a greater individual income in terms of real dollars, but a better life. This involves greater incomes, both personal and state, I expect it involves more tourists, but it involves less of these gains for the sake of preserving more of our environmental advantages. I am speaking very selfishly of course, as resident and citizen of these islands and one who hopes some of his children and his grandchildren will continue to reside in these islands. But I think the selfishness of an investor in the economy of the islands if put in a long-term setting would lead to the same conclusion, because it is this same environment we advertise to the tourist and the retiree, and it is this same environment which has put us where we are through agricultural development.

Such conferences as these are most important means of developing the kind of intelligent concern that is needed.