ILLINOIS POLLUTION CONTROL BOARD
April 28, 1971

in re) #R70-6
PHOSPHORUS WATER STANDARDS)

Opinion of the Board (by Mr. Dumelle):

1. Introduction

We like to believe that there is a time and place for everything. The time to be serious about saving our place called Lake Michigan is very quickly passing. It has been demonstrated to the Pollution Control Board that we must enact measures which will restrict the input of phosphates into the Lake now so that it will not suffer the fate of Lake Erie, so that Lake Michigan will not have its quality impaired beyond the present state, so that Lake Michigan will not be lost as a "great" lake. To preserve Lake Michigan as a source of public water supply, as a commercial and sport fishing center, as an invaluable recreation area and as a natural public possession of inestimable worth we must act now.

The first annual report of the President's Council on Environmental Quality recommends that a concerted and comprehensive attack be made on eutrophication. The report stresses three necessary actions: 1)phase phosphates out of detergents as soon as feasible, 2)find better methods to control agricultural runoff, and 3) remove from lakes more of the nutrients generated by towns and cities particularly in urban centers and critical areas such as the Great Lakes (R. 489).

With the enactment of the Environmental Protection Act, the Illinois Legislature charged the Illinois Pollution Control Board to "determine, define and implement the environmental control standards" necessary to accomplish the purpose of the Act -- "to restore, protect, and enhance the quality of the environment..." [Sec. 5(b), 2(b)]. The enactment of a water quality and effluent standard to restrict phosphorus discharges into Lake Michigan is a measure backed by that purpose.

Possibly the single most urgent concern we must have with Lake Michigan is the question of accelerated eutrophication -- that is, concern with the speed-up of the natural aging of the Lake due to man's introduction of an abundance of nutrients in a quantity fantastically beyond nature's input. As a rough but dramatic analogy we can view nature's input of nutrients into Lake Michigan as being enough to feed a suckling piglet while man's activities, including agriculture, are pouring in a sufficient

amount to sate a 500 pound hog. With final adoption of the phosphate water quality and water effluent standard on January 6, 1971, the Illinois Pollution Control Board has in effect declared that "We must save Lake Michigan - no ifs, ands or buts - starting right now".

The section of this opinion headed Eutrophication has been further subdivided to consider the following questions:

a. What is the present lake quality?
b. Why limit phosphorus?
c. At what level should phosphorus be limited?
d. What is the contribution of land-runoff?
e. Should phosphate detergents be banned?

2. Effluent and Water Quality Standard

The phosphorus standard adopted by the Board on January 6, 1971 originally proposed on August 19, 1970 in a somewhat different form. As finally enacted this standard reads as follows:

PREAMBLE

Phosphorus is an element which is a nutrient for algae. Present Federal and State policies for Lake Michigan include the control and reduction of phosphorus in order to limit the production of algae. Algae causes tastes and odors in water supplies and may reduce dissolved oxygen in water. Algae is a nuisance to swimmers and can reduce the enjoyment and property values of shore line property.

The present standards for phosphorus in the water of Lake Michigan are at levels which are thought to be those at which algae blooms will occur and greater than present bulk water levels. The new standard is 2/3 of the former standard. An effluent standard is added to provide a control on phosphorus discharges to Lake Michigan

1. Water Quality Standard. Existing Board Regulations specifying water quality standards for Lake Michigan, Wolf Lake and the Calumet River (lakeward of the O'Brien Locks) are hereby amended to provide that the concentration of total phosphorus measured on unfiltered samples in these waters shall not exceed 0.02 mg/l as phosphate (PO_4) or 0.007 mg/l as phosphorus (P).

2. Effluent Standard. Except for unavoidable combined sewer overflows during the interim period before their complete elimination, no effluent to the waters of Illinois listed in Section 1 above, shall include phsophorus in excess of 3.0 mg/l as phosphate (PO_4) or 1.0 mg/l as phosphorus (P) after December 31, 1971. Dilution of effluents shall not be acceptable alternatives to treatment. Where water is added to streams of waste water and cannot be reasonably separated, then its quantity shall be measured and effluent concentrations recomputed to exclude its diluting effect.

3. Testing. All testing pursuant to the Regulations herein provided shall be made using methods as listed in the publication "Methods of Chemical Analysis of Water and Wastes", November, 1969 as issued by the U.S. Federal Water Quality Administration.

4. Effective date. Except as specifically provided in Section 2 of these Regulations, the requirements of these Regulations shall be met within ten days after filing with the Secretary of State.

3. Eutrophication

The pollution problem or hazard presented by the introduction of phosphates into water bodies, and in this case Lake Michigan, is the enhancement or increased rate of eutrophication. Leading authorities, including Dr. A.F. Bartsch have stated that the problem of eutrophication is one of the chief concerns about Lake Michigan. Eutrophication is the aging process of the Lake in which the waters become more fertile and acquire a greater ability to grow algae and other forms of unwanted living matter. Eutrophication becomes a severe problem when the algae become so preponderant that they color the water green and interfere in many ways with the continued usefulness of the water. Considering the undesirable effects of eutrophication, it may be regarded as a severe form of pollution.

Human sewage and industrial waste are significant sources of nutrients that contribute to the eutrophication of Lake Michigan. Drainage from farm land is also an important source, a substantial quantity of the nutrients come from manure that is spread on frozen grounds which is subsequently flushed into streams during spring thaws and rains. Runoff from urban areas is rich in phosphate and nitrate. (Ex. 3, p. 4)

The abundance and species composition of planktonic, bacterial, benthic and fish populations change as eutrophication progresses and changes of this nature may be used to detect and measure the degree and rate of eutrophication. Enriched lakes develop dense populations of planktonic algae, commonly dominated by a few species of blue-green algae. Lake Erie has already experienced the elimination of benthic invertebrates and massive blue-green algae blooms. (Ex. 3, p. 4)

Dr. Bartsch has stated that some of the changes to look for are: decrease in transparency of the water; increase of total dissolved solids; loss of dissolved oxygen in the deeper layers; and changes in bottom dwelling animals and microscopic plants. When eutrophication has not proceeded to an obvious and objectionable stage, it becomes necessary to examine the combination of these more subtle clues in order to sense the existing state of affairs. In many cases, such scrutiny may reveal a forecast of things to come. Changes such as the above are now appearing in Lake Michigan (R. 69).

a. What is the present lake quality?

The testimony of Dr. Bartsch showed that extensive inshore areas of pollution were found along the entire southern perimeter of Lake Michigan. At various times swimming beaches have been closed in Chicago and other areas when large mats of foul smelling algae have been deposited on the beaches. The aesthetic character of Lake Michigan has been impared by algae on many occasions. On a far more practical level drinking water treatment plants have had their operation and efficiency impaired by short filter runs and tastes and odors resulting from high phytoplankton. Such impediments to the operation of these plants have lead to increased cost of water treatment in Chicago and other cities (R. 24).

High concentrations of phosphorus favor the blue-green algae which are capable of using nitrogen from the atmosphere as a source of nutrition. These algae are particularly obnoxious because they are more buoyant than other forms thus tending to form windrows and produce especially obnoxious "pig pen odors" because of chemical compounds peculiar to them. The seemingly inexhaustible supply of algae that has washed ashore in recent years has defied maintenance attempts to keep some beaches usable during the entire recreational period. Bathers and sunbathers must travel further to enjoy their sport (R. 27).

Bottom animals serve as a vital link in the aquatic food web by converting plant food into animal food for predatory fishes. Changes in numbers and species of bottom animals consisting predominately of burrowing worms favors a community of fishes such as carp and suckers that root for their food. An increase in worms is a product of an increased food supply from sedimentation or organic waste materials or dead algae. Changes in the kinds and numbers of bottom animals are effects that are frequently a product of pollutants; these changes result in damages to desirable aquatic organisms, and may produce increased numbers of undesirable aquatic organisms that interfere with the use that can be made of the water (R.29).

Mid-Lake Area

Deep water areas of Lake Michigan are as yet unaffected by the more intensive pollution observed in many in-shore areas. The soluble phosphate content has been determined to be 0.02 mg/l (PO_4) in deep water areas as an average with some concentrations going up as high as 0.14 mg/l. Areas close to shore averaged 0.04 mg/l with some concentrations as high as 5.00 mg/l.

In-Shore Area

Inshore areas are primarily the shoreline areas which are used for recreation, which extend out as far as one goes for water supply. This may be out to a depth of approximately 10 meters or approximately 40 feet (R. 93).

Massive areas along the perimeter of the southern half of Lake Michigan are polluted to such an extent that large populations of pollution tolerant sludgeworms occur (R. 36). For several years the Chicago Park District has reported that beaches became fouled with algae washed in from the Lake. The windrows of algae that completely lined the beaches became foul smelling after a few days exposure to the summer heat. Flies and other insects covered the decaying mass (R. 46). These biological findings reflect the deteriorated water quality of Lake Michigan and represent the gross pollution resulting from the domestic and industrial waste discharged into the Lake and the result of urban and rural land runoff of nutrients (R. 50).

The facts revealed by these studies make up the story of what has been happening to Lake Michigan in recent times. Many aspects of the story are far from clear but what is clear is that excessive amounts of nutrients are present (R. 67).

In the words of Dr. Bartsch the condition of Lake Michigan can be summarized as follows:

> The tremendous mass of data gathered on the physical, chemical, and biological status of Lake Michigan indicate that the Lake, as a whole, is beginning to show some early symptoms of accelerated eutrophication.
>
> The offshore, deep water areas of Lake Michigan do not show substantial effects of pollution or the onset of eutrophication forces. They do, however, exhibit a combination of minor and subtle changes that suggest that the real beginnings of eutrophication are just around the corner.
>
> In contrast to the offshore waters, the inshore areas have changed drastically ... In recent years both attached and free floating algae, ... frequently have appeared in nuisance proportions at various harbour and waterfront areas around the Lake.
>
> The growth of such masses of algae is a direct response to concentrated levels of nutrients brought into the Lake by way of municipal sewage, land runoff, urban drainage, industrial waste and other sources. In Lake Erie growths of [algae] seem to have been aforerunner of the more widely dispersed free floating or plankton growths that now exist there.
>
> In the southern end of the Lake there is ample evidence of deterioration of chemical water quality in areas adjacent to population centers. Total inorganic nitrogen and soluble phosphate were found to be highest here (R. 79-83).

Dr. Bartsch concluded as follows:

> While the deep water areas of Lake Michigan give only a suggestion of creeping eutrophication, the Lake's response to increasing nutrients in the inshore waters is obvious and shows that the Lake can respond when nutrients for plant growth are abundant. Lake Michigan, as a whole, is now at an early stage in the eutrophication process that was passed through by Lake Erie at some point in the past. With increasing time, nutrient levels will increase until finally the entire Lake becomes involved. With certain reservations, Lake Erie can be viewed as a prototype and a preview of what can happen in Lake Michigan if nutrient bearing wastes input continues unabated (R. 87).

b. Why limit Phosphorus?

Many nutrients are required for the growing of algae and among these are carbon and phosphorus, nitrogen and others. The easiest one to limit is phosphorus. The activities of people account for a high proportion of the phosphorus input into troubled lakes. This is a good reason to focus control on phosphorus.

Dr. Bartsch commented on carbon as a limiting factor. He stated that briefly, the carbon theory is that if bacteria in the Lake which have the capability of decomposing organic matter, in doing so liberate carbon as carbon dioxide, then the supply of carbon dioxide in the water is increased and is available to algae for growth. Obviously this accelerates the eutrophication process. The carbon theory implicates carbon as the culprit and attaches little significance to phosphorus input. An important tenet of the theory that carbon is the critical factor in the process of eutrophication is the symbiotic relationship between bacteria and algae; the relationship is the main thesis of the Lange-Kuentzel-Kerr proposition. Dr. Bartsch stated that he disagrees with this thesis and feels that the principal scientific and limnological community is also in disagreement with the thesis. The fundamental biology relating to algae, an abundance of which signifies the most onerous characteristic of eutrophication, requires that a number of nutrient elements are necessary to support their growth. Algae use up carbon in a ratio of 100 to 16 nitrogen to 1 phosphorus atom.

Also to be considered is the fact that carbon and nitrogen are very nearly ubiquitous while the same cannot be said for phosphorus. That is, phosphorus can be kept out of the water more easily than can either carbon or nitrogen. Lakes that have been studied and seem to indicate that carbon may become the limiting factor are not typical lakes, the kind generally thought of with eutrophication problems. A more in-depth look at the question leads one to the conclusion that for all practical purposes the controlling element to consider is phosphorus (R. 278).

Some lakes with high phosphorus content are not algae bloomers because other elements, sometimes trace metals, are not present. In Lake Tahoe nitrogen may be the limiting factor (R. 314).

To ascertain the limiting factors one must look at all the nutrients that are needed. If one of the nutrients, phosphorus, can be limited, then it becomes the critical limiting factor. We do not know with complete certainty what the limiting factor in Lake Michigan is (R. 286). But it is manifestly evident that phosphate has an effect on the algae population in Lake Michigan.

c. At what level should phosphorus be limited?

The generally accepted rule of phosphate in excess of 0.01 mg/l as P as causing algae blooms appears to have been derived from a paper published in 1947 by Clair N. Sawyer (Ex. 2). Before undertaking any discussion of eutrophication and phosphate input into water it should be noted that considerable confusion inevitably arises as to whether one is expressing concentrations and inputs in terms of phosphate (PO_4) or phosphorus (P). Fortuitously the conversion factor from phosphorus to phosphate is simply 3. Conversely to change basis from phosphate to phosphorus is simply a matter of dividing by 3. In this opinion the convention of expressing concentration on the phosphorus basis is used unless otherwise noted.

If the availability of phosphorus is increased, algal growth increases. Sawyer (Ex. 2) has demonstrated this although his data has been misused. Sawyer stated that if the studied lakes were to have a concentration of inorganic phosphorus at the level of .015 mg/l at the time of the spring overturn and an accompanying concentration of 0.3 mg/l of nitrogen objectionable blooms of algae would result. Some observers have ignored the spring overturn and others have interpreted these numbers to be somehow magic below which there would be no algae and above which there would be an abundance.

Mr. John Morris of the City of Chicago, Department of Environmental Control recommended the setting of a water quality standard lower than .02 mg/l (PO_4). He stated that the proposed effluent standard of 1 mg/l (P) does not appear to be adequate to protect Lake Michigan from the threat of accelerated eutrophication due to the presence of excessive amounts of phosphorus. It does not appear to reflect the more stringent standards being considered elsewhere nor the potential of current technology. He urged the Board to adopt an effluent standard which recognizes and requires utilization of the best available technology (R. 492).

The Lake Michigan and Adjoining Land Study Commission has stated that the Lake should not be allowed to deteriorate beyond its present phosphate level (R. 349). The Commission asserted that if the proposed effluent standard, 1.0 mg/l as P, were adopted and if current sources of phosphate input were allowed to continue discharging at their present rates water quality would deteriorate. The Commission urged the Board to arrive at a standard which would

not further degrade the Lake. Phosphorus removal technology is available for use today the Commission asserted, and an effluent standard of 1 mg/l will still degrade the Lake.

It must be stated that the effluent standard of 1 mg/l (as P) was not designed to meet the 0.007 mg/l water quality standard because, as was stated in the original proposal, there was no way of ascertaining that figure (R. 359). The figure of 1 mg/l was proposed as representing the application of the maximum feasible technology for phosphorus removal.

Phosphorus removal technology is both well known and readily available. Phosphorus removal can be effected by either straight biological removal, straight chemical precipitation or combined biological-chemical removal. Other, less common processes such as ion exchange, and electrodialysis are less feasible, but available. Removal efficiencies in the range of 80-05 per cent can be expected from the ordinary treatment methods. (R. 185-186).

The treatment method which can most easily be designed, constructed and operated today is chemical removal by precipitation and coagulation. The chemical removal process can be closely controlled and efficiencies in excess of 90 per cent are readily effected. (R. 190-192). An additional benefit accrues in the removal process inasmuch as other pollutants are substantially reduced. Lime, alum, polyelectrolytes and waste pickle liquor are the most common chemical additives in use today. All four treatment methods are straight-forward, reliable and easily controlled to produce a predictable effluent quality. The choice of which chemical agent to use is principally dictated by local considerations such as availability of pickle liquor and sludge disposal requirements.

Mr. Raymond E. Anderson, General Manager of the North Shore Sanitary District discussed the District's experience in using waste pickle liquor (spent hydrochloric and sulfuric acid) which is trucked from a steel works in Waukegan to the Waukegan treatment plant. The chemical is available at no cost, other than freight costs, to the District; the steel mill is happy to be rid of it as it alleviates a waste disposal problem for the mill. Eighty percent removal of the 12-15 ppm of phosphate in the plant influent is accomplished by addition to the sedimentation tanks (R. 122-127).

Costs of phosphorus removal have been variously estimated. At one end of the spectrum is the minimal capital and chemical use and operating costs associated with the use of spent pickle liquor. Dr. John Pfeffer, Professor of Sanitary Engineering at the University of Illinois, testified that technology is available for removal of phosphorus at the 90 percent level at the cost of less than 5¢ per 1,000 gallons (R. 164-165). He further testified that treatment with polyelectrolytes or lime are probably at the same cost level (R. 182). As processes improve, the record of experience is lengthened, and economies of scale are realized, it is anticipated that

treatment costs will be much improved (R. 194-196). On another basis it was estimated that removal of 50% of the phosphorus in sewage could be accomplished at a cost in the range of $.22 to $1.40 per person per year (R. 405, 419-422).

The analytical method of determining the phosphate content of waste water and Lake Michigan water was another subject of consideration for the Board. To facilitate the comparison of data from an historical prospective, it is important that reports from various years can easily be correlated. The Illinois Sanitary Water Board's report of May 1970 indicated a change in analytical technique as follows:

> During 1968...the tests were performed on unfiltered samples. It was decided prior to the 1969 season that only soluble phosphates should be measured. Therefore the 1969 samples were all filtered prior to analysis.

Such a change in laboratory methods can, and indeed has, resulted in data which cannot be easily compared. The Board therefore felt that the method or a choice of methods should be specified in the standard.

Other testimony indicated that the ratio of total phosphorus to that form of phosphorus available for plant growth varies widely and it is therefore desirable to establish limits on the total phosphorus rather than on that part of the element that may be available for immediate plant use. The appropriate phosphorus determination for water in which there is a substantial amount of suspended soil particles is currently receiving further study. For Lake Michigan the record shows that the standard should apply to total phosphorus and not simply a portion of the phosphorus such as soluble or filterable phosphorus.

d. What is the contribution of land runoff?

One of the principal factors that affects the rate of eutrophication is the extent to which nutrients needed by algae enter the body of water. Under natural conditions unaffected by man, the input of nutrients from the watershed runoff, and in deposition from rain and snow is low. The aging process thus proceeds at a low rate. Cultural developments on the watershed such as the establishment of cities and various agricultural activities accelerate the nutrient input leading to accelerated aging (R. 71). The Lake is brought more rapidly to a high level of fertility, and greater crops of algae and other plants are produced than under natural influences alone (R. 73).

Drainage areas that are primarily rural with intensive agricultural activities can be expected to have runoff as the major phosphorus input; as the land use changes from agricultural to urban, the contribution of phosphorus from land drainage decreases (R. 155-157). In heavily urbanized drainage basins a major portion of the phosphorus originates from waste water from municipalities and industry. The FWQA study of Lake Erie indicated that approximately 2/3 of the phosphorus input into Lake Erie was attributable

to urban sources. Clearly, control of municipal and industrial discharges to Lake Erie would markedly reduce the eutrophication effects. It must be noted that the Lake Erie basin is very small and highly urbanized and in this regard contrasts strikingly with the Lake Michigan basin (R. 157).

Dr. Bartsch estimated that the annual input of phosphate to the Lake from the soils of the Lake Michigan basin amount to approximately 5,000,000 pounds per year. Another 10,000,000 pounds comes from municipal and industrial waste (R. 74). Expressed as phosphorus this would be a total annual input of 5 million pounds. Although this estimate of phosphorus input is frequently heard, it is open to question and is currently undergoing re-evaluation. The sources of the phosphate can be readily identified but quantification of the phosphate input from each source is not easily made.

Mr. R. H. Harmeson reported that the annual phosphorus input to Lake Michigan in 1963-1964 totaled 4,790,000 pounds while the outflow was 262,000 pounds. The total input was estimated to be about 1/3 (1,640,000 pounds) from soil in runoff and 2/3 (3,150,000 pounds) from municipal and industrial wastes. The population for 1960 in the Lake Michigan drainage basin was 4.2 million. This excludes the large numbers of people living in the Chicago metropolitan area complex since they are outside the Lake drainage area. The reported phosphorus input calculates to a phosphorus input rate of about 0.7 pounds per person per year from the domestic-industrial source.

Using Harmeson's 1963-64 input data the extrapolated estimate for 1970 is 5,650,000 pounds of phosphorus input into Lake Michigan. Of this total 1.6 million pounds is estimated as soil runoff and 3.9 million pounds as contained in waste effluents and a comparatively miniscule 150,000 pounds as direct precipitation contained in rain and snow. These figures are the result of using an estimated annual usage rate per person of 0.7 pounds as phosphorus.

Harmeson stated that the 1964 estimate for the input rate from land runoff was 36 lbs./mi.^{2}/year which he characterized as a highly conservative rate. Sawyer's average for the Madison Wisconsin area was 255 lbs./mi.^{2}/year (R. 331-332).

The accuracy of these estimates of input rates is not nearly so significant as the relative magnitude of the contributions from various sources, the phosphorus input from waste effluent compared to that from land runoff is a ratio of 2:1.

Mr. Harmeson also reported estimated phosphorus loading using a more realistic input estimate of 4.0 pounds/person/year. With this latter rate the 1970 input estimate totals 23.75 million pounds with the soil runoff remaining the same at 1.6 million pounds and the amount attributable to waste effluents being 22.0 million pounds (R. 335).

It is interesting to note that using Sawyer's estimate of 255 lbs./mi.^{2}/year for the land runoff figure results in a total loading from this source of 11. 68 million pounds per year. When juxtaposed with Harmeson's estimate of 22.0 million pounds of phosphorus from industrial-domestic sources the ratio of 2:1 is maintained.

A very recent analysis by Mr. Michael J. Schmitt (Phosphorus and Phosphorus Input to Lake Michigan, unpublished manuscript, 1971) reports a 1969 total input level of 15,282,222 pounds/year as phosphorus. This is more than 300% greater than the input figure usually heard. No attempt is made to estimate the important ratio of waste effluents to land runoff. The great disparity in the various estimates of phosphorus inputs is a lustily waving warning flag to all investigators pointing to the fact that more definitive investigation is needed to more precisely ascertain both the actual amount of input and the relative contributions of waste discharges and land runoff.

The disparity in the estimates also suggests that the contribution attributed to land runoff may be grossly understated and that indeed runoff may be the greatest contribution. This has been suggested to the Lake Michigan Enforcement Conference with the further suggestion that the Conference undertake an immediate comprehensive survey of the question.

e. Should phosphate detergents be banned?

The amount of phosphates discharged to Lake Michigan are partly controllable and partly uncontrollable. If phosphates in treated waste water are to be controlled, two methods are available; (1) elimination at the source or (2)removal in the treatment plant process. Waste detergents are a principal source of phosphates in sewage. Steps have been taken locally and are being considered nationally to ban the sale of detergents containing phosphates (R. 120).

Mr. John Morris of the City of Chicago Department of Environmental Control requested that the Board consider regulations prohibiting the sale of detergents containing phosphates. He introduced as an exhibit a copy of the Chicago ordinance banning the sale of detergents containing greater than 8.7% (wt. % expressed as P) of phosphates after February 1, 1971 (R. 492).

Mr. Theodore Brenner testified as a witness for the Soap and Detergent Industry Association and Dr. Paul Derr testified for FMC Corporation as a major producer of phosphates for detergents. The Soap and Detergent Industry Association is an industry trade organization representing well over 90% of the soap and detergent production in the country. Mr. Brenner stated that the Association is fully in support of any effort to control nutrient inputs into lakes and other surface waters which may be endangered by accelerated

cultural eutrophication. He stated that, where feasible all wastes should be diverted from lakes and where diversion of waste water is not possible improved waste technology should be applied.

Mr. Brenner reported that the detergent industry has accelerated its research efforts in the search for a phosphate replacement. The program has first priority in several company laboratories. He further stated that the most widely discussed phosphate replacement material, NTA (nitrilotriacetate), has a primary value in combination with phosphate in detergents. There are other problems with NTA at the present time. NTA has not been thoroughly tested as to its ultimate environmental safety and there are indications that widespread use of NTA may have a more adverse effect on our environment then use of phosphates.(R. 406). Polycarboxylates were noted as another class of materials attracting attention for detergent use although these materials may not have the proper performance characteristics and they may not meet the necessary biodegradability standards (R. 407). Still other materials which are talked about as a replacement for phosphates in detergents are various forms of silicates. Sodium carbonates are also being considered (R. 416).

Why not a return to soap? It was stated that this appears to be impractical because (1)the supply of fats and oils is inadequate to furnish the needed raw materials, and (2)the performance of soap in modern automatic washing machines is not on the same level as detergents. The first synthetic detergent was marketed in 1934, it contained no phosphate and was a failure.. Following World War II phosphates and detergents were combined and from that point they enjoyed a dramatic growth to the point that by the early '50's, soap was virtually off the market place (R. 412). Phosphates are unique in that they perform several functions in detergent products and there is no single replacement material. They soften water, they are anti-redeposition agents, they emulsify oils, and they adjust alkalinity. The phosphate portion of the detergent is an extremely important part of the product (R. 431).

Although in considering the phosphate problem, the Board initially proposed only a water quality and effluent standard, the Board made clear during the hearing that matters such as a ban on phosphate containing detergents was another avenue which could and should be considered. The fact that the State of Illinois has a very limited number of phosphate dischargers into Lake Michigan was an important consideration in considering a phosphate detergent ban. The phosphate discharges to Lake Michigan from Illinois are limited, being confined almost exclusively to the discharges from the North Shore Sanitary District. The Sanitary District is presently experimenting with the use of waste pickle liquor from a steel company for phosphate removal in its waste water (R. 122). Results of full plant scale application indicates phosphate reductions on the order of 80% to be readily attainable. It appears

that the use of pickle liquor may be the answer to the North Shore Sanitary District meeting the phosphate removal requirements. Further, the North Shore Sanitary District has plans to divert away from Lake Michigan by early 1973. At that time most of the phosphate into Lake Michigan will be coming from Indiana, Wisconsin and Michigan (R. 360).

Dr. Bartsch stated that consideration should be given to banning phosphates in detergents. Curtailing the input from all sources and not only of all of the sources of waste which are treated should be the rationale. Inputs of phosphorus are additive in terms of the various sources that are involved. As regards qualifications to the banning of phosphates from detergents, Dr. Bartsch said that we would not want to replace it with an element or a compound or a substance which has a substantial deleterious effect on the environment like phosphates.

There is no question that the Board has the power to outlaw the sale or use of phosphate detergents under Section 13 of the Environmental Protection Act. Because the Board has decided not to impose a ban on phosphate detergents with this regulation does not mean that it will not do so at another time. The Board presently has before it a citizen's petition pursuant to section 28 of the Environmental Protection Act which seeks to ban the sale of all detergents or other cleaning products containing phosphorus throughout the entire state after June 1, 1972.

4. Summary and Conclusion

Perhaps the most succinct and cogent statement of the rationale underlying the adoption of the water quality and effluent standard for phosphate is the explanatory statement which accompanied the original proposal:

> Phosphorus is an element which has been implicated in the excessive growth of algae in fresh water lakes. The algae grows, dies and in decomposing robs the water of necessary dissolved oxygen. In addition, algae is a nuisance on beaches to swimmers and to water treatment plants.
>
> The proposed water quality standard for phosphorus is 2/3 of the present standard and is at the same level as the bulk waters of Lake Michigan. Since the existing phosphorus water quality standard is not at the danger level for algae blooms, it is prudent to tighten this standard.

The consideration of a phosphorus limitation of input into Lake Michigan was one of the first matters considered by this new governmental agency, the Illinois Pollution Control Board. The urgency attached to this matter was not misplaced. To prevent

Lake Michigan from becoming another Lake Erie, to preserve our beautiful Lake, we must take this action now by restoring the inshore areas of Lake Michigan to an acceptable state and preserving the offshore waters in their present state of purity. We must keep all nutrient input from all sources at the lowest possible level consistent with feasibility and reasonableness.

The offshore waters of Lake Michigan are now of high quality. They are just beginning to show slight, subtle changes in the direction of eutrophication. Localized inshore waters are now eutrophic and have lost their usefulness for many desirable purposes. If forecast of future chemical input materializes, eutrophication processes will be accelerated. Problems in inshore areas will then become even more distasteful and costly and they will gradually involve the offshore waters. Accelerated eutrophication can be prevented if actions to slow down nutrients input are taken soon enough. The Lake Michigan campaign can be largely a preventive one. Therefore, more effective and economical than a totally restorative program. All controllable nutrient input should be stopped (R. 91).

To save our lake, to preserve its present quality from further deterioration we must rein-in the present galloping eutrophication in the near-shore areas. Ample testimony has been presented before the Board which emphasized that the most feasible way of doing this at this time is to limit the input to the Lake of the essential nutrient, phosphorus.

Dr. Bartsch in stressing the importance of keeping nutrients out of the lake put it this way:

> If you like this Lake the way it is, then you ought to quit insulting it with all this junk you are putting in; and if you keep the level down to the lowest you can, maybe you can even turn it back in time (R. 305).

I concur

I dissent:

I, Regina E. Ryan, Clerk of the Illinois Pollution Control Board, certif that the Board adopted the above opinion this 28 day of April, 1971.

Regina E. Ryan, Clerk
Illinois Pollution Control Board