MINUTES OF THE MEETING
BUSINESS & INDUSTRY COMMITTEE
MONTANA STATE SENATE

March 15, 1979

The meeting of the Business and Industry Committee was called to order by Chairman Frank Hazelbaker on the above date in Room 404 of the State Capitol Building at 10:00 a.m.

ROLL CALL: All members were present with the exception of Senator Dover who was excused.

HOUSE BILL 414: Representative Michael Keedy, sponsor of HB 414, explained the bill to the Committee. This bill generally prohibits the sale of household cleaning products with a phosphorous compound content in excess of .5%. Representative Keedy stated the bill is critical to the supply of water. Rep. Keedy told the Committee that he is from Kalispell and is interested in preserving and protecting Flathead Lake. He stated that phosphorous is found in large amounts in household detergents. This bill is patterned after legislation in other states, and it is concerned with water quality.

PROPONENTS OF HOUSE BILL 414: Mr. Chris Kronberg of Missoula, Montana, representing Dr. Ronald Erickson, Chemistry Professor at the University of Montana, and himself, stated they are in support of HB 414. Mr. Kronberg's testimony is attached to the minutes.

Mr. Richard Hauer of Bigfork, Montana, representing himself and Dr. Jack Stanford, stated they support the bill. Mr. Hauer's testimony is written on the testifying form and is attached to the minutes.

Mrs. Charlotte Easter of Missoula, Montana, representing herself, spoke in support of HB 414. Mrs. Easter's printed testimony is attached to the minutes.

Mr. Chris Hunter of Kalispell, Montana, representing Flathead Drainage 208 Project, spoke in support of HB 414. Mr. Hunter stated that no subdivisions have been allowed in the Kettle Lake area because of phosphorous entering septic systems. Mr. Hunter further stated that by banning phosphates you could eliminate 50% of the phosphorous problem.

Mrs. Eugenie McGregor from Helena, representing herself, stated that she is in favor of better water in Helena, and she supports House Bill 414.

Mr. Charles Bell from New Castle, Indiana, representing the Montana Council of Trout Unlimited, spoke in support of HB 414. Mr. Bell's statement is written on the testifying form and is attached to the minutes.

Ms. Marilyn Greely of Helena, representing herself, stated she is in support of HB 414.

Ms. Willa Hall of Helena, representing the League of Women Voters, stated they are in support of HB 414. Her printed testimony is attached to the minutes.

OPPONENTS OF HOUSE BILL 414: Mr. Jerome Anderson, attorney from Billings, representing the Soap and Detergent Association, stated they are in opposition to HB 414. Mr. Anderson distributed two attachments--one on Review of Technical Data on the Lakes in Montana, and another on Montana Water Quality. These attachments are labeled and included in the minutes.

Representative Earl Lory spoke as an opponent of HB 414. He stated that phosphorous comes from everywhere and there are point sources of phosphorous. Sewage discharges from sewage treatment plants (Example: Flathead Lake) are point sources. Nonpoint sources of phosphorous are springs and ordinary land. He told the Committee that if you were to put a ban on phosphorous detergents, it would only decrease the phosphorous by 35 percent. He further stated that he is fearful we lull ourselves to sleep by thinking that we have solved a problem that has not been solved. He doesn't think our problem is as serious as many people would lead us to believe. He told the Committee that you cannot use non phosphates in dishwashers, dairy equipment, and medical equipment. He also stated that phosphate is by far the best detergent and closed by saying that this bill is ineffective and premature.

Dr. Marjorie Keiser from Bozeman, Montana, representing herself, spoke in opposition to HB 414. Dr. Keiser's printed testimony is attached to the minutes.

Mr. Ned Williams from Columbus, Ohio, representing Burgess & Niple, Ltd., stated that they oppose HB 414. Mr. Williams' printed testimony is attached to the minutes.

Mr. Abe Horpestad of Helena, representing the Water Quality Bureau, Department of Health, stated they are working on surveys to determine water quality.

Mrs. Sally Weiss of Helena, representing Columbia Chemical Co., Inc., stated they are in opposition to HB 414. Mrs. Weiss stated that this bill bans phosphates only in laundry detergents. Their firm provide laundry detergents to every hospital in the state and this factor should be considered because usually rashes are caused by some type of detergent--some need detergents with a high amount of phosphates.

Due to time limitation the following opponents of HB 414 were unable to testify:

Mr. J. K. Addy from Billings, Montana, representing the Soap and Detergent Association.

Mr. Eric Weiss of Helena, Montana, representing himself.

Mr. R. V. Tilman from Butte, Montana, representing Stauffer Chemical Company. Mr. Tilman's printed testimony is attached to the minutes.

Mr. T. E. Brenner from Rumson, New Jersey, representing the Soap and Detergent Association.

Ms. Joy Schrage from Berrien Center, Michigan, representing Whirlpool Corporation. Ms. Schrage's printed testimony is attached to the minutes.

Dr. Hayden Ferguson from Bozeman, Montana, representing himself.

Dr. John C. Wright from Bozeman, Montana, representing himself.

Dr. Lloyd Berg from Bozeman, Montana, representing himself.

Mr. Joe Rossman from Butte, Montana, representing Montana, Idaho, Utah Joint Council of Teamsters.

Mr. Peter Jackson from Helena, representing WETA.

Mrs. Rosemarie Strope of Helena, representing the Montana Chamber of Commerce.

Mr. James Jaska from St. Paul, Minnesota, representing Economics Laboratory, Inc.

Mr. Ross Cannon of Helena, representing the Montana Food Distributors Association.

There was a question and answer period from the Committee.

Senator Lowe asked Rep. Lory what happens to the phosphorous in the rivers. Representative Lory stated that it precipitates.

Senator Hager asked if Yellowstone Park had banned phosphate. Mrs. Weiss told the Committee that it had not.

Senator Blaylock asked Representative Lory if he felt 35% was a low level of phosphorous. Representative Lory stated that it was insignificant.

Senator Kolstad asked if they had figures on the tons of fertilizer dumped on soil every year. Dr. Hayden Ferguson from MSU, Bozeman, Montana, stated the figure would be about 60,000 tons.

Senator Lowe asked Mr. Ned Williams from Ohio about septic tanks. Mr. Williams stated that Montana is far in front of Ohio. He further stated that sewage should be properly treated before going into the lakes.

Senator Goodover asked about current studies on the lakes in Montana. Mr. Horpestad of Helena stated that none were currently being conducted.

Representative Keedy made closing remarks to the Committee. He stated this bill was not drafted and introduced to make headlines. They are acting out of legitimate concern. He stated the bill is cost efficient and economically feasible. He told the Committee that this bill provides the Committee and the Senate an opportunity to take appropriate and direct action to a problem before it gets out of hand. Representative Keedy urged passage of House Bill 414.

Chairman Hazelbaker closed the hearing on House Bill 414.

HOUSE BILL 454: Representative Barbara Spilker, sponsor of HB 454, explained the bill to the Committee. This bill is by request of the Board of Cosmetologists and revises the definition of "electrology".

PROPONENTS OF HOUSE BILL 454: Ms. Kathryn Tucker of Helena, Montana, representing the Board of Cosmetologists, stated that this bill is necessary in order to change the title since new devices have been developed.

There was a question and answer period from the Committee.

Senator Regan asked if they currently had the power to use the electrified tweezer. Mrs. Tucker stated they did not currently have this power.

Chairman Hazelbaker closed the hearing on House Bill 454.

DISPOSITION OF HOUSE BILL 454:

Senator Goodover moved that House Bill 454 Be Concurred In.

Senator Regan stated that she would like to look at the laws referred to in the bill. Senator Regan made a substitute motion that we table taking executive action on HB 454 until Friday, March 16. The Committee agreed to this. No further action was taken on HB 454.

HOUSE BILL 731: Representative Dan Harrington, sponsor of HB 731, explained the bill to the Committee. This bill requires a mortician to obtain continuing education before he may renew his license. The Board of Morticians is to prescribe the required number of hours, accredit programs, and develop alternative methods of compliance.

PROPONENTS OF HOUSE BILL 731: Mr. Thomas Twichel of Helena, Montana, representing the Montana Funeral Directors Association, stated they are in support of HB 731. They feel it would be a benefit to the public in general by upgrading the education of the members.

Mr. Roland Pratt of Helena, representing the Montana Funeral Directors Association, stated the Association is in agreement with Mr. Twichel and they support HB 731.

OPPONENTS OF HOUSE BILL 731: Mr. William Lloyd Linden of Helena, representing Herrmann & Co. Funeral Home, stated they oppose the bill. They feel they should be able to police their own Association.

QUESTIONS FROM THE COMMITTEE: Senator Regan asked if they would object to striking subsection 3. Mr. Pratt stated that he would have no problem with it.

Senator Goodover asked if all morticians were members of the Association. Mr. Pratt stated they were not, but 55 out of 60 members belonged to the Association.

Senator Lowe asked if this bill meant that they would have to take the education in order to keep their license. Mr. Pratt stated that this was true.

Senator Blaylock asked Mr. Pratt if they had had any complaints about the way funerals had been conducted. Mr. Pratt stated that most complaints were in the cost, but not in the way the funerals were conducted.

The hearing was concluded on House Bill 731.

No executive action was taken on bills heard today.

ADJOURN: There being no further business, the meeting was adjourned at 12:10 p.m.

Senator Frank Hazelbaker, Chairman

ROLL CALL

BUSINESS & INDUSTRY COMMITTEE

46TH LEGISLATIVE SESSION - - 1979 Date March 15

NAME	PRESENT	ABSENT	EXCUSED
Pat Goodover, Vice Chairman	✓		
Chet Blaylock	✓		
Harold Dover			✓
Tom Hager	✓		
Allen Kolstad	✓		
Bill Lowe	✓		
John Mehrens	✓		
Bob Peterson	✓		
Pat Regan	✓		
Frank Hazelbaker, Chairman	✓		

NAME: Chris Kronberg DATE: 3/10/79

ADDRESS: Box 4251 Missoula, MT. 59806

PHONE: 543-3710

REPRESENTING WHOM? Dr. R. Erickson U of M Chem. Dept Dir. Physics

APPEARING ON WHICH PROPOSAL: HB 419

DO YOU: SUPPORT? ✓ AMEND? ______ OPPOSE? ______

COMMENTS: ______

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

FOR HOUSE BILL 414

Testimony of Chris Kronberg, Graduate Student, University of Montana. Testifying as a Representative for Dr. Ronald Erickson, Chemistry Professor, University of Montana.

In most, not just some, cases, Phosphous has been recognized as the solely responsible major cause of over fertilization of lakes and rivers. In Montana, we are priveledged in that we have a generally high quality of water and I'm sure we all share a concern for protecting this valuable resource. A Phosphorous Detergent Ban would help protect this resource in a cost effective manner.

The presence, or lack, of information which precisely defines the extent of over fertilization in Montana's lakes is immaterial. It is true that water quality problems are beginning to be found in places such as Hebgen Lake, Georgetown Lake, Seely Lake, Mary Ronan, Nelson Reservoir and Koocanusa Reservoir as a result of over fertilization but what is really important is that the is an even greater potential for harm to our Phosphorus-limited waters due to the future growth which is bound to come to our state.

A Phosphorous detergent ban is a proven method of reducing Phosphorus inputs from sewage effluent. Recent studies in New York and Indiana demonstrate up to a 60% decrease in Phosphorus in STP effluent.

Point sources of Phosphorus are the easiest type to control.

The statements and conclusions of the S.D.A. testimony concerning the impact of Phosphorus on water quality and the effectiveness of a Phosphorus Detergent Ban contradicts many of the reports published in the major journals having to do with the water quality field.

The major reason for this bill to be passed is that it would have a positive effect on the quality of our water by reducing the amount of nutrients present in the aquatic systems and thus prevent premature aging in Montana Lakes and streams. The result of this ban would quite possibly save millions of dollars of taxpayers money which would be needed to establish sewage treatment plants to handel phosphorous over-loads.

NAME: Richard Hauer DATE: 15-III-79

ADDRESS: E. SHORE FLATHEAD LAKE BIGFORK, MT 59911

PHONE: 982-3488

REPRESENTING WHOM? SELF; DR. JACK A. STANFORD

APPEARING ON WHICH PROPOSAL: HB-414

DO YOU: SUPPORT? ✓ AMEND? ______ OPPOSE? ______

COMMENTS: THE NUTRIENT PHOSPHORUS HAS BEEN SHOWN REPEATEDLY TO BE THAT NUTRIENT WHICH LIMITS ALGAL GROWTH IN NORTHERN TEMPERATE LAKES. AS WE HAVE HERE IN MONTANA. NOT ONLY IS A BAN ON PHOSPHORUS CONTAINING DETERGENTS ENVIRONMENTALLY SOUND BUT ALSO ECONOMICALLY SOUND. IT IS BETTER FROM AN ENVIRONMENTAL STANDPOINT AND MUCH CHEAPER TO PREVENT DEGRADATION THAN CLEAN UP AND RESTORE LAKES AND STREAMS TO ACCEPTABLE LEVELS OF WATER QUALITY.

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

NAME: Charlotte Easter DATE: 3-15-79

ADDRESS: 1600 39th St., [illegible]

PHONE: 549-3670

REPRESENTING WHOM? myself

APPEARING ON WHICH PROPOSAL: 414

DO YOU: SUPPORT? X AMEND? ____ OPPOSE? ____

COMMENTS: ____

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

Mr. Chairman and Committee Members:

My name is Charlotte Easter. With all due respect to my good friend, Earl Lory, I am a proponent of HB 414, and I am testifying as a homemaker.

I have heard it said frequently on TV that this product or that product gets white clothes whiter and bright colors brighter, and I often wonder why the women in those ads don't have anything else to talk about. I wouldn't have the slightest idea which products they were advertising.

Years ago, when I started washing diapers, I switched from detergent to soap flakes in order to avoid diaper rash. I have been using soap flakes ever since. My whites are white and my colors bright.

Somebody asked about hard water. When I lived in Missoula, the city water was fairly soft, but I have been on a well for the last eleven years, and the water is hard. I use no water softener. My whites are still white, and my colors bright.

My washing machine has not suffered from the lack of phosphate detergent. It is still going strong after twenty years. It is a front loader, and the only thing that has had to be replaced is the rubber sleeve around the door.

Somebody said non-phosphate detergents were so expensive, much more so than phosphate detergents, so I went to the store and checked prices and amounts of detergent suggested for a wash load. I found out that the non-phosphate detergents were less expensive and used smaller amounts. Why shouldn't phosphates be more expensive? The phosphate is an additional ingredient that has be paid for.

For instance, Scotch Buy, non-phosphate, is $1.19 for 49 ozs. Tide, phosphate, is $1.79 for 49 ozs. Cold Power is $1.79 for 49 ozs. Scotch Buy, non-phosphate, uses 3/4 to 1 cup for a top loader; Tide, phosphate, uses 1¼ cup for a top loader; Cold Power uses 1¼ cup for a top loader.

ERA, a non- phosphate liquid, is $1.34 for 32 ozs. Wisk, a phosphate liquid, is $1.59 for 32 ozs. ERA, the non-phosphate, uses only ¼ cup in a top loader. Wisk, the phosphate liquid, uses ½ cup in a top loader.

In closing, I would like to emphasize there are numerous non-phosphate detergents in the stores, and, also, there is good old laundry soap like I use. I can only conclude that phosphate detergents are not really needed, and that since they diminish the good quality of our water, even if by the least amount, they are a detriment to the state.

Submitted by Charlotte Easter 3/15/79

PRICE COMPARISONS BETWEEN PHOSPHATE AND NONPHOSPHATE DETERGENTS

POWDER DETERGENTS:

phosphate	price/oz			price/washload
TIDE:	3.6¢	X 10 oz	=	36¢
COLD POWER:	3.6¢	X 10 oz	=	36¢
nonphosphate				
SCOTCH BUY:	2.4¢	X 6-8oz	=	14.6¢-19.2¢

LIQUID DETERGENTS:

phosphate				
WISK:	4.9¢	X 4 oz	=	19.6¢
nonphosphate				
ERA	4.1¢	X 2 oz	=	8.2¢
WHITE MAGIC:	4.0¢	X 2 oz	=	8.0 ¢

→

NONPHOSPHATE DETERGENTS NOW AVAILABLE IN MONTANA

DYNAMO	Colgate-Palmolive
DREFT	Proctor and Gamble
IVORY SNOW	Proctor and Gamble
ERA	Proctor and Gamble
WESTERN SHORES LIGUID	Western Family
SUN	White King Soap
WHITE KING SOAP	White King
PUREX LIGUID	Purex
FELLS-NAPTHA	Purex
ARM AND HAMMER	Arm and Hammer
AMWAY SOAP (SA-8)	Amway Products
PAR	Safeway Products
SCOTCH BUY	Safeway Products

NAME: Chris Hunter DATE: 3-15-79

ADDRESS: 651 2nd Ave WN, Kalispell, MT

PHONE: 257-5669

REPRESENTING WHOM? Flathead Drainage 208 Project

APPEARING ON WHICH PROPOSAL: HB 414 Phosphate Detergent Ban

DO YOU: SUPPORT? Yes AMEND? OPPOSE?

COMMENTS: As the director of a water quality agency serving Flathead & Lake Counties I strongly support this bill. The benefits to Flathead alone, not to mention hundreds of other bodies of water in Montana, justifies the passage of this bill

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

NAME: Charles M. Bell DATE: 15 Mar 79

ADDRESS: RRS Box 231 New Castle, Indiana 47362

PHONE: 317-836-4349

REPRESENTING WHOM? Montana Council of Trout Unlimited

APPEARING ON WHICH PROPOSAL: HB 414

DO YOU: SUPPORT? ✓ AMEND? ______ OPPOSE? ______

COMMENTS: Phosphate ban has proven to be a successful way of limiting PO_4 discharge to receiving waters in those states which have implemented a ban. Limitations on PO_4 discharges is necessary to maintain the integrity of water quality as it is one of the more important nutrient compounds.

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

NAME: [illegible] DATE: [illegible]

ADDRESS: [illegible]

PHONE: 449-3969

REPRESENTING WHOM? [illegible]

APPEARING ON WHICH PROPOSAL: SB 414

DO YOU: SUPPORT? ✓ AMEND? ______ OPPOSE? ______

COMMENTS: ______

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

NAME: Nell Hall DATE: 3-15-79

ADDRESS: 1502 Peosta - Helena

PHONE: 442-7495

REPRESENTING WHOM? League of Women Voters

APPEARING ON WHICH PROPOSAL: HB 414

DO YOU: SUPPORT? X AMEND? ____ OPPOSE? ____

COMMENTS: ____

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

montana

LWV

HB 414

March 15, 1979

The League of Women Voters of Montana supports HB 414. Here is a simple way to improve water quality without costing the taxpayers anything; in fact, it might prevent additional treatment and thus save the taxpayers money. There are already two lakes (Flathead and Tiber) suffering from a high phosphorus content. Let's prevent other waters from increased pollution by this element, as they surely will be as population increases.

This legislation will not adversly effect the consumer or industry. Non-phosphate detergents are already available and other states have similar legislation.

I hope you won't spend precious time debating about the housewife who will have to cope with the possibility of not finding her favorite detergent on the market. I've changed detergents several times over the past 20 years, for several reasons, including the desire to use a solution less harmful to the environment. I'm sure most homemakers will easily adapt.

We urge your support for this important water quality bill.

Willa Hall, Natural Resource Chairman
League of Women Voters of Montana

Senator [illegible], Chairman
Business [illegible]
Montana State Senate
Helena, [illegible]

Dear Senator [illegible] and [illegible],

I wish to support HB [illegible], [illegible] the sale of [illegible] phosphate detergents. I appreciate the thrust of this bill which [illegible] the [illegible] of phosphates [illegible] our waterways [illegible] and [illegible] adverse [illegible].

Ten years ago, [illegible] became aware of the negative [illegible] of phosphate detergents on lakes, rivers [illegible] streams and [illegible] (like [illegible]). In the last [illegible] years, I [illegible] the [illegible] 6 times [illegible] have [illegible] satisfied [illegible] results. [illegible] full [illegible] to already [illegible] pollution [illegible] problems.

You will hear the argument [illegible] doesn't get things clean. [illegible] and [illegible] (I [illegible] have to do [illegible]) [illegible] are great.

You will hear that not [illegible] why/ I can justify [illegible] having my [illegible] outside [illegible] twice as much as if I used the dryer.

You will hear that Montana doesn't need this [illegible]. [illegible] in the legislature this session. [illegible] do we wait till the environment is [illegible] damaged before we act. It is so much cheaper in terms of [illegible] and energy to prevent environmental degradation rather than to clean it up later.

Lastly, there are areas where we must use detergents such as agriculture, medical and etc. [illegible] if phosphate pollution is detrimental (which it is) [illegible]'s curtail its use where we can.

Sincerely yours,

[illegible]
Housewife

NAME: [illegible] DATE: [illegible]

ADDRESS: [illegible]

PHONE: [illegible]

REPRESENTING WHOM? [illegible]

APPEARING ON WHICH PROPOSAL: [illegible]

DO YOU: SUPPORT? ______ AMEND? ______ OPPOSE? ✓

COMMENTS: ______

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

Submitted by Jerome Anderson

Montana Water Quality

Introduction: We are all concerned about the water quality of streams, rivers, lakes and reservoirs in the State of Montana. We also all agree that it is entirely appropriate for the legislature to implement laws which will effectively lead to an improvement in water quality where problems exist, and will effectively prevent the deterioration of water quality in the future. The purpose of this document is to demonstrate why a detergent phosphate ban in the State of Montana, as proposed in HB 414, can have no perceptible effect on the water quality of Montana lakes. The information is based primarily on documented scientific facts obtained in studies of Montana lakes by the United States Environmental Protection Agency, Purdue University on Indiana lakes, Cornell University on New York lakes, National Biocentric, Inc., on Minnesota lakes, information from Montana's 208 Water Quality Projects, and monitoring information from the International Joint Commission and municipalities in the Province of Ontario on the Great Lakes.

Phosphate, a form of the element phosphorus, is a non-toxic chemical, a vital nutrient necessary for all forms of plant, animal and human life. The only environmental or safety concern associated with phosphorus is the occurrence of eutrophication in certain water bodies under conditions outlined below. Eutrophication, is in essence an over-nutrition of a water body leading to an acceleration of the normal "aging" process. In a eutrophic state, the algae, microscopic green plant organisms, overmultiply leading to nuisance growths of green masses in surface water. As these masses are broken, mats of the organisms can sink and decompose by bacterial action, utilizing oxygen in the process.

Normally, aquatic plants and fish exist in a proper balance. A lake in this condition would be considered oligotrophic. The fish supply a portion of the carbon dioxide necessary for plant growth, while the plants serve as an essential food source for the fish.

Several conditions must be met for eutrohication to occur (note Chart 1): proper sunlight is necessary, conducive temperature, the water must have a low flow rate, and essential nutrients for the algae must be present in excess. If any of these conditions are not met, eutrophication will not occur. If all conditions necessary for eutrophication to occur are found in a lake, then the nutrient present in the least amount will control the rate of algal growth. This element is referred to as the limiting nutrient. For many freshwater lakes, phosphorus is the limiting nutrient, but this is not always the case.

In summary, it is important to remember that all four conditions listed above must be met for eutrophication to occur. Therefore, eutrophication will not occur in flowing streams or rivers, turbid waters, or deep waters regardless of the level of the limiting nutrient. Further, when other conditions are proper, as soon as the level of the limiting nutrient reaches the critical level, eutrophication occurs. To achieve significant improvement of eutrophic conditions in affected lakes where phosphorus is the limiting nutrient, the phosphorus level must be reduced below this critical level. Removal of only a small portion of the phosphorus source will have no significant effect on the eutrophic conditions.

Phosphorus enters lakes in two ways (Chart 2), from point sources, i.e. sewage plants and direct industrial discharge, or non-point sources, i.e. land run-off and atmospheric sources. Some people have expressed the view that drainage from septic tanks can be a source of phosphorus to a lake, and for ease of discussion it is included as a point source. However, there is little support that it is a significant source of phosphorus loading.[1]

Phosphorus from detergents enters lakes through sewage effluent point sources, comprising an estimated 35% of the total phosphorus load in municipal sewage (Chart 3). The remainder of the phosphorus present in municipal sewage is from human waste, kitchen garbage and the like. Estimates are still given by some that detergents contribute 50% of the phosphorus to sewage. This is based on outdated information which considers the level of phosphates in detergents in the early 1970's. Since that time, phosphates have been reduced by 50% in detergents, so that they are now composed on the average of 6% phosphorus by weight.

Let's now consider how eutrophication can be prevented in lakes if phosphorus is the limiting nutrient. We must focus our attention on the amount and source of phosphorus entering a lake. For a control measure to be effective, it must remove a source of phosphorus which can significantly reduce the total amount of phosphorus entering a lake. Removal of just a little bit will have no perceptible benfit.

Sixteen lakes in Montana have been studied.[2] The attached map (Montana map) shows that they represent a sampling which covers almost every area of the State. The next chart shows the information determined in these studies. The first two columns show the current pounds of phosphorus entering each lake yearly, and the amount which would enter the lakes if phosphate were banned from all detergents. The final column shows the percent reduction in phosphorus loading which would occur with a detergent phosphate ban.

As you can see, the contribution of detergent phosphates is extremely small. The removal of this source of phosphorus by a detergent phosphate ban would have no perceptible effect on the lakes' eutrophic status.

Thus, while we are all desirous of having the best water quality possible in our lakes, we must assure ouselves that any measures taken are sound, cost-effective and help achieve our noted goal. This will not be achieved by banning phosphates from detergents. The information collected in these studies uniformly show that such an action will have no effect on the water quality of our lakes.

Before concluding, let's consider what is known about areas where phosphates in detergents have been reduced or banned.

In 1970, the Canadian Government limited the phosphorus content of laundry detergents to 8.7% by weight and then to 2.2% by weight in 1973. Target phosphorus concentrations of 1 mg/l in the effluent, or the material discharged from the sewage treatment plants were established. Information from phosphorus monitoring studies done in 94 sewage treatment plants in Ontario are shown in the next chart.[3]

Phosphorus reductions in detergents from an initial average of 11% in 1969 to 2.2%, or an approximate 80% decrease resulted in only a 30% decrease in the raw sewage concentration of phosphorus from 1969 to 1976. To achieve what is most important, that is reduction of phosphorus in effluent, that phosphorus entering lakes, has primarily been accomplished by the development of effective phosphorus removal in treatment plants, not a detergent phosphate reduction. In 1978, the Province of Ontario has achieved its goal of 1 mg/l concentration of phosphorus in the effluent through its completion of an effective sewage [illegible] program.

This demonstrates where point source discharges represent a significant contribution of phosphorus to lakes, a fact not shown in any of the Montana lake studies, effective sewage plant treatment is much more effective than detergent phosphate reductions in achieving desired water quality goals.[3] Chemically treating sewage can reduce the amount of phosphorus present in sewage by 90% or more, regardless of its municipal source.[4,5] This is a significantly greater reduction than the 35% reduction that might result from a detergent phosphate ban. In addition, this process can be implemented at existing treatment plants, including lagoons.

Finally, studies have been performed on lakes in three states which have instituted detergent phosphate bans: New York[6], Indiana[7] and Minnesota[8]. Water quality parameters have been compared before and after the bans were put into effect. The Indiana lake studies, performed by researchers at Purdue University, indicate that the ban of detergent phosphate has not resulted in any improvement in the trophic status of the fifteen lakes studied, even four years after the ban became effective. In fact, no improvement in water quality was seen. Similar results were found in both New York and Minnesota. The thirteen Minnesota lakes studied for two years before and after the ban, not only showed no improvement in water quality, but showed signs of a continued gradual progression towards eutrophication. This is very strong evidence that detergent phosphate bans have not been successful in substantially slowing, much less reversing, the process of eutrophication in states which have instituted such regulation.

In conclusion, a ban on detergent phosphate in the State of Montana can have no significant beneficial effect on the water quality of our lakes. This statement is supported by the experience of states which have instituted bans, and more specifically, by facts which have been developed in studies of Montana lakes.

References

1. Jones, R.A. and Lee, G.F. Occasional Paper No. 13 Center for Environmental Studies, University of Texas at Dallas, July 1, 1977.

2. U.S. Environmental Protection Agency, National Eutrophication Surveys, Working Papers Numbers 790-804, 894.

3. Appleby, D.J. The Impact of Phosphorus Control Activities: The Experience in Ontario. ERCO Industries Limited, October 1977.

4. Sedlak, R.I. The Impact of a Phosphate Detergent Ban on: I. Wastewater Treatment and II. Water Quality. The Soap and Detergent Association, January 24, 1978.

5. Department of Natural Resources, State of Michigan, "Consideration of Municipal Wastewater Treatment for Phosphorus Removal in the Evaluation of a Detergent Phosphorus Ban", August, 1976.

6. Plunkert, K.C.,Kimerle, R.A., and Wilson, J.D. "Analysis of the Indiana and New York Lake Survey Results", The Monsanto Company, November 23, 1977.

7. Bell, J.M. and Spacie, A. "Trophic Status of Fifteen Indiana Lakes in 1977", Purdue University, March, 1978.

8. "Limnological Investigation of Selected Minnesota Lakes: An Overview", National Biocentric, Inc., February 14, 1979.

Chart 1

CONDITIONS NECESSARY FOR EUTROPHICATION TO OCCUR

- ADEQUATE LIGHT
- CONDUCIVE TEMPERATURE
- LOW FLOW RATE
- SUFFICIENT AMOUNTS OF :
  - CARBON
  - NITROGEN
  - PHOSPHORUS
  - IRON
  - COPPER
  - OTHER TRACE METALS
  - VITAMINS
  - INORGANIC SALTS
  - OTHER MINOR ELEMENTS

Chart 2

Sources of Phosphorus

Point Sources	Non-Point Sources
Sewage Treatment Plants	Land Run-off
Industrial Discharges	Atmospheric contributions
Septic Tanks(?)	

Chart 3

Sources of Phosphorus in Domestic Sewage

Source	Pounds of Phosphorus /capita/year	%
Laundry Detergents	1.2	35
Human Waste	1.4	41
Miscellaneous*	.8	24
Total	3.4	100

* Includes kitchen food waste, industrial and institional cleaners, etc.

References:

1. 1978 National Market Research

2. AWWA Journal, Sources of Nitrogen and Phosphorus in Water Supplies Task Group, Report 2610P. March 1967, Vol. 59.

3. Appleby, D.J. The Impact of Phosphorus Control Activities: The Experience in Ontario, ERCO Industries Limited, October 1977.

4. Data supplied by Mike Stifler, Michigan Department of Natural Resources, personal communication.

5. Bates, Dale I., "Study of Benefits Relative to Phosphorus Removal Costs Resulting from Limitation of Phosphorus in Cleaning and Water Conditioning Agents," Western District Office, EPA, June 9, 1978.


Lincoln
Flathead
Glacier
Toole
Liberty
Hill
Havre
Blaine
Phillips
Valley
Daniels
Sheridan
Roosevelt
Richland
Mc Cone
Dawson
Wibaux
Prairie
Fallon
Carter
Custer
Miles City
Powder River
Rosebud
Treasure
Big Horn
Garfield
FORT PECK LAKE
Petroleum
Fergus
Musselshell
Golden Valley
Yellowstone
Billings
Carbon
Stillwater
Sweet Grass
Wheatland
Judith Basin
Meagher
Park
Gallatin
Bozeman
Madison
Beaverhead
Jefferson
Broad Water
Butte
Silver Bow
Deer Lodge
Granite
Ravalli
Powell
HELENA
CANYON FERRY LAKE
Lewis and Clark
Cascade
Great Falls
Chouteau
Teton
Pondera
Kalispell
FLATHEAD LAKE
Lake
Sanders
Mineral
Missoula
Yellowstone National Park
MISSOURI RIVER

MONTANA

Reduction In Phosphorus Loading Which Would Occur In The 16 Montana Lakes Studied If Detergent Phosphates Are Banned

Lake	Total Phosphorus Entering Lake (lbs/yr)	Phosphorus Loading With A Detergent Phosphate Ban (lbs/yr)	% Phosphorus Loading Reduction With A Detergent Phosphate Ban
Canyon Ferry Reservoir	726,000	725,000	0.1
Georgetown Lake	1,700	1,660	2.4
Hebgen Lake	53,300	53,250	0.1
Mary Ronan Lake	2,500	2,490	0.4
Swan Lake	37,400	37,360	0.1
Lake McDonald	20,600 ~~21,000~~	20,545 ~~20,840~~	0.3 ~~0.8~~
Whitefish Lake	12,900	12,860	0.3
Nelson Reservoir	16,800	16,790	0.1
Seeley Lake	7,450	7,420	0.4
Tiber Reservoir	70,800	67,400	4.8
Tongue River	294,000	294,000	0.0
Koocanusa Reservoir	58,600	57,200	2.4
Yellowtail Reservoir	2,311,000	2,311,000	0.0
Flathead Lake	382,400	363,700	4.9
Tally Lake	6,000	5,990	0.1
Clark Canyon Reservoir	44,000	43,995	0.1

Chart 5

Weighted Average Phosphorus Concentrations
For 94 Treatment Plants In Ontario

	1969	1971	1973	1976
Raw Sewage (mg/1)	10.2	8.8	7.2	6.9
Effluent (mg/1)	5.7	4.6	3.5	1.5

↑ Detergent Phosphorus Reduction to 8.7% (between 1969 and 1971)

↑ Detergent Phosphorus Reduction to 2.2% (at 1973)

Taken from the D. J. Appleby report, "The Impact of Phosphorus Control Activities, The Experience in Ontario", October, 1977.

Submitted by Jerome Anderson

Review of Technical Data

on the Lakes in Montana

For a clear understanding of why a ban on phosphate in laundry detergents would not perceptibly improve the water quality of the lakes in Montana, it will be useful to review the lakes individually, and to examine each one's distinct pattern of phosphorus loading.

The Canyon Ferry Reservoir is one of the three largest water impoundments in Montana (the other two being Flathead Lake and Fort Peck Lake). It is located in the western counties of Lewis and Clark and Broadwater, close to the capital city, Helena. Canyon Ferry Reservoir is a eutrophic lake, and is nitrogen-limited. According to a U.S. EPA National Eutrophication Survey (NES)[1], more than 99% of the phosphorus loading into this lake is from non-point sources. The sewage treatment facility at Townsend contributes only 0.4% of the phosphorus loading into this lake. It is the only point source within a 40 km distance of the lake. In addition to this point source, it has been estimated that septic tanks in the area contribute less than 0.1% of the total phosphorus loading. The present phosphorus loading of 2.27 $g/m^2/year$[1] is twice that proposed by Vollenweider[2] as a eutrophic loading. Since more than 99% of this loading is from non-point sources, removal of the phosphorus contribution due to detergents could have absolutely no effect on the overall water quality of this reservoir.

Georgetown Lake, in the far western part of Montana, is located in both Deer Lodge and Granite Counties. It is a nitrogen-limited eutrophic lake. There are no point sources located on or near the lake. The NES survey[3] performed on this lake indicates that 7.0% of the phosphorus loading is attributable to septic tanks in the area. If one assumes that 35% of the septic tank contribution is due to detergent phosphates, then only ~2.5% of the total phosphorus loading into the lake is from detergent origin. Thus, a detergent phosphate ban could not be expected to significantly alter the trophic status of Georgetown Lake. The NES report states that the submarine springs which feed the lake are probably the major contributors of phosphorus into the lake; however, this contribution cannot be accurately quantified at this time. Nevertheless, approximately 93% of the measurable loadings of phosphorus into Georgetown Lake are due to non-point sources and thus would remain unaffected by a detergent phosphate ban.

Clark Canyon Reservoir in Beaverhead County is in the southwestern corner of Montana. There are no known point sources on this lake. It is classified as eutrophic, and over 99% of the total phosphorus loading is attributable to land run-off, precipitation, and tributary contributions. It is estimated that septic tanks in the area contribute less than 0.1% of the total phosphorus loading. A detergent phosphate ban would not appreciably reduce the phosphorus loading into the Clark Canyon Reservoir, nor could it have any beneficial effect on its trophic status.

Hebgen Lake is located in the southern border county of Gallantin, very close to Idaho. This lake has been classified as meso-eutrophic[4] and is nitrogen-limited.

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1 U.S. EPA, NES, Working Paper No. 790, 1977
2 Vollenweider, R. A. and P. J. Dillon, The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Center for Inland Waters, Burlington, Ontario. 1974.
3 U.S. EPA, NES Working Paper No. 793, 1977.
4 U.S. EPA, NES Working Paper No. 794, 1977.

Less than 0.3% of the total phosphorus loading is attributable to septic tanks, and the lake has no point sources. More than 99% of the phosphorus loading is due to non-point sources, and would be unaffected by a detergent phosphate ban.

Mary Ronan Lake is located in Lake County in the northwest area of Montana. It is very similar to Hebgen Lake, being meso-eutrophic and nitrogen-limited.[5] Approximately 98.7% of the phosphorus loading is due to non-point sources, mainly its tributaries. About 1.8% is estimated to come from area septic tanks. There are no point sources on Mary Ronan Lake. Also located in Lake County is Swan Lake. It is mesotrophic and nitrogen-limited for most of the year.[6] During July and September, the lake may be phosphorus-limited. Approximately 99.7% of the phosphorus loading into Swan Lake is due to non-point sources, with the remaining 0.3% contributed by area septic tanks. Neither Swan Lake nor Mary Ronan Lake would be affected with respect to water quality or trophic status by a ban on detergent phosphates.

Lake McDonald, Tally Lake and Whitefish Lake are all located within the northwestern county of Flathead. Whitefish and McDonald are oligotrophic lakes,[7,8] and Tally Lake is classified as oligo-mesotrophic.[9] All have very good overall water quality. None of them has any point source discharge of phosphorus. (Until 1976, Lake McDonald had a single sewage treatment plant discharging into it. The contribution of phosphorus from this plant was calculated to be ~2.1% at that time. Currently, the discharge from this plant has been diverted and no longer impacts on the lake). Lake McDonald receives no septic tank input of phosphorus. Septic tank phosphorus loadings into Tally Lake and Whitefish Lake are calculated to be 0.2% and 0.9%, respectively, of the total phosphorus loading into each lake. Therefore, better than 99% of the phosphorus loading into these three Flathead County lakes is due to non-point sources. A detergent phosphate ban would have no perceptible benefit for either the water quality or the already excellent trophic status of any of these lakes.

Nelson Reservoir is in Phillips County, a north-central county on the Canadian border. It is a nitrogen-limited eutrophic lake, which receives 99.8% of its total phosphorus-loading from non-point sources.[10] The remaining 0.2% is attributed to septic tanks in the area. There are no point-sources on the lake. Therefore, a detergent phosphate ban could have no perceptible effect on the trophic status of the Nelson Reservoir.

Seely Lake, in Missoula County, is in the southwestern part of Montana. It is classified as being meso-eutrophic and nitrogen-limited.[11] There are no point sources on this lake, and only 1.2% of the total phosphorus loading into Seely Lake has been attributed to septic tanks. Since 98.8% of the phosphorus-loading into this lake is from non-point sources, a detergent phosphate ban could neither slow nor reverse the current trend to a eutrophic status. In addition, the NES report states that poor circulation in the southern areas of the lake is likely responsible for a substantial accumulation of nutrients in the lake (Ref. 11, pg. 2), which would be independent of any controls applied to the current point and non-point sources of nutrients.

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5 U.S. EPA, NES Working Paper No. 796, 1977.
6 U.S. EPA, NES Working Paper No. 800, 1977.
7 U.S. EPA, NES Working Paper No. 804, 1977.
8 U.S. EPA, NES Working Paper No. 797, 1977.
9 U.S. EPA, NES Working Paper No. 801, 1977.
10 U.S. EPA, NES Working Paper No. 798, 1977.
11 U.S. EPA, NES Working Paper No. 799, 1977.

Tiber Reservoir is located in both Liberty and Toole Counties, on the central northern border of the state. It is limited by both phosphorus and light, with the latter being the usual controlling factor. When turbidity in this lake periodically decreases, light is no longer the limiting factor to algal growth, and phosphorus becomes the limiting nutrient. The Tiber Reservoir is classified as meso-eutrophic.[12] It has as the single point source a sewage treatment plant in Shelby. It has been estimated that this plant contributes 13.7% of the total phosphorus loading into this lake. The rest comes from non-point sources. A ban on detergent phosphates could reduce the current phosphorus loading by only 4.8%, and most probably would have a very minimal effect on the overall water quality and the trophic status of the lake.

The Tongue River Reservoir in Bighorn County is on the south-central border of Montana close to Wyoming. It is a nitrogen-limited lake of eutrophic status.[13] The only point source which impacts on this lake is a sewage treatment plant in Sheridan, Wyoming which discharges into the Tongue River about 20 miles away from the Reservoir. The contribution of this plant to the total phosphorus loading into the Reservoir is calculated to be 11.1%. The remainder comes from non-point sources. Since the only point source to this lake is in Wyoming, a detergent phosphate ban in Montana would cause no reduction in the phosphorus loading to the Tongue River Reservoir.

The Koocanusa Reservoir is located in both Lincoln County, Montana and British Columbia, Canada. According to an NES report[14], 86% of the drainage area of this lake lies in Canada. The survey calculated phosphorus loadings solely from U.S. sources. The Koocanusa Reservoir is nitrogen-limited and mesotrophic. Approximately 93.1% of the U.S. phosphorus loading into this lake is fron non-point sources. The remaining 6.9% is from the single U.S. point source which impacts on the lake, a sewage treatment plant in Eureka. A detergent phosphate ban could reduce the U.S. loading by a maximum of 2.3%, which is probably negligible when viewed relative to the Canadian point and non-point source contributions to the phosphorus loading into the Koocanusa Reservoir.

The Yellowtail Reservoir is located in both Montana and Wyoming. It crosses through Bighorn and Carbon Counties in Montana, and is also in Bighorn County, Wyoming. The Yellowtail Reservoir is eutrophic in Wyoming, progressing to meso-eutrophic in southern Montana, and then becomes mesotrophic at its northern end.[15] Presently, 0.8% of the total phosphorus loading is from four sewage treatment plants around the lake. The rest is contributed by non-point sources. The present yearly phosphorus loading into the Yellowtail Reservoir would have to be reduced by nearly 93% to just equal the eutrophic loading (Ref. 15, pg. 3), according to the U.S. EPA report. Such a reduction would clearly require non-point source control. A detergent phosphate ban would have no perceptible effect on the trophic status of this lake.

Flathead Lake, in the northwestern counties of Lake and Flathead, is probably the most extensively studied of all the lakes in Montana. It is an oligotrophic lake and is probably phosphorus-limited during most of the year, although data on this subject are not always in agreement (Ref. 16, pp 1-2; Ref. 17, pg. 9). The overall water quality is excellent, as evidenced by the abundance and diversity of

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12 U.S. EPA Working Paper No. 802, 1977.
13 U.S. EPA Working Paper No. 803, 1977.
14 U.S. EPA Working Paper No. 795, 1977.
15 U.S. EPA Working Paper No. 894, 1977.

fish species in the area, as well as the documented surveys of the major water quality parameters.[16,17,18]

The only point sources of phosphorus are five sewage treatment plants with discharges which impact on Flathead Lake. The largest of these is the plant at Kalispell (~9 miles up the Flathead River) which serves a population of approximately 10,500 and has a mean flow of about 1.5 MGD. It discharges ~15,270 kg P/year, or about 8.8% of the total phosphorus loading into Flathead Lake. The community of Whitefish (~20 miles up the Whitefish River) has a sewage treatment plant which serves a population of approximately 3,400. The mean flow of this plant is 0.3 MGD. It discharges ~ 3,855 kg P/year, or about 2.2% of the total phosphorus loading into Flathead Lake. The third largest sewage treatment plant on Flathead Lake serves the community of Columbia Falls (population ~2,000), which is located ~ 20 miles up the Flathead River. The mean flow for this plant is ~0.2 MGD. It discharges 2,270 kg P/year, or about 1.3% of the total phosphorus loading into Flathead Lake. The treatment plant which serves the community of Big Fork (population ~500) has a mean flow of 0.2 MGD and discharges ~2,400 kg P/year directly into Flathead Lake. This amounts to 1.4% of the total phosphorus loading into the lake. None of these plants practice phosphorus removal by chemical treatment. The reamining point source of phosphorus is the treatment facility at the Yellow Bay Biological Station. This plant serves an average population of 125 (350 during the summer months and only 12 during the winter months). Mean flow is very low, ~ 35,000 gallons per day, although this figure must be much higher during the summer months. The plant does practice chemical removal of the phosphorus in its wastewater, and contributes only ~ 5 kg P/year to Flathead Lake, which is much less than 0.1% of the total phosphorus loading into the lake. The combined phosphorus contribution of all five point sources amounts to only ~ 13.7% of the total phosphorus loading into the lake. Detergent phosphates represent only 35% of this point source contribution, or ~4.8% of the total phosphorus loading.

There are 465 septic tanks in the vicinity of Flathead Lake. They contribute an estimated 0.3% of the phosphorus loading into the lake. Only 35% of this figure can be attributed to detergent phosphates, bringing the total phosphorus contribution to Flathead Lake from all detergent origins to ~ 4.9%. A detergent phosphate ban would therefore be expected to decrease the phosphorus loading into this lake by less than 5%. The result would be an insignificant decrease in the overall phosphorus concentration in the lake.

Septic tanks have been estimated to contribute phosphorus to nearly all the Montana lakes. To date, however, no studies have been performed in Montana to demonstrate whether or not this is true. A brief review of the published literature concerning phosphate removal in soils adjacent to septic tanks will yield some perspective on this question.

Most soils are capable of fixing very large amounts of phosphorus. The mechanisms of phosphorus fixation include: adsorption, precipitation reactions with iron, aluminum and calcium, and replacement reactions involving a change in

16 U.S. EPA NES Working Paper No. 792, 1977.

17 Flathead Drainage 208 Project, Executive Summary, 1978.

18 Gaufin, A.R., G. W. Prescott and J.F. Tibbs, Limnological Studies of Flathead Lake, Montana: A Status Report, April, 1976. EPA-600/3-76-039. EPA Ecol. Res. Series.

crystalline structure. In addition, phosphorus present in the soluble orthophosphate form may be converted by certain bacteria to insoluble forms.[19] In hard water areas, the likelihood of significant phosphate transport from septic tank systems to the surface waters is greatly reduced by the presence of calcium carbonate in the soil, which reacts to form insoluble phosphorus precipitates.[20] Even though phosphorus may be found to be present in septic tank effluents in concentrations of 20 mg/l (as phosphate), it is usually not present in significant concentrations in ground water adjacent to the system.[21] The Michigan Department of Health has conducted a study of nutrient transport from septic tanks to ground water [21], and reports that very little phosphorus migrates from septic tanks to local ground waters in their study area. Childs[22], in a study of septic tank systems in the Houghton Lake area in Michigan, concludes that 98% of the phosphorus present in septic tank effluents is adsorbed into the soil within the zone of saturation. He further concludes that the adsorption capacity of soil can be as great under water saturated conditions as under aerated conditions.

Given the above information, it is possible that the contribution of phosphorus from septic tanks to the surface waters of Montana is not as great as estimated in the U.S. EPA NES studies (maximum to any given lake is 7.0%), and may actually be non-existent. If the septic tanks are indeed contributing phosphorus to the surface waters, it is likely that bacterial, viral and nitrogen contamination are also occurring. If this is the case, a ban on detergent phosphates will not solve the other potential more serious pollution problems presented by the septic tanks. Upgrading the condition of the septic tanks and tile fields would seem to be a more appropriate solution.

To summarize, while eutrophic problems do exist in some of Montana's lakes, these problems are <u>without exception</u> due to non-point source discharges of nutrients. Detergent phosphates do <u>not</u> represent a significant contribution to the point-source phosphorus loading of any of the studied lakes. In addition, although the phosphorus loading from septic tanks around the Montana lakes has not been accurately quantified, the maximum contribution by this route from detergent phosphates is 2.5% in one lake, and less than 1% in all the others.

The water quality studies performed on sixteen Montana lakes support the statement that a detergent phosphate ban will have no perceptible effect on the water quality or eutrophic status of Montana lakes.

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19 Dudley, J.G. "Nutrient Enrichment of Ground Water From Septic Tank Disposal Systems", Master's Thesis, University of Wisconsin, 1973.

20 Lee, G.F. and R.A. Jones. "Septic Tank Wastewater Disposal Systems as Phosphorus Sources for Surface Waters". Occasional Paper No. 13, Center for Environmental Studies, University of Texas at Dallas, 1977.

21 Polta, R.C. "Septic Tank Effluents. Water Pollution by Nutrients: Sources, Effects and Control". Paper presented at the 1969 Annual Meeting of the Minnesota Chapter of the Soil Cons. Soc. of America. Univ. of Minn. Water Resources Research Center Bulletin 13: pg. 53-57.

22 Childs, K.E.. "Migration of Phosphorus Wastes in Ground Waters", Geological Survey Division, Michigan Department of Natural Resources, 1974.

NAME: Marjorie Kaiser DATE: [illegible]

ADDRESS: 1115 S. [illegible], [illegible]

PHONE: 586-6204

REPRESENTING WHOM? myself

APPEARING ON WHICH PROPOSAL: HB 412

DO YOU: SUPPORT? ________ AMEND? ________ OPPOSE? ________

COMMENTS: ________________________________

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

My name is Marjorie [illegible]. I have been a resident of Montana for over ten years. One of the reasons I came here was because of the environment, and have worked to maintain it ever since. During the last twenty years, I have worked as a home economist in education, journalism, utility home service, and research. In these positions, it has been my responsibility to help interpret technical information for the consumer, indicate consumer issues to business and government, and participate in research activities that would help solve some of these issues. I have directed several major laundry research studies. Two of these were funded as a result of a competitive award from the American Home Laundry Association. During 1978 I was the scientist designated at USDA to review and approve home economics research projects for funding under the Agricultural Act of 1978. Some of these studies were in the laundry field. I am here today to address some aspects of the House Bill 414 relating to the use of phosphate detergents on the quality of living in Montana.

There is no question that phosphorus is one of the many ingredients necessary for life and growth. For algae to grow in our lakes and streams, three conditions are necessary. First, there must be all of the essential nutrients present. Phosphorus is but one of these. Second, there must be sufficient amounts of each of these essential nutrients. Third, there must be the correct environmental conditions. There is a question as to whether each of the three above conditions exist in Montana lakes and streams. In considering environmental conditions, for example, it is my understanding that the majority of Montana's streams are fast moving - the reason we enjoy such excellent fly fishing and the presence of such good eating fish like trout. Our lakes have both ingress and egress and for the most part are of a deep water type. None of these conditions, fast moving water or cold water, support plant growth. Even if, however, optimum environmental conditions were present - slow moving, [illegible], when water [illegible] is insufficient information [illegible] the source of phosphorus in these [illegible]. Household cleaning agents [illegible] one of [illegible]. Phosphorus occurs in significant amounts in agricultural products, industrial waste, human and animal waste, and as a natural constituent of soil and air. Each of these contributes phosphorus to our lakes and streams. Data to date does not give us conclusive proof that household detergents are the culprit that is causing increasing amounts of phosphorus to be present. One major study, the Kirkland Drainage 208 Project, shows that about 6.8 percent of the phosphorus present in that area might be attributed to laundry detergents. Even in the executive summary of this study, none of the 11 actions recommended listed the elimination of household cleaning agents as a possible cure. The other study which I know [illegible] Study. In that one, an even lower amount of phosphorus due to detergents is cited — [illegible], and furthermore, phosphorus can be easily removed by sewage treatment plants. On the basis of this data, it would seem [illegible] that household cleaning agents are a significant factor in the eutrophication of [illegible] waters.

[illegible] as important as the environment in the life of [illegible] residents is the amount of money in their pocketbooks. Within my memory, the citizens of this state refused to support a sales tax as a method of raising state revenue. The most frequently cited cause for the failure was the adverse effect on the fixed and low income people that live here. From this action, I would observe that legislation resulting in the increase of [illegible] for those low and fixed income citizens would not be looked on favorably. In order to discuss the manner in which the [illegible] of phosphate detergents [illegible] a short description of the laundry process and the ingredients necessary for effective, efficient cleaning.

The laundry process concerns the removal of soil from fabrics, suspending this soil in a water solution until it can be removed by rinsing. Laundry detergents are one of the agents used to remove dirt and keep it in suspension. The major ingredients and their function are listed in Table 1. The backbone of the detergent is the surfactant, a term derived from the words "surface active agent", and describes the dominant method used by it to facilitate soil removal. This phenomenon permits fabrics and soils to "get wet" more rapidly and promotes penetration of the wash solution between soil particles and fabric surface to initiate soil removal. It's second task is to hold soil once it is removed by mechanical action of the washer in suspension so it cannot redeposit on the clothes. It is especially effective in emulsifying oily soils and suspending particulate soils. This becomes important in [illegible], as I will show later. Even the most effective surfactants are inhibited by water hardness minerals, and thus need help from the second ingredient listed in Table 1 - a builder.

While the primary function of a builder is to soften water, you will see from Table 2 that it is only one of several functions that are performed. Phosphates are a class of builders that enable the surfactant to perform at maximum efficiency, contribute to the removal of a wide variety of soils and stains, have an excellent soil suspending property, maintain the alkalinity level of the wash solution at optimum, yet within that safe for people's clothes and washing machines. The substitutes that are now available and may be in the future are shown in Table 3.

Most of the current phosphate substitutes are water softeners but do not hold water hardness minerals in soluble form. Instead, they combine with [illegible] to form an [illegible] residue which deposits on [illegible], and even plumbing. In addition, they have a lower ability to suspend [illegible] soil in the laundry solution. This results in increased redeposition of soil on fabrics which we can see as graying on white clothing, and dinginess on colored ones. In areas where there is a phosphate ban, washer manufacturers report increased service calls and a shorter part life for [illegible], outer posts, agitators, and pumps. On fabrics, the residue build-up makes fabrics feel stiff and harsh, shortens the life of sewing threads in places like elastic waist bands and sock tops, as well as [illegible] abrasion on such areas as shirt collars, trouser cuffs, and ends of hems. All of these things shorten apparel life, and some research shows that this can be as much as 15 percent. In a survey of consumers in areas where a detergent ban has been in effect some time, 2/3 of the women noted that clothes were [illegible] clean, and nearly half reported more cases of skin irritation on family members or friends, some of which required medical attention.

An emerging problem in the use of detergents is the need to reduce energy requirements. President Carter has recently recommended turning down water heaters to 105 degrees F. For optimal fabric cleaning, temperatures should be 120 degrees. If thermal energy is to be reduced, it will have to be replaced with either mechanical energy (longer wash cycles) or additional chemical energy (more and better detergents). The logical way to work in [illegible] water is to use more chemical energy, since longer washing cycles will result in increased energy use as well as [illegible] water. Chemical energy is supplied in the form of detergents. [illegible] of how much is used, non-phosphate detergents have not been able to equal the performance of phosphate detergents [illegible] they [illegible] in [illegible] than do phosphate detergents.

The new builders listed in Table 3 are carboxylates and zeolites. These are also water softening agents, but do have some advantages over the commonly used substitutes. They are relatively new, still in test market, and relatively more expensive to produce. Considerations necessary when selecting a laundry detergent are:

<u>First:</u> The kind of dirt to be removed. Soil on clothing comes from the type of work in which we participate. The leading ways of earning a living here in Montana are farming, ranching, and mining. Each of these generate high levels of particulate dirt that becomes embedded or ground into our clothing. In addition, the amount of body soil will be high because of the physical exertion these occupations require. This means that any deficiency in the laundry detergent will add to the task of removing the grime and can be readily seen by the consumer. This may be why market studies in the Rocky Mountain region show that given a choice of cleaning agents, phosphate and non-phosphate, 85 percent of the consumers buy liquid or granular phosphate detergents.

<u>Second:</u> Water hardness. Our water is considered hard to very hard according to the data provided by the Department of the Interior. Table 4 shows the water hardness of major cities in Montana. For the larger cities of Montana, the average water hardness ranges from moderately hard to hard. By percent of population, this means about [illegible]% of our residents have a hard water problem. We are in need of water softeners. Those of a non-precipitating type will be especially beneficial. Builders are added to detergents for this purpose. Phosphate is a non-precipitating type. Without them, consumers are forced to take corrective measures, such as increased use of laundry detergents, putting in water softeners, pre-wash [illegible], presoak and laundry products, bleaches, fabric [illegible], installation of water softening

[illegible] and the use of increased [illegible] energy [illegible] [illegible] items, greater clothes wear [illegible], [illegible] not sufficiently cleaned, and additional rinsing. All of these alternatives cost the consumer additional money. A bottom line figure is estimated at $15.10 per family per year. This has been broken down into the factors shown in Table 2.

Still another alternative is for the consumer to purchase the preferred detergent out of state. We are surrounded by states that do not have phosphate detergent bans. Such would be relatively easy to reach for many Illinois residents. In Indiana, a study of consumer adjustments to the phosphate ban showed that 13 percent of the respondents had used out of state detergents during the three year period. Of these, nine percent said they are currently using such detergents. It is believed that percentages were underestimated because in answering this, the women would have had to admit they were not following the intent of the law. Such a practice causes loss of revenue to supermarket owners and other merchants who sell detergents.

In summary, it seems to me that House Bill 414, which bans the use of household cleaning agents containing phosphorus, does not solve the environmental problem of algae growth in our lakes and streams. In fact, studies in those states where such a ban has been in effect for some period of time indicate no significant improvement. In our state, the current amount of eutrophication is low, 13 percent, and the percentage of phosphorus present that can be attributed to cleaning products is minimal, 3.1 to 4.0 percent. [illegible] means of phosphate cleaners [illegible] [illegible] [illegible] septic tank does not contribute to phosphorus concentrations. In fact, current evidence shows that phosphorus from this source is rapidly absorbed to soil particles in the tile fields. In addition, many phosphate products are not eliminated; personal care items such as toothpaste, shampoo, hand soap, and some bulk package water softeners. Adjustments to the lack of phosphate detergents can be needlessly inflationary, costing as much as $55.60 per family per year, or resultant "detergent running" by the Montana consumer who purchases detergents out of state.

I support the resolution of my professional organization, the American Home Economics Association, which has a chapter here in Montana. The full text of their resolution is attached. In essence, it states that the consumer should be entitled to the right of free choice in the market place, and encourages states to promote the removal of all algae growth producing nutrients through improved waste treatment legislation like the Clean Water Act and improvement in waste treatment facilities. I urge this committee not to consider this bill further and vote against recommending it for full debate on the floor of the Senate.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]
[illegible] Phosphates [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	
[illegible]	[illegible]

TABLE 2

FUNCTIONS OF DETERGENT PHOSPHATE

1. Increases the activity of surfactants.
2. Softens water by sequestering calcium ions that cause hardness.
3. Dissolves precipitates of hardness ions.
4. Neutralizes fatty acid soils to form a soap.
5. Disperses soil aggregates into small particles.
6. Suspends soil particles.
7. Emulsifies oily soils.

TABLE 3

DETERGENT PHOSPHATE SUBSTITUTES

CURRENTLY IN USE

Sodium Carbonate

Sodium Silicate

Sodium Citrate

Hardness Insensitive Surfactants

POTENTIAL

Ether Carboxylates (TMS, TDS)

Sodium Aluminosilicate (Zeolite)

TABLE 4

AVERAGE WATER HARDNESS IN MONTANA MUNICIPALITIES

CITY	SOFT 0-3.5 GPG	MEDIUM HARD 3.6-7.0 GPG	HARD 7.1-10.5 GPG	VERY HARD Over 10.5 GPG
Anaconda		5.4		
Billings			9.8	
Bozeman		5.8 →	9.7	
Butte	3.2			
Great Falls			9.3	
Havre				23.6
Helena	1.9 →			[illegible]
Kalispell			8.5	
Lewistown				12.0
Livingston		4.0		
Miles City		3.8		
Missoula	.9			

TABLE 5

ANNUAL CONSUMER COSTS

Increased cost of cleaning products	4.78
Shortened wear life of washable clothes	34.15
Increased washing machine service calls	2.45
Washing machine parts replacement	13.75
TOTAL COST PER FAMILY PER YEAR	$55.13

TOTAL COST (ANNUAL) TO ALL MINNESOTA FAMILIES $14,500,000 [illegible] 6

RESOLUTION OF THE AMERICAN HOME ECONOMICS ASSOCIATION

WHEREAS, The American Home Economics Association is concerned about the environment; and

WHEREAS, several state and local governments have enacted legislation limiting the use of phosphorus in household cleaning products in an attempt to reduce eutrophication of surface waters; and

WHEREAS, phosphorus is only one of many nutrients that may promote algae growth in water and since phosphorus from household cleaning products represents only about one-fourth of the total phosphorus input the remainder coming from human and industrial waste and drainage from agricultural land; and

WHEREAS, presently available substitutes for phosphate are potential home safety hazards, are less effective in softening water and removing and suspending soil, and may damage laundry and dishwashing equipment and reduce the wear life of clothing; and

WHEREAS, laboratory findings show that the positive effects of the Federal flammability regulation on children's sleepwear may be nullified by phosphate bans; and

WHEREAS, legislation limiting phosphorus in cleaning products denies consumers freedom of choice of these products; and

WHEREAS, the Clean Water Act provides capital funding for improved waste treatment facilities, therefore, be it

RESOLVED, that National, state and local associations support the principle of the right of consumer choice in purchasing cleaning products and, further support the purposes of the Clean Water Act and encourage efforts toward removal of all algae growth producing nutrients through improved waste treatment facilities.

BIBLIOGRAPHY

1. [illegible], C.C. and B.E. [illegible], A Comparison of Phosphate and Non-phosphate [illegible]tergents in the Laundering of Men's Shirting Fabrics, Bulletin 415, [illegible] Island Agricultural Experiment Station, University of Rhode Island, [illegible], Rhode Island, 1975.

2. [illegible], P., S. Klein, D. Stankel, J. Sheffer, M. Wilbur (Central Michigan University), testimony on Proposal Banning Phosphorus Content in Household Laundry Detergents before the Committee on Conservation, Environment and Recreation, State of Michigan, March 30, 1977.

3. [illegible] Michigan Home Economists in Business (HEIB), Legislative News, [illegible] 10, 1976.

4. [illegible], A. (College of Human Ecology and Agricultural Extension Service, [illegible] State University), testimony presented at a hearing of the [illegible] House Committee on Conservation, Environment and Recreation, [illegible] 30, 1977.

5. [illegible] Electric Co., [illegible] Detergents and Their Effect Upon Clothing and Home Laundry Equipment.

6. [illegible] Testing Corporation, Cost of Home Laundry, Phosphate vs. Non-phosphate Detergent in Kansas City, Kansas and Indianapolis, Indiana, [illegible], 1976.

7. [illegible], K.A. (University of Wisconsin), Effect of Detergent Type on Wear Life of an Apparel Item Varying by Fiber Content, doctoral dissertation, School of Family Resources and Consumer Sciences, University of Wisconsin, [illegible], Wisconsin, 1975.

8. [illegible], M.A. and H.H. Prato (University of California, Davis), Fabric Damage During Laundering, California Agriculture, 30 (12), 9, 1976, also [illegible] Abrasion of Durable Press Cotton Fabric During Laundering with Phosphate and Carbonate Built Detergents, Textile Research Journal, pgs. [illegible]-401, May, 1975.

9. Olson, W. (Agricultural Extension Service, University of Minnesota), Using Non-phosphate Detergents in Machine Laundry, Fact Sheet, Home Economics Family Living, No. 33-1976.

10. [illegible] (Purdue University), Consumer Impact of Detergent Phosphate Ban, Indiana, August, 1976.

11. [illegible] (Cornell University), testimony for the Conservation Committee, Vermont House, regarding H.402, February 10, 1976.

12. [illegible], B.J., Performance Characteristics of Currently Available Laundry Detergents, testimony presented March 15, 1978 to the Energy and Environment Committee, Ohio House of Representatives. Also testimony presented at hearing of the Michigan Department of Natural Resources, Lansing, Michigan, December 8, 1976.

13. [illegible], A.C., Utilization of Type A Zeolite as a Laundry Detergent Builder, Soap and Cosmetic Chemical Specialties, 53 (3), 29-[illegible], 64, 66, March, 1977.

14. J. Schrage, Powdered Non-phosphate Detergents, Major Effects on the Consumer, testimony presented March 15, 1978 to the Energy and Environment Committee, Ohio House of Representatives.

15. [illegible], D.M., testimony presented February 28, 1978 to the Committee on Natural Resources and Tourism, Wisconsin Senate.

16. [illegible], testimony for Public Hearing on HB 332 Regarding Proposed Phosphate Ban in the State of Ohio, presented to Energy & Environment Committee, Ohio House of Representatives, March 13, 1978.

17. [illegible] Research, Inc., Phosphate Detergents Ban Effect on Indiana Households, 1976. Summary prepared by H.S. [illegible], Inc., 1976, attached.

18. Water Hardness of Public Water Supplies, Geological Survey Papers 1299 and 1300, U.S. Department of Interior, Government Printing Office, Washington, D.C., [illegible].

NAME: Ned E. Williams DATE: 3-15-79

ADDRESS: 1382 Cambridge Blvd. Columbus, Ohio 432

PHONE: 614-486-6615

REPRESENTING WHOM? Burgess & Niple Ltd.

APPEARING ON WHICH PROPOSAL: HB 414

DO YOU: SUPPORT? ______ AMEND? ______ OPPOSE? ✓

COMMENTS: Wish to testify

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

MONTANA WATER QUALITY TESTIMONY

Gentlemen: My name is Ned E. Williams. During the last twenty years I have been Chief Engineer of the Department of Natural Resources, Executive Director of the Ohio Water Development Authority, and until January 8 of this year, Director of the Ohio Environmental Protection Agency. I am now a Project Director with the firm of Burgess & Niple, Limited in Columbus, Ohio.

I have been asked by the Soap & Detergent Association to review the testimony given by proponents in House Hearings on HB 414 and reports of lake studies done in Montana by the United States Environmental Protection Agency. I understand the time constraints you are under and will keep my comments brief.

Your position in considering this bill is very similar to mine four years ago in Ohio - should the EPA support a phosphate bill? Our decision was no - and the bill was not passed. The decision was reached on technical research, not emotion, and in the ensuing four years, I have seen no reason to question the direction we took.

Although comparing Ohio to Montana is like comparing apples to oranges, our experience in Ohio can be of help in your decision making.

A few points relative to detergent phosphates. Phosphate is a non-toxic chemical, a nutrient necessary for all forms of plant, animal, and human life. The only environmental concern associated with phosphorus is the occurrence of over-nutrition of a water body which results in algae growth multiplying and leading to nuisance growths of green masses in surface water. Several conditions must be met for this to occur:

1. Proper sunlight
2. The water must have a low flow rate
3. Essential nutrients for the algae must be present in excess

If all conditions necessary are found in a lake, then the factor present in the least amount will control the rate of algal growth. For many fresh water lakes, phosphorus is the limiting factor, but this is not always the case.

Phosphorus enters lakes in two general ways, one referred to as point sources; this includes sewage and direct industrial discharge, or from non-point sources, such as land runoff. Phosphorus from detergents enters lakes from sewage or point sources. Detergents contribute, at most, 35% of the phosphorus in sewage. In the House testimony, it was stated that detergents contributed 50% of the phosphorus in sewage, but this information is outdated. Voluntary reductions in the amount of phosphates in detergents by manufacturers have resulted in a maximum 35% contribution to the current total sewage phosphorus.

Another way of looking at this is to realize that a detergent phosphate ban in Montana could only reduce 35% of the phosphorus entering lakes from sewage. It would have no effect on phosphorus entering from other sources. A review of the 16 U.S. EPA lake studies in Montana shows that the maximum detergent phosphorus loading in any of the lakes is 4.9%. Only three of the lakes receive more than 2% of their phosphorus from Montana detergents, and the remaining 13, 0.4% or less. The removal of this small amount by a detergent phosphate ban would have no perceptible effect on water quality.

This raises another point which warrants some clarification. Much of the support for the proposed ban centers on remarks which state marked improvement of water quality has occurred in Great Lakes' states after the institution of detergent phosphate bans. This is an area in which I have had considerable experience in my former position as Director of the Ohio EPA. As I noted a moment ago, only a very small portion of phosphorus enters lakes in Montana from sewage. In the Great Lakes, however, sewage may comprise 40% of the source of phosphorus entering a lake.

Even in this situation, where a detergent phosphate ban would have a much better chance of improving water quality, no improvement has been seen which relates to the banning of phosphate detergents. Claims were made by proponents during the House hearings that such bans have led to decreased eutrophication, but this is not the case.

No documented scientific studies have been done to support such claims. In contrast, documented studies have been done in the states of New York by Cornell University, Indiana by Purdue University, and Minnesota by Biocentrics Labs. In each of these states, results showed no improvement of eutrophication problems by detergent phosphate bans, and in fact a worsening of the condition has been observed in some of the lakes. The improvement claimed is from sewage treatment, not phosphate bans.

An important point is the role of chemical treatment in the removal of phosphates at sewage treatment plants. This has been shown in Great Lakes' states to be highly effective, removing more than 90% of the sewage phosphorus, as opposed to the maximum 35% reduction that can be expected with a detergent phosphate ban. In my tenure at Ohio EPA, I became strongly convinced that in areas where a need existed to control sewage phosphorus, chemical treatment was the answer. Additionally, the cost of such treatment has been overestimated by proponents of the ban. Where treatment is required, the cost for removal of detergent phosphorus is about $1.80 per household per year.

I would like to correct a few other erroneous statements made by the proponents of the bill so that your decision will be based on accurate information. First, the states of Maine, Connecticut, Illinois, Pennsylvania, and Ohio have not enacted detergent phosphate bans. Second, Canada does not have a ban. Detergent phosphorus concentrations are limited to a maximum of 2.2% by weight.

Additionally, improvements in Canadian water quality have been shown to be the result of wastewater treatment programs, not a reduction in detergent phosphates.

Finally, it was mentioned that Lake Onondaga in New York has undergone a dramatic improvement in water quality since a detergent phosphate ban was instituted. In reality, this lake did not have a phosphorus problem, it had a severe pollution problem. A salt-mining operation in the area had caused the lake to become brackish. A chemical plant was discharging waste directly into the lake, and in addition, the Syracuse Metropolitan Sewage Treatment Plant was discharging only partially treated or untreated sewage into the waters. Corrective measures have been made to prevent the industrial and mining pollution and upgrade sewage treatment. This is resulting in improvement of water quality, not a detergent phosphate ban.

I would feel remiss as an engineer and former regulator of Environmental quality if I didn't comment on some of the statements which were made during the House hearings regarding septic tank contributions of phosphorus. It has been clearly documented in scientific studies that properly installed septic tank systems will not contribute any significant amount of phosphorus to surface waters. This is due to the rapid binding of phosphorus by soil particles. If phosphorus is being transferred to surface waters from such systems, it indicates a much more severe pollution problem exists, that being the passage of microorganisms from human wastes into the water.

So, if systems are inadequate, it is far more important to control these pollution problems than simply reduce the small amount of phosphorus that may be transferred to waters. This is a human health problem, not a fish life problem.

In conclusion, I feel it is important to direct our energies and resources to control measures which have a realistic probability of improving the quality of our environment. If we channel our efforts elsewhere, tending not to focus on the real solutions, we make no progress towards our goals. I cannot identify a positive benefit which would be achieved by a detergent phosphate ban in your state, but could relate to experience I have had in the Midwest where similar actions have resulted in a loss of concentration on meaningful control measures. This is an important pitfall to avoid, if those of us concerned with the quality of our environment are to realize significant progress in meeting our objectives.

I hope my comments will be useful to you in making your decision, and would be happy to address any questions which you may have.

NAME: ______ DATE: ______

ADDRESS: ______

PHONE: ______

REPRESENTING WHOM? ______

APPEARING ON WHICH PROPOSAL: ______

DO YOU: SUPPORT? ______ AMEND? ______ OPPOSE? ______

COMMENTS: of

opposition

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

NAME: Sally E. Weiss DATE: 3/15/79

ADDRESS: 67 Franklin Mine Rd.

PHONE: 443-3433, 442-6300

REPRESENTING WHOM? Columbia Chemical Co., Inc.

APPEARING ON WHICH PROPOSAL: H.B. 414

DO YOU: SUPPORT? ______ AMEND? ______ OPPOSE? ✓

COMMENTS: We oppose passage of this legislation because we feel it would be detrimental to the majority of people in the state without providing any of the benefits anticipated.

I would like to present oral testimony.

SEW.

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

NAME: J. L. [illegible] DATE: [illegible]

ADDRESS: [illegible]

PHONE: [illegible]

REPRESENTING WHOM? [illegible]

APPEARING ON WHICH PROPOSAL: [illegible]

DO YOU: SUPPORT? ________ AMEND? ________ OPPOSE? ✓

COMMENTS: ______________________________

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

Dist. by Mr. Addy

Facts About Home Laundering In Montana

The purpose of this paper is to review, emphasize and explain the reasons why the proposed ban on phosphate in laundry detergents would inflict a real and needlessly costly hardship on the people of Montana.

The Impact of the Montana Economy

A major segment of the work force of Montana is involved with work which results in difficult laundering problems. A quick review of the major industries vital to the economy of the State demonstrates this fact. It also emphasizes the point that a law which would reduce the performance of laundry detergents would be a disservice to Montana residents primarily responsible for the State's economic vitality.

Major Industries (Figure 1) (Reference 1)

Agriculture accounts for more than half of the value of goods produced annually in Montana. The agricultural industry in the State is composed of two major segments:

- Crop production with hard winter wheat of primary importance and hay a close second. Sugar beets, beans, corn, oats, barley and potatoes are also important. Both the valley regions of the mountains and the plains are productive crop-wise.
- Livestock production includes not only the predominant cattle for beef and sheep for wool but dairy cattle and hogs which are also important to the State's economy.

Forestry represents one of the fastest growing areas of economic activity.

Mining is carried out in almost every county in the State and accounts for about one-fifth of the value of goods produced.

Manufacturing provides more than one-fourth of the value of Montana's products. Largely this is devoted to the processing, refining, or fabricating of the products of Montana's own farms, forests and mines.

This says something about the people of Montana. They surely are an industrious lot, and not afraid of hard work. To be specific, here are some statistics on Montana's working people:

Types of Work Done by Montana People (Figure 2) (Reference 2)

According to the latest census data (1975), this is how the Montana population breaks out by type of employment:

Types of Workers	Number of Workers: Male (14 years and older)	Number of Workers: Female (14 years and older)	Total	%	
	229,000	163,000	392,000		
White Collar	74,000	91,000	165,000	42%	
Blue Collar	96,000	11,000	107,000	27%	58%
Service	20,000	51,000	71,000	18%	
Farm	40,000	9,000	49,000	13%	

Another way of saying this is that 58% of the people of Montana are employed in jobs involving hard, physical, dirty work. This in turn translates into dirty clothes. Let's look at a few examples:

<u>Farmers</u> - one can't work a back yard garden without getting dirty - let alone plowing, planting and harvesting crops from a 2000 acre farm in the dusty plains.

<u>Ranchers</u> - managing cattle and sheep roving over thousands of acres is not easy. While the work entailed in handling these animals may be romanticized in fiction, in fact it is rigorous and dirt producing.

<u>Miners</u> - wresting ore, any ore, from the ground would scarcely qualify as a clean occupation. The work clothes will be permeated with a variety of earthy types of dirt with coal dust being among the worst.

These and many of the other occupations will generate high levels of particulate dirt that will become embedded or ground into fabrics. Beyond the dirt associated with the various jobs, the level of ground in body soil will be high as a result of physical exertion. This means that the task of laundering in Montana under the best of conditions will not be easy for many of the people. <u>Any deficiencies in the laundry detergent used (reduced cleaning performance, poor soil suspension) will not only add to the burden but will be readily recognized by these Montana people.</u>

<u>Montana Water Hardness</u> (Figure 3) (Reference 3)

Compounding the problems of laundering is the fact that Montana is a hard water state. The presence of minerals, primarily calcium and magnesium, in water constitutes water hardness.

Figure 3 shows the precent of people in Montana having soft, moderately hard, hard and very hard water.

Water Hardness Ranges As defined in U.S. Geological Surveys, U.S. Department of Interior		Water Hardness Distribution By % Population on Public Water Supplies (419,535 people)	
Soft Water	(0-3.5GPG; 0-60PPM)	10%	
Moderately Hard Water	(3.6-7.0GPG; 61-120PPM)	21%	
Hard Water	(7.1-10.5GPG; 121-180PPM)	41%	69%
Very Hard Water	(Over 10.5GPG; Over 180PPM)	28%	

Of the remaining 45% of the population, many will likely be using well water, much of which will probably be quite hard. Thus the 69% figure representing the population having hard or very hard water is very likely a conservative figure.

<u>Hard water impedes detergent products in doing their work of removing dirt and holding that dirt in the wash water so that it will not settle back on the clothes. The harder the water the more difficult these tasks become.</u> However, detergents differ in their ability to handle water hardness and soil, so let's now turn our attention to the detergents themselves and how they work.

<u>Detergents and How They Work</u> (References 4 and 5)

While a laundry detergent has several important ingredients, each included to improve some aspect of overall performance, the two major ingredients common to most laundry detergents are the surfactant and the builder.

Surfactants (Figure 4, What Surfactants Do)

The surfactant or surface active agent is the primary cleaning ingredient. Its functions are to:

- Make water wetter and go to work faster
- Loosen and remove dirt - with the help of the washing action
- Hold removed dirt in the wash water - with help from the builder

The most effective surfactants are inhibited by water hardness minerals in performing some of these functions, hence the need for help from an ingredient known as the builder.

Builders (Figure 5, What Builders Do) (References 4,5,6)

The primary function of a builder is to soften water, but it is too simplistic to stop the definition here or to imply that all builders perform in the same manner. There are non-precipitating builders which sequester or tie-up hardness minerals in soluble form and there are precipitating builders which combine with hardness minerals to form insoluble residues. These insoluble residues cause serious problems both in terms of limiting cleaning ability and causing damage to fabrics and washing machines.

The Benefits of Phosphate

Phosphate is a superior sequestering or non-precipitating builder, thus it ties up calcium, magnesium, and other minerals and holds them in solution thereby avoiding undersirable deposits. It also:

- Increases surfactant efficiency
- Contributes to good cleaning for clay, mud, dust, body soils and stains
- Has good soil suspending ability
- Provides a free flowing, easy to dissolve product.

The soil removal capabilities of the phosphate formulas have not been matched by any of the non-phosphate laundry detergents presently being offered for sale. The deficiencies of the non-phosphate products in cleaning will be evident on body soils, such as mud, clay or dust and in the removal of many stains commonly found in the home laundry.

Compounding the cleaning inadequacies will be the lesser ability of all of such non-phosphate laundry detergents to suspend removed soil in the washing solution. This results in increased redeposition of soil on fabrics which leads to fabric discoloration -- the greying of whites, the dinginess of colors.

What is the alternative to phosphate? Carbonate!

Carbonate and Its Limitations

Sodium carbonate has been the primary replacement builder because of its availability and feasibility from a cost standpoint. However, it has serious drawbacks:

- Softens water by precipitating the hardness minerals

- Forms harsh, insoluble limestone residue
- Has limited cleaning ability
- Has poor soil suspending ability
- Causes finished product to cake, lump and dissolve slowly

Problems Created by Carbonate (Figure 6) (References 4,5,6,7,8,9a & b, 10a & b, 11,12,13)

Deposits of insoluble precipitates create problems for both automatic washers and for fabrics.

In automatic washers calcium carbonate can build-up in the pump, in hoses, around perforations in the wash basket, and in the collector tub. In time this can cause machines to malfunction. In fact it has already done so in phosphate ban areas.

On fabrics the build-up of precipitates:

- Masks colors causing the fabrics to look faded
- Makes the fabrics feel stiff and scratchy
- Makes sewing threads in elastic waist bands or sock tops brittle causing them to break
- Makes zippers and grippers hard to operate
- Speeds up abrasion of shirt collars, trouser creases, edges, hems, cuffs, etc., causing items to wear out faster

Up to now considerable emphasis has been placed on the relative performance of these builders in hard water. However, it should be stressed that sodium tripolyphosphate offers very real benefits in soil removal and suspension in soft water.

Figure 7 illustrates the relative ability of the various builders mentioned to remove particulate soils by themselves (no surfactant present) in soft water. Notice that sodium tripolyphosphate surpasses all of the others on the three fabric types tested: polyester/cotton blend, a 100% cotton and a 100% polyester, all of similar fabric construction.

Unbuilt Laundry Liquid Detergents

In any discussion of detergents it should be noted that some liquid laundry detergents do not contain a builder. Instead, they rely on the surfactant system to do the whole job. Logically, a high level of surfactant is used in these products. Generally these products offer particular benefits in removal of oily/greasy soils. They will not do as good a job of removing particulate and body soils, nor of holding them in the wash solution. And remember, particulate and body soils will be a major problem for many people in Montana.

Consumer Recognition of Problems (References 7,8, 10a)

The problems associated with non-phosphate detergents that have been pointed out here are real. They have happened in the laboratory and in people's homes in Indiana; New York State; Minnesota; Dade County, Florida; Chicago, Illinois or wherever phosphate bans have been enacted. We know this because people voluntarily communicate their problems to detergent manufacturers.

For example, let's contrast consumer complaints received by one major detergent manufacturer for all granular laundry products from Minnesota (the nearest state to Montana to enact a ban and one that is reasonably similar in many ways) for 1977, the year after the ban went into effect versus 1976 when there was no ban. In 1977 total consumer complaints were two and one half times higher than in the preceding year. In 1978 complaints tripled in contrast to 1976. In other words the complaints continue to rise.

Further evidence of this perception of negative detergent performance by consumers is found in the results of a survey done by an independent research firm in the State of Indiana. The 1975 survey was conducted across five major cities among 1500 women selected at random. Results showed that 5% of all respondents purchased detergents outside the State. Important to consider, is that 3½ years after the phosphate ban became effective, many residents in the State accepted this inconvenience and the fact that they were violating the intent of the law to obtain a phosphate-containing detergent.

<u>Consumer Adjustments to Non-Phosphate Detergents</u> (Figure 8) (References 6,8,15,16)

Consumers must and do adjust the way they normally do laundry to compensate for the lower overall performance of non-phosphate products. The reduced cleaning, increased redeposition of soil and deposition of insoluble residues will necessitate one or more of the following corrective measures:

- Increased use of laundry detergents
- Increased use of such laundering aids as packaged water softeners, pretreating products, presoak or detergent booster products, bleaches, fabric softeners
- Pretreatment of more items
- Presoaking of clothes
- Rewashing of clothes not satisfactorily cleaned
- Extra rinsing in an attempt to remove residues
- Special treatments such as a vinegar rinse to remove residues (involving risk of damaging porcelain tubs)
- Installation of household water softening system
- Increased rate of replacement of washable garments
- Increased rate of repair and/or replacement of the washing machine

<u>All of these adjustments cost consumers money.</u>

<u>Total Cost Per Montana Household – $55.13</u> (References 9a & b, 10b, 12, 13, 15, 16)

The "bottom line" figure given above ($55.13) is the estimated cost per family per year of a detergent phosphate ban in Montana. The factors that comprise this total figure are:

- Increased cost of cleaning products – $4.78. The cost listed here, $4.78, represents about a 10% increase in a family's annual cleaning products budget. It is based on market surveys of product purchases in demographically similar phosphate ban and non-ban areas.
- Shortened wear life of washable clothing – $34.15. This figure is based on laboratory studies which have measured decrease in wear life using carbonate-

based detergents and U.S. Government figures on the average annual dollars spent by households for clothing.

- Increased washing machine service calls - $2.45
- Washing machine parts replacement costs -- $13.75. Service and replacement costs are based on actual service call records of two major washer manufacturers.

Review of all important factors in the State of Montana indicate that a detergent phosphate ban will lead to poor detergent performance and exorbitant consumer costs. Based on the current number of estimated households in Montana, a detergent phosphate ban would cost this State's residents fourteen and a half million dollars annually, a high price to pay unless definite rewards can be justified by fact, not wishful thinking.

Circulated by:

Jerome Anderson
Kelly Addy
Barry Hjort
Chad Smith

Lobbyists for:

The Soap and Detergent Association
Monsanto

In opposition to HB 414.

Reference Documents

1. Data source for Montana industries; World Book Encyclopedia.

2. Data source on Montana workers; 1975 census data, Bureau of Census, U.S. Department of Commerce (latest available data issued July 1978).

3. Water hardness data source; "Chemical Analysis of Municipal Water Supplies", Water Quality Bureau, Montana Department of Health and Environmental Sciences.

   Population data source; Census data updated in several instances to 1975 as published in the Rand McNally Atlas.

4. B. J. Rutkowsky, Senior Research Chemist (Whirlpool Corp.) "Performance characteristics of Currently Available Laundry Detergents". Whirlpool research as presented in testimony March 15, 1978, to the Energy and Environment Committee, Ohio House of Representatives and at hearing of the Michigan Department of Natural Resources, Lansing, Michigan, December 8, 1976.

5. A. Lyng (Procter & Gamble Co.) testimony presented at a hearing of the Minnesota Pollution Control Agency, Roseville, Minnesota, February 13, 1975, and for the Vermont House of Representatives' Natural Resources Committee, July 1, 1975).

6. Dr. M. E. Purchase (Cornell University), testimony for the Conservation Committee, Vermont House of Representatives, regarding H.492, February 10, 1976.

7. Dr. M. E. Purchase (Cornell University), letter to H. A. Tanner, Michigan Department of Natural Resources, December 1, 1976.

8. J. Schrage (Whirlpool Corp.) "Powdered Non-phosphate Detergents, Major Effects on the Consumer", testimony presented March 15, 1978 to the Energy and Environment Committee, Ohio House of Representatives.

9a. General Electric Company research report, "Carbonate Detergents and Their Effect Upon Clothing and Home Laundry Equipment."

b. R. Schuck (General Electric Co.), testimony for Public Hearing on HB882 Regarding Phosphate Ban in the State of Ohio, presented to Energy and Environment Committee, Ohio House of Representatives, March 13, 1978.

10a. A. Olson (Speed Queen), Consumer Problems with Non-phosphate Detergents, testimony presented at a hearing of the Minnesota Pollution Control Agency, Roseville, Minnesota, February 13, 1975.

b. D. M. Schultz (Speed Queen), testimony presented February 28, 1978 to the Committee on Natural Resources and Tourism, Wisconsin Senate.

11. M. Ross (Frigidaire), testimony presented to Energy & Environment Committee, Ohio House of Representatives, March 15, 1978.

12. M. A. Morris and H. H. Prato (University of California, Davis), Fabric Damage During Laundering, California Agriculture, 30 (12), 9, 1978, also Edge Abrasion of Durable Press Cotton Fabric During Laundering with Phosphate and Carbonate Built Detergents, Textile Research Journal, pgs. 395-401, May, 1975.

13. K. A. Jansen (University of Wisconsin), Effect of Detergent Type on Wear Life of an Apparel Item Varying by Fiber Content, doctoral dissertation, School of Family Resources and Consumer Sciences, University of Wisconsin, Madison, Wisconsin, 1975.

14. W. Olson (Agricultural Extension Service, University of Minnesota), Using Non-phosphate Detergents in Machine Laundry, Fact Sheet, Home Economics Family Living, No. 38-1976.

15. Homemaker Testing Corporation, Cost of Home Laundry, Phosphate vs. Non-phosphate Detergent in Kansas City, Kansas and Indianapolis, Indiana, October, 1976.

16. Walker Research, Inc., Phosphate Detergents Ban Effect on Indiana House-wives, 1976. Summary prepared by H. S. Wilcox, Inc. 1976.

FIGURE 1

Major Montana Industries

- Agriculture
  - Crop production
  - Livestock
- Forestry
- Mining
- Manufacturing
  - Processing of Montana's raw materials

FIGURE 2

Types of Work Done by Montana People

Types of Workers	Number of Workers (14 years and older) Male	Female	Total	%	
	229,000	163,000	392,000		
White Collar	74,000	91,000	165,000	42%	
Blue Collar	96,000	11,000	107,000	27%	58%
Service	20,000	51,000	71,000	18%	
Farm	40,000	9,000	49,000	13%	

Source:
Bureau of Census, U.S. Department of Commerce, 1975

FIGURE 3

Montana Water Hardness Distribution

	Water Hardness Ranges As defined in U.S. Geological Surveys, U.S. Department of Interior	Water Hardness Distribution By % Population on Public Water supplies (419,535 people) *	
Soft Water	(0-3.5GPG;0-60PPM)	10%	
Moderately Hard Water	(3.6-7.OGPG;61-120PPM)	21%	
Hard Water	(7.1-10.5GPG;121-180PPM)	41%	69%
Very hard Water	(Over 10.5GPG;Over 180PPM)	28%	

* Data covers 162 communities constituting 55% of total Montana population. Estimated population for 1978 - 763,800

Source:

Water Hardness Data: Chemical Analysis of Municipal Water Supplies
Water Quality Bureau
Montana Department of Health and Environmental Sciences

Population Data: Census Data updated to 1975; Rand McNally Atlas

FIGURE 4

What Surfactants Do

- Make Water Wetter
- Loosen and remove dirt with help of the washing action
- Hold removed dirt in the wash water - with help of builder

FIGURE 5

What Builders Do

Phosphate	Carbonate
• Softens water by sequestering No residues form	• Softens water by precipitating Forms harsh, insoluble limestone residue
• Good cleaning ability for clay, mud, dust, body soil, stains	• Limited cleaning ability for clay, mud, dust, body soil, stains
• Good soil suspending ability	• Poor soil suspending ability
• Provides free flowing, easy dissolving product	• Causes product to cake, lump, dissolve slowly

FIGURE 6

Problems Caused by Carbonate

In Automatic Washers

- Builds up in

  Pumps
  Hoses
  Under the agitator
  In wash basket
  In collector tub

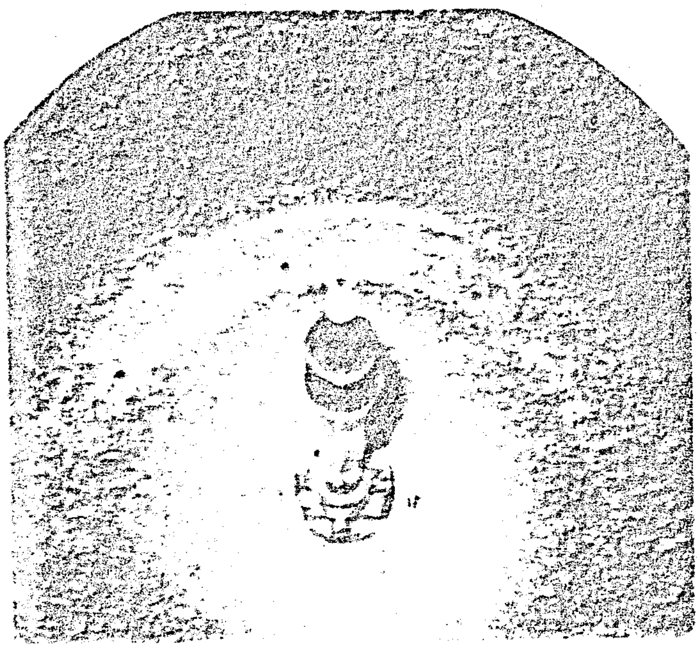
- Causes parts to fail faster
- Increases service calls

On Fabrics

- Masks colors - Makes fabrics look faded
- Makes fabrics stiff and scratchy
- Makes sewing threads in elastic areas brittle-break easily
- Makes zippers and grippers hard to operate
- Makes garments wear out faster; Speeds up abrasion on creases, edges, hems, collar points, cuffs

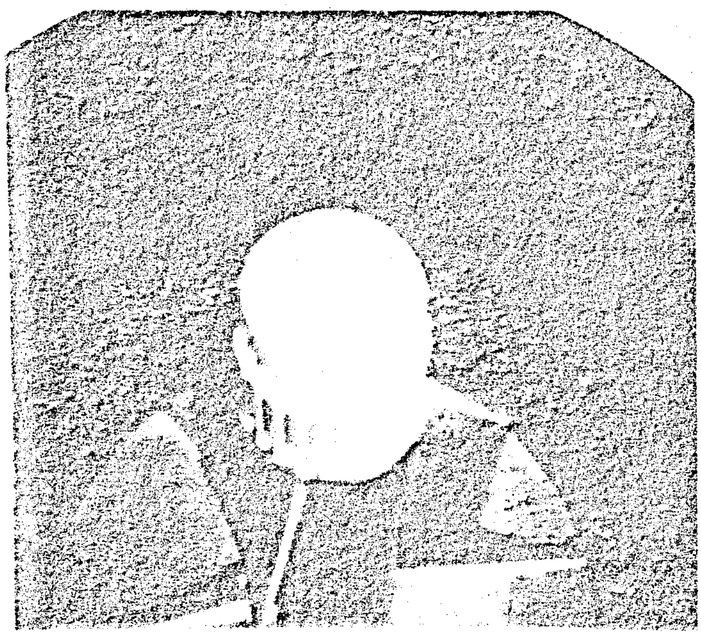
PHOSPHATE DETERGENT EFFECT ON WASHING MACHINE PARTS

(AFTER 5 YEARS' TOTAL SERVICE)

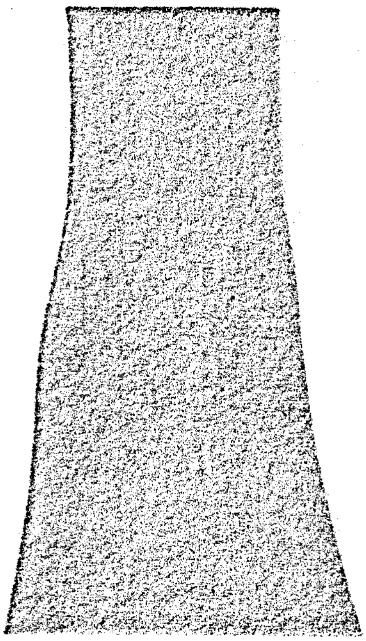


Tub

Phosphate builder forms soluble complexes with mineral hardness in the washing process which are removed with the wash water leaving the washing machine parts unaffected.



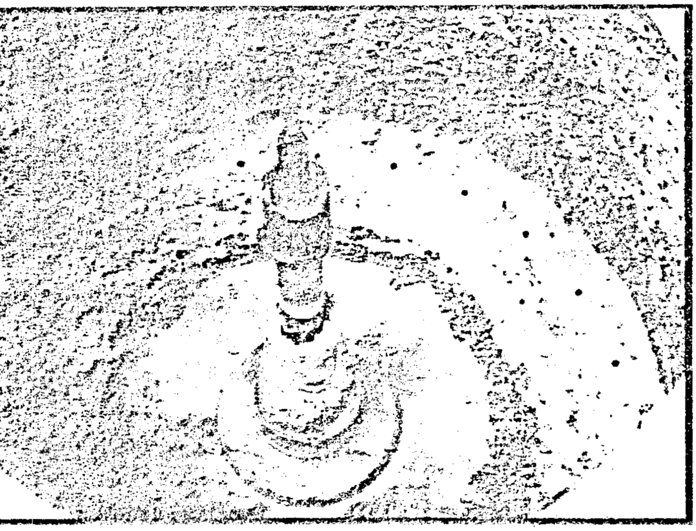
Tub



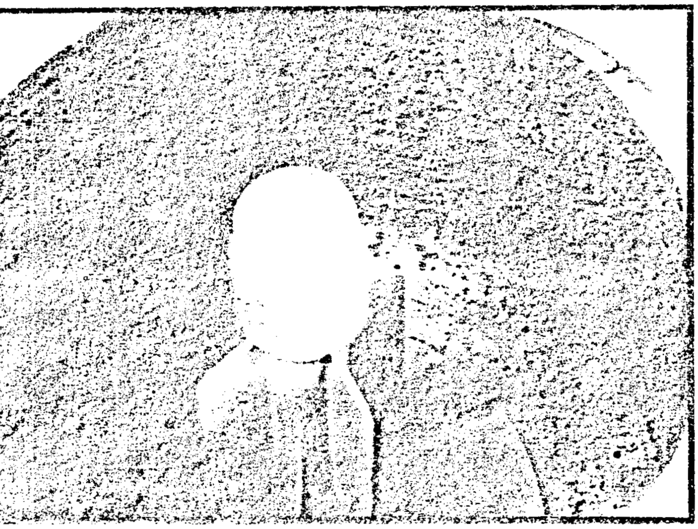
Hose

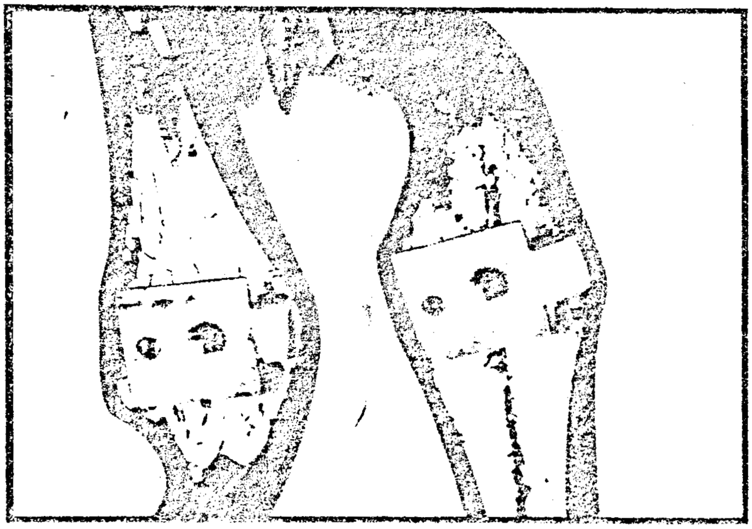
0% P DETERGENT CARBONATE PRECIPITATION ON WASHING MACHINE PARTS

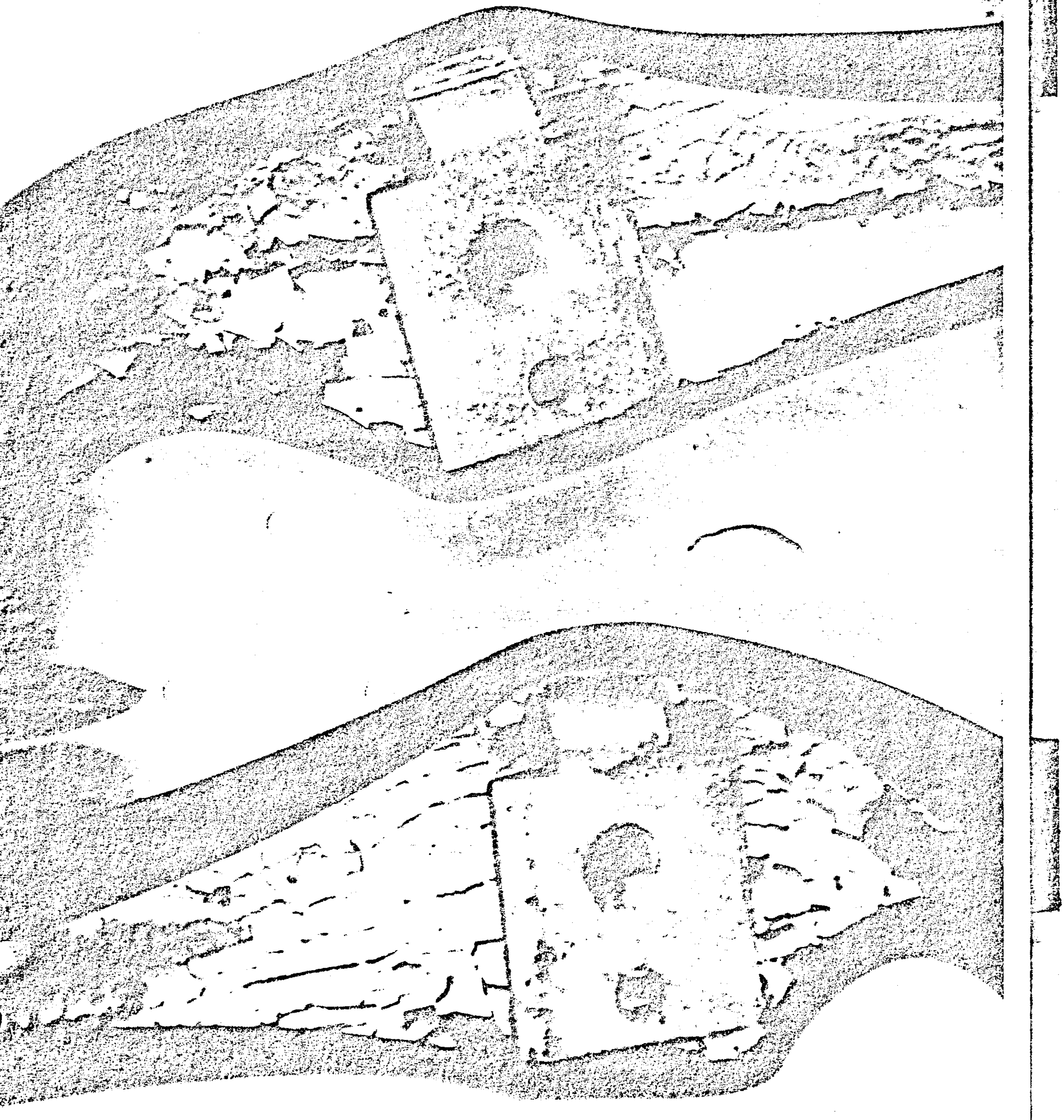
(After 4½ years' total service;
2 years with 0% P detergents.)

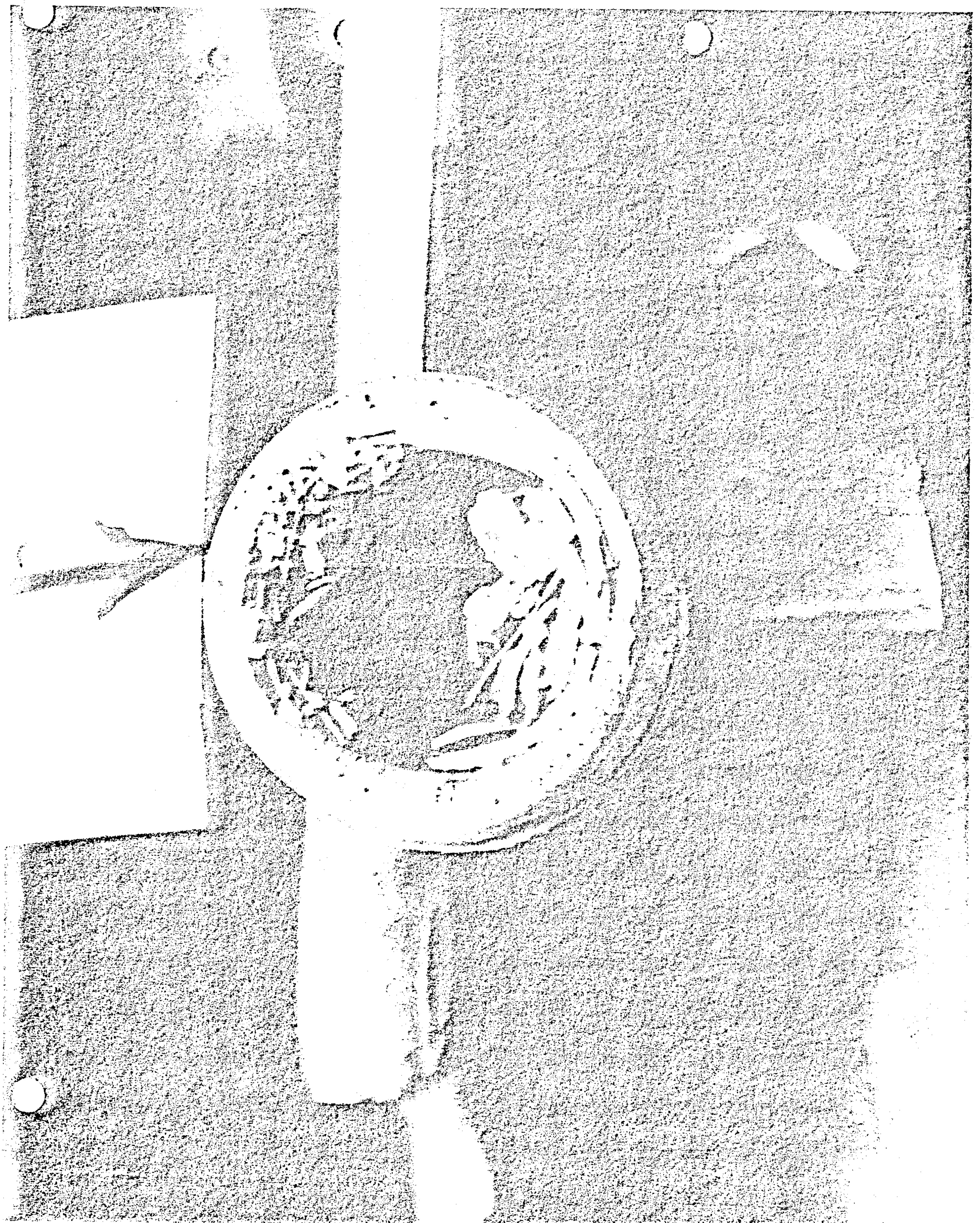


Carbonate has been the primary replacement builder for phosphate in phosphate ban areas. This builder forms insoluble particles with mineral hardness in the washing process -- which in turn deposits on clothes and washing machine parts (agitators, hoses, pumps, pipes, etc.). As a result, machine service calls have been 10% higher in zero-phosphate ban areas compared with non-legislated areas (based on 1976 G.E. summary).



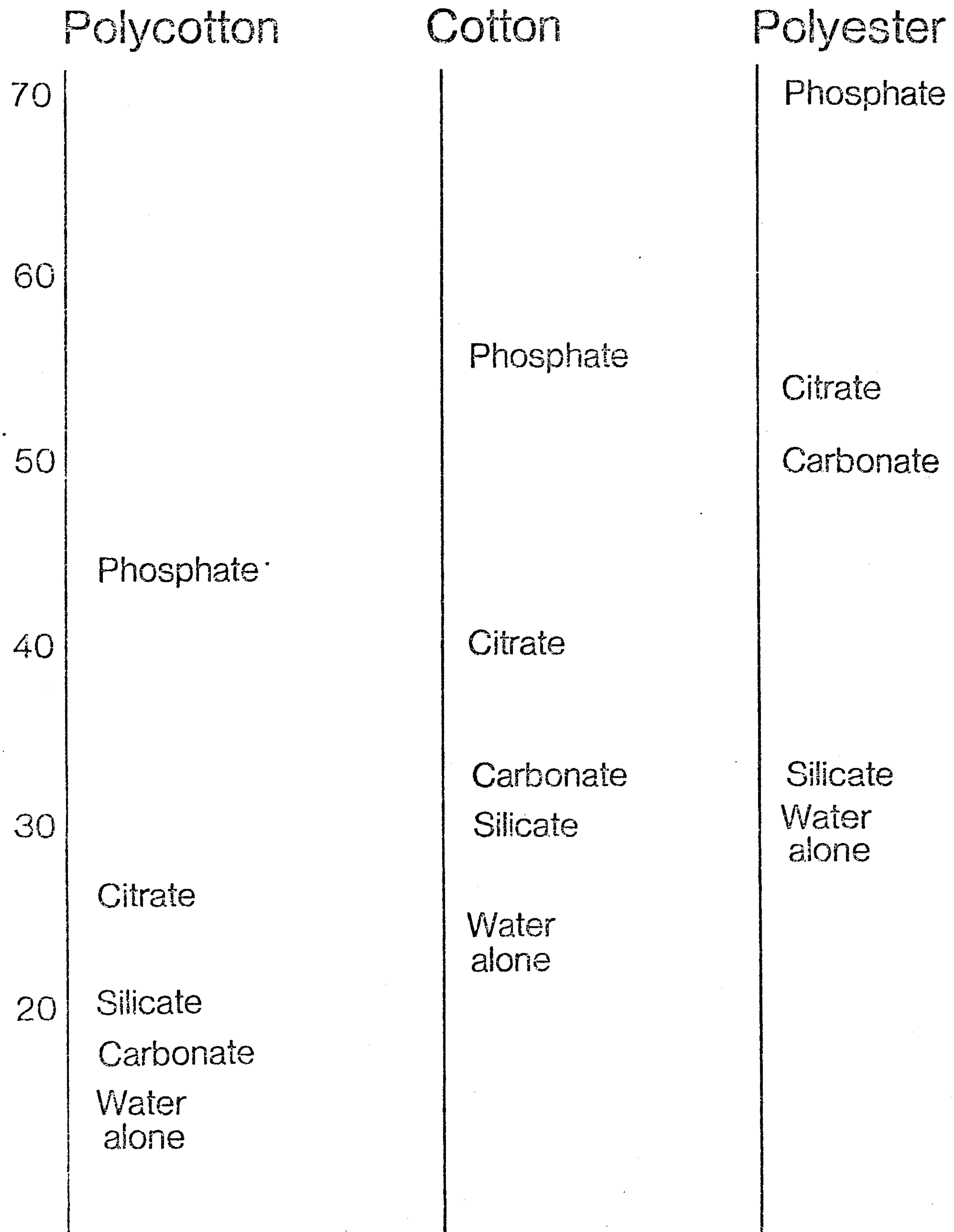






Particulate Soil Removal by Free Builders

100°F, no hardness present, 300 ppm. builder concentration (the level present at recommended usage of a 6.1% P detergent).



FIGU... 8

Consumer Adjustments to Non-Phosphate Detergents

- Increased use of laundry detergents
- Increased use of such laundering aids as packaged water softeners, pretreating products, presoak or detergent booster products, bleaches, fabric softeners
- Pretreatment of more items
- Presoaking of clothes
- Rewashing of clothes not satisfactorily cleaned
- Extra rinsing in an attempt to remove residues
- Special treatments such as a vinegar rinse to remove residues (involving risk of damaging

FIGURE 9

Annual Consumer Costs

Increased cost of cleaning products	4.78
Shortened wear life of washable clothes	34.15
Increased washing machine service calls	2.45
Washing machine parts replacement	13.75
Total cost per family per year	$55.13
Total annual cost to all Montana families	$14,500,000

NAME: Eric Weiss DATE: 3/15/[illegible]

ADDRESS: 67 Franklin Mine Rd

PHONE: 443-3433

REPRESENTING WHOM? Myself

APPEARING ON WHICH PROPOSAL: HB 414

DO YOU: SUPPORT? ______ AMEND? ______ OPPOSE? X

COMMENTS: I am oppo[illegible]

to [illegible]

rep[illegible]

da[illegible] than [illegible]

I would like to present [illegible]

testi[illegible]

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

NAME: R. V. Ulman DATE: 03-15-79

ADDRESS: 3480 Hannibal

PHONE: 494-4596

REPRESENTING WHOM? Stauffer Chemical Company

APPEARING ON WHICH PROPOSAL: HR 414

DO YOU: SUPPORT? ______ AMEND? ______ OPPOSE? X

COMMENTS: ____________________

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

INDUSTRIAL CHEMICAL DIVISION

Stauffer Chemical Company

P. O. Box 3146 / Butte, Montana 59701 / Phone (406) 792-1215

My name is Ray Tilman, I am the Plant Manager for Stauffer Chemical Company's Silver Bow Plant just West of Butte. I am here today to testify against House Bill 414 which would ban the use of phosphates in the detergents in Montana. I think expert testimony here has indicated, at the present time, there is not a good need to ban the use of phosphates in detergents. However, I would like to let you, this Senate Committee, hear our thoughts as to what this type of a bill may do to employment in the State of Montana. As you are probably aware, Stauffer's Silver Bow Plant produces elemental phosphorus, which is one of the ingredients used in producing tripolyphosphate, which makes up a big portion of detergents used in the household. Elemental phosphorus is also produced by our competitors to the South, both Monsanto and FMC in Pocatello, Idaho. These two companies are the major producers of sodium tripolyphosphate, which ends up in detergents. These two producers also have a competitive edge over Stauffer's Silver Bow Plant in the production of elemental phosphorus. Therefore, they can stay in the sodium tripolyphosphate business because of this competitive edge.

If such a bill as House Bill 414 is passed, that will take a certain number of tons of elemental phosphorus production out of the market place. The companies, such as FMC and Monsanto in Southern Idaho, will then look to other areas to compete with their phosphorus. This type of competition will cut down on the amount of available market for Stauffer's Silver Bow Plant elemental phosphorus. How many tons, ultimately, this might lead to depends on how many tons of marketable elemental phosphorus that FMC and Monsanto will take out of the tripoly business and put into other lucrative areas. Ultimately, this loss of elemental phosphorus production would lead to an economic disadvantage to Stauffer's Silver Bow Plant and would cut down on our tonnage produced every year. If this number became large enough we would, sooner or later, have to shutdown at least one elemental furnace operation. This cutback in production would lead to a layoff of people in the Silver Bow area. This layoff could amount to as much as approximately 80 to 100 people, with a very significant impact on the already depressed economy of the Butte-Silver Bow area.

At this time I would, therefore, very strongly urge that you, the Senators of this Senate Committee, ask that the Senate does not pass House Bill 414 in an effort to help preserve jobs in the Butte-Silver Bow area.

Thank you very much for your time.

NAME: J. E. Bremer DATE: 15 Mar 79

ADDRESS: 5 Tyson Lane Rumson N.J.

PHONE: 201-842-1606

REPRESENTING WHOM? The Soap & Detergent Assoc.

APPEARING ON WHICH PROPOSAL: HB 714

DO YOU: SUPPORT? ______ AMEND? ______ OPPOSE? X

COMMENTS: ______

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

NAME: [illegible] DATE: [illegible]

ADDRESS: [illegible]

PHONE: (616) [illegible]

REPRESENTING WHOM? Whirlpool Corporation

APPEARING ON WHICH PROPOSAL: HB 414

DO YOU: SUPPORT? ______ AMEND? ______ OPPOSE? X

COMMENTS: I would like to make comments [illegible]

[illegible]

[illegible]

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

NON-PHOSPHATE DETERGENTS:

MAJOR EFFECTS ON THE CONSUMER

Joy Schrage
Manager, Customer
Assurance Home Economics
Whirlpool Corporation
Benton Harbor, Michigan
March 15, 1979

NON-PHOSPHATE DETERGENTS:

MAJOR EFFECTS ON THE CONSUMER

My name is Joy Schrage. I am Manager of Customer Assurance Home Economics at Whirlpool Corporation in Benton Harbor, Michigan. I am here today to outline for you some of the effects a laundry detergent phosphate ban has on consumers.

During the past 20 years, I have worked as a home economist in education, Cooperative Extension Service, manufacturing, utility home service, laundry research and industry consumer affairs. In all of these professional positions, it has been my job to communicate with consumers and represent their interests to my employers.

At Whirlpool Corporation, it is my job to represent consumers and provide information on their problems, wants and needs to all other company departments. We are vitally concerned about the impact of this proposed phosphate regulation on consumers in Montana.

Based on our research at Whirlpool Corporation and our contact with consumers, educators and the textile industry, this is a general summary of consumer problems encountered with non-phosphate detergents:

1. Consumers report poorer washability than with phosphate-containing detergents. Satisfactory washing can only be achieved with special pre-treatment and if water is hard, by using an installed water softener. Our detergent chemists have analyzed and evaluated liquid, no-phosphate laundry detergents and have found them to be poorer in washing performance and higher in cost per wash than currently available low phosphate powdered detergents.

2. Consumers report higher costs for home laundry with all non-phosphate detergents because of the need to use special pre-treatment products, additional laundry additives, water softeners or conditioners, increased water usage and extra energy needed for rewashing or use of extra washer cycles (such as pre-soak or pre-wash).

3. Consumer and laboratory reports show very poor solubility of powdered, carbonate non-phosphate detergents in cold water (temperatures lower than 70°F). Consumers who want to use cooler water temperatures for washing must change their laundry practices and use liquid detergents. Current usage of detergents is about 80% powdered and 20% liquid.

4. Consumers complain of poor rinsing of detergents from textiles in harder water (above 4 grains per gallon) resulting in potential skin irritations. Clothes feel stiff, harsh and have a powdery residue. Water samples sent in to us from Montana consumers have ranged from about 10 grains to 18 grains hardness.

5. In 1975, no-phosphate detergent problems were 24.3% of our total customer washability problems. In 1978 this percentage increased to 52.5% of customer washability problems. While the total number of washability problems has increased only slightly since 1975, the percentage of washability problems directly attributable to no-phosphate detergent usage has more than doubled.

Some of the known effects which Montana consumers can expect from non-phosphate laundry detergents include:

1. Powdered carbonate non-phosphate detergent residue on flame retardant cotton fabrics can render them flammable. Many families will have cotton flame retardant childrens' sleepwear in their laundry baskets. Safety hazards to young children, caused by conflicting legislation, are difficult to justify when based on known water research. Limestone-type residues on fabrics can be avoided if the homemaker will change her practices to use one of the citrate liquids.

2. Powdered carbonate non-phosphate detergent residues on textiles and surfaces of automatic washer components can result in abrasion, damage and early wear out of fabrics. Costs to the consumer in hard water areas can be extremely high. Textile manufacturers and retailers report cutting of sewing threads, especailly in elasticized areas, as well as build-up of deposits on seams and fabric surface, causing apparent color change and abrasion of garments. Reduced wear life to textiles in hard water areas has been reported in the literature to be 15-20%. This can be a high cost to consumers, especially those with large families.

3. I have samples of damaged machine parts, as well as clothing samples from homes of Whirlpool consumers who were using non-phosphate detergents. The cost to replace washer parts which fail most frequently from calcium carbonate build-up (filters and pumps and in very hard water, agitators and baskets) falls in a range of $35-59. Throughout the U.S., this cost has occurred with consumers who provided the failed parts within 1 to 4 years of use for their automatic washers.

4. Most appliance manufacturers do not have detailed service data on appliances after the warranty period. However, based on reports from our engineering tests and our field service organization, increased service costs can be expected to occur after the warranty period, with the consumer paying the costs. An average service call for major home appliances in the U.S. is $28.00, plus the cost of parts. In very hard water areas (such as 30+ grains per gallon in Indiana) where the customer uses only carbonate non-phosphate detergents, this could mean increased annual service costs for coated agitators and baskets and clogged filters and pumps.

The performance, safety and added cost aspects of non-phosphate detergents are strong consumer negatives which should be carefully weighed in any proposal to ban phosphorous in laundry detergents.

To summarize our concerns, these are the factors which many consumers will face if phosphorous in laundry detergents is banned:

1. More energy required for the same kind of washing results seen with phosphate detergents.

2. Added cost to the consumer.

3. More potential service calls where water is hard.

4. Clothing may have to be replaced sooner.

5. Added economic hardship on those least able to afford it.

Thank you.

# # #

NAME: Hayden Ferguson DATE: 3/15/79

ADDRESS: 1618 Alder Ct, Bozeman MT

PHONE:

REPRESENTING WHOM? Self

APPEARING ON WHICH PROPOSAL: HB-414

DO YOU: SUPPORT? ____ AMEND? ____ OPPOSE? ✓

COMMENTS: Relates to Restrictions on [illegible] and septic tank systems

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

NAME: ______________________________ DATE: ______________

ADDRESS: ____

PHONE: ____

REPRESENTING WHOM? ____________________________________

APPEARING ON WHICH PROPOSAL: ___________________________

DO YOU: SUPPORT? ________ AMEND? __________ OPPOSE? __________

COMMENTS: ____

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

NAME: LLOYD BERG DATE: 3-15-79

ADDRESS: 1314 S. 3rd BOZEMAN, MT.

PHONE: 586-5706

REPRESENTING WHOM? Myself

APPEARING ON WHICH PROPOSAL: 414

DO YOU: SUPPORT? ______ AMEND? ______ OPPOSE? ✓

COMMENTS: ______

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

NAME: Joe Rossman DATE: ____________

ADDRESS: 3314 Hannibal st

PHONE: 494-4446

REPRESENTING WHOM? Montana Idaho Utah Joint Council of teamsters

APPEARING ON WHICH PROPOSAL: H B 414

DO YOU: SUPPORT? ________ AMEND? ________ OPPOSE? ✓

COMMENTS: ____________

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

NAME: Peter Jackson DATE: 3-15-79

ADDRESS: 1804 11Th AVE HELENA Mont

PHONE: 443 - 5541

REPRESENTING WHOM? WETA - MONT.

APPEARING ON WHICH PROPOSAL: HB 414

DO YOU: SUPPORT? ______ AMEND? ______ OPPOSE? ✓

COMMENTS:

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

NAME: [illegible] DATE: [illegible]

ADDRESS: Box 1730

PHONE: 442-0945

REPRESENTING WHOM? Montana Chamber

APPEARING ON WHICH PROPOSAL: HB 444

DO YOU: SUPPORT? _____ AMEND? _____ OPPOSE? ✓

COMMENTS:

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

NAME: JAMES JASKA DATE:

ADDRESS: Osborn Building, St. Paul, Mn.

PHONE: (612) 451-5691

REPRESENTING WHOM? Economics Laboratory, Inc.

APPEARING ON WHICH PROPOSAL: HB 414

DO YOU: SUPPORT? ______ AMEND? ______ OPPOSE? ✓

COMMENTS: Clarification of the Minnesota phosphorus legislation.

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

ersuading the big producers jet phosphates out of etergents seemed a quick vay to help rescue fouled kes. But neither the iology of lakes nor the hemistry of detergents urned out to be that simple.

FACT AND FOA IN THE ROW OVER PHOSPHATES

/ *William Simon Rukeyser*

One of the most persistent and bewildering national ntroversies of recent years has swirled around a matter hat once attracted little public notice except in advertise- s and nursery rhymes—the way we wash our clothes. nufacturers, government officials, and scientists, mong others, have joined in convoluted disputes over e possibility that laundry detergents containing phos- ates may be harming the environment. Long-established market patterns have been disrupted, the U.S. Govern- ent has been caught in embarrassing public wobbles, and nfusion has washed across the land.

The outcry against phosphates rose to a crescendo in the irst half of 1970, and phosphate-free detergents soon gan arriving in the stores. By the middle of 1971, phos- ate-free products—some eighty brands in all—had lipped more than half a dozen percentage points from e combined market share of the big three "soapers"— octer & Gamble, Lever Brothers, and Colgate-Palmolive. apid shifts of market share *among* the big three are mmon, but for years their collective share had been ite stable, normally about 85 percent of the $1-billion- year market for heavy-duty laundry products.

The heyday of the nonphosphate brands was brief, how- er. Last September the Surgeon General and other fed- al officials cautioned that some phosphate-free deter- ents are hazardous to human health. Since then, sales of nphosphate products—in which phosphate is replaced ostly with old-fashioned washing soda—have slid by a . Nevertheless, a number of states and localities are ng ahead with bans on detergents containing phos- hates. Last month Procter & Gamble and Colgate-Palm- olive announced that they would withdraw from the etergent market in at least one such area—Dade County, lorida—rather than distribute washing-soda detergents. n some places, therefore, the nonphosphate producers may win a bigger market share again, by default.

Reverberations of the detergent controversy by now ave spread well beyond the corridors of industry and overnment. Around the country, concerned housewives re at a loss as to how they can launder without either uilt or fear. And in what had been one of the most placid kwaters of science—limnology, the study of fresh water—experts have taken to lunging at one another like barracudas in angry public disputes over the dimensions and possible causes of the problems afflicting the nation's lakes and streams.

What's in the boxes

The controversy has focused unaccustomed attention on the details of detergent formulation. The basic ingredient of all detergents, phosphate or nonphosphate, is a surface-active agent, or "surfactant"—a sort of synthetic soap, derived from petroleum, that makes up 15 to 20 percent of a typical heavy-duty formula. Surfactant is the ingredient chiefly responsible for actual soil removal. But it cleans cotton and some other fabrics poorly unless combined with chemicals known as "builders," which create conditions in the wash water that enable the surfactant to work efficiently. For a quarter of a century the most widely used builder has been some form of phosphate, which in recent years has accounted for 35 to 55 percent of most detergents, by weight.

Phosphates assist the surfactant chiefly by softening water and by keeping dirt and particles that cause hardness in suspension so that they are not redeposited on clothes or on the machine. Other familiar chemicals also have the power to soften water or to limit redeposition of dirt, but phosphates perform their various functions especially well. Moreover, they are exceptionally free of undesirable side effects inside the washing machine. Even those who oppose phosphate laundry detergents generally concede that automatic-dishwasher detergents and some industrial and institutional cleaning products would not work satisfactorily without phosphates.

When detergents first became commercially available in the early 1930's, they consisted almost entirely of surfactant. Consequently they cleaned cottons badly and made practically no inroads against soap in the grocery stores. Not until 1947, when Procter & Gamble's Tide first combined surfactant and phosphates in the same box, did detergents arouse any enthusiasm among consumers. But from then on, enthusiasm became almost too mild a description for what amounted to one of the watersheds of

Research associate: Beth Bogie

n Studios

business history. With phosphates added, detergents aned noticeably better than soap, and were cheaper, too. And because they left so little residue, they made possible the design of modern automatic washing machines. In half a dozen years, housewives relegated soap, with which people had been washing clothes since the dawn of history, to a minority share of the laundry-products market. Some manufacturers tried to hold back the flight from soap—notably Lever Brothers, which continued to spend some $5 million a year promoting laundry soap. Lever, whose Rinso White had been the country's best-selling soap powder, plaintively advertised: "Rinso White or Rinso Blue: soap or detergent, it's up to you!" By the early 1950's the verdict was in: Rinso White was clearly washed up.

A food that fills a universal need

Since then, brands of detergents have come and gone, but none has ever approached the astonishing market appeal of Tide. Procter & Gamble also makes eight other successful heavy-duty detergents, but the chasm between its total share of the market—recently around 50 percent—and the shares of Lever and Colgate-Palmolive—both well under 20 percent—derives overwhelmingly from the sales of Tide. Between 1949 and 1966, Tide's high-phosphate formula was protected by one of the detergent industry's rare patents, and in the early years, before Procter & Gamble began granting licenses to some other manufacturers, the product had about half the market to itself.

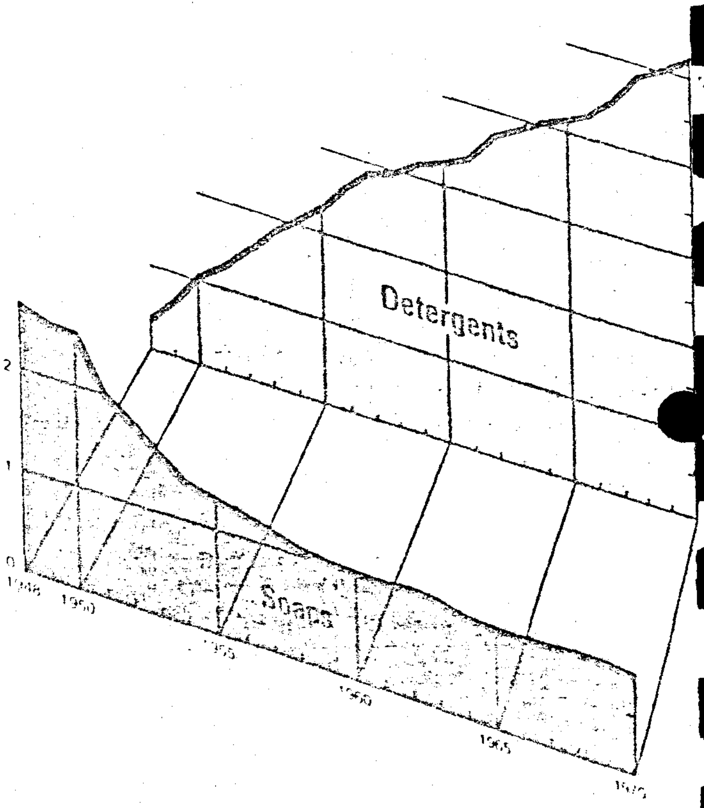
Even now, when important qualitative differences among leading detergents have certainly narrowed and possibly disappeared, Tide's market share is 24 percent. Its closest competitor is Lever Brothers' All, with 7 percent (including Cold Water All). Tide's cleaning performance remains the standard against which newcomers to the market judge themselves, sometimes even publicly. Claimed an early ad for Purex Corp.'s Brillo: "At last a no-phosphate detergent that cleans as white as Tide."

Phosphates have shown themselves to be unusually safe as well as effective compounds. Their presence enables detergents to clean with less alkalinity even than soap. Though the federal government annually receives reports of around 4,000 ingestions of cleaning products, mostly by young children, no deaths or even serious injuries are known to have been caused by phosphate laundry detergents in a generation of use. Phosphate, in fact, is a constituent of many foods. Several million pounds are consumed by Americans each year in beer and soft drinks, of which the old-fashioned lemon phosphate is a famous example.

Indeed, it is the role of phosphate as a food that has made it so controversial; for among the organisms that share the universal need for a little phosphorus in the daily diet are aquatic weeds and algae—microscopic, mostly greenish plants that live in water. In limited quantity, algae are beneficial, creating oxygen through photosynthesis and forming a link in the aquatic food chain. An excess of algae, however, is a nuisance, though not a peril to human health.

During certain seasons, algae proliferate in some lakes until they become visible as unsightly green "blooms" on the surface of the water. When these superfluous algae die, they can produce obnoxious odors and sometimes wash slimily ashore. Furthermore, while live algae give off oxygen, dead algae—like any organic waste in water—create what is known as biochemical oxygen demand (BOD), provoking bacterial activity that reduces a lake's oxygen supply. In severe cases this can destroy the lake's ability to nurture certain desirable varieties of fish, including trout. Still, the familiar charge that some famous U.S. lakes are "dead" is imprecise at best. Lake Erie, the most frequently mourned, is badly polluted (largely with substances considerably more noxious than algae), and recent decades have seen a marked change in the kinds of fish it contains. But Lake Erie continues to produce as much fish as the other Great Lakes combined, and in 1970 yielded the biggest catch in its history. Arthur D. Hasler, director of the University of Wisconsin's highly regarded Laboratory of Limnology, aligns himself strongly with those who want phosphates out of detergents, yet he observes: "Erie will be around for thousands of years. Instead of calling a lake dead, I like to say repulsive."

Many bodies of water apparently can never support excessive algae growth because they are too deep, fast-moving, muddy, or cold. But in lakes, ponds, and other slow-moving waters the availability of nutrients is often the factor critical to whether or not algae get out of hand. Indeed, the technical term for the process by which lakes become clogged with algae is eutrophication, defined as overfertilization with nutrients. Eutrophication is common in nature, for nutrients enter water from sources as varied as rainfall and the decomposition of dead fish. Wisconsin's Green Bay, to take one example, was blanketed with algae when white men first glimpsed it. But human activities can greatly accelerate the process, as has happened in Lake Erie and elsewhere. Man puts nutrients into lakes chiefly through municipal sewage, industrial wastes, and the runoff of agricultural fertilizer during rainstorms.



Detergents have scrubbed soap from most laundry rooms. The figures, from the Soap and Detergent Association, refer to sales of all kinds of soap and synthetic detergents. In recent years laundry products have accounted for only a small proportion of soap sales.

lgae require fifteen to twenty different nutrients, of phosphorus is quantitatively the third most impor- fter carbon and nitrogen. As long as other neces- conditions exist, algae will multiply until they ex- st the available supply of some nutrient. The one that s out first is said to be "limiting." Different nutrients be limiting in different bodies of water, or even in same body of water at different times and places.

here is not much hard evidence that phosphorus is the rient chiefly responsible for eutrophication. But of the rients that may be responsible, phosphorus is consid- d the most *controllable*. Unlike nitrogen, which passes ely through soil and can even be extracted from the osphere by some types of algae, phosphorus is effec- ly trapped by most farmland and by properly func- ning septic systems. In many lakes as much as 70 per- t of the incoming phosphorus is thought to flow from nicipal sewage plants. Of the phosphorus contained in wage, 40 to 70 percent often comes from phosphate ergents—and nearly all of these are manufactured by t three corporations. In sum, the simple expedient of rcing three companies to change their product formulas ght eliminate close to 50 percent of all the phosphorus ng into some lakes. No other nutrient offers any com- rable prospect for reduction by fiat.

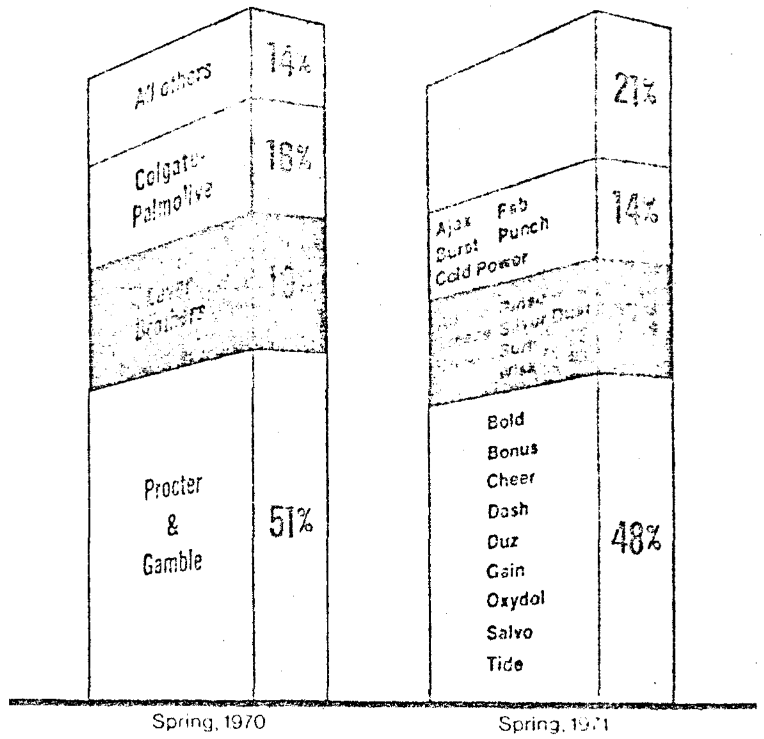
The issues in the debate about phosphates are often sed with those in a well-remembered controversy detergents that foamed in rivers and streams, and th more recent but also essentially unrelated worries out the side effects of enzyme detergents. Detergent m first became a matter of national concern in the early 60's, when Representative Henry S. Reuss of Wiscon- , among others, pointed out that detergents were per- ting, and sometimes sudsing, in the environment. After any assertions by U.S. manufacturers that the problem s intractable, Reuss was able to disclose triumphantly t German manufacturers were on the verge of pro- ing biodegradable detergents. The somewhat abashed S. manufacturers switched entirely to biodegradable ergents in 1965, amid threats that Congress would act hey did not.

The foam in the rivers was caused by surfactant, not osphates, and the problem was solved by switching om chemically "hard" to "soft" surfactant. Surfactant as also the target of a ban on sales of all detergents, osphate or nonphosphate, imposed last year by Suffolk unty, Long Island—an area where chemicals in sewage, luding detergents, sometimes recycle between cesspools d wells. Presumably many Suffolk households are still tting sewage in their drinking water; but at least it ld gradually become less visible.

"very real culprit"

Detergent makers generally date the emergence of hosphates as a public issue to July 31, 1967, when Stew- t L. Udall, then Secretary of the Interior, addressed the dustry's leaders at a meeting in Washington. According the official text, Udall noted the recommendation of a echnical committee studying Lake Erie that "a suitable bstitute should be found to replace phosphates in de- rgents." He added: "We ask that the soap and detergent ndustry do just that—work with us to research and de- lop substitutes . . . We would hope to see a reasonable adual replacement."

Udall's listeners had reason to feel that they could meet that goal. By 1967 the major detergent compa- nies, which constantly experiment with new materials in hope of gaining a product advantage over their rivals, were aware of the commercial promise of a phosphate substitute known as sodium nitrilotriacetate, or NTA. First produced in Germany during the 1930's, NTA had for years been considered too expensive for general use. But improved methods of synthesis patented in 1962 by a division of W.R. Grace & Co. brought down costs, and tests indicated that in some respects NTA was even more effective than phosphate.



The market shares of the big three shrank as agitated consumers switched to phosphate-free detergents, supplied by dozens of smaller competitors. But sales of the phosphate-free brands reached a plateau last spring, and have lately declined. (The figures on the chart, based on industry estimates, represent shares of the total U.S. market for heavy-duty laundry products sold in stores.)

The readiness of detergent makers to cooperate with Udall did not, however, grow out of any agreement that their products were harming the environment. Despite confident assertions such as Udall's that "phosphates are a very real culprit" in water pollution, there was prac- tically no conclusive evidence one way or the other. In- deed, even now, after more than four years of by far the most intensive study these matters have ever received, nobody has definitive answers even for such elementary questions as how many lakes are troubled by algae—to say nothing of more sophisticated problems such as what the limiting nutrient may be in each case.

One of the very few areas of consensus among the people who study water is that in lakes where eutrophi- cation has coincided with increases in sewage, total re- moval of sewage tends to reduce or eliminate the problem. Total removal has been tried with good results at such places as Lake Tahoe in California and Seattle's Lake Washington; sewage-plant effluent is piped around the lakes and disgorged elsewhere.

There is considerably less scientific accord on whether use of advanced sewage treatment to remove just a sin- gle nutrient—phosphorus—will improve lakes. Exper- ience at Lake Zurich in Switzerland suggests that it can;

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: in waters where the limiting nutrient is not phosphorus, h treatment could be wholly ineffectual. On the merits of *tial* removal of a single nutrient, such as would be iieved by banning phosphates in detergents, informed nion is very much divided. Some authorities think such step would have value in slowing the deterioration of tain lakes. Many others argue that because the quantity phosphorus needed to support nuisance growths of algae so tiny—on the order of ten parts per billion—simply ving the phosphorus content of typical sewage from haps 10,000 to 5,000 parts per billion would do no good all. In the words of William J. Oswald, a professor of pub- health and sanitary engineering at Berkeley who has stud- algae for twenty years, "To attain the low growth rates eded for effective algae control, complete removal of al- ost all phosphate and nitrogen will probably be required."

ı emergency tone

For a couple of years after Secretary Udall's exhortation, big detergent makers and the federal government worked gether in reasonable amity. Procter & Gamble was already perimenting with small amounts of NTA in a few deter- and the government's position on phosphates re- ained quite consistent with Udall's speech. As stated as ently as August, 1969, in an emphatic memorandum by vid D. Dominick, Commissioner of the Federal Water llution Control Administration, the official position was s: "The reduction or elimination of phosphorus from ergents is desirable in concept but undesirable for im- mentation *at this time*," because substitute ingredients uld cause other, even more severe, pollutional effects."

Relations between the big three and Washington cooled idly, however, in the wake of hearings held in December, 69, by the House conservation and natural resources sub- mmittee, chaired by the detergent makers' old nemesis, nry Reuss. Several witnesses—including a divisional sident from W. R. Grace, the NTA producer—strength- ed the Congressmen's opinion that satisfactory phosphate stitutes, notably NTA, did exist and should be adopted thout further delay. Stung by the subcommittee's impa- nce, federal officials soon began talking and acting as if need to replace detergent phosphates constituted a tional emergency. This abrupt change of tone has been the root of most of the embarrassment that the govern- nt has since suffered on the phosphate issue.

One of the first serious collisions between detergent ecutives and government officials came in March, 1970, g two days of unpublicized meetings called by Secretary Commerce Maurice Stans. Noting that the Reuss report s nearing publication, Administration officials stated—as lustry people remember it—that they thought "it would good" to announce the manufacturers' intention of reduc- phosphate levels immediately. The company representa- es responded with a detailed case against hasty action; at st one stressed the view that NTA had not been suffi- ntly tested to justify early use in the quantities necessary replace the 2.5 billion pounds of phosphate annually cked into detergents. The government officials seemed tak- aback by the militancy of the companies' positions. Indus- executives remember being asked by Stans, "Why don't u take your case to the public and get us off the hook?"

At the end of March, Procter & Gamble announced in full-page newspaper ads that within two months it would be us NTA in place of 25 percent of the phosphate in some prod ucts. As the notion spread that NTA was now availabl as an effective substitute for phosphate, the government's stance grew increasingly rigid. On May 1, 1970, the Interio Department's water-quality agency publicly demanded a immediate cut in phosphates by all manufacturers. Soon thereafter, according to industry sources, Russell Train, head of the President's Council on Environmental Quality, be came especially vigorous in urging manufacturers still un committed to NTA to get hold of supplies and begin using it in place of phosphate.

At the end of 1970, the foundation of theory and opinio on which the government was operating abruptly crumbled. Late in the afternoon on Wednesday, December 16, phone jangled in the head offices of the detergent companies an even in the homes of some executives who had already left work. Washington was on the line with a request that corpo rate officials appear the next day at the Department o Health, Education, and Welfare in order to make an urgen decision regarding NTA. No further details were supplied.

At four o'clock the next afternoon, about forty peopl gathered around a long table in an H.E.W. conference roo at 330 Independence Avenue. After an apology for the short notice, Surgeon General Jesse Steinfeld told the manu turers of a study with rats, conducted at the National In tute of Environmental Health Sciences, indicating that NTA could combine with mercury or other heavy metals in th water supply so as to cause birth defects. Recalls an execu tive who was present: "We weren't allowed to examine th data. The people we had down there had no technical re sources." Nevertheless, officials insisted that they wanted t announce the research findings, along with a statement o the industry's "voluntary" agreement to suspend the use of NTA, at a press conference the next morning.

Why tomorrow? industry people immediately asked. was explained that there are a lot of leaks at H.E.W. and besides, Senator Muskie's subcommittee on air and wat pollution was scheduled to issue a staff report in a few da that would include some questions about the safety of NTA. As the meeting broke up, around six o'clock, executives raced for phones inside the H.E.W. Building and began dictatin the research findings to their home offices in order to get som technical evaluation by the morning.

A policy of saying as little as possible

The quick reaction of many of the people at the other end of the phones was that the test data seemed internally inco sistent and that further studies would be required to t whether the conclusions were valid. Government offi agreed that more testing was needed, but insisted that, in meantime, use of NTA had to cease. Since the government efforts to push the industry toward a fast removal of pho phates had been predicated on the availability of NTA, the suspension put policy makers in a quandary. In a joint stat ment issued at the press conference, Steinfeld and Willia D. Ruckelshaus, head of the Environmental Protection Agency, essentially returned to the position the government had advocated prior to the Reuss hearings—i.e., they urg the removal of phosphates by sewage treatment. For man months thereafter, it became the apparent policy of almost all responsible federal officials to say as little about detergen and phosphates as possible.

No such option was open to the detergent makers, who to decide what to put in their cartons in the face of unab agitation in Congress and the press and local laws restrictin

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osphate content. Lever Brothers and Colgate-Palmolive cted to stabilize the phosphate content of all their heavy-ty laundry detergents at about 35 percent—equal to 8.7 rcent elemental phosphorus, a reduction from a previous erage of roughly 10 percent. An 8.7 percent phosphorus ntent is generally considered the minimum needed for effec-e heavy-duty cleaning. But higher concentrations do rease cleaning power somewhat, particularly in hard water with heavily soiled clothes. Procter & Gamble, convinced at its commanding market share owes something to con-mer preference for high-phosphate products, has continued, ere legally permitted, to market some detergents contain-; up to 14.6 percent phosphorus. This policy is expensive as ll as politically daring. It creates costs both for distributing ferent formulas and for the phosphates themselves, which several times as expensive as the filler material with ich they are partially replaced in the 8.7 percent brands.

theme of unselfish concern

If NTA had remained available, the replacement of phos-es in detergents might well have been accomplished ut a serious challenge to the market dominance of the aree. Major new entrants to the detergent industry had n rare, partly because huge advertising budgets are con-ered necessary. The confusion following the suspension NTA use, however, created a unique opportunity for the kers of washing-soda detergents. At their peak, non-osphate products—many with trend-catching names such Concern, Pure Water, the Un-Polluter, and Ecolo-G - zed roughly 10 percent of the market.

n the promotion that heralded the arrival of the washing-a brands, the common theme was unselfish concern for environment, spiced with intimations of scientific break-oughs. The classic example was Sears, Roebuck's first ergent commercial, featuring, of all people, Stewart all, who had by then retired from the Interior Department o private life. Udall began by asserting, "I have never e a commercial before and I won't take any money for g this one," and ended by urging the use of Sears' non-osphate detergent "for our water's sake." His claim that would not "take any money for doing this one" was ctly accurate, since the fees specifically related to the com-rcials he filmed were turned over to a foundation for In-n education. Udall neglected to mention, however, that he also serving Sears as a consultant on the environment, an ment for which he did accept payment. Sears confirms e fee, while "small," was in the thousands of dollars.

ugh the switch to a phosphate-free formula doubled its e of the detergent market, to an estimated 3 percent, rs was soon awash in perplexity. Last summer a fifteen-th-old Connecticut girl died after inhaling a quantity of & Hammer detergent with ingredients similar to se in the Sears brand; a month later came the Surgeon neral's warning about certain nonphosphate products. rs had already discovered that washing-soda detergents, ding its own, could inactivate flameproof finishes on hing—a feature Sears itself had pioneered.

Perhaps the unkindest cut of all came from Whirlpool ., as unlikely a corporate adversary as Sears could encountered. Whirlpool is the exclusive supplier of Kenmore washing machines, and shipments of ap-ces to Sears account for two-thirds of its revenues. Yet, at a time when Sears was proudly displaying its own detergent alongside Kenmore washers and claiming on the side of the box that the detergent is "great for your wash . . . and your washer too," Whirlpool began packing a pale-blue leaflet into the essentially identical machines it sells under its own brand name. Entitled "Ecology, your new washer and you," the leaflet warned that in water of the hardness that is supplied to two-thirds of the population, phosphate-free detergents leave "a scaly build-up" that can interfere with the functioning of the washer's pump, agitator, and filter and "can cause abrasion or wear of clothes as they rub against the agitator and tub."

Some nonphosphate detergents do a satisfactory job of removing dirt, but they tend to stiffen fabrics and leave white deposits on dark clothes, especially after repeated washings in hard water. Certain brands, moreover, are sufficiently caustic to damage eyes and mucous membranes irreversibly if splashed or eaten, a particularly worrisome characteristic in a household product often sold in large, heavy boxes hard to store out of children's reach. Some *phosphate* detergents, to be sure, may contain ingredients other than phosphate that make them more irritating than some nonphosphate detergents. But washing soda and certain other chemicals sometimes used in nonphosphate formulas are inherently irritating substances, while phos-phate is not.

The refusal of Procter & Gamble and Colgate-Palmolive to make washing-soda detergents does not reflect any tech-nical incapacity to do so. Both could manufacture these products with their existing equipment (Lever Brothers is already producing a nonphosphate brand to be sold in places that ban phosphates). Moreover, washing soda costs less than one-third as much as phosphate.

The back-to-soap school

Many concerned people, including ecologist Barry Com-moner, believe that the choice between phosphate and non-phosphate brands is too narrow. They argue that the country should forswear detergents of all types and go back to soap. And indeed, with lightly soiled articles washed in soft water, soap can do a good job. But consumers without soft water would either have to add washing soda, which brings with it some of the drawbacks of the nonphosphate detergents, or invest in a mechanical water softener. Even in soft water, soap can leave an unsightly residue and, like nonphosphates, soap makes flame-resistant garments flammable. It also currently costs about 20 percent more than detergent.

Finally, not even soap is entirely free of unwanted environ-mental consequences. Since it is an organic substance, it adds to the biochemical oxygen demand in sewage-treatment plants, which depend in part on bacterial action to break down wastes. Estimates of the BOD increase that would result if everyone switched to laundry soap run as high as 2 percent. That would overload many treatment plants, caus-ing them to discharge untreated sewage into the water an ultimately requiring enlarged facilities. One forty-year ve eran of the detergent business remembers that among th first customers for detergents were textile plants, which ha come under criticism for putting too much soap and starc into the lakes and rivers. "The cry of the ecologists then w 'high BOD,' " he recalls. "We offered a synthetic surfacta that had no BOD."

By last summer, extensive testing of NTA by the gover ment and industry appeared to clear the chemical of t birth-defect charges that had been the basis of its suspensi But another question had been posed: might NTA be a ca

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cancer? Procter & Gamble and other producers, increas-gly desperate both to rescue their investment in NTA and have access to what they regard as the only satisfactory own substitute for phosphate, pointed out that tests had oduced no evidence of carcinogenicity. They noted that her careful countries, such as Canada and Sweden, con-nued to permit NTA.

The Surgeon General responded that he was dissatisfied ith the way some of the tests had been conducted and anted additional studies that could take as long as two ears. "From the industry's point of view, it was the first me anyone had asked for this kind of data," says Dr. teinfeld. "But I felt and I continue to feel that we needed know more if it is to be used in large quantity."

On September 15, Steinfeld, Ruckelshaus, Train, and Dr. harles Edwards, head of the Food and Drug Administra-on, held a memorable press conference. The message was at, despite earlier hopes, it now seemed unlikely that NTA ould be quickly cleared for renewed use. In these circum-ances, they felt the public should know that some other oducts being marketed as phosphate substitutes - the caustic washing-soda detergents - could present safety zards. The best course at present was for localities with gae problems to build sewage-treatment facilities capable removing phosphates; the federal government was ear-arking $500 million to support such construction over the xt year. In answer to a question, Steinfeld suggested that the time being housewives should use phosphate deter-nts because they are "safe for human health."

Because of that advice, the press conference was widely ndemned as a sellout to the big three and in particular to octer & Gamble, whose chief lobbyist, Bryce Harlow, is former Nixon aide. There is irony in the charge, for from octer & Gamble's point of view the Surgeon General's stimonial hardly offset the immediate financial and market-g impact of the company's defeat on NTA; in fiscal 1971, octer & Gamble wrote off $7,100,000 of binding contracts purchase NTA. In any case, rising governmental concern er the safety of nonphosphates represented no sudden arnabout. Among other things, the Food and Drug Ad-inistration last March seized 1,145 cases of Ecolo-G and hack brand no-phosphate detergents, both made by cology Corp. of America, after tests showed them to be toxic, corrosive to intact skin, and the cause of severe eye ritation." Those brands have since been reformulated.

ew thoughts on sewage

e emotions stirred by the controversy churn on. But actical steps toward minimizing algae growth induced by man activity will require dispassionate weighing of all e trade-offs involved in possible remedies. All things con-dered, advanced sewage treatment may prove not only to the most effective way to turn but also one of the most pidly available and most economic ways.

The conventional view among environmentalists is that aling with eutrophication by means of sewage treatment ould cost many billions of dollars and take years, or even ecades. These projections rest on the assumption that get-ng out phosphorus, which is almost untouched by conven-onal treatment, requires complex, expensive tertiary treat-ent. But new techniques of sewage treatment developed the last few years make it possible to remove nearly all the phosphorus in sewage, whatever its source, with only relatively minor additions to existing treatment pl

These processes can reduce phosphorus in sewage efflue to less than 1,000 parts per billion at a median per-capit cost of less than a penny a day, including removal of the additional sludge and amortization of capital investment. F just *over* a penny a day per person, the phosphorus can be c to a couple of hundred parts per billion. Since effluent is diluted when it enters lakes and rivers, advanced treatmen of this kind could reduce the phosphorus in many waters n just to the level of pre-detergent days, but to a level that h not been seen since the widespread adoption of indoor plumb-ing. Under a bill passed unanimously by the Senate i November, the federal government would pay up to 70 pe cent of the capital costs.

In the country's most prominent eutrophic waters—chiefl Lake Erie, Lake Ontario, and the Potomac estuary—most the incoming sewage already passes through conventional treatment plants. Equipment for phosphorus removal, whic is needed in those areas regardless of detergents, coul almost certainly be added to the plants sooner than approva could be gained for mass marketing of any of the phosphate substitutes now under laboratory development. Furthe more, localized removal of phosphorus from sewage might cheaper, as well as more effective, than wholesale replace-ment of phosphates in detergents. Virtually all the stitutes under study are considerably more expensive t phosphate. A complete switchover to NTA, for example, would add an estimated $80 million to the detergent in dustry's annual raw-material costs, and presumably more what consumers pay.

After the awakening

If phosphorus is removed from the sewage entering e trophic waters, the original rationale for the detergent con-troversy will disappear. It makes no difference to lakes wh chemical is used as long as they don't receive it. But val reasons will remain for replacing detergent phosphates in a measured way as fully proved substitutes become availabl Providing that the substitutes do not create comparable pro lems, phosphate-free detergents could marginally reduce the costs of operating some phosphorus-removal processes and could lessen somewhat the flow of nutrients into waters fro malfunctioning septic systems. In addition, it is estimated that "if demand continues to grow at the current rate," k world reserves of phosphorus - vital in agricultural fer ers - will be exhausted in less than a century. For present, in regions where phosphate detergents add directly to the cost of running sewage plants, it might be fair to ta these products to offset the additional costs they create. An perhaps the manufacturers should be required to divulg their cartons a fact that *Consumer Reports* magazine, a with many ordinary citizens, has discovered—that a fractio of the usually recommended one-cup dosage can give accept able results in many households.

Reviewing the phosphate controversy, Dr. Ian Mitchell, thoughtful H.E.W. official, observes: "We've all sought th simplest or least troublesome way of dealing with the prob-lem, not realizing that it may not be the simplest or least troublesome approach in the end." The recent great awa ening to the vulnerability of our natural surroundings h fanned hope that environmental damage can be avoided. It has also spread discouragement, as the complexity of th issues and the cost of effective solutions have become ap parent. The campaign to change detergent ingredients nostrum for ailing lakes may come to be seen as on society's understandable but futile hunts for painless an swers to hard questions. EN

Submitted by Mr. Jaka

Phosphate Replacements: Problems with the Washday Miracle

Detergents containing phosphates have been under indictment for some time as a significant cause of the eutrophication of lakes and other waterways. Phosphates are believed to contribute to the unwanted growth of algae that often choke bodies of water and that, in their decay, can exhaust the oxygen supply in the bottom waters, so that the lake becomes uninhabitable for cold water fish and less attractive for recreational use. Although many scientists are convinced that phosphates should be controlled, there is evidence that under certain circumstances the availability of other nutrients such as nitrogen or carbon limits algal growth; in these waters, phosphates may be present in such amounts that their removal from detergents would make little difference in water quality. But detergents are marketed nationally, rather than regionally, and the federal government seems to be committed to removing phosphates as soon as suitable replacements can be found. In Canada and in some local areas of the United States laws have been passed restricting the phosphate content of detergents. The detergent industry is reluctantly getting ready to shift to phosphate replacements; and within the past year products containing both new materials, such as nitrilotriacetate (NTA), and new formulations of standard ingredients, notably carbonates and silicates, have appeared on the market. Some of these products have been accompanied by advertised claims that these detergents are "nonpolluting." However, the nonphosphate products available today are far from perfect: in addition to some possibly detrimental environmental effects, there are unanswered questions about their safety and washing effectiveness.

Detergents in the Ecosystem

Most of the laundry detergents available today contain between 35 and 50 percent sodium tripolyphosphate, and sales of these products by the three largest detergent manufacturers, Procter & Gamble, Lever Brothers, and Colgate-Palmolive, account for about 80 percent of the total U.S. market. Almost 2.5 million metric tons of detergents are used in the United States annually, resulting in the release of about 1 million metric tons of phosphates into waste water, and hence into the environment, every year (*1*). Domestic waste water—in which detergents predominate, but which also contains phosphates from human wastes and industrial processes—is the largest single source of phosphates in most waterways. The relative contributions from waste water, urban storm sewer runoff, and agricultural runoff from fertilized fields and livestock feedlots vary widely from place to place and, particularly in the case of agricultural runoff, show large seasonal variations as well. It is generally agreed, however, that detergents account for about 50 percent of the phosphates in waste water and for some lower fraction of the total amount entering waterways. Near large metropolitan areas where there is little dilution of waste water, some estimates of the relative contribution from detergents run as high as 70 percent.

Algae blooms are no longer a rare occurrence in many parts of the United States. In some instances it appears that phosphorus has clearly been the limiting nutrient, implying that a reduced supply of phosphates would have reduced the amount of algal growth; in other incidents, it is simply not known what the limiting nutrient was or how much of the algal growth could have been controlled by lower concentrations of phosphates. Research into the water chemistry of nutrient cycles is intensifying, but the complexity and variability of aquatic systems tend to obscure the details of how nutrients are taken up by algae and other primary producers, then released as the algae die and are decomposed by bacteria. Comprehensive field studies have so far been carried out in relatively few bodies of water.

The relative importance of phosphorus in contributing to excess algal growth and hence to the accelerated decay of a lake seems to depend on the trophic state of the lake. Phosphorus may be limiting to algal growth in nutrient-poor or oligotrophic lakes, but it may be present in excess in nutrient-rich waters. In the Great Lakes, for example, it is estimated by Fred Lee of the University of Wisconsin—in a talk given at the recent American Chemical Society (ACS) meeting in Los Angeles—that phosphorus is the limiting nutrient in the open waters of Lakes Superior, Huron, and Michigan; he believes that in more eutrophic waters, such as Erie and Ontario, phosphorus may be no longer limiting, but could be made so by removing phosphates from waste water. But in some shallow, near-shore sections of the lakes the total input of phosphates from other sources is such, Lee believes, that the removal of phosphates from detergents or even the removal of 80 percent of the phosphates from waste water in treatment plants—as is now planned for much of the Great Lakes region—would not improve water quality substantially. In order to make phosphorus limiting in these sections, Lee thinks it will be necessary to reduce urban and rural runoff as well.

Much less is known about nitrogen inputs to waterways, although both natural and manmade sources of this nutrient appear to be abundant. The input from ammonia found in rainfall is apparently high in many areas, and fertilizers and sewage wastes contain large amounts. Some types of algae and bacteria can fix nitrogen, and although this process appears to be an insignificant source of nitrogen for lakes, it may give the nitrogen-fixing blue-green algae that usually are commonly found in blooms an advantage over other forms. Nitrogen sources are hard to control because of their diffuse nature, in contrast to many sources of phosphorus. At the ACS meeting, A. T. Prince of the Department of Energy, Mines, and Resources in Ottawa, Canada, estimated that 70 percent of the phosphates entering Lake Erie are from point sources that are potentially controllable, compared to only 40 percent of the nitrogen.

It is generally agreed, however, that nitrogen is a limiting nutrient in some lakes and in many or perhaps even most estuarine and coastal waters. John Ryther and William Dunstan of the Woods Hole Oceanographic Institute point out in a recent report that coastal waters receive the sewage of roughly half of the population of the United States, and their measurements in the New York City region indicate that nitrogen is the limiting nutrient in such waters (*2*). Hence they question the value of replacing phosphates in detergents in these regions.

Under some circumstances carbon may be the limiting nutrient, especially in extremely eutrophic, soft-water lakes, according to Pat Kerr of the Environmental Protection Agency (EPA) laboratory in Athens, Georgia. In her talk at the ACS meeting, Kerr emphasized the interdependence of algae and decomposing bacteria, which often compete for the same nutrients; typically they are linked in a daily cycle in which carbon dioxide is removed by algal growth by late afternoon and regenerated during the night by the bacteria. Because of this linkage, Kerr believes that the control of carbon may be important.

However, the circumstances in which carbon is really a limiting nutrient may be fairly restricted. For example, although Lake Erie is a highly eutrophic system, the carbon reservoir provided by dissolved bicarbonate in the lake appears to be much larger than all human inputs of carbon. Prince estimates the biological oxygen demand in the lake at about 200,000 tons per year, which is equivalent to about 75,000 tons of annual carbon input from sewage. The carbon content of the biomass in the lake is estimated to be about 1.8 million tons, clearly larger than could be supplied from the sewage source, but small compared to the 10 to 12 million tons of bicarbonate in the lake. Hence Prince believes that carbon in sewage waste is not an important nutrient in this lake. Many scientists also believe that where carbon does become limiting, further algal growth would lead to relatively little additional deterioration in water quality.

Options in Detergent Formulation

A typical household laundry detergent is made up of a builder, a surfactant, and miscellaneous ingredients such as brighteners, perfumes, antiredeposition agents, and, in some products enzymes. The builder's primary role in a detergent is as a sequestering agent which ties up calcium and magnesium ions that are present in hard water and that would otherwise interfere with the surfactant. Builders also provide in the washing solution a source of alkalinity which is necessary for effective soil removal. The surfactant acts as a wetting agent, which helps to float off dirt from fabrics. The detergent action of most current surfactants, such as the widely used linear alkylate sulfonate (LAS), is poisoned by unsequestered hardness ions. Antiredeposition agents help to keep dirt—once it is removed from the fabrics—in suspension.

Phosphates are excellent builders for detergents, except for their detrimental effects on the environment. Phosphate detergents perform well in soil removal and have a good safety record as far as the phosphate content itself, although some questions have been raised about adverse health effects from enzyme additives. Continued low level exposure to the enzymes used in detergents may cause an allergic sensitization reaction in some persons, although there is considerable disagreement at present as to the exposure level at which this reaction might occur and the frequency of its occurrence.

The search for phosphate replacements has not as yet turned up any widely accepted substitutes, despite research efforts in the detergent industry and in some independent laboratories under contract to EPA. So far replacement efforts seem to be following one of two directions. The approach favored by the large detergent manufacturers is to look for a new builder that has properties similar to phosphates. The favorite candidate for at least partial replacement of phosphates was NTA, which was increasingly used in some products last year as large quantities began to be available from suppliers.

As of 18 December, however, the industry agreed at the request of the Surgeon General to "voluntarily" suspend use of NTA pending further tests. The request was based on a report from the National Institute of Environmental Health Science (NIEHS) that NTA may have a teratogenic effect in combination with a heavy metal, such as cadmium and mercury, by increasing the transmission of these metals across the placental barrier to the fetus, thus increasing the likelihood of birth defects. NTA is normally degraded in waste treatment systems and in the environment and thereby loses its ability to combine with the metals. But NTA does not degrade in anaerobic systems such as may be found in some septic tanks. Since mercury and other heavy metals occur widely in many waterways (*Science*, 26 February, pp. 788–789), there is apparently some basis for concern.

These preliminary findings were a major setback to industry plans. Procter & Gamble, for example, estimates that it has already spent many millions of dollars in the development and testing of NTA detergents, and since December the entire industry has been examining the NIEHS experimental data and conducting its own tests. The major companies might be expected, on the basis of substantial investments, to be reluctant to move on to other phosphate replacements while there is still hope for NTA, and in fact both the large detergent manufacturers and their suppliers continue to believe that NTA is a safe material at concentrations that would occur in the environment. They expect eventually to go ahead with NTA as, at least, a partial phosphate replacement. Apart from its possible role in the mobilization of heavy metals, NTA appears to be a nontoxic material that performs well as a detergent builder. Total dependence on NTA is unlikely, however, because the material is hygroscopic and would tend to absorb moisture from the air, causing the detergent to cake.

Another potential class of new builders is the polyelectrolytes, principally derivatives of polycarboxylic acids, which appear to have good sequestering properties and good washing characteristics and are available at reasonable cost. The trouble with these compounds is that those tested so far have poor biodegradability, an essential property in the quantities that would eventually be used in detergents. Other compounds including various proteins have been suggested as builders, but their safety has not yet been determined.

A second approach toward finding a nonphosphate detergent—and the approach which seems to be advancing most rapidly at the present—involves the development of surfactants that will work without a sequestering agent. Many of the nonphosphate products on the market are of this type. Small companies—some of them entering the detergent business for the first time—produce essentially all of these products. The surfactants are combined with a builder to provide alkalinity and to improve washing performance. The nonphosphate detergents on the market have largely used precipitating builders—carbonates and silicates—so called because they usually comb[illegible] with calcium ions in hard water [illegible] precipitate as an insoluble residue. The buildup of this residue on cloth and in washing machines is apparently one of the major potential disadvantages with detergents which do not use sequestering builders. Nonphosphate detergents of the type now available have also been criticized for poor cleaning performance, although presumably the individual housewife will be the ultimate judge of washing performance, and so far many of the new no-phosphate products seem to be selling well. The large variety of possible combinations of soils, fabrics, and water hardness make most laboratory washing tests—and hence most claims about washing performance—unreliable.

If small companies have the advantage of a lesser commitment to existing methods and materials so that they can be more innovative in detergent formulation, they can also be more irresponsible, and the products on the market now include instances of both. The use of precipitating builders results in more alkaline detergents. Most phosphate detergents at normal use levels—about 0.15 percent solution—have a *p*H between 9 and 10.5, whereas the nonphosphate detergents based on silicates and carbonates typically have a *p*H between 10.5 and 11. A few products have been marketed with high concentrations of metasilicates—which are highly alkaline in contrast to the more widely used liquid silicate formulations—and products based on metasilicates have been reported to have *p*H higher than 11. Above *p*H 11, alkaline substances can apparently cause gel formation in protein tissue, making it difficult to flush out any of the material that comes in contact with the eyes or is accidently swallowed. The Food and Drug Administration (FDA) is beginning to screen new detergent products for skin corrosion, eye irritation, and ingested toxicity in tests on animals. Under the Hazardous Substances Act, the FDA requires all products alkaline enough to cause tissue damage to carry a warning label indentifying the caustic substance, although with such a label even very alkaline substances can be sold. It was for violation of this labeling requirement that two detergents with high metasilicate content, Ecolo-G and Bohack, were seized last month.

Many industrial detergents are highly alkaline, but the major manufacturers have avoided such products for home use on the basis that, even with warning labels, children would inevitably come into contact with the material. Some 2000 to 3000 cases of children swallowing detergents and other cleaning products are commonly reported each year, so that the trade off between the safety hazards of highly alkaline detergents and washing efficiency, which generally improves at higher alkalinities, is substantial. By no means all the nonphosphate detergents contain metasilicates, however, even though many of them carry warning labels.

Social Options

Essentially everyone agrees that the best long-range method for controlling nutrients in waste water lies with advanced sewage-treatment systems. Phosphates are easily precipitated by the addition of metal ions such as aluminum or iron, and methods for the removal of other nutrients are under rapid development. But because of the time lag in getting public financing for comprehensive treatment systems, many scientists believe that detergent reformulation to remove or reduce phosphates is necessary in the short run. It has been argued, for example by the large detergent manufacturers, that since the elimination of phosphates from detergents would only cut the input of this nutrient in sewage by about half, there would be little to no improvement in water quality. Critics of phosphates in detergents, while admitting that this estimate is probably correct in some areas, point out that such a reduction would at least help to reduce the rate of eutrophication in the future, and more importantly, would help to keep those lakes that are now relatively free of excess algae from becoming like the western basin of Lake Erie, which is largely choked with algae every summer.

If phosphates ought to be removed from detergents, then should laws banning phosphate-containing products by a specific date be passed? The industry has argued that antiphosphate legislation will not help them come up with replacements, and it is true that replacement chemicals need careful testing, as the questions about NTA make clear. On the other hand the large companies—which would be primarily affected by such laws—have not taken the lead in developing and test marketing no-phosphate products based on [illegible]ew surfactants, presumably in part [illegible]cause of their large investments in NTA and in current processing methods. National no-phosphate laws would probably restrict the available technological options too severely, since there are probably some regions of the country where phosphate nutrients are not a critical problem, but it appears likely that more regional and local legislation will be passed.

The replacement of phosphates in detergents with other formulations does appear to involve some trade offs among environmental quality, safety, washing performance and cost. This last factor is a significant constraint, because detergents based on surfactants alone, for example, would apparently be possible if about ten times more product—at a comparable increase in cost to the consumer—were to be used per wash.

Although there is some concern over the nutrient input from replacements products containing nitrogen or carbon, it appears that the amounts of these elements that would be released into waste water from detergents would augment the input from other sources at most only slightly—about 5 percent for nitrogen, in most estimates—as compared to the 50 percent relative contribution of detergent phosphates. More alkaline detergents, in the case of products based on precipitating builders, do pose greater safety problems for home use. According to the makers of phosphate detergents, the phosphate replacements now available are inferior in washing performance, and it is not yet clear whether they will satisfy most users—is whiter than white necessary, or will simply clean do? Although there seems to be no perfect answer, it might well be that regional marketing of products tailored to a given watershed—an idea that appears to horrify the industry because of the complexities involved and the greater expenses that the lack of a national market entails—would help to minimize environmental impact of detergents until adequate waste treatment systems are available while retaining maximum flexibility for the consumer.—ALLEN L. HAMMOND

References

1. Hearings on phosphates in detergents before a subcommittee of the Committee on Government Operations of the House of Representatives, 15 and 16 December 1969 (U.S. Government Printing Office, Washington, D.C., 1969).
2. J. Ryther and W. Dunstan, *Science* 171, 1008 (1971).

Submitted by [illegible]

86 (1964); *Amer. J. Sci.* 267, 1 (1969); K. S. Valdiya, *J. Geol. Soc. India* 4, 125 (1967); *ibid.* 10, 1 (1969).

10. Seventy distinctive columnar stromatolites were used in plotting the curve (*4, 9*). The subdivisions of the Precambrian are those used by B. M. Keller, V. G. Korolov, M. A. Semikhatov, and N. M. Chumakov [*Int. Geol. Congr. Rep. 23rd Sess.* 4, 189 (1968)].
11. P. Hoffman, B. W. Logan, C. D. Gebelein, in preparation; B. W. Logan, *J. Geol.* 69, 517 (1961); ———, R. Rezak, R. N. Ginsburg, *ibid.* 72, 68 (1964).
12. Adapted from H. D. Pflug [*Palaeontogr. Abh.* A 134, 226 (1970)] with additions from P. E. Cloud and C. A. Nelson [*Science* 154, 766 (1966)]; M. F. Glaessner, *Geol. Soc. Amer. Bull.* 82, 509 (1971); S. B. Misra, *ibid.* 80, 2133 (1969); M. Wade, *Trans. Roy. Soc. S. Aust.* 94, 87 (1970).
13. M. F. Glaessner, *Biol. Rev. Cambridge Phil. Soc.* 37, 467 (1962); *Geol. Soc. Amer. Bull.* 82, 509 (1971).
14. The increase in diversity from the Lower Riphean to the Upper Riphean also supports the concept of the morphological evolution of stromatolites in the Precambrian.

15. I thank H. E. Andrews, E. S. Barghoorn, C. Jones, B. Kummel, and J. Sepkoski (Harvard University) and M. R. Walter (Yale University) for comments and aid in preparing this report. C. Jones drafted the figure.

17 June 1971

Eutrophication of Lake Water Microcosms: Phosphate versus Nonphosphate Detergents

Abstract. *The eutrophication potentials of a phosphate-containing detergent and two phosphate-free detergents, as determined in oligotrophic algal microcosms after activated sludge treatment, were not significantly different. All activated sludge effluents, including those from detergent-free waste water, lowered the algal diversity of the microcosms to about the same extent below that of the lake water controls.*

In their concern for the environment, federal and local legislators have introduced a deluge of bills aimed at controlling various pollutants. In particular, the detergent industry has been pressured to eliminate phosphates from detergent formulations. Some observers have expressed concern that excessive emotion and precipitous action may lead to ineffective and toxic detergent formulations (*1*), and yet the rush to pass new legislation continues.

Eutrophication is a surface water problem that has reached widespread proportions (*2*). Although there is some argument about which nutrients are the causative agents in eutrophication (*3*), many ecologists, limnologists, and environmental engineers agree that control and elimination of sources of phosphorus can control the nuisance blue-green algae blooms which often accompany eutrophic conditions in a lake. In general, only 50 percent or less of the total phosphate in lakes enters through domestic waste water (*4*); this source is, however, the one now receiving most attention.

Present-day domestic waste water contains about 10 mg of total phosphorus per liter, and one-half to two-thirds of this amount is from detergent phosphates (*5*). Thus, even with the elimination of detergent phosphates, about 3 to 4 mg of phosphorus per liter would remain in effluents from domestic waste water treatment plants, since conventional treatment generally does not remove much phosphate. Therefore, the real question is: Would a 50 to 60 percent reduction in phosphorus concentrations in domestic waste water significantly reduce the eutrophic conditions in our lakes?

I here report some direct experimental evidence indicating that the elimination of phosphates from detergents would make no significant improvement in eutrophic conditions in the lake receiving the resulting waste water effluent. The microcosm algal assay procedure developed by Mitchell and Buzzell (*6*) was used. The ecological significance of the various waste waters tested was assessed in terms of the resulting algal diversity calculated as Shannon's diversity index (*7*)

$$H_1 = -\Sigma P_i \log P_i$$

where $P_i = n_i/N$, n_i is the population of the *i*th species, and N is the population of the total community. The index ranges from zero for unialgal populations to unity for very diverse algal communities.

In general, the diversity of a lake's algal community diminishes with eutrophication (*8*). Thus, oligotrophic lakes would probably have diversity indices of from 0.7 to 1.0, and, as the lakes become eutrophic, the diversity index would drop to 0.3 or less.

Three detergent formulations were chosen for this study from store shelves to give a wide range of composition (Table 1). Product 1 was a phosphate-containing anionic surfactant formulation. The other two detergents were phosphate-free formulations, with nonionic and anionic surfactants. Both products 2 and 3 have been extensively advertised as "ecologically safe" for the environment.

A synthetic waste water was prepared whose composition was based on the glucose-peptone waste water designed by Wiener (*9*) to model domestic waste water in activated sludge treatment, but with the inclusion of a bicarbonate buffer in place of the phosphate buffer. A stock solution of the synthetic waste water was made up to 1 liter deionized water as follows: 16.0 g of glucose, 16.5 g of peptone, 2.5 g of urea, and 10.0 g of sodium bicarbonate for buffering. The syn-

Table 1. Composition and properties of detergents.

Characteristics	Detergent		
	1	2	3
*Ingredients (% by weight)**			
Anionic surfactant	18		5
Nonionic surfactant	2	11	2
Sodium tripolyphosphate	50		
Sodium carbonate		65	21
Sodium silicate solids (from liquids)	6	8	
Sodium metasilicate pentahydrate			21
Sodium chloride			45
Sodium sulfate	14		4
Sodium carboxymethyl cellulose (65% pure)	<1	5	1
Water	10	10	
Brighteners, perfume, etc. (estimated)	<1	<1	<1
Properties			
Loose density (g/cm³)	0.33	1.04	0.85
Solution *p*H in the concentration used	9.7	10.8	11.3
Alkalinity (% Na_2O)†	9.6	42	19
Recommended amount (cups)	1¼	½	1
Grams per wash load	98	123	201
Solution concentration for the recommended amount of detergent (% by weight)	0.15	0.19	0.31

* Values are based on analyses of purchased samples carried out in the Monsanto detergent laboratory. † Titration to *p*H 4.

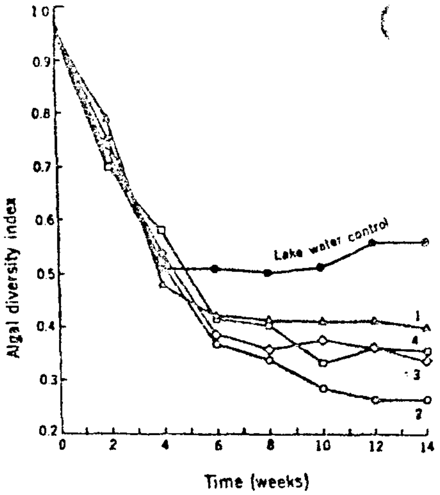

Fig. 1. Diversity indices of microcosms receiving 10 percent treated waste water: unit 1 from phosphate-containing detergent; unit 2 from nonphosphate nonionic detergent; unit 3 from nonphosphate anionic detergent; unit 4 from waste water with no detergent.

thetic waste water was prepared by diluting 10 ml of the stock solution to 1.0 liter with tap water. The final concentration of phosphorus was about 3 mg/liter (from the peptone), corresponding to domestic waste water without detergent phosphates. A synthetic waste water of this type may be more readily biodegradable than domestic waste water and hence may yield more inorganic nutrients in the treated effluent. However, the data in Table 2 do not support this expectation. This conclusion is based on the results of an experiment in which four activated sludge units (1.5 liters of total mixed liquor volume) were fed the synthetic waste water, with or without the detergents, on the 24-hour semicontinuous operation schedule recommended in the Soap and Detergent Association test procedure (*10*). The detergent concentrations (Table 2) were selected to approximate the concentration of conventional household detergents in the average domestic waste water and were based upon the amounts recommended for use by the manufacturers (Table 1).

Table 2 shows analyses of the daily effluents from the activated sludge treatment. Both unit 1, treating the phosphate-containing detergent, and unit 4, the control with no detergent, had an average soluble inorganic carbon (SIC) content of about 9 mg/liter and an average *p*H of 7.4. In contrast, the effluents of units 2 and 3, treating the detergents without phosphate, contained almost twice as much SIC as the treated waste water and had *p*H's about 0.5 higher. The titratable alkalinity of the four effluents showed this same trend. All the effluents had approximately the same soluble organic carbon (SOC) content, 5 to 6 mg/liter, an indication that none of the detergents hampered the biodegradation of organic carbon compounds by the activated sludge microorganisms.

Predictably there were no significant differences in the amounts of ammonia and nitrate nitrogen in the effluents, and there was no significant

Table 2. Activated sludge treatment of detergents.

Characteristics	Activated sludge unit			
	1	2	3	4
	Influent			
Detergent formulation	1	2	3	Control
Detergent added (mg/liter)*	60	87.5	146	None
SIC (mg/liter)†	11	16	15	10
SOC (mg/liter)†	95	108	96	90
	Effluent			
SIC, average (mg/liter)‡	9.5	18.8	17.2	8.7
SIC, difference (mg/liter) §	0.7 ± 0.8	10.2 ± 0.9	8.5 ± 1.0	
SOC, average (mg/liter)	6.4	4.9	5.5	5.2
SOC, difference (mg/liter)	1.3 ± 0.8	− 0.2 ± 0.7	0.2 ± 0.9	
NH_3, average (mg of N per liter)	1.2	1.2		1.2
NO_3, average (mg of N per liter)	9.5	11.0		10.0
NO_3, difference (mg/liter)	0.8 ± 1.3	0.8 ± 1.0		
PO_4, average (mg of P per liter)	2.8	0.5		0.7
PO_4, difference (mg/liter)	2.1 ± 0.5	0.2 ± 0.2		
*p*H, average	7.4	7.8	7.9	7.3
*p*H, difference	0 ± 0.2	0.5 ± 0.1	0.5 ± 0.1	
Alkalinity (meq/liter) ‖				
To *p*H 7	0.17	0.40	0.28	0.20
Total	0.91	2.00	1.51	0.75

* Based on the amounts recommended for use by the manufacturer. † Soluble inorganic carbon or soluble organic carbon in centrifuged samples (Beckman carbon analyzer model 915). ‡ Averages based on 19 to 20 samples over a 12-week period. § Differences from the control were calculated individually for each sampling, averaged ± 2 standard deviations from the arithmetic mean. ‖ Amount of acid needed to titrate a sample to *p*H 7 or to the breakpoint near *p*H 4.8 to 5.

ble 3. Characteristics of Table Rock Lake ater.

Characteristics	Initial value
*p*H	7.4
Soluble inorganic carbon (mg of C per liter)	12
Soluble organic carbon (mg of C per liter)	< 2
PO_4 (μg of P per liter)	0
Total P (μg of P per liter)	< 10
NO_2 (μg of N per liter)	0
NO_3 (μg of N per liter)	50
NH_3 (μg of N per liter)	0
Total algae (cell/ml)	199
Algal genera	17
Diversity index	0.93

difference between the effluent phosphate concentrations of unit 2 and that of the control unit. As expected, the effluent from unit 1 contained about 2 mg more phosphate per liter than the control unit.

Effluent (600 ml settled but not centrifuged) from each of these activated sludge units was added in duplicate to laboratory microcosms prepared from mud (0.5 liter) and water (5.4 liters) taken from Table Rock Lake, an oligotrophic impoundment in southwestern Missouri. The initial characteristics of the lake water are given in Table 3. To maintain natural diversity 250 ml of the lake water was withdrawn and replaced with 25 ml of the respective effluent and 225 ml of fresh lake water, with its natural algal community, every 2 weeks. The control microcosms were made up with 0.5 liter of mud and 6 liters of lake water and were replenished with 250 ml of lake water.

The diversity indices of the microcosms are shown in Fig. 1. Each point represents the mean of the two duplicates. The difference between the two values was never more than 0.2 and was usually less than 0.1. The lake water controls developed rather stable algal communities with diversity indices between 0.5 and 0.6. This is below the 0.7 value for oligotrophic lakes but well above the 0.4 value for eutrophic lakes. The fact that the microcosm algal community was not as diverse as the lake community can be attributed to the differences between conditions in the laboratory and those in the natural environment. The diversity indices of microcosms receiving the activated sludge effluents were considerably lower than that of the lake water control (98 percent confidence level, *t*-test). The effluents from activated sludge units 2 and 3 caused even lower diversities than the effluents from unit 1, but the differences are significant only at the 95 percent confidence level.

All the waste water microcosms developed eutrophic conditions, with growths of blue-green algae well in excess of 1000 cell/ml, predominantly *Phormidium* accompanied by two to three other algal genera. The concentrations of algae in the lake water controls remained below 500 cell/ml with the green algae *Staurastrum* and *Ankistrodesmus* often predominating, accompanied by 7 to 12 other species.

On the basis of these results, it is evident that domestic waste water will produce eutrophic conditions in receiving waters. However, the data are not in support of the often stated position that the simple elimination of the phosphates from detergents will significantly decrease the rate of eutrophication caused by the resulting waste waters. Furthermore, the data show that the "ecologically safe," high-alkalinity, high-carbonate detergents offer no improvement.

Substitution of untested detergent formulations of this sort may appear to be an easy way out politically, but there is no indication that this technique will reduce eutrophication. Eutrophication may actually increase as the result of additional alkalinity, which would be still another factor added to our overall pollution problem. A much more effective idea would be the construction of facilities for the removal of all nutrients from waste waters in those areas where algal control is a problem.

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References

1. P. H. Abelson, *Science* **169**, 1033 (1970).
2. K. M. Stewart and G. A. Rohlich, *Eutrophication, A Review* (California Water Quality Control Board Publication No. 34, Sacramento, 1967).
3. J. H. Ryther and W. M. Dunstan, *Science* **171**, 1008 (1971); D. King, *J. Water Pollut. Contr. Fed.* **42**, 2035 (1970); W. Lange, *J. Phycol.* **6**, 230 (1970); P. Kerr, D. Paris, D. Brockway, *Fed. Water Quality Agency Water Pollut. Contr. Res. Ser. 16050 FGS 07170* (1970).
4. Task Group 2610P, *J. Amer. Water Works Ass.* **59**, 344 (1967).
5. C. Sawyer, *ibid.* **57**, 1431 (1965).
6. D. Mitchell and J. Buzzell, Jr., *J. Sanit. Eng. Div. Amer. Soc. Civil Eng.* **97**, 453 (1971).
7. C. Shannon and W. Weaver, *The Mathematical Theory of Communication* (Univ. of Illinois Press, Urbana, 1963).
8. J. Wilhm and T. Dorris, *BioScience* **18**, 477 (1968).
9. H. Wiener, thesis, Washington University, St. Louis (1966).
10. Soap and Detergent Association, *J. Amer. Oil Chem. Soc.* **42**, 986 (1965); *ibid.* **46**, 432 (1969).

26 April 1971; revised 12 August 1971

Asymmetry, Its Importance to the Action and Metabolism of Abscisic Acid

Abstract. *Unlabeled and* ^{14}C*-labeled enantiomorphs of abscisic acid (ABA) were obtained through acetylcellulose chromatography and tested as inducers of abscission, as inhibitors of seed germination, and as antagonists of gibberellic acid-induced synthesis and release of α-amylase. The activity of the* R *isomer was either equal to or less than that of the naturally occurring* S *form. Greatest differences were in the inhibition of root-related growth. In excised beam axes, although uptake of* S-[^{14}C]*ABA is faster, the internal concentration of* R-*ABA is higher because of faster conversion of* S-*ABA to inactive metabolic products. In axes a reversal in chirality is less important to the physiological action of ABA than to its metabolism.*

Abscisic acid (ABA) has been implicated in the regulation of a host of physiological responses in higher plants (*1*). Apparently the S isomer is the only naturally occurring form, but the other enantiomorph can be obtained by resolution of the synthetic racemate (*2*). This makes ABA the only optically active plant hormone for which both enantiomorphs are available. The only record of the relative effectiveness of these enantiomorphs consists of a statement by Milborrow to the effect that R- and S-ABA are equally active in inhibiting the coleoptile growth of dissected wheat embryos (*3*). We report a new procedure for the resolution of RS-ABA, the synthesis of R-[2-^{14}C]- and S-[2-^{14}C]ABA, and data on the relative effectiveness, uptake, and metabolism of these optically active substances.

RS-ABA can be separated from the accompanying *trans* analog obtained in the synthesis of Roberts *et al.* (*4*) by crystallization from ethyl acetate–toluene (1:3). Resolution is achieved in two steps; enantiomorphic enrichment on an optically active chromatographic column and selective solubilization of the optically active component with a hydrocarbon solvent containing a low percentage of a hydrogen-bonding compound (*5*). Chromatography of 80 mg of RS-ABA on a column of acetylcellulose (Woehlm) and elution with 3.3 percent ethanol in toluene in subdued light at 4°C leads to about 5 percent enantiomorphic enrichment. The S isomer is eluted first. Extraction of the combined, enriched fractions from several runs with 2.5 percent *n*-butanol in isooctane (by volume), thin-layer chromatography on silica gel GF_{254} with a benzene, ethyl acetate, acetic acid system (50:5:2), to remove accompanying *trans*-ABA, yields crystalline S- and R-ABA of optical purity comparable to that obtained by Cornforth *et al.* (*2*).

S-[2-^{14}C]ABA and R-[2-^{14}C]ABA were synthesized by the same procedure as that used by us for RS-[2-^{14}C]-ABA (*6*). RS-1-Hydroxy-4-keto-α-ionone (*4*) was partially resolved on acetylcellulose columns with 3 percent ethanol in toluene at 4°C, yielding enriched S isomer in the material eluted first. Extraction with 7 percent *n*-butanol in hexane (by volume) yielded oils that

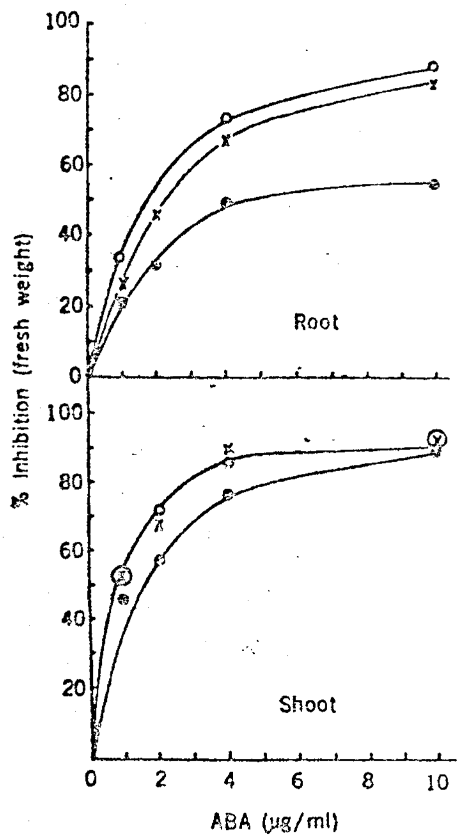

Fig. 1. Effect of ABA enantiomorphs on shoot and root growth of germinating barley seeds, *Hordeum vulgare* (var. Himalaya). The seeds were incubated in the dark at 26° to 27°C for 56 hours in 0.01*M* Hepes buffer *p*H 7.1 with 50 μg of chloramphenicol per milliliter. An average of 20 seeds was used per assay, and germination was close to 100 percent even in the presence of ABA. Shoots and roots were removed from the seeds, and their fresh weight was determined. ○, S-ABA; ×, RS-ABA; ⊙, R-ABA.

NAME: [illegible] DATE: [illegible]

ADDRESS: [illegible]

PHONE: 449 9730

REPRESENTING WHOM? [illegible]

APPEARING ON WHICH PROPOSAL: HB 914

DO YOU: SUPPORT? ______ AMEND? ______ OPPOSE? ______

COMMENTS: ______

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NAME: Kathryn McPunko DATE: 3-15-79

ADDRESS: 156 Fairway Drive - Helena, Mt.

office
PHONE: 449-3937

REPRESENTING WHOM? Board of Cosmetologists

APPEARING ON WHICH PROPOSAL: ______

DO YOU: SUPPORT? ✓ AMEND? ______ OPPOSE? ______

COMMENTS: ______

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

NAME: Thomas F. Tinkel DATE: [illegible]

ADDRESS: Helena, Mont

PHONE: 442-1550

REPRESENTING WHOM? Mont. Funeral Directors Association

APPEARING ON WHICH PROPOSAL: HB 931

DO YOU: SUPPORT? yes AMEND? ______ OPPOSE? ______

COMMENTS: ______

PLEASE LEAVE ANY PREPARED STATEMENTS WITH THE COMMITTEE SECRETARY.

NAME: Edward McGrath DATE: 2/12/89

ADDRESS: Helena

PHONE: 442-1432

REPRESENTING WHOM? Mt. Farm Bureau Assn

APPEARING ON WHICH PROPOSAL: HB 751

DO YOU: SUPPORT? ✓ AMEND? ______ OPPOSE? ______

COMMENTS: ______

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NAME: [illegible] DATE: 1-10-91

ADDRESS: 314 N Rodney Helena MT 59601

PHONE: 442-1734

REPRESENTING WHOM? Herrmann [illegible] Funeral Home

APPEARING ON WHICH PROPOSAL: HB 231

DO YOU: SUPPORT? ______ AMEND? ______ OPPOSE? [illegible]

COMMENTS: [illegible]

[illegible]

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NAME: [illegible] DATE: [illegible]

ADDRESS: Helena

PHONE: 442-8535

REPRESENTING WHOM? Funeral Directors

APPEARING ON WHICH PROPOSAL: HB 931

DO YOU: SUPPORT? yes AMEND? ________ OPPOSE? ________

COMMENTS: ________

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DATE 3/15/79

COMMITTEE ON Business & Industry BILL NO. 414

VISITOR'S REGISTER

NAME	REPRESENTING	Check One: Support	Check One: Oppose
John [illegible]	Mt Council [illegible]	✓	[illegible]
Scott Fisher	Prickly Pear Sportsmen's Club	✓	
Margaret [illegible]	Mont [illegible] Assn.		✓
[illegible]			✓
[illegible]	Republican (?) Dist 99 (?)		✓