The new pollution

Urbanization, increased use of fertilizers and detergents, and, paradoxically, advances in wastewater treatment are accelerating the problem of eutrophication. The problem and a relatively low-cost method of control are described.

GILBERT V. LEVIN, M. ASCE, Director, Life Systems Division, Hazleton Laboratories, Inc., Falls Church, Va.

This paper was originally prepared for the International Conference on Water for Peace, Washington, D.C., May 23-31, 1967

Like the water it afflicts, the shape of the pollution problem constantly shifts and changes. The relatively recent and unanticipated emergence of nutrient pollution, or "eutrophication," as a major problem in lakes and estuaries around the world is a prime example of this characteristic.

As a result, the magic word in pollution circles today is "phosphate." In less than a quarter of a century, and particularly within the last three years, this previously unrecognized pollutant has been catapulted to the forefront of scientific and public scrutiny in the quickening effort to clean up rivers and lakes.

The intense interest in phosphates centers about a belated recognition that the traditional objectives of wastewater treatment—the removal of particulate matter and the reduction of the biochemical oxygen demand—no longer suffice to protect surface waters from pollution. Biological oxidation, as practiced in nearly all wastewater treatment processes, liberates the mineral constituents of the organic matter treated. These go into solution and are discharged in the treated effluent. The resulting fertilization, or eutrophication, of receiving waters can promote undesirable, luxuriant growth, or "blooms," of aquatic vegetation, particularly unicellular algae. Such blooms produce obnoxious odors when decaying, preclude recreational use of the water, are sometimes toxic to desirable aquatic and terrestrial forms of life, clog water supply intakes and filters, and generally result in esthetic and economic degradation. Perhaps, excluding the health problem, the effects are as bad, or worse than, those caused by direct discharge of raw sewage.

Factors in the problem

Several factors have acted together to bring the phosphate pollution problem into sharp focus. First, intensive urbanization and increased per capita water consumption concentrate burgeoning quantities of wastewater into local areas of receiving waters. Next is the dramatic rise in phosphate consumption, most of which is attributable to agricultural fertilizers and household detergents. A portion of the former reaches our surface waters by runoff, and almost all of the latter is discharged into sewerage systems. Moreover, the new biodegradable detergents, while solving the problem of foaming, contain considerably more phosphates than the products they replace.

The impact of the increased use of phosphates is compounded, strangely enough, by advances in wastewater treatment. The processes have become more efficient at degrading organic matter, thereby releasing larger quantities of inorganic phosphates. Similar increased efficiency in solids removal has reduced effluent turbidity, resulting in increased penetration of sunlight. The fertilized waters and abundant sunlight promote rapid and extensive growth of photosynthetic organisms (see photo).

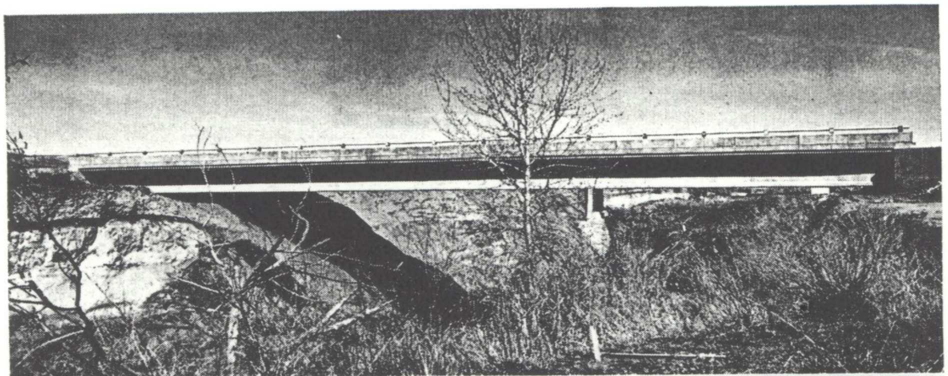
As a consequence, changes in natural bodies of water which would have required thousands of years through normal eutrophication processes, have been brought about in five to ten years by wastewater discharge. Prominent examples include the Madison, Wisconsin, lakes,[1] Lake Washington,[2] Lake Zoar, Lake Sally, and Lakes Geneva and Zurich. National attention has been drawn recently to the potentially serious eutrophication of the Potomac estuary and Lakes Michigan and Erie. Acting on this threat, even before adequate phosphate removal methods have been devised and tested, various Federal state and local authorities recently advocated or imposed severe phosphate limitations or treated effluent discharged in certain areas.

Under provisions of the Federal Water Pollution Control Act (Public Law 84-660, as amended through 1966), the Secretary of the Interior of the United States convened an Enforcement Conference on Lake Erie. The five Lake Erie watershed states summoned to the Conference—Michigan, Indiana, Ohio, Pennsylvania, and New York—agreed to a uniform set of pollution abatement measures to protect the lake. Acting to meet these requirements, the State of Michigan Water Resources Commission and the City of Detroit agreed that the City remove at least 80 percent of the soluble phosphate in its sewage prior to discharge. The only pollution control standard imposed by the City-State stipulations on Detroit's 700-mgd sewage treatment plant which cannot readily be attained through conventional treatment processes is that of phosphate removal. All municipalities within the Lake Erie watershed of the five states must, under terms of the Enforcement Conference, impose similar phosphate control over sewage effluent. In addition to Detroit, prominent cities now facing this problem include Cleveland and Buffalo.

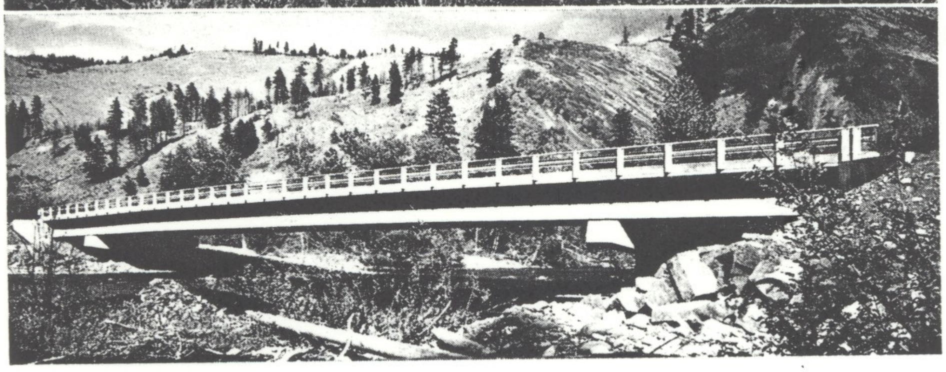
Out of similar fear of the eutrophication problem, the State of Virginia, through its Health Department and Water Control Board, has refused to permit the town of Manassas to discharge treated sewage effluent into the tidal area of the Potomac River in metropolitan Washington unless phosphate removal is accomplished.

Why phosphorus?

Why has the pollution control finger been pointed at phosphorus when, obviously, other elements are also essential for algal growth? Those elements appearing most amenable to control from the standpoint of metabolic requirements compared to background levels were determined to be nitrogen and phosphorus by numerous investigators. In recent years, phosphorus in



③



④

of a constant depth and heavily reinforced over the piers for the large negative moment; it will have about half as much reinforcing at the middle of the span to resist positive moment. This type of slab is usually supported on concrete piles, or columns, topped with a concrete cap. It appears that the constant depth slab and the pile cap combination is a carry-over into concrete form from the timber trestle type of construction with piles, caps, and and stringers. The structure illustrated carries HS-20 loading on a roadway 26 ft wide with 2-ft curbs. Its spans of 32-40-40-40-40-32 ft have a straight-line haunched slab and rest on prestressed concrete piles without caps. The slab is 1 ft 9 in. deep over the piers, 1 ft 1 in. deep in the middle of the spans, and is reinforced with nearly the same amount of steel for both the negative and positive moments.

Adams Street Bridge in Connell, photo 2, represents the same concept and system as the Samish River structure. But during the planning process, after analyzing the bridge as a reinforced concrete structure and estimating that the main flexure reinforcement would cost about $8,000, the designer replaced the steel with an equal value in prestressing force to be installed in the field. Much less than $8,000 was required to buy the required strength in prestressing strands. Less concrete was necessary in the slab—and then the foundation piles could be reduced.

The final design was a concrete slab bridge cast in place, with spans of 36-46-36 ft, planned for HS-20 loading on a roadway 28 ft wide with 3-ft sidewalks. Readily available 4,000 psi concrete was delivered by truck mixer. Because the forms were free of layers of closely spaced reinforcement, the concrete could be placed quite dry. A maximum slump of 2 in. was permitted; Plastiment was used to increase workability. Flex-tube ducts containing the stressing strands were secured in the forms for their required profiles. The strands were stressed and grouted after slab concrete had attained the 4,000 psi strength. Two men performed all stressing and grouting in less than two days.

Dry Creek Bridge, near Walla Walla, photo 3, is a precast, prestressed concrete girder structure 141 ft long. It has spans 10-120-10 ft, a 28-ft roadway, 1.5-ft curbs and concrete rail bases. It carries HS-20 loading on four lines of concrete girders at 8-ft centers. This structure differs substantially from the ordinary, simple-span prestressed concrete girder configurations used in bridges. The Dry Creek Bridge is a concrete grill formed by the four girders and heavy and deep concrete endwalls, which encase all four girder ends and retain the earth embankments, intermediate diaphragms and concrete roadway slab. The system is torsionally stiff and stiff in flexure. It distributes wheel loads better than bridges without the flexure restraints—the endwalls—at girder ends.

Considerable variation is possible in precast girder structural efficiency. The girders used for this structure are 4 ft 10 in. deep, with top and bottom flanges 25 in. wide and a 6-in. web. The combination of 7,000 psi concrete with about 1,100,000 lb of prestressing force in each girder forms a very efficient (light and strong) structure with the necessary flexural resistance. It is difficult to transport girders 140 ft long. Girders for the Dry Creek Bridge were cast in halves, transported 300 miles, and joined by epoxy adhesives and field prestressing before launching (on dollys over the adjacent old bridge, note old pier) and erection. Any other system would have been more costly, for the bridge crosses a deep ravine.

Naches River Bridge, near Yakima, photo 4, is a precast, prestressed concrete structure 215 ft long, with spans of 30-155-30 ft, a 26-ft roadway, 2-ft curbs, and six lines of concrete girders to carry HS-20 loading. The system is similar to the Dry Creek Bridge, except that the concrete girders are 214 ft long. A different type of girder, 5 ft deep and with a wide top flange, is used. The grill system is similar to the Dry Creek Bridge with massive endwalls; two piers are used with no abutments. Because girder top flanges are wide, the roadway slab is only 4½ in. thick. The long girders were manufactured in 62-90-62 ft lengths; voids were provided for threading post-tensioning tendons in the field. Timber falsework bents in the river were used at the field joints during erection. Splice joints 8 in. wide were filled with 7,000 psi concrete and cured; tensioning wires were threaded through each girder—two tendons with twelve ½-in. strands and one with eight ½-in. strands—and promptly stressed. Tendon grouting was postponed until spring since there was 2 ft of snow on the ground during stressing operations. The resulting structure accomplished the requirement of providing a clear passage across the stream with an economical structure.

The four structures illustrate the practical use of the three objectives discussed earlier—to achieve economy, efficiency, and an engineer's type of esthetics in a small concrete bridge. There are no limitations to variations, design layout and configuration possibilities that one may choose to meet these objectives.

the form of dissolved, inorganic orthophosphate—reported[3] to be the only form in which the mineral can be utilized by algae—has been singled out as the principal target. The reason is that blue-green algae, frequently the first type setting off a bloom, can fix nitrogen from the atmosphere. Hence, removal of nitrogen from sewage effluent might not prevent blue-green blooms which, in turn, would release nitrogenous compounds for subsequent blooms of green algae.

One important question remains in the attempt to control algal blooms through the removal of available phosphorus in sewage effluent. If most of the phosphate can be removed from sewage effluent, will it do any good or will the phosphate in agricultural runoff be sufficient to trigger intensive algal growths? No unequivocal answer to this question has yet been demonstrated.

"Minimum" phosphate levels capable of giving rise to algal blooms have been cited over several orders of magnitude by various experts. The range extends from 10^{-5} mg/1 to 10^{-1} mg/1 of phosphate.[4, 5] In a study of surface waters in Illinois[6], the mean orthophosphate content of eight lakes and reservoirs was found to be 0.036 mg/1 (milligrams per liter) compared to the average orthophosphate concentration of 0.411 mg/1 in streams known to receive sewage effluent. Based on calculations, these investigators attributed approximately 45 percent of the inorganic phosphate found in the streams to land drainage. In an experimental approach to the problem, it was reported[7] that effluent from the Washington, D.C., Water Pollution Control Plant grew algal populations in proportion to the amounts of phosphate added. The inference is that the wastewater effluent, already relatively rich in phosphate, sustains increased algal growth with added phosphate. Hence, it would seem that phosphate removal would exercise a significant degree of algal population control. These findings have been supported by additional research recently.[8, 9]

Effects of eutrophication on the Potomac River near Washington, D.C. Mats of floating algae and rooted plants develop where tributary discharges treated sewage effluent. (Photo courtesy of Interstate Commission on the Potomac River Basin.)

Phosphate removal

Recognition of the role of phosphate in algal blooms was accompanied by various attempts at phosphate reduction in wastewater effluent. Most of these attempts centered about the addition of chemicals capable of precipitating phosphate. The use of effluent lagoons to grow and contain the algae was investigated. Distillation, ion exchange, and absorption were also considered as was the use of algacides. Each of the contemplated processes had one factor in common—a requirement for tertiary treatment of the entire sewage flow. This would result in a major increase in the capital and operating costs of wastewater treatment.

In 1960, the writer began a personal involvement with the phosphate problem when, at the suggestion of Dr. Joseph Shapiro[10], he started a research program to explore the possibility of removing phosphate through the metabolic action of sewage microorganisms. Reports from India[11] and The Johns Hopkins University[12] strongly hinted at the possibility of such a treatment process. The ensuing research[13, 14] identified the source and mechanism of phosphate release in activated sludge treatment plants and devised a phosphate removal process compatible with activated sludge treatment.

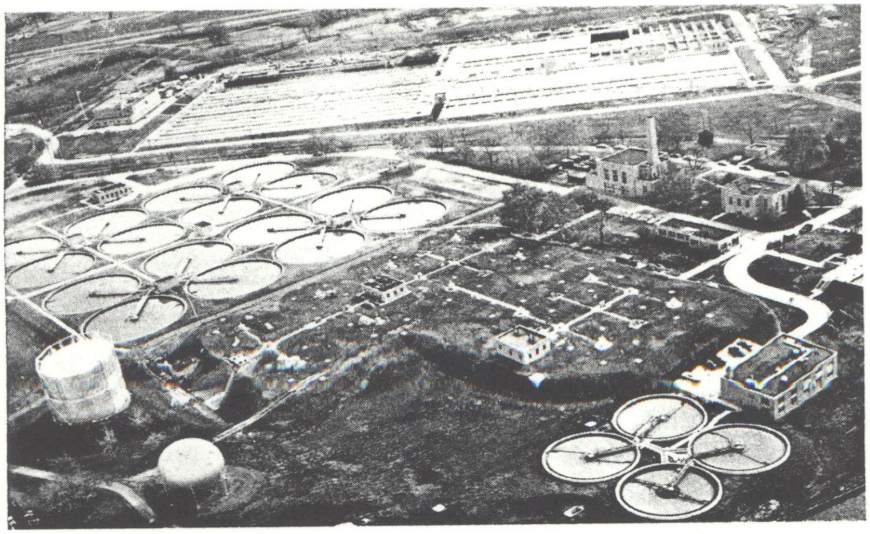
It was found that the principal sources of phosphate release were the secondary settling basins, the sludge thickeners, and the digesters. The mechanism of release in each of these sites was the imposition of anaerobic conditions on the sludge organisms. Denied oxygen, the organisms cannot exert the energy necessary to maintain internally stored phosphate against the concentration gradient across the cell membrane. Phosphate quickly leaks out of the cells into the liquid phase of the sewage. Additional quantities of phosphate are released directly from dead organic matter degraded in the sewage treatment process.

The research established the fact that sludge organisms can readily be induced to take up quantities of dissolved orthophosphate in excess of those required for growth. This uptake can be effected without the addition of carbohydrates or any other energy compounds. The rate at which oxygen is applied to the mixed liquor of activated sludge is the single most important factor in inducing phosphate uptake. Under anaerobic conditions, or in the absence of sufficient oxygen, dissolved phosphate leaks out of sewage microorganisms. The active fraction of the mixed liquor responsible for phosphate uptake is the return sludge; the pH of the mixed liquor vitally affects orthophosphate uptake, but, fortunately, the normal pH range of the mixed liquor is satisfactory.

In laboratory experiments which sought to optimize the above factors, orthophosphate uptake of as high as 80 percent was achieved. To the limited extent possible with existing equipment, operation of the District of Columbia Water Pollution Control Plant, treating 180 mgd of wastewater, was modified in accordance with the research findings. For a period of five days, dissolved orthophosphate removal averaged better than 15 percent for the one-third of the plant operated as a test unit compared to the remaining two-thirds operating in normal fashion as a control.

"Biological conveyor belt"

A secondary treatment plant capable of removing high percentages of dissolved, inorganic orthophosphate was designed based on the research.[13,14] Essentially, the activated sludge microorganisms are induced to take up phosphate through increased aeration of the mixed liquor in which the solids content is controlled. To increase the degree of phosphate removal, based on laboratory experiments, a "biological conveyer belt" is incorporated into the



The District of Columbia Water Pollution Control Plant, where the preliminary full-scale experiment described in the text was performed. (Photo courtesy of the D.C. Department of Sanitary Engineering.)

scheme. This is accomplished by removing the phosphate-rich microorganisms from the aeration basin and placing them in a "phosphate stripper" tank where they are induced to give up their phosphate. The phosphate-depleted organisms are then used as return sludge. The supernatant from the phosphate stripper is treated with lime to precipitate the phosphate. The amount of sludge in excess of that required to be returned to the aeration basin is not stripped of its phosphate, but is taken directly to an incinerator where the phosphate is bound into the ash. The process restricts the lime treatment to a small percentage of the total flow in which most of the phosphate has been concentrated through the biological action.

In conjunction with the phosphate pollution problem at Manassas, Va., another laboratory program was undertaken to refine the process design and operating parameters. A fairly consistent ability to remove more than 80 percent of the dissolved orthophosphate in mixed liquor was developed which, on occasion, demonstrated removals as high as 95 percent within a three-hour treatment period. The amount of oxygen consumed, rather than the amount applied as in the previous research program, was determined. This program also showed that the total quantity of oxygen required is less than one-fifth of the application rate thought necessary on the basis of the earlier work. A simplified, cheaper way to induce the sludge to give up the accumulated phosphate without damaging the ability of the cells to take up additional phosphate was found. It merely utilizes the anaerobic conditions which cause phosphate release. This work[15, 16] resulted in the design of the process shown in Fig. 1. Preliminary estimates on the phosphate removal process indicated a cost beyond normal secondary treatment of somewhat less than \$50 per million gal. While appreciable, this compares to approximately \$140-\$190 per million gal of sewage subjected to lime precipitation as a tertiary treatment process for phosphate removal.

Bridging the gap

If good engineering practice is to be followed in bridging the vast gap from the laboratory flask to the plant treating hundreds of millions of gallons per day, pilot plant experience is necessary. The writer has been retained to conduct a pilot study on phosphate removal for the City of Detroit. A 150,000-gpd pilot plant capable of investigating the metabolic process described here and many variations is currently under construction at the Detroit Wastewater Treatment Plant. The study will seek to establish design criteria for new construction and improvements to the Detroit Wastewater Treatment Plant for its ultimate flow of 1.2 bgd.

Eutrophication raises an interesting philosophical question. Recently the definition of pollution has been extended to include thermal pollution. Should a further extension of this concept now include sunlight? In some instances, sunlight qualifies even under the strict definition which requires that the pollutant be added by man. For example, if nutrient-rich sewage effluent is discharged into an artificial reservoir where desilting takes place, the clarification of the waters will introduce additional sunlight resulting in the objectionable products of eutrophication.

Agricultural runoff

Although wastewater phosphate removal can help, an attack on eutrophication through phosphate control cannot overlook the role of agricultural runoff. Better fertilizer application methods and farming procedures may

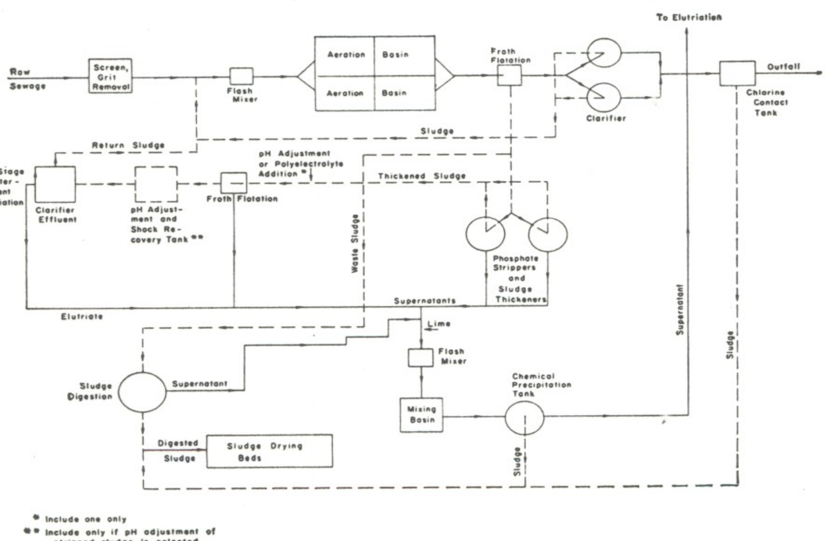


FIG. 1. Flow sheet for proposed phosphate removal process.

considerably reduce the amounts of phosphate entering surface waters. A joint approach through wastewater treatment and agricultural practices offers the best prospect for the quickest control of eutrophication. This goal amply warrants continued research in the former area and the initiation of specific research toward phosphate runoff control in the latter.

Finally, careful ecological studies of surface waters are needed for proper appreciation of the many interrelated facets of the water pollution problem. When substances are introduced or removed from the biosphere or conditions are changed, a chain of events is generally initiated. The course of these events must be properly anticipated or controlled to preclude surprises from future "new pollutants," whether in the form of newly added substances or unmasked ones long present.

REFERENCES

1 Governor's Committee Report No. 2, "Investigation of the Odor Nuisance Occurring in the Madison Lakes, Particularly Lakes Monona, Waubesa and Kegonsa from July 1943 to July 1944," State of Wisconsin, Madison, 1944.

2 Edmondson, W. T., et al, "Artificial Eutrophication of Lake Washington," *Limnology and Oceanography*, Vol. 2, 1956, p. 1.

3 Katchman, B. J., "Phosphates in Life Processes," *Phosphorus and Its Compounds*, Van Wazer, ed., Vol. II, New York, Interscience Pub. Inc., 1961, p. 1,283.

4 Mackereth, F. J. "Phosphorus Utilization by *Asterionella Formosa* (Hass.)," *Journal of Experimental Botany*, Vol. 4, 1952, p. 12.

5 Sawyer, C. N., "Biological Engineering in Sewage Treatment," *Sewage Works Journal*, Vol. 16, 1944, p. 925.

6 Englebrecht, R. S. and Morgan, J. J., "Studies on the Occurrence and Degradation of Condensed Phosphate in Surface Waters," *Sewage and Industrial Wastes*, Vol. 31, 1959, p. 458.

7 Shapiro, J. and Riberiro, R., "Algal Growth and Sewage Effluent in the Potomac Estuary," *Journal of Water Pollution Control Federation*, Vol. 37, 1965, p. 1034.

8 Abbott, W., "Microcosm Studies of Effects of Single Doses of Nitrate and Phosphate on Estuarine Ecology, *Journal of Water Pollution Control Federation*, Vol. 39, 1967, p. 113.

9 Personal communication from Dr. Hans Bouveng, Swedish Water and Air Pollution Research Laboratory, Stockholm, during visit to author's laboratory, Oct. 26, 1966.

10 Then Assistant Prof., Dept. San. Engineering, The Johns Hopkins Univ., Baltimore, Md.

11 Srinath, E. G., et al, "Rapid Removal of Phosphorus from Sewage by Activated Sludge," *Experientia*, Vol. 15, 1959, p. 339.

12 Alarcon, G. O., "Removal of Phosphorus from Sewage," Master's essay, The Johns Hopkins Univ., Baltimore, Md., May, 1961.

13 Levin, G. V., "Metabolic Uptake of Phosphorus by Sewage Organisms," Doctoral dissertation, The Johns Hopkins Univ., Baltimore, Md., April, 1963.

14 Levin, G. V., and Shapiro, J., "Metabolic Uptake of Phosphorus by Wastewater Organisms." *Journal of Water Pollution Control Federation*, Vol. 37, 1965, p. 800.

15 Levin, G. V. and Shaheen, D. G., "Development of Sewage Treatment Process to Effect Metabolic Removal of Phosphorus." Hazelton Laboratories, Final Report to Wiley and Wilson, Lynchburg, Va., Sept. 30, 1965.

16 Levin, G. V. and Shaheen, D. G., "Metabolic Removal of Phosphate from Sewage Effluent," Presented before the American Chemical Society Division of Microbial Chemistry and Technology, New York, N.Y., Sept. 12, 1966, in press.

Engineering education—a consulting engineer's view

WILLIAM J. CARROLL, M. ASCE, Vice President
James M. Montgomery, Consulting Engrs., Pasadena, Calif.

The young engineer entering a private engineering office steps into a business. It is a professional business but still **business.** And the prime purpose of business is to make money. It can be called "striving for economic performance" and colored with other purposes but making money is a prime requisite to staying in business to practice the profession we enjoy.

What we have to sell to make this profit is the work product of men, not machines. This work product—in our particular field—requires imaginative thinking and the ability to translate this thinking into practical solutions, and then further translating the solutions into designs that can be constructed. This is not an easy task. It requires engineers who are adequately prepared in the fundamental sciences, have a thorough understanding of practical design, and have experience in the fields of economics, planning, construction, and public relations. Yet in addition these engineers must be capable of changing with the times; as science and research develop new ideas and materials, they must have the flexibility and basic training to be capable of adapting these new concepts into an improved environment.

It is difficult to train men to fill these roles, but it must be done. In my opinion it is being done satisfactorily under the present method of engineering education, which includes advanced degrees for a large percentage of engineers. There is considerable debate about changing the engineering curriculum and related factors, such as time in school, elimination of specialities, degrees offered, and the like.

What we want is an engineer with a good background in basic sciences and the capability of interpreting new concepts within the framework of these basic sciences, yet with a practicality and a design capability that will help us make a profit today. If he is trained only for the sophistication of the future, he is no good to us today and we can not use him. Conversely, if he is educated so narrowly that he can not grow and adapt to the future, he becomes technically and professionally obsolete. We could then no longer consider him as a useful component of our engineering profession and we would have to discard him.

I favor a balanced educational system for engineers. This term connotes a responsibility both for the educational institution and the practicing consulting engineer. It is not possible for the educational institution to train the engineering student in the minute details of our work. Proper orientation, indoctrination and on-the-job training is necessary and an obligation owed the young engineer by the consulting engineer. The educational institution has an obligation to the student to educate him so that he can readily absorb his on-the-job training and quickly become a producing member of the organization. Those of us engaged in the management of an engineering business and in designing engineering facilities must be part-time educators, part-time students and part-time practitioners of the science and art of engineering.

In the long-range picture the technological growth of the young engineer is imperative. The continuing education of the engineer that keeps him in the "technological stream" and permits him to adapt to changing conditions is the responsibility of all of us—the consulting engineer, the educational institution and the young engineer himself. The educational institution has a responsibility to teach him the basic course upon which he can build, and then to provide the opportunity for him to return to school and permit this building sequence to occur. The consulting engineer has a responsibility to motivate the young engineer to continue his education. Not only the young but all engineers must be willing to continue their learning to compete as valuable members of the profession.

Engineering education is an important field for all practicing engineers, and the continued interest and participation in it by consulting engineers is imperative.

THE READERS WRITE

Words to the Secretary on . . . Specialization and Social Responsibility in Civil Engineering

I agree fully with your comments relative to the "humanities" in engineering education in "Specialization and Social Responsibility in Civil Engineering," (February, p. 31). I cannot agree, however, that courses in the humanities should be taught to engineering students by engineering faculty. More than information in some other field, the civil engineer needs contact with the minds prevailing in other fields. This would have a far more broadening effect upon the civil engineer than mere information filtered through an engineering mind. Engineering is not the only profession that needs broadening, but it needs it more than many others.

Some efforts in this direction of broadening could be done in CIVIL ENGINEERING—as a beginning, a wider selection of articles outside of, but immediately adjacent to, the engineering field. There could also be some notice taken of the activities of civil engineering members in fields outside design and construction. The magazine could very well run a column reviewing books or articles written by members of ASCE, as one possibility.

A. BRINTON CARSON, M. ASCE
Chief, Inspection Division
Bureau of Eng. and Construction
Commonwealth of Pennsylavnia

Harrisburg, Pa.

Assistance for foreign engineers

TO THE EDITOR: The ideas in the article "Exporting Engineering Services," (CIVIL ENGINEERING, November 1966, p. 80) and emphasized again in the Metropolitan Section ASCE, Newsletter Overseas Edition of Feb. 15, 1967, merit further consideration. The article reported comments of an engineering trade mission to South America; it included the statement, "Most of the work is tied to foreign financing since nearly all development is done with foreign money. However, it was found that recipient countries generally resent the requirement of lending agencies for foreign consultants. In almost all countries the local engineers feel competent and their governments feel they are competent."

This is a very difficult area since its boundaries are the national conveniences of both the creditor and the debtor countries and the code of ethics. It is my personal opinion, with which many South American engineers will agree, that:

- We need assistance in planning, design and construction of large civil works, mainly in the hydroelectric and water control fields. We do not yet have the necessary experience or the research facilities for achieving the maximum utilization of the funds invested.
- This assistance should be given by very well qualified personnel. Otherwise we get neither the best solution for our problems nor the top experience we need for future development projects.
- We feel competent to plan, design and construct water supply and sewerage works, roads and the like. Planning of these projects by foreign engineers results in over design and in excessive cost of engineering and construction, which is a waste of money needed for our development.
- We do not resent being assisted and directed by competent and experienced engineers, working directly in the recipient country, on projects for which we really need assistance.

It seems desirable for the lending agencies to investigate for each country the capability of local engineering and construction forces to determine the requirements of foreign assistance.

HERNANDO GONZALEZ-HURTADO, M. ASCE
Consulting Engineer

Cali, Colombia, S.A.

For engineers in private practice

TO THE EDITOR: I am pleased that you printed "How the Cities Solved Their Transportation Problems: A Fable," by Wilfred Owen (CIVIL ENGINEERING, Feb. 1967, p. 42). Although it would be convenient and expedient to rationailze that the message it contains is directed principally at policy-making officials of the several levels of government, the professional civil engineer would do well to sift this challenge through his technical-social conscience and examine objectively and thoughtfully his commitments to traditions. A superb article—and may there be more of this scope and quality!

M. B. MCPHERSON, M. ASCE
Project Director
Eng. Sciences Lab.
Harvard Univ.

Cambridge, Mass.

Words to the Secretary on . . . Your Place in Your Local Section

Years ago, when I was still a Junior Member, I had the opportunity to attend a Local Section meeting. At the time, in addition to being fairly young in the profession, I also worked for the government. All during the business session of the meeting both categories of engineers, i.e., young and/or government employed, were so thoroughly castigated by the old-time members of the Section that I left the meeting determined to never attend another one anywhere until I attained Member status.

As my employment took me to various places in the world, my address change data would eventually fall into the hands of a Local Section that would contact me, not welcoming me to its jurisdiction, but with a statement—"Your Local Section dues are $______." Sometimes those notices came from Sections hundreds of miles away. Needless to say, the bold effrontery of the approach caused me to take no action other than to treat the notice as "junk mail."

The above is not an indictment of every Local Section as I am certain there are some that do not practice what I have experienced. But I do say my reactions to the few that have been my source of contact have caused me to tar every section with the same brush.

Now that I have had many years in the profession and my engineering experiences have been most varied, I have no desire to associate with a Local Section for, not being in the local "know," I would be regarded as in interloper in the "cell" and would have to spend several years before final acceptance as an engineer and one of them.

Maybe my experiences have been shared by others. If so, perhaps it would be a good idea for Local Sections to examine themselves before criticizing the ASCE member in their midst who shows no interest in their activities.

JAMES W. DARLING, F. ASCE
Advance Planning Div.
Base Devel. Office

Da Nang, Vietnam

More on failures

TO THE EDITOR: Some of the many causes for failure of bulkhead and excavation bracing (CIVIL ENGINEERING, Jan. 1967, p. 72) are little understood, for example:

(a) Lack of consideration of construction operations, (b) scheduling and designing adequately fixed supports, (heels, tie-backs, etc.) before installation of shoring, (c) adequate backfilling between the exterior face of the sheetpiling and the undisturbed banks, (d) tracking down sources of ground water flow, etc.

The most frequently neglected variable in all sheeting jobs is the parameter of Time. An experienced shorer can "sense" a potential danger by speed of installation and correctly appraising the time vs. exposed-height of unprotected bank relationship for the particular soil he is working with. Earth banks under certain conditions can maintain steep slopes during construction for a limited time, giving builders and/or general contractors a false sense of security.

It is suggested that ASCE sponsor a state-of-the-art symposium. Hopefully out of this effort will come a fresh awareness for the need to use sheetpiling properly and to plan for its installation before it becomes an emergency or a remedial procedure. The article by Messrs. Sowers, critical of current installation methods, can serve to stimulate further discussion and implement an up-to-date code of procedure.

LEON LEVY, F. ASCE
Urban Foundation Co., Inc.

New York, N.Y.