LABORATORY of the Life Systems Division, located at Reston, Virginia, has chemistry, virology-microbiology, radiobiology, bioengineering sections to study all aspects of water supply and pollution.

Laboratory Provides Consulting Services And Routine Analysis For Water Pollution Control

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The subject of environmental pollution must loom high in the activities of any organization broadly concerned with the life sciences. One of the major research problems currently defying the water pollution control experts is that of eutrophication, or fertilization, of our rivers, lakes and estuaries with dissolved minerals extracted from sewage during the treatment process. The principal culprits are dissolved nitrates and phosphates which foster a high rate of photosynthetic activity in the receiving waters. The result is the annual occurrence, in spring or summer, of green carpets of algae covering the water surface. Their sheer numbers cause their death, and the ensuing decay produces conditions in the river tantamount to those which would have occurred if the sewage had been discharged without treatment. Recently, the Life Systems Division at Hazleton Laboratories, Reston, Virginia, developed a process which seeks to control this objectionable growth through the removal of phosphate from the sewage effluent. If successfully applied, this process could have far-reaching effects on the nation's waterways.

Laboratory offers consultation and analytical services

The laboratory of the Life Systems Division plays three basic roles in its water pollution control program. First, it offers consulting services of individual members on its staff. Such consultants may serve industrial plants or muncipalities on specific pollution problems. Consulting services may or may not require supporting laboratory work.

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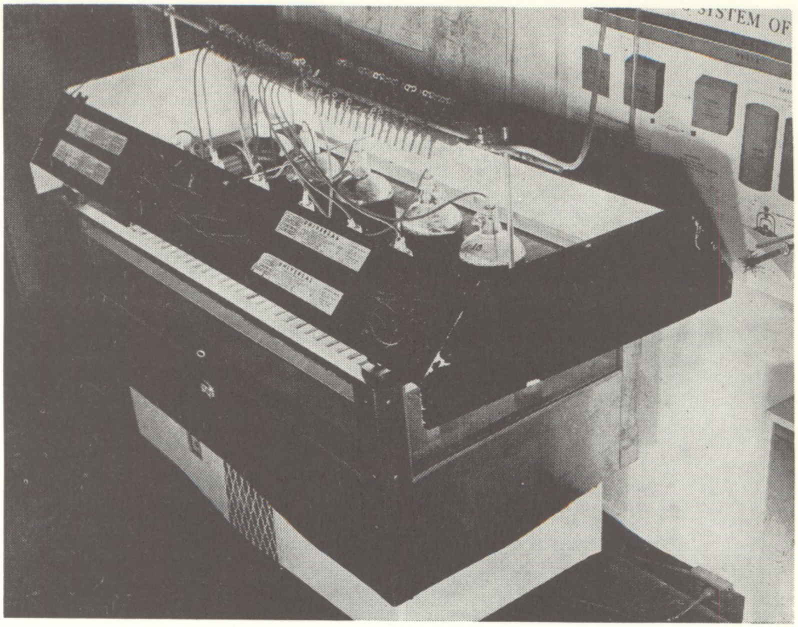
Facility's research program concentrates on dissolved nitrates and phosphates that pollute rivers, lakes and estuaries. Another important function is centered on the development of rapid methods of detecting these dissolved materials as well as detecting microorganisms.



TEMPERATURE CONTROL BOX maintains controlled temperature within a desired range to culture algae. Carbon dioxide blended in air is bubbled into the culture bottles. Fluorescent lighting furnishes the energy source for these organisms. With this set-up, staff personnel of Life Systems Division can study algal characteristics, so that pollution of water by these organisms can be prevented.

Two examples will indicate the range covered by this type of service. On the macro-scale, some residents of a very small elite community outside Washington D.C., were anxious to determine the cause of the approximately one-half-inch head of foam which consistently capped each glass of water drawn from their kitchen taps. It was relatively easy to show that the foam was caused by detergent-laden sewage which percolated into individual well water supplies from the cesspools serving these homes. The laboratory effort mounted in this case was minimum, consisting of the deposition of small amounts of fluorescent dye into several toilets, flushing the toilets and patiently waiting for the telltale green to appear in nearby kitchen taps. Requiring no laboratory services at all, a consulting job performed on the macro-scale was the preparation of a report to the Congress on the total sewage disposal problem confronting metropolitan Washington and recommended solutions.

The second role of the laboratory is the provision of laboratory services ranging from fairly routine analyses to the development of highly sophisticated techniques for determining trace quantities of complex pollutants. For example, the chemistry section of the Division has mastered very delicate techniques for the determination of pesticide residues in water and in animals and plants exposed to such contaminated water. One project, for example, requires the painstaking analysis of hundreds of wild bird wings collected by a Government agency to determine whether pollution of watering grounds inhabited by the fowl is approaching the problem stage.

Authorities at a military reservation wished to determine whether pesticides used in the foundation construction for base housing to prevent termite attack were entering nearby surface waters. Samples of water and vegetation were collected and assayed in the laboratory. The pesticide laboratory is equipped with a wide array of powerful analytical instruments including gas chromatographs with ionization and electron capture detectors, various types of recording spectrophotometers, and a flame emission atomic absorption spectrometer. In addition, thin-layer and column chromatography are used routinely as analytical tools.

In another instance, the sewage discharged from one of NASA's Space Centers in monitored for the presence of a wide range of chemicals used at the Space Center. Such analytical services may be executed in conjunction with consulting services performed by the staff or may be reported to outside clients for their own use. Sometime it is necessary to set up field stations at points quite distant from the laboratory. An example of this type of activity was the on-site investigation of a unique pollution problem occurring on Okinawa several years ago. The laboratory staff was faced with the problem of determining the source and mechanism of antimony pollution of the new water supply reservoir of an important military installation. This entailed the taking of hundred of samples of water, soil, and vegatation at the site. The samples were air-freighted back to the laboratory in the States.

Sewage microorganisms must be easily detected

The third role of the water pollution control laboratory is research and development. One of the problems associated with the use of sewage lagoons is the familar one of algae. In this case, the algae, now deliberately grown in the ponds in symbiosis with bacteria to attack sewage, escape with the pond effluent and cause problems in the receiving stream. These tiny, unicellular plants with specific gravities barely greater than unity are very difficult to remove or "harvest" from the sewage ponds. In connection with a research problem involving the mass culture of algae for other purposes, it became necessary to devise an algal harvesting system. A modified method of froth flotation was developed which can produce cell-free effluent from algal cultures. Applied to sewage lagoon wastes rich in algae, the method produced highly promising results.

Classical bacteriological methods for the detection of sewage microorganisms in water require one to three days for an assay. By the time the results become known, they are of historical interest only in that the water has generally been consumed or used for swimming. The incorporation of radioisotopes into the bacteriological assay made it possible to complete the determination within four hours. The rapid method for monitoring water pollution has been adopted by the State of Illinois as a standard procedure in emergency water supply work.

Removal of phosphate is at the top of the pollution list

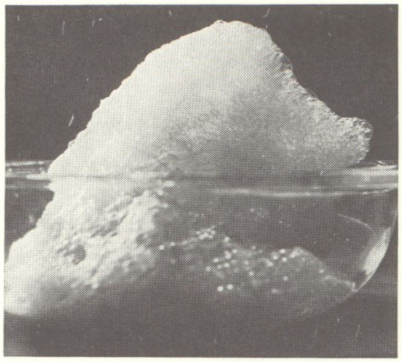
Interest is currently running very high in phosphate removal processes. A Presidential Advisory Committee has considered the problem of phosphate removal. Secretary Udall recently presided over a session in Cleveland where it was stressed that the city must remove phosphate from its sewage effluent. Detroit was told that it must do the same for its approximately 800 million gallons of sewage processed daily. Virginia requires phosphate removal from sewage effluent discharged into the Potomac in the vicinity of metropolitan Washington. Numerous treatment processes are under development to cope with the situation. However, it is hoped that the singular advantage of the "PhoStrip" process developed at the Life Systems Division is that it does not require tertiary treatment of the entire sewage flow.

In essence, the process functions as follows: Raw sewage entering the treatment plant is blended with return sludge (concentrated sewage microorganisms returned from the treatment process) in an aeration basin where diffused air is applied at rates exceeding those administered in conventional sewage treatment. A key feature of the research was the finding that the increased rate of aeration induced the microorganisms to assimilate the dissolved orthophosphate present in the sewage. The sewage is maintained in the aeration basin until most of the dissolved orthophosphate has been assimilated by the microorganisms. The phosphate-enriched microorganisms are then removed from the sewage in a liquid volume constituting only several percent of the total throughput of the sewage treatment plant. The concentrated organisms are placed into a phosphate stripping tank where they are maintained anaerobically. With no oxygen available, the microorganisms release the phosphate previously taken up. The organisms are again separated from the liquid phase, washed to remove traces of the phosphate-rich water, and returned to the aeration basin to meet incoming raw sewage. They are ready to imbibe another round of phosphate. The phosphate-rich liquor produced in the phosphate stripping tank is led into a chemical precipitation tank where tricalcium phosphate, or other appropriate precipitants are applied. The clarified supernatant may then be discharged. Excess sludge (sewage microorganisms grown or present in quantities exceeding those required for return sludge) is removed just prior to entering the anaerobic tank. It is pumped to a conventional sludge disposal system or may be flash-dried for use as fertilizer which will now be richer in phosphate than previous sludge fertilizers.

Phosphate concentration is monitored

An attractive feature of the process is that it is quite compatible with conventional activated sludge treatment so that existing plants might be modified to incorporate phosphate removal. The first plant to operate on this principle is planned at Manassas, Virginia and is scheduled to be on stream in approximately one year. It is hoped that phosphate removals of at least 50% and, hopefully, as high as 85%, will be achieved. Throughout the development of the phosphate removal process, the amount of phosphate dissolved in the liquid phase of the sewage was monitored. When the organisms took up phosphate, this was reflected by diminution in the phosphate concentration of the filtered sewage. Phosphate uptake was found to be a sensitive index for metabolic activity.

Behind the various sections of the Life Systems Division, chemistry, virology-microbiology, radio-biology, bioengineering, and water supply and pollution control, lie the complete resources of the manifold operation of Hazleton Laboratories. Thus, a wide spectrum array of life scientists, including physicians, veterinarians, pharmacologists, toxiologists, engineers, physicians, behavioral scientists, pathologists, pharmaceutical chemists, plant pathologists and others, together with the necessary supporting services and research facilities, are available for back-up wherever needed.



ALGAL FROTH, produced by a harvesting process developed by personnel of the Life Systems Division, is found in bodies of water where algae accumulate.

Dr. Levin received his doctorate in Sanitary Engineering from the Johns Hopkins University, where he also did his undergraduate work. He began his experience with 10 years of public service in the health departments of Maryland, California and the District of Columbia. His activities were in the areas of water pollution control, water supply quality, aquatic biology and sanitary microbiology. He helped found Resources Research, Inc., where, as Vice President, he offered consulting services in sanitary and public health engineering and undertook research programs in water and wastewater treatment, saline water conversion, microbiology and space biology. In 1963, Resources Research, Inc., merged with Hazleton Laboratories, Inc., where Dr. Levin is now Director of the Life Systems Division. Here he is active in programs spanning a variety of disciplines including microbiology, virology, chemistry, radiobiology, space biology, bioengineering and sanitary engineering. He is active in a number of scientific committees, has lectured to the Georgetown University School of Medicine as Clinical Assistant Professor in Preventive Medicine, and is a member of the editorial board of BioScience. □

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