# Thermal Pollution: A Threat to Cayuga's Waters?

*Ithaca, New York.* In June of 1967 the New York State Electric & Gas Corporation (NYSE & G) announced plans to build an 830-megawatt, nuclear-fueled steam electric generating plant 16 miles north of here on Cayuga Lake. Such projects inevitably raise questions of thermal pollution, for, unless a closed-circuit cooling system is used, enormous amounts of water must be drawn from the lake, river, or other body of water on which the plant is located, and then run through the plant's condensers and discharged while still warm. Nevertheless, news of the Cayuga Lake plant was at first received calmly. Little or no public criticism of the project was heard, and most people who thought about it must have assumed that construction of the plant would arouse no controversy.

In recent months, however, many of the Cayuga Lake area's leading citizens, including its most prominent politicians, have become alarmed, and they are now demanding assurances that the lake, which is regarded as one of upstate New York's prime recreational assets, will not be harmed. This aroused state of public opinion has come about largely because of a pamphlet published in June by 17 Cornell University faculty members, most of them aquatic and fishery biologists. The prime mover and chairman of this group was Alfred W. Eipper, an associate professor of fishery biology in Cornell's Department of Conservation. The Eipper group warned that, if the plant's waste heat were discharged into the lake, as planned, Cayuga might be harmed, possibly suffering a proliferation of algae that would cause its waters to look like "diluted pea soup." Cayuga, the largest of the Finger Lakes, is 38 miles long and about 1½ miles wide; it is cold and very deep, having a maximum depth of 435 feet and a mean depth of 179 feet. In summer, the lake is thermally stratified, the upper layer (epilimnion) being so much warmer (and therefore less dense) than the lower layer (hypolimnion) that the two layers do not mix, even when the surface waters are agitated by high winds. Stratification usually begins in May and continues until late October or November. The power plant would be continuously withdrawing water, for purposes of cooling, from the hypolimnion at about 45°F and discharging it to the epilimnion at about 65° to 70°F. According to Eipper and his collaborators, the plant's operations could be expected to speed up the natural process of eutrophication, whereby a lake's waters become overenriched and laden with algae and other plant growth, and thus lose much of their value for recreation and as habitat for desirable fish, such as lake trout.

The lake's period of thermal stratification—hence its season of biological productivity—would be extended by the discharges of heated water from the plant, the Eipper pamphlet said. At the same time, nutrients from the colder, less biologically productive lower layer of the lake would be transferred to the warmer upper layer. The combined effect of these alterations in the lake's natural regime would almost certainly be harmful, the pamphlet indicated, though it did not try to predict the extent to which eutrophication would be accelerated.

In concluding, Eipper and his associates said it was up to the power company to prove that the plant posed no threat to the lake. They did not, however, oppose construction of the plant. Rather, they suggested that it be built with a closed-circuit cooling system in which most of the waste heat could be dissipated to the atmosphere by evaporation from large towers. This suggestion was not calculated to please the utility, for use of a closed-circuit system entails significant, if seldom prohibitive, capital and operating costs, and may cause fogging and icing in the area. Moreover, an open, flow-through cooling system, besides being cheaper, is more efficient than closed-circuit cooling when cold lake water is available.

Eipper first became concerned about the lake after attending a meeting held in early February by Cornell's Water Resources Center, an organization set up in 1962 to be the catalyst and coordinator of water resources studies at the university. Representatives of NYSE & G had been invited to explain plans for the proposed plant. These company spokesmen, though taking the view that the plant would do no harm, conceded, during a lively discussion of possible heat pollution problems, that some questions remained unanswered and that further research was needed.

Eipper says he later went to the Water Resources Center's acting director, David J. Allee, an economist, and suggested that the center take the lead in expressing concern at the proposed plant's possibly harmful ecological impact. "I found his attitude to be rather cynical," Eipper now recalls. "His feeling seemed to be, 'you can't stop progress.' "

In these circumstances Eipper concluded that it was up to him to take the initiative. Accordingly, on 22 March he held a meeting attended by some 16 persons, most of them, like Eipper himself, professors in the Department of Conservation. Subsequently, work on the pamphlet began, continuing until late May, with Eipper preparing three successive drafts and circulating them among his collaborators for suggested revisions. Although made up mostly of biologists, the Eipper group included a geologist and two engineers, and Eipper solicited comments on the drafts from a number of engineers and other specialists outside the group. The final draft was sent to the power company and to two of the state agencies having jurisdiction over water resources—the departments of health and conservation.

Meanwhile, Allee had, in March, drafted a prospectus for research on the ecological impact of the nuclear plant on Cayuga Lake. This document confirms Eipper's view that Allee was taking it for granted that the plant would be built, with little or nothing done to prevent or mitigate possible adverse effects. This, presumably, was also the attitude of other senior people active in the center's affairs, for they had assisted in preparing the prospectus, a document remarkable in its academic detachment.

Establishment of the plant, the prospectus said, would provide a "unique opportunity to study the effects of thermal pollution" in a deep, stratified lake. Observing that the heated water discharged by the plant into the lake would, over a year's time, be equal to about one-fourth of the lake's total

volume, the prospectus said, "it is reasonable to expect that there will be an effect, perhaps a large effect, on the lake environment." It outlined a long-term study of the plant's impact and suggested that nearby Seneca Lake, a body of water similar to Cayuga but at present facing no threat of heat pollution, would give a "nearly perfect control."

The prospectus was prepared by the center with a view to approaching various sources of funding, and, in this year of tight federal research budgets, NYSE & G was an especially attractive prospect. What the company needed, however, was not a long-term academic study but some research data, produced on short order to support its applications for construction and operating licenses by showing that the plant would do no harm. The experience of other power companies in encountering strong opposition to their plans to build nuclear plants, together with the questions being raised by the Eipper group, made it unlikely that the applications would go unopposed.

In an effort to have the new plant in service by the spring of 1973 and thus meet projected power demands, NYSE & G already had undertaken, at a cost of nearly $2 million, to acquire and prepare the plant site, gambling that further progress would not be blocked by failure to obtain the necessary licenses. Eipper and others have observed that the more logical (but more time-consuming) procedure would have been to have selected the site after first determining, by ecological studies, that the plant could be built without cooling towers and yet operated without harming the lake. For the site is on a hillside, which means that, if cooling towers must be provided, extensive and costly excavation may be required.

The behavior of NYSE & G in this instance, however, is typical of the kind of utility industry practice of which Senator Edmund S. Muskie of Maine, chairman of the Senate Air and Water Pollution Subcommittee and the Democratic nominee for Vice President, has complained. According to Muskie, the utilities and the agencies which regulate them seldom have taken ecological considerations into account in the selection of power sites. The principal regulatory agencies involved in the present case are the Atomic Energy Commission and the New York Department of Health, the agency responsible for enforcing state water-quality standards (such standards are yet to be established for thermal discharges). The AEC does not now consider heat pollution in granting construction permits but is under congressional pressure to do so.

The Cornell Water Resources Center did, by late May, prepare a research plan which was more in line with NYSE & G's needs and which the company would support financially. This plan, calling for biological studies to be carried out at a cost of about $135,000 over a period of a year to 18 months, was to complement a program of physical studies undertaken by Cornell Aeronautical Laboratory, a university subsidiary in Buffalo. NYSE & G also had arranged for a biologist at the State University of New York, Buffalo, to make certain ecological studies. Thus, by summer, a program of company-sponsored research, to cost, all told, about $500,000, was under way.

The study results may turn out to be in the company's favor, for there are responsible biologists and engineers at Cornell who believe, from their own investigations, that the Eipper pamphlet was unduly pessimistic. If the results do tend to support NYSE & G's plans, they may be criticized on the grounds that the studies covered too brief a period, but it will probably not be said that they were conducted in a spirit of complacency. According to one of Cornell's most senior people, a man intimately familiar with the Water Resources Center's affairs, the Eipper group has had a definite influence on the attitude of the center's researchers in regard to Cayuga Lake and the possible heat pollution threat. Even before the published pamphlet was distributed, the circulation of early drafts of the paper within the university stirred a good deal of discussion. "During the spring," this informant recalls, "there was a kind of evolution of thought [within the center], from 'this [possible pollution] is going to happen, so let's watch it,' to 'Should this happen?,' to 'Let's try to stop it.' "

Four professors who have had a major role in the center's Cayuga Lake studies took part in the early stages of preparation of the Eipper paper and, according to Eipper, endorsed the first draft. These four later left the Eipper group, some of them, it seems, at least in part because NYSE & G had complained that their endorsement of the Eipper statement would seem to prejudice the results of their company-sponsored research.

In August, Eipper moved to set up a lay "Citizens Committee to Save Cayuga Lake," to which his group would serve as science advisory committee. Chosen as executive director of the new citizens group was David D. Comey, a 33-year-old specialist and part-time consultant on Soviet science policy, who has an independent income and is able to devote much of his time to recruiting new committee members and generating publicity.

Comey, aided by the receptive climate of opinion the Eipper pamphlet has created, appears to have been highly successful. The committee's board of sponsors now includes not only a state senator and other prominent local politicians but also a newspaper publisher, a former state commissioner of conservation, and several prominent local educators.

Thousands of copies of the pamphlet on heat pollution have been distributed, by Eipper and the citizens committee, and soon the committee may have a second politically potent document to distribute. One of Eipper's colleagues, Clarence A. Carlson, Jr., also a fishery biologist, has in preparation a paper warning of possible radiation hazards from the proposed plant's discharging of radionuclides into the lake and the atmosphere.

Although the Eipper group and the new citizens committee are admittedly conservative in their attitude toward man-made works that alter the environment, they clearly have played a useful role by creating a climate in which NYSE & G officials, Cayuga Lake researchers, and the regulatory agencies are on their mettle to see that the lake is not harmed. Mrs. Constance E. Cook of Ithaca, a state assemblywoman and a sponsor of the citizens committee, has high praise for Eipper and hopes that other Cornell professors will follow his example when they have information to contribute on important questions of public policy. "You rarely find a scientist," she says, "doing what Al Eipper did—risking his scientific reputation on an issue of this kind."

Eipper has sometimes felt that some of his colleagues at Cornell have looked askance at his stepping out of his laboratory to influence public opinion. But, for one, Hans Bethe, Cornell physicist and Nobel laureate, believes, though without passing judgment on the soundness of the pollution pamphlet, that it is entirely proper for a group such as Eipper's to speak out. "As long as they know their business, I think they should," Bethe says.

—LUTHER J. CARTER