Sport Fishery Research Foundation
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DATE: February 7, 1980

MEMORANDUM

TO: Richard H. Stroud

FROM: Robert G. Martin

SUBJECT: Project inspection trip -- "Polychlorinated Biphenyls Translocation and Environmental Control" -- Tulane University, January 24-25, 1980

Project Leader Dr. Robert R. S. Reimers had carefully prepared for the project review session. As noted by the attached copy of the agenda, I was able to interview each of the project advisors and graduate students currently associated with the project.

The project, initiated in August of 1977, is now entering the final segment and is scheduled for completion by November, 1980.

A summary of project progress, by major activity, follows.

A. Translocation and bioaccumulation studies

No additional findings have been obtained since the last (November, 1979) report concerning the PCB translocation rate (euphemistically referred to as "half life" in previous reports). As previously noted, the PCB body burden in fish collected in the stream segment nearest the plant outfall has decreased by one half over each 21-month period. The PCB body burden from fishes collected at this station still averages above 5 ppm.

Analysis of fish collections obtained from (downstream) reservoir stations indicate a doubling of PCB body burden values on an average of 40 months. However, the PCB concentration in fish is usually below 2 ppm in reservoir fishes. This pattern suggests a gradual downstream movement of the PCB laden sediments over time, probably as a result of periodic flooding and associated downstream sediment movement. Confirmatory PCB analysis of these

collections has been obtained at no cost to the project by the project leader from Enviro Medical Laboratories, Inc., Baton Rouge, Louisiana. (This represents a substantial savings to the project and adds increased confidence within the scientific community as to the results reported to date).

As the rate of increase in PCB concentration in reservoir fishes (doubling in 40 months) is much less than the rate of decrease in stream fishes (decreasing by ½ in 21 months), apparently a considerable amount has been covered by silt and thus effectively prevented from entering the fish food chain. Soil and sediment core samples will be collected from the stream bottom, flood plain, and reservoir over the next few months and analyzed for PCB concentration. This information should be invaluable for describing the rate of downstream deposition of PCBs and for predicting the eventual concentration to be expected in reservoir fishes.

The student assigned to this project phase, Mary Vitter (Ph.D. candidate) has completed her academic degree requirements except for her dissertation. Two other M.S. candidates assisting Mary, Henry Gardner and Robert Brown, have also completed academic requirements except their theses.

Laboratory bioassay PCB uptake studies conducted by Ph.D. candidate Chong-l Paul Lo (Paul Lo) are currently under way and should be completed during this final project segment. The student, with the assistance of Dr. Reimers, has developed a new and unique technique for spiking known PCB concentrations in water over and above normal water solubility levels. The process involves dissolving the PCB in humic acid (which also occurs naturally in the stream and reservoir system) rather than conventional organic solvents such as acetone. Although PCBs are only slightly soluable in distilled water (approximately 50 ppb for Aroclor 1254), concentrations associated with suspensions of humic acid, such as occur naturally, can be increased many fold.

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Acute and long-term toxicity of PCBs to bluegill, as well as rate of uptake at known concentrations, will be determined during this project segment. The student investigator, who appears to be exceptionally well qualified for this assignment, is also coordinating PCB analyses for all other project phases.

B. Aquatic plant uptake

This project phase, involving attempts to screen various aquatic plants with potential for efficient PCB uptake, has progressed satisfactorily. Of the 10 plants which have been screened to date, arrowhead, duckweed, elodea, rush and water hyacinth all demonstrated a strong provlivity for PCBs bioaccumulation. However, water hyacinth is not expected to dependably survive winter temperatures in the study area.

I suggested that project personnel [Mike Hebert (student) and Dr. A. J. Englande (advisor)] develop a theoretical model to determine the amount of PCBs which could be bioaccumulated (and subsequently harvested) by the various plants tested. This model would be based on extant PCB concentrations in the water, rate of PCB uptake from the water by plants, and the anticipated field density at which the plants could be grown. [In all probability, the plants would have to be grown in off-river impoundments (which would involve construction of expensive diversion facilities) in order to provide a suitable growing environment)].

Also, I suggested (since it is possible that PCB removal from the water column would be of limited value) that they examine the feasibility of bioaccumulating PCBs by terrestrial and/or appropriately adaptable marsh species from contiguous flood plain sediments. This suggestion was made because of the possibility that the flood plain sediments may constitute a large reser-

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voir of PCBs which are recirculated during high water.

The planned (within the next 2 months) core samples should indicate if large amounts of PCB are, indeed, present in flood plain sediments. Assumances were made by the project supervisor that both suggestions would be persued.

C. Biodegradation studies

Results from this project phase have been primarily negative. The student investigator, Paul Sawyer, has not been able to demonstrate any evidence of biodegradation of Arochor 1254 by the bacterial cultures examined to date (six months of acclamitization and exposure of 5 different bacterial strains). This applies to both single source (where PCBs furnished the only carbon source) and multicarbon source experiments (sludge). Limited microbial degradation of Arochlor 1242 (after sonication) has been evidenced.

A bacterial strain which has proven effective in previous studies conducted in Illinois will be tested in the immediate future.

Complementary ultrasonication studies have evoked some encouragement. Intensive sonication of illite bound PCB with currently available equipment appears to have facilitated the release (made more available) of low levels of PCBs from the illite-bound sample. However, recently acquired transducers, which were expected to provide for greater degrees of ultrasonication, have not performed as expected. Replacement transducers are expected momentarily and will be evaluated during this last segment.

The student investigator will also evaluate the effects of ultrasonication on bacteria, since it is possible that the degree of sonication necessary to break down the PCBs in smaller segments may also adversely affect the bacteria. Such a finding would indicate the need for a two-step treatment

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approach. First, sonication of soil sediments followed by seeding appropriate bacterial streams.

D. Monsanto supplementary fund

Unfortunately, no substantial progress other than the initial contacts reported previously has been made in obtaining supplemental project funds from Monsanto. However, the project leader provided his assurance that such funds will be forthcoming. Also, that he will request that Monsanto make such funds available to the project leader through the Sport Fishery Research Foundation. I will keep his "feet-to-the-fire" on this one.

To summarize, the project has either afforded to date, or can be expected to provide on completion, the following positive benefits:

1. A well documented chronology and description of the rate of PCB dispersion and/or degradation, mechanisms of PCB transport, and subsequent ecological fate of PCBs in a heavily contaminated stream-reservoir ecosystem. Such information will be useful for predicting and evaluating the ultimate effects on fish communities and associated utilization by recreational anglers in this and similar situations.

2. Sufficient information to determine the feasibility of propagating and harvesting plants for removing PCBs from contaminated water and/or sediments.

3. Sufficient information to evaluate the effectiveness and practicability of sonication as a tool for dissociating tightly-bound aggregations of highly stable PCB compounds, such as Arochlor 1254, to facilitate microbial degradation.

4. To provide for testing and evaluating the effectiveness of specially selected bacterial strains and various techniques for degrading PCB

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compounds in contaminated sediments.

5. Provision of student fellowship stipends sufficient to make possible the training of four M.S. candidates and 3 Ph.D. candidates over the life of the project.

6. Extensive publication (three already approved) in a variety of chemical and other technical society journals which will provide SFRF exposure to scientific disciplines not usually contacted -- with possible long-term implications for attracting additional funding.

mcb