

1374

UNITED STATES GOVERNMENT

# Memorandum

718449

TO : R. G. Humphries, Director  
Contract Division

FROM : Herman M. Roth, Director  
Research and Development Division

SUBJECT: REQUEST FOR CONTRACT ACTION

ORS:EMM

DATE: MAR 28 1967

It is requested that you take the necessary steps to process the following described contract action:

1. Nature of Action Requested:

Selection of New Contractor and/or  
Negotiation of Contract  
Number:  
Contractor:

Modification of Contract  
Number: AT-(40-1)-2100  
Contractor: North Carolina State University at Raleigh  
Raleigh, North Carolina

2. Nature of Services to be Covered by Contract: Research

Title: "Studies in the Ecology of Fresh-Water Algae in North Carolina"

3. Type of Contract:  Lump-Sum  Cost-Type  Other

4. Amount to be Obligated by this Contract Action: \$7,552.00

5. Description of Other Changes to be Covered by Contract Action:

Modify contract to provide for the performance of additional research to be completed during the period March 1, 1967 through August 31, 1967. The AEC will support the project in the amount of \$7,552 in new funds. Title to equipment, if any, shall vest in the contractor under authority of the Atomic Energy Act of 1954 since the contractor's contribution is expected to equal or exceed the value of the equipment.

6. Authority:

Form AEC-481 (Contract Authorization) from C. L. Dunham to S. R. Sapirie dated March 15, 1967

*Herman M. Roth*  
Herman M. Roth

REPOSITORY *Clark Ridge Operations*  
COLLECTION *Records of Mining Area*  
BOX NO. *A-69-5 108-6 Bldg. 2714-H*  
FOLDER *Contract 47-(40-1)-2100*  
*North Carolina State College*

APPENDIX "A"

For the Contract Period March 1, 1967 through August 31, 1967.

A-I RESEARCH TO BE PERFORMED BY CONTRACTOR

The Contractor will complete studies on the ecology of fresh-water algae in North Carolina, including the preparation of a paper on the ecology of certain species and a manual listing all taxa of fresh-water algae in North Carolina with keys and illustrations.

A-II APPROXIMATE LEVEL OF RESEARCH EFFORT

(a) <u>Contractor Personnel:</u>		<u>Approx. % of time</u>
Dr. L. A. Whitford	Academic	50% (3 mos.)
Principal Investigator	Summer	100%
Research Associate		50%

(b) Premises, Facilities, and Materials to be  
Furnished by the Contractor:

Adequate facilities and equipment are available for the Contractor to conduct studies in the ecology of fresh-water algae in North Carolina.

A-III ITEMS OF EQUIPMENT TO BE PURCHASED OR FABRICATED BY CONTRACTOR  
COSTING \$500 OR MORE

None

U. S. ATOMIC ENERGY COMMISSION  
**CONTRACT AUTHORIZATION**

		1. DATE <b>MAR 15 1967</b>	2. AUTHORIZATION NO. <b>EM-67-409</b>
3.A. TO <b>S. R. Sapirie, Manager Oak Ridge Operations Office</b>		3.B. FROM <b>C. L. Dunham, M.D. Director Division of Biology and Medicine, HQ</b>	
4.A. CONTRACTOR (Name, Address, Department, etc.) <b>Institute of Biological Sciences NORTH CAROLINA STATE UNIVERSITY Raleigh, North Carolina 27607</b>		4.B. PRINCIPAL INVESTIGATOR(S) <b>Larry A. Whitford</b> <i>Telephone consultation with Elizabeth Hansen for M on 3-22-67. Emm</i>	
5. <input type="checkbox"/> NEW CONTRACT <input checked="" type="checkbox"/> RENEWAL <input type="checkbox"/> OTHER	6. TERM OF CONTRACT <i>3-1-67 per telephone</i> <b>3-1-67 thru 2-29-68</b>	7. CONTRACT NUMBER <b>AT(40-1)-2100</b>	
8. RECOMMENDED TYPE OF CONTRACT: <input checked="" type="checkbox"/> FIXED PRICE <input type="checkbox"/> COST REIMBURSEMENT <input type="checkbox"/>	9. PROPERTY TITLE TO VEST IN: <input type="checkbox"/> AEC <input checked="" type="checkbox"/> CONTRACTOR	10. SECURITY CLASSIFICATION: Work to be performed is under category <b>I</b> as defined by AEC Manual Appendix 3401.	
11. PROJECT TITLE <b>"STUDIES IN THE ECOLOGY OF FRESH-WATER ALGAE IN NORTH CAROLINA"</b>			
12. HEADQUARTERS TECHNICAL CONTACT <b>Mr. Jared J. Davis</b> <i>JJD</i>			
13. FINANCING (New AEC Funds, Not To Exceed Amounts Indicated):			
A. OPERATING EXPENSES .....		\$	<b>8,326</b>
Budget and Reporting Classification: <b>06 05 01</b>			<b>less any unexpended</b>
Allotment Transfer: <b>06-71-91(24)</b>			<b>balance</b>
B. PLANT AND CAPITAL EQUIPMENT .....		\$	
Budget and Reporting Classification:			
Allotment Transfer:			
14. SPECIAL PROVISIONS AND INSTRUCTIONS:			
<p>The technical aspects of the proposed work have been reviewed and are approved. A need currently exists for the results of the research or other work that is to be undertaken. None of the AEC funds shall be used to confer a fellowship.</p> <p>Please keep us informed as to any problems encountered in your negotiations, as well as the date of execution of this contract and the amount of funds obligated. If the budget as negotiated differs substantially from that in the proposal, please forward a copy of the revised budget to Headquarters.</p> <p>If not already submitted, a 200-word summary of the proposed work should be forwarded by the contractor as soon as possible after negotiation of the contract.</p>			
15. SCOPE OF WORK			

Complete analyses and report on ecological studies of algae and complete manuscript for a manual on the algae of North Carolina.

*Amount of new AEC funds reduced to \$7,552 based on new unexpended balance of \$774.*

*Emm  
3-22-67*

11 2722

MAR 20 1967

1129397

A0536P EST MAR 21 67 CTA367 AC426

A RGA365 PD RALEIGH NCAR 21 508P EST

DR C S SHOUP

CHIEF BIOLOGY BRANCH RESEARCH AND DEVELOPMENTS U S ATOMIC  
ENERGY COMMISSION OAKRIDGE TENN

PROJECT AT-40-1-2100 UNINCUMBERED BALANCE FEB 28 774.26

L A WHITFORD

AT-40-1-2100 28 774.26

(14).

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MAR 22 8 19 AM 1967

BY JAW

H 2846

MAR 22 1967

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A RENEWAL PROPOSAL TO  
U. S. ATOMIC ENERGY COMMISSION  
CONTRACT NO. AT-(40-1)-2100  
STUDIES IN THE ECOLOGY OF FRESH-WATER ALGAE IN NORTH CAROLINA

Requested Amount: \$8,326 for a period of one year  
March 1, 1967 through August 31, 1967 inclusive

Submitted by

Larry A. Whitford  
Larry A. Whitford, Principal Investigator  
Professor of Botany  
North Carolina State University at Raleigh  
Raleigh, North Carolina

H. F. Robinson  
H. F. Robinson  
Administrative Dean for Research  
North Carolina State University at Raleigh  
Raleigh, North Carolina

A. H. Shepard, Jr.  
A. H. Shepard, Jr.  
Assistant Vice President and Treasurer  
University of North Carolina  
Chapel Hill, North Carolina

North Carolina State University at Raleigh  
Raleigh, North Carolina

Date Submitted \_\_\_\_\_

H 617

1129399

JAN 20 1967

## OVERALL PROJECT

### Studies in the Ecology of Fresh-water Algae in North Carolina

#### OBJECTIVES

1. To organize data at hand and write a fresh-water algal flora of North Carolina, including data on the ecology of many species.
2. To organize data and write a paper on the ecology of certain species of fresh-water algae.

#### JUSTIFICATION

Work during the past eight years has almost tripled the number of taxa of fresh-water algae known in the state. All classes have been intensively worked. Data on distribution, habitat and ecology are at hand for hundreds of species. A complete published fresh-water algal flora of the state with annotations on distribution, habitat, and ecology of many species would be of great value to phycologists everywhere, and to limnologists and ecologists working in the region. In addition, such a work would have value to ichthyologists and sanitary engineers and would, furthermore, constitute a valuable record of the plant life of the state which would be invaluable to botanists in future generations. It would be the first state flora in the southeast and one of three for the country as a whole.

Part of this record would be the thesis on the Mesotaeniaceae and Desmidiaceae being completed by Yoon C. Kim.

Officials of the North Carolina State University Experiment Station regard such a work of sufficient importance that they have agreed to publish it.

Relatively little has been published on the species ecology of fresh-water algae. Since a fair amount of data has been accumulated on the ecology of species of algae, it seems publication of this data would be justified. It would be of value to fresh-water phycologists everywhere since most species are very widely distributed.

## SUBPROJECTS

- I. To complete preparation of a manual of the fresh-water algae in North Carolina.

OBJECTIVES

To complete and have published a manual listing all taxa of fresh-water algae reported as occurring in North Carolina. The manual will include keys to genera and species, together with illustration. Notes on the distribution and ecology of many species will be included.

JUSTIFICATION

Work on the text of the manual is well under way and it is believed that a first draft of the body of the book can be completed by the end of the project period. During the six months of the proposed renewal proposal, it is believed that revision, completion of illustrations, and preparation of a bibliography and index can be completed. The manual will be the first for any southeastern state and one of three for the nation. It would be of much use to phycologists and ecologists in the region, and because of the wide distribution of many species, of considerable use to phycologists everywhere.

- II. To complete a paper on the ecology of certain species of fresh-water algae.

OBJECTIVES

To complete the preparation of a paper on species ecology of several dozen species of fresh-water algae, with tables and data.

JUSTIFICATION

Relatively little has been published on the ecology of fresh-water algae. Much that has been published relates to genera. It is well known that species in the same genus vary in their requirements. It would seem well worthwhile to publish ecological data on species which are common or widespread in all temperate regions of the world.

BACKGROUND AND STATUS OF PERSONNELScientific Personnel:

Senior Investigator --Larry A. Whitford, Professor of Botany, N. C. State University at Raleigh. (See original proposal for biography and bibliography.) 100% June, July, August.

Associate Investigator --George J. Schumacher, Professor of Biology, Harpur College, State University of New York. (See renewal proposal for 1959-1960 for biography and bibliography.) 100% of time June, July, August.

Other Personnel:

None

FACILITIES, SUPPLIES, ETC.

Stenographic help for typing of manuscripts, paper and other supplies will be furnished by N. C. State University and New York State University at Binghamton. The sum of \$50 is requested for page cost for the research paper, or for cost of reprints.

TRAVEL

The sum of \$50 is requested for the Associate Investigator to travel to Raleigh for a single conference at the time the manuscript of the manual is being checked in its final form.

A RENEWAL PROPOSAL TO  
 U. S. ATOMIC ENERGY COMMISSION  
 CONTRACT NO. AT-(40-1)-2100

PROPOSED BUDGET

TITLE: Studies in the Ecology of Fresh-water Algae in North Carolina

PROJECT LEADER: Larry A. Whitford

DEPARTMENT: Botany

ESTIMATED EXPENSES FOR: March 1, 1967 THROUGH August 31, 1967 - RENEWAL PROPOSAL

	<u>Requested from AEC</u>	<u>N. C. State University</u>	<u>Total</u>
1. SALARIES			
Principal Investigator (100% June, July, August, Academic Year 50%)	\$ 2,800	\$ 285*	\$ 2,800 285
Investigator (100% June, July, August)	2,800		2,800
<hr/>			
Fringe Benefits @12%	672	34**	706
2. TRAVEL	50		50
3. PRINTING	50		50
<hr/>			
4. TOTAL DIRECT COSTS	\$ 6,372	\$ 319	\$ 6,691
5. INDIRECT COSTS (34.9% of salaries)	1,954	99	2,053
	<hr/> \$ 8,326	<hr/> \$ 418	<hr/> \$ 8,744

\* This amount does not represent 50% of the Principal Investigator's salary but rather that part used for cost sharing.

\*\* This is not a direct payment by the University. Payment is made annually from a special State Appropriation for all general fund employees.

No person will, on the grounds of race, color or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under this program.

1129403

NORTH CAROLINA STATE UNIVERSITY | AT RALEIGH

SCHOOL OF AGRICULTURE AND LIFE SCIENCES

INSTITUTE OF BIOLOGICAL SCIENCES  
DEPARTMENT OF BOTANY  
BOX 5186 ZIP 27607

December 9, 1966

Dr. C. S. Shoup  
Chief, Biology Branch  
Research and Development Division  
United States Atomic Energy Commission  
Oak Ridge, Tennessee 37830

Dear Dr. Shoup:

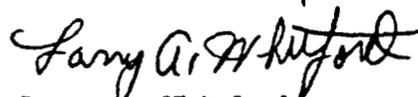
Enclosed is a completed form AEC-427 for our annual report. For the papers presented orally during the year there are no written versions.

The report number for the annual report is ORO-2100-10. We are enclosing a mimeographed cover sheet for the annual report in case you care to use it.

Also enclosed are four copies of Notice of Research Project.

I am sorry that I overlooked Dr. Roth's letter of April 25, 1965. I must have lost it in my files. I also regret that a short illness has delayed this letter and other material.

Yours very truly,



Larry A. Whitford  
Professor of Botany

LAW:gw

Enclosures *OK*

P.S. Due to a number of circumstances, carry-over at the end of this project period will be substantially less than estimated in our report. We now estimate a carry-over of about \$100 or \$200. Because of moving into new quarters, purchase of a small refrigerator will be necessary, and expenses for printing of a Ph.D thesis and travel expenses will also be higher than estimated. Reprints of our recently published paper have not yet been received.



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DEC 12 1966

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NORTH CAROLINA STATE UNIVERSITY | AT RALEIGH

SCHOOL OF AGRICULTURE AND LIFE SCIENCES

INSTITUTE OF BIOLOGICAL SCIENCES  
DEPARTMENT OF BOTANY  
Box 5186 Zip 27607

October 4, 1966

Dr. C. S. Shoup  
Chief, Biology Branch  
Research and Development Division  
United States Atomic Energy Commission  
Oak Ridge, Tennessee 37830

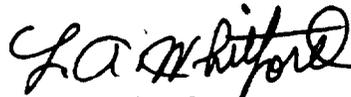
Dear Dr. Shoup:

We have decided to ask for a renewal of our Contract No. AT-(40-1)-2100 for at least another year. There are a number of reasons for this. Among them are the following:

1. We were awarded somewhat less for the current contract period than was necessary for both investigators to be able to devote full time to the writing of our proposed manual on the fresh-water algae of North Carolina.
2. We should like support for six more months in order to complete the manual.
3. The principal investigator has decided not to retire for several more years.
4. We have several interesting facets of algal ecology and morphology we should like to investigate, and at least one graduate student to help pursue these investigations.

You should receive our annual report and a new project proposal soon, since we have already sent them to the University administrators for review and transmittal.

Yours very truly,



L. A. Whitford  
Professor of Botany

G.10051(A)

LAW:gw

NOV 7 1966

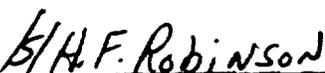
1129405

A RENEWAL PROPOSAL TO  
U. S. ATOMIC ENERGY COMMISSION  
CONTRACT NO. AT-(40-1)-2100  
STUDIES IN THE ECOLOGY OF FRESH-WATER ALGAE IN NORTH CAROLINA

Requested Amount: \$12,039 for a period of one year  
March 1, 1967 through February 29, 1968 inclusive

Submitted by

  
Larry A. Whitford, Principal Investigator  
Professor of Botany  
North Carolina State University at Raleigh  
Raleigh, North Carolina

  
H. F. Robinson  
Administrative Dean for Research  
North Carolina State University at Raleigh  
Raleigh, North Carolina

  
A. H. Shepard, Jr.  
Assistant Vice President and Treasurer  
University of North Carolina  
Chapel Hill, North Carolina

North Carolina State University at Raleigh  
Raleigh, North Carolina

Date Submitted \_\_\_\_\_

1129406

## OVERALL PROJECT

### Studies in the Ecology of Fresh-water Algae in North Carolina

#### OBJECTIVES

1. To organize data at hand and write a fresh-water algal flora of North Carolina, including data on the ecology of many species.
2. To organize data and write a paper on the ecology of certain species of fresh-water algae.

#### JUSTIFICATION

Work during the past eight years has almost tripled the number of taxa of fresh-water algae known in the state. All classes have been intensively worked. Data on distribution, habitat and ecology are at hand for hundreds of species. A complete published fresh-water algal flora of the state with annotations on distribution, habitat, and ecology of many species would be of great value to phycologists everywhere, and to limnologists and ecologists working in the region. In addition, such a work would have value to ichthyologists and sanitary engineers and would, furthermore, constitute a valuable record of the plant life of the state which would be invaluable to botanists in future generations. It would be the first state flora in the southeast and one of three for the country as a whole.

Part of this record would be the thesis on the Mesotaeniaceae and Desmidiaceae being completed by Yoon C. Kim.

Officials of the North Carolina State University Experiment Station regard such a work of sufficient importance that they have agreed to publish it.

Relatively little has been published on the species ecology of fresh-water algae. Since a fair amount of data has been accumulated on the ecology of species of algae, it seems publication of this data would be justified. It would be of value to fresh-water phycologists everywhere since most species are very widely distributed.

An ecological study of the algae of the littoral zone of lakes and ponds would seem worthwhile since almost no good ecological data on this important habitat has been collected.

A study of cell wall formation and structure in the Oedogoniaceae would be of interest to all phycologists since it is an important family of green algae. A peculiar type of cell wall formation apparently occurs in this family. No good modern study has been undertaken of any of the genera and one genus has never received any study.

#### METHODS

An attempt will be made to devise methods of obtaining quantitative data on the algae of the littoral zone. Collecting on glass plates, as well as other methods, will be tried. The effect of high light on certain species will be investigated both in the field and laboratory. If possible, C<sup>14</sup> and P<sup>32</sup> will be used in these studies.

Ordinary histological methods, microchemical techniques, radioautographs and electron photomicrographs will be used in the study of cell wall formation and development in the Oedogoniaceae.

#### SUBPROJECTS

- I. To complete preparation of a manual of the fresh-water algae in North Carolina.

#### OBJECTIVES

To complete and have published a manual listing all taxa of fresh-water algae reported as occurring in North Carolina. The manual will include keys to genera and species, together with illustration. Notes on the distribution and ecology of many species will be included.

#### JUSTIFICATION

Work on the text of the manual is well under way and it is believed that a first draft of the body of the book can be completed by the end of the project period. During the six months of the proposed renewal proposal, it is believed

that revision, completion of illustrations, and preparation of a bibliography and index can be completed. The manual will be the first for any southeastern state and one of three for the nation. It would be of much use to phycologists and ecologists in the region, and because of the wide distribution of many species, of considerable use to phycologists everywhere.

II. To complete a paper on the ecology of certain species of fresh-water algae.

#### OBJECTIVES

To complete the preparation of a paper on species ecology of several dozen species of fresh-water algae, with tables and data.

#### JUSTIFICATION

Relatively little has been published on the ecology of fresh-water algae. Much that has been published relates to genera. It is well known that species in the same genus vary in their requirements. It would seem well worthwhile to publish ecological data on species which are common or widespread in all temperate regions of the world.

III. To initiate and pursue an ecological study of the algae of the Littoral zone of lakes and ponds.

#### JUSTIFICATION

Although there has been much floristic work done on the littoral zone algae, there has been relatively little good ecological work. This is due in part to the difficulty of obtaining good quantitative data on attached species. If this can be done, much useful data could be obtained on community and seasonal relations in these important communities.

#### METHODS

An attempt will be made to devise methods of collecting algae from unit areas and relate species and growth to season and other habitat factors. Collecting on glass plates and other substrata, as well as other methods, will be tried. Studies will be made of organisms growing at various depths, both attached forms as well as those inhabiting bottom ooze. The possible inhibiting

effect of high light will be investigated in the field and in the laboratory, using the several refrigerated tanks already purchased and used in previous years. It is possible that both C<sup>14</sup> and P<sup>32</sup> can be used in these studies. A two-year study is proposed in order to get data for one complete year after study areas and methods have been picked.

IV. A comparative study of the formation and development of the cell wall in the Oedogoniaceae.

#### JUSTIFICATION

The development of the cell wall in this small but important family of green algae has never been carefully investigated. The three genera in the family all have a peculiar type of cell wall development. It is possible that there are two types of cell formation and also that the complex type of cell wall formation varies in the several genera. No study of cell wall formation has ever been made in one genus and the results of a comparative study in all genera would be of considerable importance to fresh-water phycologists.

#### METHODS

By means of ordinary histological methods, as well as the use of several microchemical techniques, the formation of the cell wall in the three genera will be followed and investigated. In addition, radioautographs of cell sections will be studied to establish time relations in the formation of wall layers. If possible, electron photomicrographs will also be made in order to study the finer details of cell wall structure and formation. Field collected material as well as laboratory cultured material will be used in the studies. It is believed that data can be obtained to substantiate a theory that cell wall formation is basically similar in all genera of the Oedogoniaceae. It is hoped that data can be obtained to settle a problem which has puzzled phycologists for 50 years.

BACKGROUND AND STATUS OF PERSONNELScientific Personnel:

- Senior Investigator --Larry A. Whitford, Professor of Botany, N. C. State University at Raleigh. (See original proposal for biography and bibliography.) 100% June, July, August; 50% remainder of year.
- Associate Investigator --George J. Schumacher, Professor of Biology, Harpur College, State University of New York. (See renewal proposal for 1959-1960 for biography and bibliography.) 100% of time June, July, August.
- Graduate Assistant --Martha P. Sebastian, B.S., M.S. Candidate for the Ph.D. degree, N. C. State University.  $\frac{1}{2}$  time for 9 months (beginning June 1, 1967).

Other Personnel:

Student labor will be used principally for the inking of drawings of algal species and for clerical work in sorting and arrangement of data.

MATERIALS, EQUIPMENT, AND FACILITIES

In addition to adequate equipment and growth chambers listed under previous proposals, 400 sq. ft. of laboratory space is used exclusively for phycology research the year round. Any amount of additional space is available during June, July and August.

NEW RESEARCH PROJECTS

The two new proposed research projects, studies of the ecology of the littoral zone algae, and a comparative study of cell wall formation in the Oedogoniaceae, are each two-year studies.

TRAVEL

Travel monies will be used for the Associate Investigator to travel to Raleigh for conference and work on the manual, for both investigators to attend the AIBS meetings in Texas, and for travel to and from research lakes and ponds by the two investigators.

PROPOSED BUDGET

TITLE: Studies in the Ecology of Fresh-water Algae in North Carolina

PROJECT LEADER: Dr. Larry A. Whitford

DEPARTMENT: Botany

ESTIMATED EXPENSES FOR: March 1, 1967 THROUGH February 29, 1968 - RENEWAL PROPOSAL

	<u>Requested from AEC</u>	<u>N. C. State U.</u>	<u>Total</u>
<b>1. SALARIES</b>			
Principal Investigator (100% 3 mos.) (Academic Year 50%)	\$ 2,800	\$434*	\$ 2,800 434
Investigator (100% 3 mos.)	2,800		2,800
Graduate Assistant (50% 9 mos.)	2,250		2,250
<hr/>			
Labor, Student (75 hrs.)	150		150
Fringe Benefits @12%	672	52**	724
<b>2. TRAVEL</b>	350		350
<b>3. PRINTING</b>	100		100
<b>4. COMMUNICATIONS</b>	25		25
<b>5. SUPPLIES</b>	<u>100</u>	<u>      </u>	<u>100</u>
<b>6. TOTAL DIRECT COSTS</b>	\$ 9,247	\$486	\$ 9,733
<b>7. INDIRECT COSTS (34.9% of salaries (and labor)</b>	<u>2,792</u>	<u>151</u>	<u>2,943</u>
<b>8. TOTAL BUDGET</b>	\$12,039	\$637	\$12,682 <sup>76</sup>

\* This amount does not represent 50% of the Principal Investigator's salary but rather that part used for cost sharing.

\*\* This is not a direct payment by the University. Payment is made annually from a special State Appropriation for all general fund employees.

No person will, on the grounds of race, color or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under this program.

1129412

**REPORT ON THE BUDGET**

March 1, 1966 to November 30, 1966

Contract No. AT-(40-1)-2100 with U. S. Atomic Energy Commission

<u>Item</u>	<u>Contributed by AEC Expended to Nov. 30</u>	<u>Needed to Feb. 28 1967 (est.)</u>	<u>Contributed by NC State Univ.* and NY State Univ.**</u>	<u>Total</u>
Salaries and labor	\$8,962.50	\$4,856.26	\$15,100.00* 3,400.00**	\$32,318.76
Equipment, supplies, and travel	244.08	150.00		394.08
Matching contributions	275.99	138.27	7,097.00	7,511.26
Indirect costs	4,968.00			<u>4,968.00</u> \$45,192.10

Carry-over from last year	\$ 744.41
Contributed by AEC 1966-67	20,000.00
Contributed by N.C. State U.	22,197.00
Contributed by N.Y. State U.	<u>3,400</u>
	\$46,341.41
Less total estimated expenditures	45,192.10
Estimated carry-over	1,149.31

Financial Statement approved:

\_\_\_\_\_  
J. D. Wright  
Assistant Business Manager

1129413

UNITED STATES GOVERNMENT

# Memorandum

TO : R. G. Humphries, Director  
Contract Division

FROM : Herman M. Roth, Director  
Research and Development Division

SUBJECT: REQUEST FOR CONTRACT ACTION

ORS:EMM

DATE: MAR 25 1966

It is requested that you take the necessary steps to process the following described contract action:

1. Nature of Action Requested:

Selection of New Contractor and/or  
Negotiation of Contract  
Number:  
Contractor:

Modification of Contract  
Number: AT-(40-1)-2100  
Contractor: North Carolina State University at Raleigh  
Raleigh, North Carolina

2. Nature of Services to be Covered by Contract: Research

Title: "Studies in the Ecology of Fresh-Water Algae in  
North Carolina"

3. Type of Contract:  Lump Sum  Cost-Type  Other

4. Amount to be Obligated by this Contract Action: \$20,000.00

5. Description of Other Changes to be Covered by Contract Action:

Modify contract to provide for the performance of additional research to be completed during the period March 1, 1966 through February 28, 1967. The AEC will support the project in the amount of \$20,000 in new funds. Title to equipment, if any, shall vest in the contractor under authority of the Atomic Energy Act of 1954.

6. Authority

Form AEC-481 (Contract Authorization) from C. L. Dunham to S. R. Sapirie dated March 4, 1966

*Herman M. Roth*  
Herman M. Roth

37295

1129414

APPENDIX "A"

For the Contract Period March 1, 1966 through February 28, 1967.

A-I RESEARCH TO BE PERFORMED BY CONTRACTOR

The Contractor will continue to conduct research on the ecology of fresh-water algae in North Carolina. This work will include such approaches as (1) study of the uptake of Phosphorus-32 by algae in streams as a function of current speed, (2) identification of all species possible of diatoms on some 500 slides previously made during ecological and floristic studies, (3) completion of a floristic and ecological study of the Mesotaeniaceae and Desmidiaceae in North Carolina, (4) organization of data and preparation of an article on the effects of light, temperature, and current on certain species of fresh-water algae, and (5) organization of data at hand and preparation of an article on fresh-water algal flora of North Carolina, including data on the ecology of many species.

A-II APPROXIMATE LEVEL OF RESEARCH EFFORT

	Approx. % of time
(a) <u>Contractor Personnel:</u>	
Dr. L. A. Whitford, Principal Investigator	75%
Research Associate	75%
Research Assistant	55%
(b) <u>Premises, Facilities, and Materials to be Furnished by the Contractor:</u>	

Adequate facilities and equipment are available for the Contractor to conduct studies in the ecology of fresh-water algae.

A-III ITEMS OF EQUIPMENT TO BE PURCHASED OR FABRICATED BY CONTRACTOR  
COSTING \$500 OR MORE

None

AECPR 9-4.8]

**U. S. ATOMIC ENERGY COMMISSION  
CONTRACT AUTHORIZATION**

1. DATE

MAR 4 1966

2. AUTHORIZATION NO.

BM-66-399

3.A. TO

S. R. Sapirie, Manager  
Oak Ridge Operations Office

3.B. FROM

*John R Zoller for*  
C. L. Dunham, M.D., Director  
Division of Biology & Medicine, HQ

4.A. CONTRACTOR (Name, Address, Department, etc.)

Dept. of Botany and Bacteriology  
NORTH CAROLINA STATE OF THE UNIVERSITY OF  
NORTH CAROLINA, Raleigh, North Carolina

4.B. PRINCIPAL INVESTIGATOR(S)

Larry A. Whitford

5.

NEW CONTRACT     RENEWAL     OTHER

6. TERM OF CONTRACT

3-1-66 thru 2-28-67

7. CONTRACT NUMBER

AT(40-1)-2100

8. RECOMMENDED TYPE OF CONTRACT:

FIXED PRICE  
 COST REIMBURSEMENT

9. PROPERTY TITLE TO VEST IN:

AEC     CONTRACTOR  
 CONTRACTOR UNDER AUTHORITY OF PUBLIC LAW 85-934. This has been determined to be in furtherance of the objectives of the Atomic Energy Commission.

10. SECURITY CLASSIFICATION:

Work to be performed is under category I as defined by AEC Manual Appendix 3401.

11. PROJECT TITLE

**"STUDIES IN THE ECOLOGY OF FRESH-WATER ALGAE IN NORTH CAROLINA"**

12. HEADQUARTERS TECHNICAL CONTACT

Dr. John N. Wolfe

*by RFR*

13. FINANCING (New AEC Funds, Not To Exceed Amount Indicated):

A. OPERATING EXPENSES ..... \$ 20,000

Budget and Reporting Classification: 06 05 01

Allotment Transfer: 06-61-91(24)

B. PLANT AND CAPITAL EQUIPMENT ..... \$

Budget and Reporting Classification:

Allotment Transfer:

14. SPECIAL PROVISIONS AND INSTRUCTIONS:

The technical aspects of the proposed work have been reviewed and are approved. A need currently exists for the results of the research or other work that is to be undertaken. None of the AEC funds shall be used to confer a fellowship.

Please keep us informed as to any problems encountered in your negotiations, as well as the date of execution of this contract and the amount of funds obligated. If the budget as negotiated differs substantially from that in the proposal, please forward a copy of the revised budget to Headquarters.

If not already submitted, a 200-word summary of the proposed work should be forwarded by the contractor as soon as possible after negotiation of the contract.

NOTE: TERMINAL YEAR.

SCOPE OF WORK

An investigation of the ecology of heterotrophic algae living in subarctic lakes.

G 2173

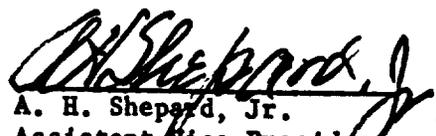
MAR 7 1966

1129416

Revised Budget  
on  
Contract No. AT-(40-1)-2100  
L. A. Whitford  
N. C. State University at Raleigh

	<u>Requested From AEC</u>	<u>N. C. State Univ. and State Univ. of New York</u>	<u>Total</u>
1. Salaries			
Principal Investigator	3,000	10,500	13,500
Investigator	7,500	5,200	12,700
Graduate Assistant	3,300		3,300
Matching Contribution (11% of \$10,500 and \$15,700)	1,155	1,727	2,882
Supplies	77		77
Indirect Costs (36% of \$13,800)	<u>4,968</u>	<u>5,652</u>	<u>10,620</u>
Total	20,000	23,079	43,079

Approved by

  
A. H. Shepard, Jr.  
Assistant Vice President  
and Treasurer

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G 2739

MAR 21 1966

REC'D  
OF  
TELETYPE

MAR 16 8 24 1966

BY \_\_\_\_\_

HQ

6- 3'5 .-4 16 66 CTA603 AA904

A RCA500 NL PD RALEIGH NCAR 15

DR C S SHOUP

CHIEF BIOLOGY BRANCH US ATOMIC ENERGY COMM OAK RIDGE TENN  
WILLING TO ACCEPT AEC CONTRIBUTIONS AT \$20,000.00 ON CONTRACT  
NUMBER AT-(40-1)-2100 STOP HAVE REVISED NCS CONTRIBUTIONS TO  
\$23,079.00 MAKING TOTAL COST OF \$43,079.00 STOP REVISED BUDGET  
BEING FORWARDED

H F ROBINSON ADMINISTRATIVE DEAN FOR RESEARCH NC STATE UNIVERSITY  
AT RALEIGH

AEC \$20,000.00 AT-(40-1)-2100 NCS \$23,079.00 \$43,079.00

G 2550

MAR 16 1966

1129418

NORTH CAROLINA STATE UNIVERSITY | RALEIGH

P. O. Box 5356, RALEIGH, N. C. 27607  
919-755-2117

ADMINISTRATIVE  
DEAN FOR RESEARCH

December 14, 1965

Dr. C. S. Shoup  
Chief, Biology Branch  
Research and Development Branch  
U. S. Atomic Energy Commission  
Oak Ridge, Tennessee 37831

Re: ORS:EMM

Subject: Contract No. AT-(40-1)-2100

Dear Dr. Shoup:

In reference to your letter of December 8, we were not aware of a carry-over from the previous period on this contract. We are aware, however, that a deficit on this or any contract with AEC must be covered by local funds.

I have checked with Dr. Whitford's office and find their records after further checking do agree with your accounting. Thank you for calling this to our attention. We will incorporate these figures into the final fiscal report on the subject contract.

Sincerely,

(Mrs) Colleen M. Cole  
Administrative Assistant

CMC:bk  
cc: Dr. L. A. Whitford

1129419

1129419

DEC 17 1965

UNITED STATES GOVERNMENT

# Memorandum

TO : G. L. Dunham, Director  
Division of Biology and Medicine, HQ

DATE: December 2, 1963

FROM : Herman M. Roth, Director  
Research and Development Division, OR

SUBJECT: RENEWAL OF CONTRACT NO. AT-(40-1)- 2100 WITH NORTH CAROLINA STATE  
UNIVERSITY (DR. LARRY A. WHITEFORD)

CRS:Bas

We are submitting for your review and appropriate action the following information concerning the contract which will expire on **February 28, 1964**:

1. Renewal Proposal (4)
2. Progress Report (4)
3. Financial Statement (4 - included in Progress Report)
4. 200-Word Summary (3 - 2 ea)

We shall appreciate your advising us of your decision so that we may proceed with the necessary contract action at the earliest possible date.

  
Herman M. Roth

Enclosure:  
As Listed Above

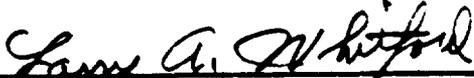
CC: G. S. Shoup, w/encl.  
D. S. Zachry, w/progress report  
Alice Brown ✓

1129420

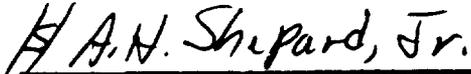
A RENEWAL PROPOSAL TO  
U. S. ATOMIC ENERGY COMMISSION  
CONTRACT NO. AT-(40-1)-2100  
STUDIES IN THE ECOLOGY OF FRESH-WATER ALGAE IN NORTH CAROLINA

Requested Amount: \$44,002.00 for a period of one year  
March 1, 1966 through February 28, 1967 inclusive

Submitted by

  
Larry A. Whitford, Principal Investigator  
Professor of Botany  
North Carolina State University  
Raleigh, North Carolina

  
Harold F. Robinson  
Administrative Dean for Research  
North Carolina State University  
Raleigh, North Carolina

  
A. H. Shepard, Jr.  
Business Officer and Treasurer  
Consolidated University of North  
Carolina  
Chapel Hill, North Carolina

North Carolina State University  
Raleigh, North Carolina

Date Submitted \_\_\_\_\_

1129421

SUMMARY OF PROPOSED WORK

A few more experiments on the uptake of  $P^{32}$  will be done during the remainder of the present project period.

A paper will be written on the ecology of certain species of fresh-water algae.

Yoon C. Kim will complete a Ph.D. thesis on the species of Mesotaeniaceae and Desmidiaceae occurring in the state including notes on distribution by area and major habitat factors.

An attempt will be made to identify all species of diatoms (Bacillariophyceae) occurring in the state.

A book on the fresh-water algal flora of the state will be written for publication by the North Carolina University Experiment Station. This work will include an estimated 200 pages of text and 500-600 illustrations together with keys to all taxa known from the state. The number of taxa listed will approximate 1,700 - considerably more than the number in either of the two other published state floras. The book will not be simply a state flora but will include a description of the habitat of all genera listed together with ecological notes on hundreds of species. This should make the work of value to investigators of fresh-water algae in all parts of the world.

NOTE

Because of the approaching retirement of the Principal Investigator and increasing administrative duties of the Associate Investigator, this is the final renewal proposal under this contract.

OVERALL PROJECT

Studies in the Ecology of Fresh-water Algae in North Carolina.

OBJECTIVES:

1. To complete certain studies on the communities of algae in the rapids of streams.
2. To identify all species possible of diatoms on some 500 slides previously made during ecological and floristic studies.
3. To complete a floristic and ecological study of the Mesotaeniaceae and Desmidiaceae in North Carolina.
4. To organize data and write a paper on the effects of light, temperature, and current on certain species of fresh-water algae.
5. To organize data at hand and write a fresh-water algal flora of North Carolina, including data on the ecology of many species.

JUSTIFICATION:

More data is needed on the uptake of minerals by algae in light and darkness; in a current and still water. These data will be of value both to phycologists and plant physiologists in general.

A record of the complete flora of diatoms (Bacillariophyceae) would be of value to phycologists, and especially to limnologists and ecologists working in aquatic areas.

Work during the past eight years has almost tripled the number of taxa of freshwater algae known in the state. All classes except the diatoms have been intensively worked. Data on distribution, habitat and ecology are at hand for hundreds of species. A complete published freshwater algal flora of the state with annotations on distribution, habitat, and ecology of many species would be of great value to phycologists everywhere, and to limnologists and ecologists working in the region. In addition, such a work would have value to ichthyologists and sanitary engineers and would, furthermore, constitute a valuable record of the plant life of the state,

which would be invaluable to botanists in future generations. It would be the first state flora in the southeast and one of three for the country as a whole.

Part of this record would be the thesis on the Mesotaeniaceae and Desmidiaceae being completed by Yoon C. Kim.

Officials of the North Carolina State University Experiment Station regard such a work of sufficient importance that they have agreed to publish it.

#### EXPERIMENTAL PROCEDURES:

A few more experiments on the uptake of  $P^{32}$  by algae will be made, using methods previously described.

Using slides made during previous studies, identification of species of all diatoms collected in the state will be made.

Illustrations will be prepared and data on the Mesotaeniaceae and Desmidiaceae collected in the state will be organized for a Ph.D. thesis by Yoon C. Kim.

All data on fresh-water algae will be organized and a book on the algal flora of the state will be written.

#### SUBPROJECTS

I. To complete certain studies on the communication of algae in the rapids of streams.

#### OBJECTIVES:

To determine how mineral concentration ( $P^{32}$ ) affects uptake over a period of time in light and darkness, and in a current and in light.

#### JUSTIFICATION:

The question has been raised as to whether mineral uptake is a passive diffusion process or an active one depending on metabolism of the cells.

An attempt will be made to obtain data bearing on this problem.

METHODS:

Previously described and used methods of suspending algae in a current and in still water will be used; exposing the algae to light and darkness and using varying concentration of P<sup>32</sup>. This work will be done during the last of the present project period.

II. To identify all species of diatoms collected in the state.

OBJECTIVES:

To determine species of diatoms occurring in the state and to correlate their distribution with habitat factors and place them in recognized algal communities.

JUSTIFICATION:

Before good ecological work can be done a knowledge of the flora of a habitat or region must be acquired. Identification of diatom species will complete our knowledge of the fresh-water algal flora of the inland waters of the state.

METHODS:

Using a compound microscope and a camera along with standard reference works some 500 slides will be examined and all possible taxa of diatoms present will be identified.

III. To complete a floristic and ecological study of the Mesotaeniaceae and Desmidiaceae in North Carolina.

OBJECTIVES:

To record the complete desmid flora of the state and determine the effect of habitat factors on the distribution of species.

JUSTIFICATION:

Since these families constitute two very important and widely

distributed groups of green algae, a knowledge of the species present in the state and their relation to area and habitat factors would seem worth recording.

METHODS:

All taxa will be illustrated, data will be organized, and keys will be constructed to all known taxa and a Ph.D. thesis will be completed on the two families in North Carolina.

IV. To organize data and write a paper on the ecology of certain species of fresh-water algae.

OBJECTIVES:

To organize and write a paper on the ecology of all species of fresh-water algae on which data is at hand.

JUSTIFICATION:

Relatively little data has been published on the ecology of species of fresh-water algae, particularly on the separate effects of light and temperature, and of a current vs still water. Publication of data on the effects of these important habitat factors in relation to certain species would add to the meager data now available to phycologists, limnologists and ecologists.

METHODS:

By means of tables and graphs the data will be organized and a short paper written presenting all adequate data at hand.

V. To organize data at hand and write a fresh-water algal flora of North Carolina.

OBJECTIVES:

To write for publication a book on the fresh-water algal flora of North Carolina containing notes on the geography of the area, distribution

of inland species of algae, with notes on the habitat and ecology of numerous species.

JUSTIFICATION:

Since it is believed we have the most complete record of the algal flora of any state, and in addition much ecological data on individual species; it would seem well worth while to organize the material and publish it for the use of botanists, phycologists, limnologists, and ecologists.

METHODS:

Work will be begun immediately on the preparation of illustrations of all genera known to occur in the state. Keys to all taxa will be constructed, and all taxa will be listed in systematic order with habitat and ecological notes under each plant listed. The material will be published as a book by the Experiment Station of North Carolina State University.

MATERIALS AND METHODS:

North Carolina State University will furnish adequate working space for the Graduate Assistant to complete her thesis and for the two investigators to work. In addition much of the stationery and stenographic help necessary in the preparation of the manuscript will be furnished. The State University of New York will likewise furnish space for the Associate Investigator and a certain amount of stenographic and clerical assistance.

TRAVEL

Early in the project year the Graduate Assistant will travel some to collect desmid material in a few areas from which adequate collections have not been made. Most of the travel money will be used for travel and subsistence for the Investigators to hold several week-long conferences and work periods. Personal obligations make it necessary that each remain on

his own campus most of the time but it will be necessary for them to work together for short periods during the preparation of the algal flora manuscript.

#### BACKGROUND AND STATUS OF PERSONNEL

##### Scientific Personnel:

Senior Investigator	--Larry A. Whitford, Professor of Botany, N. C. State University of North Carolina. (See original proposal for biography and bibliography.) 50% 6 mos., 100% 6 mos.
Associate Investigator	--George J. Schumacher, Professor of Biology, Harpur College, State University of New York. (See renewal proposal for 1959-1960 for biography and bibliography.) 100% of time July 1966-February 1967.
Graduate Assistant	--Yoon C. Kim, B. S. and two years graduate work, Seoul National University. Candidate for Ph.D. degree, N. C. State University. 1/2 time 9 months. 3/4 time June, July, August.

##### Other Personnel:

Student labor will be used principally for the inking of drawings of algal species and for clerical work in sorting and arrangement of data.

##### Other Financial Assistance:

North Carolina State University will support the project in the amount of half the salary of the Principal Investigator for 6 months and at full salary for 6 months, as indicated in the budget; and The State University of New York, Harpur College, will support the Associate Investigator in the amount of half his salary for nine months.

PROPOSED BUDGET

TITLE: Studies in the Ecology of Fresh-water Algae in North Carolina

PROJECT LEADER: Dr. Larry A. Whitford

DEPARTMENT: Botany

ESTIMATED EXPENSES FOR: March 1, 1966 THROUGH February 28, 1967 -  
RENEWAL PROPOSAL

	<u>Requested from AEC</u>	<u>N. C. State U. &amp; State Univ. of New York</u>	<u>Total</u>
1. SALARIES			
Principal Investigator (50% 6 mos., 100% 6 mos.)	\$5,750.00	\$7,250.00*	\$13,000.00
Investigator (100% 9 mos.)	7,500.00	5,200.00**	12,700.00
Graduate Assistant (50% 9 mos., 75% June, July, August)	3,300.00	0.00	3,300.00
<hr/>			
Labor	300.00	0.00	300.00
Matching Retirement and Social Security Contributions: (11% of \$13,250 & \$12,450)	1,458.00	1,370.00	2,828.00
2. TRAVEL	800.00	0.00	800.00
3. PRINTING (Cost of publications)	300.00	0.00	300.00
4. COMMUNICATIONS	50.00	0.00	50.00
5. SUPPLIES	<u>100.00</u>	<u>0.00</u>	<u>100.00</u>
6. TOTAL DIRECT COSTS	\$19,558	\$13,820.00	\$33,378.00
7. TOTAL INDIRECT COSTS (36.26% of salaries and labor)	<u>6,110.00</u>	<u>4,514.00</u>	<u>10,624.00</u>
8. TOTAL BUDGET	\$25,668.00	\$18,334.00	\$44,002.00

\*N. C. State University contribution

\*\*State University of New York contribution

No other Federal assistance available

No person will, on the grounds of race, color or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under this program.

1129429

**REPORT ON THE BUDGET**

Mar. 1, 1965 to Nov. 30, 1965

Contract No. AT-(40-1)-2100 with U. S. Atomic Energy Commission

<u>Item</u>	<u>Contributed by AEC Expended to Nov. 30</u>	<u>Needed to Feb. 28 1966</u>	<u>Contributed by N. C. State Univ.</u>	<u>Total</u>
Salaries and labor	\$7,077.64	\$1,968.60	\$5,371.00*	\$14,417.24
Equipment, supplies and contractual	290.89	50.00		340.89
Travel and per diem	761.38	0.00		761.38
Overhead**	3,182.00		1,850.00	5,032.00
				<u>\$20,551.51</u>

\*Includes retirement and Social Security contribution of \$306.  
 \*\*Overhead charged AEC (39.50% of all salaries and wages)

Carry-over from last year \$311.06

Contributed by AEC 1965-66  
 (\$13,396. less carry-over \$311.06) \$13,084.94

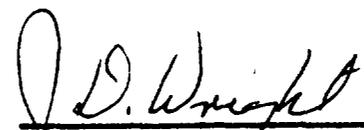
Contributed by NCSU 1965-66 7,221.00

\$20,305.94

Less total estimated  
 expenditures \$20,551.51

Estimated deficit  
 1965-66 \$245.67

Financial Statement approved:

  
 \_\_\_\_\_  
 J. D. Wright  
 Assistant Business Manager  
 Acting

UNITED STATES GOVERNMENT

# Memorandum

TO : R. G. Humphries, Director  
Contract Division

FROM : Herman M. Roth, Director  
Research and Development Division

SUBJECT: REQUEST FOR CONTRACT ACTION

DATE:

MAR 16 1965

ORS:EMM

It is requested that you take the necessary steps to process the following described contract action:

1. Nature of Action Requested:

Selection of New Contractor and/or  
Negotiation of Contract  
Number:  
Contractor:

Modification of Contract  
Number: AT-(40-1)-2100  
Contractor: North Carolina State of the University  
of North Carolina at Raleigh  
Raleigh, North Carolina

2. Nature of Services to be Covered by Contract: Research

Title: "Studies in the Ecology of Fresh-Water Algae in  
North Carolina"

3. Type of Contract:  Lump-Sum  Cost-Type  Other

4. Amount to be Obligated by this Contract Action: \$4,000.00

5. Description of Other Changes to be Covered by Contract Action:

Modify contract to increase amount of new AEC funds for period  
March 1, 1965 through February 28, 1966, from \$13,054 to  
\$17,054. Revised Appendix "A" is attached.

6. Authority:

Form AEC-481 (Contract Authorization) from C. L. Dunham to  
S. R. Sapirie dated March 3, 1965

*Herman M. Roth*  
Herman M. Roth

1129431

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APPENDIX "A"  
(REVISED)

For the Contract Period March 1, 1965 through February 28, 1966.

A-I RESEARCH TO BE PERFORMED BY CONTRACTOR

The Contractor will continue to conduct research on the ecology of fresh-water algae in North Carolina. This research will include such approaches as (1) study of the ecology of species inhabiting the rapids of streams, (2) study of method of determining the average current speed within a small area, (3) continuation of floristic and ecological study of the Mesotaeniaceae and Desmidiaceae in North Carolina, and (4) continuation of work toward completion of a compilation of algal flora of North Carolina. The Contractor will also conduct an investigation of the ecology of heterotrophic algae living in subarctic lakes.

A-II APPROXIMATE LEVEL OF RESEARCH EFFORT

		Approx. % of time
(a) <u>Contractor Personnel:</u>		
Dr. L. A. Whitford	Academic	50%
Principal Investigator	Summer	100%
2 Research Associates		66%
2 Research Assistants		34%
1 Research Assistant		As Needed
Student Help		As Needed

(b) Premises, Facilities, and Materials to be  
Furnished by the Contractor:

Adequate laboratory facilities and equipment, including growth chambers, are available to conduct studies in the ecology of fresh-water algae and of heterotrophic algae living in subarctic lakes.

A-III ITEMS OF EQUIPMENT TO BE PURCHASED OR FABRICATED BY CONTRACTOR  
COSTING \$500 OR MORE

None

ADOPS 9-4-61

<b>U. S. ATOMIC ENERGY COMMISSION CONTRACT AUTHORIZATION</b>		1. DATE <b>MAR 3 1965</b>	2. AUTHORIZATION NO. <b>BM-65-381A</b>
3.A. TO <b>S. R. Sapirie, Manager Oak Ridge Operations Office</b>		3.B. FROM <i>John R. Zoller</i> <b>C. L. Dunham, M.D., Director Division of Biology &amp; Medicine</b>	
4.A. CONTRACTOR (Name, Address, Department, etc.) <b>North Carolina State of the University of North Carolina Raleigh, North Carolina</b>		4.B. PRINCIPAL INVESTIGATOR(S) <b>Larry A. Whitford</b>	
5. SUPPLEMENT <input type="checkbox"/> NEW CONTRACT <input type="checkbox"/> RENEWAL <input checked="" type="checkbox"/> OTHER		6. TERM OF CONTRACT <b>3-1-65 thru 2-28-66</b>	7. CONTRACT NUMBER <b>AT(40-1)-2100</b>
8. RECOMMENDED TYPE OF CONTRACT: <input checked="" type="checkbox"/> FIXED PRICE <input type="checkbox"/> COST REIMBURSEMENT <input type="checkbox"/>		9. PROPERTY TITLE TO VEST IN: <input type="checkbox"/> AEC <input checked="" type="checkbox"/> CONTRACTOR <input type="checkbox"/> CONTRACTOR UNDER AUTHORITY OF PUBLIC LAW 85-934. <i>This has been determined to be in furtherance of the objectives of the Atomic Energy Commission.</i>	
		10. SECURITY CLASSIFICATION: Work to be performed is under category <u>I</u> as defined by AEC Manual Appendix 3401.	
11. PROJECT TITLE <b>"STUDIES IN THE ECOLOGY OF FRESH-WATER ALGAE IN NORTH CAROLINA"</b>			
12. HEADQUARTERS TECHNICAL CONTACT <b>Mr. Jared J. Davis</b> <i>J. J. Davis</i>			
13. FINANCING (New AEC Funds, Not To Exceed Amounts Indicated):			
A. OPERATING EXPENSES .....		\$	<b>4,000</b>
Budget and Reporting Classification: <b>06 05 01</b>			
Allotment Transfer: <b>06-51-91(24)</b>			
B. PLANT AND CAPITAL EQUIPMENT .....		\$	
Budget and Reporting Classification:			
Allotment Transfer:			
14. SPECIAL PROVISIONS AND INSTRUCTIONS: The technical aspects of the proposed work have been reviewed and are approved. A need currently exists for the results of the research or other work that is to be undertaken. None of the AEC funds shall be used to confer a fellowship. Please keep us informed as to any problems encountered in your negotiations, as well as the date of execution of this contract and the amount of funds obligated. If the budget as negotiated differs substantially from that in the proposal, please forward a copy of the revised budget to Headquarters. If not already submitted, a 200-word summary of the proposed work should be forwarded by the contractor as soon as possible after negotiation of the contract.			
15. SCOPE OF WORK			

An investigation of the ecology of heterotrophic algae living in subarctic lakes.

210  
MAR 5 1965

112963

NORTH CAROLINA STATE  
OF THE UNIVERSITY OF NORTH CAROLINA  
AT RALEIGH

SCHOOL OF AGRICULTURE AND LIFE SCIENCES  
OFFICE OF THE DEAN AND DIRECTORS

P. O. Box 5847  
RALEIGH, N. C. 27607

March 9, 1965

Dr. C. S. Shoup  
Chief, Biology Branch  
Research and Development Division  
Box E  
U. S. Atomic Energy Commission  
Oak Ridge, Tennessee

Dear Dr. Shoup:

We were informed this morning that \$4,000 has been allocated for research to be done by Dr. John E. Hobbie, and that this amount is to be added to Dr. L. A. Whitford's present AEC contract No. AT-(40-1)-2100.

The Administration of the School of Agriculture and Life Sciences agrees to this arrangement and anticipates no difficulties in the disbursement of these funds.

We are most appreciative of your continued support and assistance for our research endeavors.

Sincerely,



H. A. Stewart  
Acting Director of Research

HAS:CMC:eu

cc: Dr. L. A. Whitford  
Dr. B. S. Martof

1129434

F 2356

MAR 12 1965

8 February 1965

Jared J. Davis  
Aquatic Ecologist  
Environmental Sciences Branch  
Division of Biology and Medicine  
AEC, Washington, D.C. 20545

Dear Dr. Davis,

Thank you for your letter of February 5. I am not sure whether or not you have a copy of the proposal I submitted to the Arctic Institute (one was sent to Dr. Wolfe). Therefore, I enclose a copy for your information. I also have sent a copy of this to Dr. Whitford at North Carolina State for his information.

The requested funding of 4000 dollars is correct.

I will be in the Department of Zoology at North Carolina State, while Dr. Whitford is in the Dept. of Botany and Bacteriology. I hope this will not complicate things too much.

I have the chance to make a field trip to Lapland in early March as a graduate student from this institute will be sampling some lakes then. This is during the regular vacation here, so I feel that I can take the time off without hurting my NIH project. As there are only a few hours of sunlight in Lapland at that time, it would be a fine time to start sampling. While I wouldn't need any funds at that time, I would need a little more information about my chances for AEC funding. Therefore, I would certainly appreciate any information you can pass on.

Please let me know if there is any more information you require.

Sincerely yours,  
*John E. Hobbie*  
John E. Hobbie

1129435

1116

Objective.

To discover if subarctic freshwater algae are adapted to their environment through heterotrophy.

Purpose.

The report of Rodhe (1955) that algae exist under the winter ice of Lapland lakes has stimulated much discussion about the heterotrophic abilities of algae, particularly their ability to take up dissolved organic compounds. Rodhe postulated that the algae may be excreting organic matter into the water during the summer and taking it up during the winter. Fogg (1958, 1963), acting on this, was able to show a large amount of excretion of organic matter by natural populations, so much, in fact, that he cast serious doubts on the reliability of the carbon 14 method of measuring primary productivity. Yet, neither Fogg nor Rodhe were able to study the uptake of dissolved organic material in natural populations with the available techniques.

For the past 18 months, R. Wright and myself have worked in Prof. Rodhe's laboratory on the problem of the uptake of dissolved organic material. We have now worked out a new method, using isotopes, that gives the rate of uptake of organic compounds by phytoplankton and also separates the rate into that part due to bacteria and that part due to algae. Using this method, I would like to study the ability of subarctic algae to take up dissolved organic material under the ice and in early summer. If Rodhe's postulate is true, there should be high rates of uptake per algal unit during winter and lower rates during the summer as the algae adapt or as the population changes. The project, therefore, would give basic information about the survival of algae under the ice of subarctic lakes and about some of the adaptations they have made to the severe environment. Naturally, the phytoplankters that grow under the ice are extremely important to the survival of the zooplankton, especially those animals that reproduce under the ice.

As well as being basic to the study of subarctic plankton, the project would also be of basic importance to the study of production in all natural waters. Most of the volume of the oceans and of deep lakes lies beneath the photic zone where it is usually considered that little production occurs. Both bacteria and algae have been found in the depths of lakes and thousands of meters deep in the sea (Wood 1963), yet little is known of their survival and growth. Recently, however, ~~aximittam~~ Parsons and Strickland (1962) suggested that "the heterotrophic assimilation may be a significant fraction of the photosynthetic production, when considering the whole water column in a deep ocean." Thus, if the bacteria and algae extensively use the tremendous reservoir of energy represented by the dissolved organic matter of natural waters (Juday 1942), then the usual energy pathways of aquatic biology must be radically modified. Heterotrophy may also be important to the benthic algae as R. Wilce (personal communication) found algae growing well below the 1% light level in the Canadian arctic. Certainly the question of algal heterotrophy is a current one, and very important to aquatic problems.

The subarctic lakes are ideal places to study this question, mainly because the number of experimental variables is greatly reduced. An ice and snow cover seals off the lakes, yet chemical conditions do not change appreciably. The resulting long-term stability should enable a sizeable population of algal heterotrophs to develop. In addition, as is common in the polar regions, the number of species is reduced sharply, which simplifies the enumeration of the algae.

Techniques.

The basic technique involves the addition of unlabelled and labelled substrate (such as glucose and glucose C14) to samples of lake water. Differing amounts of the unlabelled substrate are added to a series of duplicate samples so that uptake is tested over a range of concentrations. After filtration and measurement of the fixed substrate with a C-14 counter, uptake rates are calculated. It has been found (Wright and Hobbie in press) that the bacteria take up the substrate according to Michaelis enzyme kinetics while the algae take up the substrate according to simple diffusion kinetics. By appropriate calculations, the uptake rates of the bacteria and algae can be separated. By a modification of the techniques so that pure cultures with known kinetics may be used, bacteria can give a bioassay to find the original concentration of substrate in the water (Hobbie and Wright in press). This bioassay enables us to calculate the true rate of uptake.

For the enumeration of the algae, the inverted microscope and settling chambers will be used.

Localities.

The study area will be the lakes around Abisko, Sweden, at 68°N and 19°E. Laboratory space and living quarters are available at the Abisko Naturvetenskapliga Station and a variety of lakes are close by. These range from the subarctic Torneträsk to high mountain lakes that approach high-arctic conditions. The main reason for the choice is that these lakes are by far the best studied subarctic lakes in the world (Ekman 1957, Rodhe 1962) and perhaps the only ones where the nanoplankton are adequately known (Skuja 1964). Finally, rail transportation is available throughout the year.

Bibliography.

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- Wood, E.J.F. 1963. Heterotrophic micro-organisms in the ocean. p. 197-222. In E. Barnes, (ed.) *Oceanography and marine biology*, vol. 1. Allen and Unwin, London.
- Wright, R.T. and J.E. Hobbie. In press. Studies on the uptake of organic solutes in lake water. *Limnol. and Oceanogr.*

Personnel.

A part-time assistant is needed for help with the field experiments. I have found a highly-trained assistant, he will do much of the specimen identification and counting. This will enable me to finish all of the project except for the final reports and papers during the summer season.

Staffan Holmstrom, born 3 April 1936, home address Eksala, Sweden, formerly Professor, Uppsala University (app. to U.S.A.). He has been teaching and doing research at the Institute of Limnology, Uppsala. Experience: Spitzbergen, summer 1959, Ecological expedition, Uppsala University. One year and 3 summers at Abisko, Lappland, working on PhD thesis on an arctic lake near Abisko.

Field Plan.

It is imperative for the success of the project that the data are worked up as the project progresses. With this technique the experimental conditions (experimental time, amount of isotopes) must be adjusted as conditions in the lakes change. As the laboratory at Abisko does not have C-14 counting equipment, I must return to Uppsala to work up the data. This trip takes less than one day by train and costs less than 50 dollars so little time and expense are involved. With transportation so convenient, I can adjust the sampling schedule to fit the snow and ice conditions.

At least two weeks of April, May, June, and July will be spent in the field and the rest of the time at Uppsala. Two or three lakes will be sampled for heterotrophy, first under normal conditions and then during the spring and summer. It takes about 4 days to set up and complete an experiment.

August will be spent in Uppsala finishing the calculations and preparing a short paper on this work to be presented at the International Congress of Limnology at the end of August.

Equipment and Materials.

Travel. 6 round trips Uppsala-Abisko for self and assistant.		300
Incidental. Typing 10, Photogram 30, reprints (self) 20		60
Direct costs. Salary for self, 4 months (May-Aug.)		2000
Salary for assistant (part-time)		500
Isotopes: 1 mc Glucose (U) C14	300	
1 mc H <sub>2</sub> Acetate-1,2-C14	127	
0.5 mc Na Glycollate-1-C14	127	
		<u>534</u>
	Total dollars	4000

Recommendation to send Staffan Holmstrom to U.S.A. The Swedish Government will provide him with a stipend for his living expenses and housing quarters at Abisko and he will be provided with field equipment and traveling expenses at the Institute of Limnology, Uppsala, Sweden.

UNITED STATES GOVERNMENT

# Memorandum

TO : R. G. Humphries, Director  
Contract Division

FROM : Herman M. Roth, Director  
Research and Development Division

SUBJECT: REQUEST FOR CONTRACT ACTION

ORS:EMM

DATE: February 9, 1965

It is requested that you take the necessary steps to process the following described contract action:

1. Nature of Action Requested:

Selection of New Contractor and/or  
Negotiation of Contract  
Number:  
Contractor:

Modification of Contract  
Number: AT-(40-1)-2100  
Contractor: North Carolina State of the University of  
North Carolina at Raleigh  
Raleigh, North Carolina

2. Nature of Services to be Covered by Contract: Research

Title: "Studies in the Ecology of Fresh-Water Algae in  
North Carolina"

3. Type of Contract:  Lump-Sum  Cost-Type  Other

4. Amount to be Obligated by this Contract Action: \$13,054.00

5. Description of Other Changes to be Covered by Contract Action:

Modify contract to provide for the performance of additional research to be completed during the period March 1, 1965, through February 28, 1966. The AEC will support the project in the amount of \$13,054 in new funds.

6. Authority:

Form AEC-481 (Contract Authorization) from C. L. Dunham to  
S. R. Sapirie, dated January 28, 1965.

*Herman M. Roth*  
Herman M. Roth

1129439

APPENDIX "A"

For the Contract Period March 1, 1965, through February 28, 1966.

A-I RESEARCH TO BE PERFORMED BY CONTRACTOR

The Contractor will continue to conduct research on the ecology of fresh-water algae in North Carolina. This research will include such approaches as (1) study of the ecology of species inhabiting the rapids of streams, (2) study of method of determining the average current speed within a small area, (3) continuation of floristic and ecological study of the Mesotaeniaceae and Desmidiaceae in North Carolina, and (4) Continuation of work towards completion of a compilation of algal flora of North Carolina.

A-II APPROXIMATE LEVEL OF RESEARCH EFFORT

(a) Contractor Personnel:

		Approx. % of time
Dr. L. A. Whitford	Academic	50%
Principal Investigator	Summer	100%
Research Associate		21%
2 Research Assistants		34%
Labor		As Needed

(b) Premises, Facilities, and Materials to be  
Furnished by the Contractor:

Adequate laboratory facilities and equipment, including growth chambers, are available to conduct studies in the ecology of fresh-water algae in North Carolina.

A-III ITEMS OF EQUIPMENT TO BE PURCHASED OR FABRICATED  
BY CONTRACTOR COSTING \$500 OR MORE

None

AECPR 9-4.81		U. S. ATOMIC ENERGY COMMISSION <b>CONTRACT AUTHORIZATION</b>		1. DATE <b>JAN 28 1965</b>	2. AUTHORIZATION NO. <b>EM-65-381</b>
3.A. TO <b>S. R. Sapirie, Manager Oak Ridge Operations Office</b>		3.B. FROM <b>C. L. Dunham, M. D. <i>Director</i> Division of Biology &amp; Medicine, HQ</b>			
4.A. CONTRACTOR (Name, Address, Department, etc.) <b>Department of Botany and Bacteriology NORTH CAROLINA STATE OF THE U. OF NORTH CAROLINA Raleigh, North Carolina</b>		4.B. PRINCIPAL INVESTIGATOR(S) <b>Larry A. Whitford</b>			
5. <input type="checkbox"/> NEW CONTRACT <input checked="" type="checkbox"/> RENEWAL <input type="checkbox"/> OTHER		6. TERM OF CONTRACT <b>3-1-65 thru 2-28-66</b>		7. CONTRACT NUMBER <b>AT(40-1)-2100</b>	
8. RECOMMENDED TYPE OF CONTRACT: <input checked="" type="checkbox"/> FIXED PRICE <input type="checkbox"/> COST REIMBURSEMENT <input type="checkbox"/>		9. PROPERTY TITLE TO VEST IN: <input type="checkbox"/> AEC <input checked="" type="checkbox"/> CONTRACTOR <input type="checkbox"/> CONTRACTOR UNDER AUTHORITY OF PUBLIC LAW 85-934. <i>This has been determined to be in furtherance of the objectives of the Atomic Energy Commission.</i>		10. SECURITY CLASSIFICATION: Work to be performed is under category <u>I</u> as defined by AEC Manual Appendix 3401.	

11. PROJECT TITLE  
**"STUDIES IN THE ECOLOGY OF FRESH-WATER ALGAE IN NORTH CAROLINA"**

12. HEADQUARTERS TECHNICAL CONTACT  
**Mr. Jared J. Davis**

13. FINANCING (New AEC Funds, Not To Exceed Amount Indicated):

A. OPERATING EXPENSES ..... \$ **13,054**  
 Budget and Reporting Classification: **06 05 01** **342 Unexpended Balance**  
 Allotment Transfer: **06-51-91(24)**

B. PLANT AND CAPITAL EQUIPMENT ..... \$  
 Budget and Reporting Classification:  
 Allotment Transfer:

14. SPECIAL PROVISIONS AND INSTRUCTIONS:

The technical aspects of the proposed work have been reviewed and are approved. A need currently exists for the results of the research or other work that is to be undertaken. None of the AEC funds shall be used to confer a fellowship.  
 Please keep us informed as to any problems encountered in your negotiations, as well as the date of execution of this contract and the amount of funds obligated. If the budget as negotiated differs substantially from that in the proposal, please forward a copy of the revised budget to Headquarters.  
 If not already submitted, a 200-word summary of the proposed work should be forwarded by the contractor as soon as possible after negotiation of the contract.

15. SCOPE OF WORK

**A study of the ecological factors which control natural distributions, habitat requirements, and seasonal cycles of fresh-water algae.**

FEB 1 1965

1129441

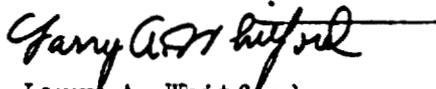
January 4, 1965

Dr. C. S. Shoup  
Chief, Biology Branch  
Research and Development Division  
U. S. Atomic Energy Commission  
Oak Ridge, Tennessee 37831

Dear Dr. Shoup:

Enclosed is a revised and corrected estimate of our expected expenditures until the end of the contract period, including the change in format you suggested.

Yours very truly,



Larry A. Whitford  
Professor of Botany

LAW:es

Enclosures

PK

OAK RIDGE RESEARCH  
RECEIVED

JAN 8 2 52 PM '65

RECEIVED

41

1129442

JAN 6 - 1965

REPORT ON THE BUDGET

(Revised)

March 1, 1964 to November 30, 1964

Contract No. AT-(40-1)-2100 with U. S. Atomic Energy Commission

Item	Contributed by AEC Expended to Nov. 30	Needed to Feb. 28	Contributed by N. C. State	Total
Salaries and labor	\$8,870.08	\$ 2,148.75	\$4,250.00*	\$15,268.83
Equipment, supplies and contractual	776.16	594.00		1,370.16
Travel and per diem	634.80	140.00		774.80
Overhead**	4,407.00		1,793.00	<u>6,200.00</u> \$23,613.79

\*Includes retirement and Social Security contribution of \$306.

\*\*Overhead charged AEC (39.50% of all salaries and wages).

Carry-over from last year	\$ 0.00
Contributed by AEC 1963-64	17,913.00
Less total estimated expenditures (AEC funds)	17,570.79
Estimated carry-over 1964-65	<u>\$ 342.21</u>

Financial Statement approved:

*W. L. Turner*  
W. L. Turner  
Business Manager

1129443

F 21  
JAN 6 1965

UNITED STATES GOVERNMENT

# Memorandum

TO : **C. L. Bushan, Director**  
**Division of Biology and Medicine, HQ**

DATE: **December 1, 1944**

FROM : **Herman M. Roth, Director**  
**Research and Development Division, OR**

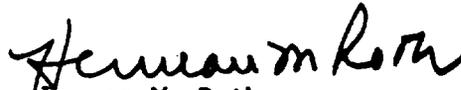
SUBJECT: **RENEWAL OF CONTRACT NO. AT-(40-1)- 2300 WITH NORTH CAROLINA STATE OF**  
**THE UNIVERSITY OF NORTH CAROLINA AT RALPH (DR. L. A. WHITFORD)**

**Enclosure**

We are submitting for your review and appropriate action the following information concerning the contract which will expire on **February 28, 1945**:

1. Renewal Proposal ( 4 )
2. Progress Report ( 4 )
3. Financial Statement ( 4 - included in progress report )
4. 200-Word Summary ( 2 )

We shall appreciate your advising us of your decision so that we may proceed with the necessary contract action at the earliest possible date.

  
Herman M. Roth

Enclosure:  
As Listed Above

cc: **C. S. Shoup, w/encl.**  
**B. S. Sherry, w/progress report**  
**Alice Brown** ✓

A RENEWAL PROPOSAL

to

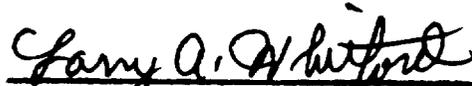
UNITED STATES ATOMIC ENERGY COMMISSION

CONTRACT NO. AT-(40-1)-2100

Covering the period from March 1, 1965 through February 28, 1966

Requesting support in the amount of \$20,617.00

Title of the Project: Studies in the Ecology of Fresh-water  
Algae in North Carolina



---

Larry A. Whitford, Principal Investigator  
Department of Botany and Bacteriology

APPROVED



---

R. L. Lovvorn, Director  
North Carolina Agricultural Experiment Station

NORTH CAROLINA STATE OF THE  
UNIVERSITY OF NORTH CAROLINA  
at Raleigh, North Carolina

1129445

E11555

## SUMMARY OF PROPOSED WORK

The work planned is a continuation of last year's work with one added project involving a method of determining average current speed in a small area. Radioactive material will be used in this study.

The two Investigators plan a few more experiments on the uptake of radio-active phosphorus. They will also investigate the possibility of using radio-active sulfur to make radio-autographs of colonies of crustose algae. These would be useful in studies of the ecology of rapids species. Most of the time the Investigators will study the species ecology of selected stream species using an artificial stream apparatus which has been devised. With this apparatus the effects of light, and temperature on single species are being compared in still water or at different current speeds. Further work on primary production in streams will be continued.

Mr. Gary E. Dillard, Graduate Assistant, expects to complete the requirements for the Ph.D. degree during the summer of 1965. Support for his work is requested for three months only.

Mrs. Yoon C. Kim will continue her study of the species of desmids in North Carolina and their distribution in relation to geographic area and major habitat factors. Collections with habitat data are at hand from all regions of the state but some further travel to make collections will be done.

Since genera and species new to the state are still being collected a small amount of time will be devoted to their study. The distribution within the state of several apparently rare species of fresh-water algae will be investigated.

A paper will be prepared for publication including data on important

ecological factors affecting a number of species of fresh-water algae.

OVERALL PROJECT

Studies in the Ecology of Fresh-water Algae in North Carolina

OBJECTIVES:

1. To obtain further data on the species and communities of algae in the rapids of streams together with habitat factors influencing their growth.
2. To continue a floristic and ecological study of the Mesotaeniaceae and Desmidiaceae in North Carolina
3. To continue work toward a compilation of an algal flora of North Carolina.

JUSTIFICATION:

Work during the past two years has demonstrated that lotic species of green algae (Chlorophyceae) respond to a current with increased respiration and mineral uptake in proportion to speed of current, and their response is greater than in case of lenitic species. These data could be of practical importance in the management of streams for fish production and in the concentration and removal of radioactive wastes from streams. This work should be extended to include all important groups of algae. A parallel study of the morphology, distribution and ecology of little known but important genera of crustose algae would seem important. Data on these species as well as on other important stream species would fill a serious gap in our knowledge of stream ecology and limnology. Data on production in streams, particularly a comparison of production in rapids as compared with that in quiet areas, would be well worthwhile. Little such data is at present available.

The Desmidiaceae and the related Mesotaeniaceae are two of our most important families of fresh-water algae. Knowledge of the distribution, abundance and ecology of these groups, which are abundant in both lenitic and certain lotic habitats, would seem well worthwhile.

Work during spare time toward compiling a complete fresh-water algal flora of the state also seems justified.

EXPERIMENTAL PROCEDURES:

A few more experiments on the uptake of radioactive phosphorus in a current as compared with that in still water will be done. More data is needed on the effect of time on uptake and also on the effect of phosphorus level on rate of uptake. This work will be done in the laboratory using methods previously used. The possibility of making radioautographs of microscopic colonies by using radioactive sulfur will be tried.

A study will be made of a method of determining the average current speed in small areas by means of diffusion tubes containing radio-active materials or dyes.

Further data on the effect of a current and of light on the growth of important species will be collected. Studies of the morphology of several interesting species of Chlorophyceae will be continued using slides placed in streams.

Studies of the effects of light, temperature and a current will be studied in the laboratory using an artificial stream apparatus which has been devised. With this apparatus the separate effect of light and of temperature can be studied.

The study of the distribution of the Mesotaeniaceae and Desmidiaceae

in North Carolina will be continued, and habitat factors such as water temperature, depth, pH, and influence of associated species will be noted. A large number of herbarium specimens from the state will be studied also.

Particularly during the winter months, a search will be made for rare and little known species believed to occur in the state.

#### SUBPROJECTS

##### I. A Study of the Ecology of Species Inhabiting the Rapids of Streams

###### OBJECTIVES:

- a. To determine whether light, temperature, or current speed is most important in determining the presence and abundance of important species in rapids.
- b. To collect data on production by dominant rapids species.
- c. To collect further data on the effect of current speed on distribution of rapids species.
- d. To continue morphological and life history studies of certain rapids species.
- e. To collect further data on mineral uptake by lotic species of algae.

###### JUSTIFICATION:

If, as preliminary data indicates, a current has a marked influence in mineral uptake, and lotic species show a greater response to a current; reliable and adequate data on all groups possible which inhabit rapids would seem desirable. In management of streams for fish production it might prove practicable to construct a series of rapids in order to increase basic organic production. The removal of undesirable amounts of

radioactivity for streams might be achieved by the construction of weirs or rapids where lotic species of algae would absorb radioactive minerals. Weirs or rapids could be so constructed that the radioactive algae could be harvested for disposal of wastes.

Relatively much less data is at hand on lotic habitats than is available on the plankton community and other lenitic habitats. It would seem that any ecological data would be of general scientific value as well as for the two practical reasons cited in the paragraph above. A determination of the relation of current speed to distribution of species would be of value in a comparison of different types of streams as well as of practical value in the construction of artificial rapids or weirs. A knowledge of any variation in organic production in various parts of streams would be of similar value.

Several important rapids species are poorly known. Data on the morphology, life history and growth rates of these species would seem valuable for any of the reasons given above.

METHODS:

a. During the past year an artificial stream apparatus was devised by means of which stream water at controlled temperature, exposed to full daylight can be circulated in a "stream" two meters in length. It is proposed to expose colonies of rapids algae collected on pebbles and glass micro-slides to variations in light temperature and current speed. By using two sets of apparatus two factors can be held constant and the third varied so that it can be determined if this factor is the limiting one. Preliminary tests have indicated that any one of the three can be limiting

for certain species. The most favorable light intensity, temperature and current speed will be determined for important lotic species and for several interesting rare species.

b. Counts of individual cells and colonies of algae collected on glass micro-slides in different habitats will be made and the results subjected to statistical analysis. Dry weight samples of the total algal population from the same habitats will be used to determine total production and for comparison with data from species counts.

c. Further data will be collected on the effect of current on the distribution of species. Special attention will be paid to species occurring in late winter and early spring since almost no data is at hand for these forms.

d. More data will be collected on the effect of time and of phosphorus concentration on the uptake of that element by lotic species of algae.

## II. A Study of a Method of Determining the Average Current Speed Within a Small Area.

### OBJECTIVES:

To determine if the diffusion or radio-active materials and dyes can be used to measure the average current speed in a small area.

### JUSTIFICATION:

Since current speed markedly affects growth of many species of organisms, and since current speed is known to vary considerably within relatively small areas in the rapids of streams; a method of measuring average current speed within a small area would be valuable.

EXPERIMENTAL METHODS:

Small tubes filled with water in which radio-active salts or dyes is dissolved will be covered with a plastic film permeable to the dissolved material and anchored in a current and in still water. The amount of diffusion out of the tube in a 24-hour period will be determined by means of a radio-activity counter or a colorimeter. If there is a significantly different amount of diffusion out of the tubes in still water and a current an attempt will be made to construct a table or graph of diffusion rate in currents of different speeds. It is hoped the data or curve can be used to indicate average current speed over a period of time.

III. To Continue a Floristic and Ecological Study of the  
Mesotaeniaceae and Desmidiaceae in North Carolina.

OBJECTIVES:

To record all species in these two important families occurring in the state and their distribution in relation to geographic area and important habitat factors.

JUSTIFICATION:

Desmids are an important element of the flora of the littoral zone and the plankton; and occur to some extent even in smaller streams. An estimated 450-500 species and varieties occur in the state. Ecological data on most algal communities would be incomplete without the inclusion of desmid species. Several hundred collections, with some ecological data, are already at hand, and the common species have already been identified. Half as many more collections at different seasons and from some of the less accessible areas of the state would permit a complete flora to be compiled and conclusions drawn as to the relation of distribution to

season and important habitat factors.

EXPERIMENTAL METHODS:

Detailed microscopic study of the collections already at hand will be made and the desmid flora compiled. Further collections will be made and species studied as far as possible in the fresh conditions. These collections will enable conclusions to be drawn as to distribution of species in relation to season and geographic area. Habitat data will be recorded to enable conclusions to be drawn as to distribution in relation to water quality, pH, temperature, light and the algal community occupied by each species. Particular attention will be paid to the distribution of some apparently rare species known to occur in the state and to the meeting and commingling of northern and southern floras of desmids.

IV. To Continue Work Toward Completion of an Algal Flora of North Carolina.

OBJECTIVES:

To compile a complete flora of the fresh-water algae of North Carolina.

JUSTIFICATION:

Before good ecological work can be done in an area of any size a knowledge of the species occurring in that area is necessary. Completion of fresh-water algal flora of the state would enable future ecological work to be undertaken in any algal habitat. A complete record of the flora would also enable workers in the future to record possible changes in relation to changes in physical habitat, weather, climate, radioactivity, etc. Although more than 1,400 species and varieties of fresh-water algae have already been reported from the state, it is estimated the flora is only 60% complete; therefore, considerably more work will be needed to

complete a flora.

EXPERIMENTAL METHODS:

Little time will be taken from other projects to work on the flora, but new, rare, and unrecorded species will be identified when found. Except for the Mesotaeniaceae and Desmidiaceae the species of Chlorophyceae have been well worked, therefore attention will be paid chiefly to other groups.

BACKGROUND AND STATUS OF PERSONNEL

Scientific Personnel:

Senior Investigator	--Larry A. Whitford, Professor of Botany, N. C. State College. (See original proposal for biography and bibliography.) 100% of time June, July, August, 50% remainder of year.
Associate Investigator	--George J. Schumacher, Professor of Biology, Harpur College, State University of New York. (See renewal proposal for 1959-1960 for biography and bibliography.) 100% of time July, August; 25% of time Sept. and Oct.
Graduate Assistant	--Gary E. Dillard, M. S. Southern Illinois University. Candidate for Ph.D. degree, N. C. State College. 1/2 time 3 mos.
Graduate Assistant	--Yoon C. Kim, B. S. and two years graduate work, Seoul National University. Candidate for Ph.D. degree, N. C. State College. 1/2 time 9 months. 3/4 time June, July, August.

Other Personnel:

Undergraduate students will be employed as labor for glass-washing and laboratory routine and as occasional field assistants for one day only, without per diem.

Other Financial Assistance:

None.

Materials, Equipment and Facilities:

In addition to adequate equipment and growth chambers listed under previous proposals, 400 sq. ft. of laboratory space is used exclusively for phycology research the year round. Any amount of additional space is available during June, July and August.

Travel:

About 75% of the travel money would be used as in past years; that is, for regular travel to the three study areas by the graduate student working on the ecology of rapids, for collecting desmids in all sections of the state by the other graduate student, and travel by the two investigators at irregular intervals to areas where stream ecology studies are being carried out.

Travel money in the amount of \$225 will be used for the two investigators to attend the annual meeting of the American Institute of Biological Sciences at which each will give a paper.

PROPOSED BUDGET

TITLE: Studies in the Ecology of Fresh-water Algae in North Carolina

PROJECT LEADER: Dr. Larry A. Whitford DEPARTMENT: Botany & Bacteriology

ESTIMATED EXPENSES FOR: March 1, 1964 THROUGH Feb. 28, 1965 -  
RENEWAL PROPOSAL

	<u>Requested from AEC</u>	<u>N. C. State College</u>	<u>Total</u>
1. SALARIES			
Principal Investigator (50% 9 mos., 100% June, July, August)	\$2,500.00	\$5,000.00	\$7,500.00
Investigator (100% July, Aug., 25% Sept., Oct.)	2,000.00		2,000.00
Graduate Assistant (50% time for 9 mos., 75% June, July, August)	3,300.00		3,300.00
Graduate Assistant (50% time for 3 mos.)	750.00		750.00
<hr/>			
Student Help (Undergraduate Assistants)	50.00		50.00
Matching Retirement and Social Security Contributions: 7.425% of \$4,500.00	334.00	371.00	705.00
2. EQUIPMENT			
Circulating pumps	130.00		130.00
3. TRAVEL	900.00		900.00
4. COMMUNICATIONS	50.00		50.00
5. PRINTING (Cost of publications)	100.00		100.00
6. SUPPLIES			
Chemicals, glassware, tools, lumber, etc.	<u>100.00</u>		<u>100.00</u>
7. TOTAL DIRECT COSTS	\$10,214.00	\$5,371.00	\$15,585.00
8. TOTAL INDIRECT COSTS (37% of salaries and labor)	<u>3,182.00*</u>	<u>1,850.00**</u>	<u>5,032.00</u>
9. TOTAL BUDGET	\$13,396.00	\$7,221.00	\$20,617.00

\*Overhead based on 37% of all salaries and wages.

\*\*Overhead cost assumed by N. C. State.

No person will, on the grounds of race, color or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under this program.

1129456

REPORT ON THE BUDGET

Mar. 1, 1964 to Nov. 30, 1964

Contract No. AT-(40-1)-2100 with U. S. Atomic Energy Commission

Item	Contributed by AEC Expended to Nov. 30	Needed to Feb. 28	Contributed by N. C. State	Total
Salaries and labor	\$8,870.08	\$2,148.75	\$4,250.00*	\$15,268. <sup>83</sup> <del>30</del>
Equipment, supplies and contractual	776.16	340.00		1,116.16
Travel and per diem	634.80	140.00		774.80
Overhead**	4,407.00		1,793.00	6,200.00
				<u>\$23,359.<sup>26</sup></u> <sub>79</sub>

\*Includes retirement and Social Security contribution of \$306.  
 \*\*Overhead charged AEC (39.50% of all salaries and wages)

Carry-over from last year	\$0.00
Contributed by AEC 1963-64	\$17,913.00
Contributed by NCS 1963-64	6,632.00
	<u>\$24,545.00</u>
Less total estimated expenditures	\$23,359. <sup>79</sup> <del>26</del>
Estimated carry-over 1964-65	1,185.21 \$885.74

*Carry-over AEC Fund \$596.21*

Financial Statement approved:

*W. L. Turner*  
 W. L. Turner  
 Business Manager

UNITED STATES GOVERNMENT

# Memorandum

TO : R. G. Humphries, Director  
Contract Division

FROM : Herman M. Roth, Director  
Research and Development Division

SUBJECT: REQUEST FOR CONTRACT ACTION

ORS:LM

DATE: MAR 9 1964

It is requested that you take the necessary steps to process the following described contract action:

1. Nature of Action Requested:

Selection of New Contractor and/or  
Negotiation of Contract  
Number:  
Contractor:

Modification of Contract  
Number: AT-(40-1)-2100  
Contractor: North Carolina State of the University  
of North Carolina at Raleigh  
Raleigh, North Carolina

2. Nature of Services to be Covered by Contract: Research

Title: "Studies in the Ecology of Freshwater Algae in  
North Carolina"

3. Type of Contract:  Lump-Sum  Cost-Type  Other

4. Amount to be Obligated by this Contract Action: \$17,898.00

5. Description of Other Changes to be Covered by Contract Action:

Modify contract to provide for the performance of additional research to be completed during the period March 1, 1964 through February 28, 1965. The AEC will support the project in the amount of \$17,898 in new funds.

6. Authority:

Form AEC-481 (Contract Authorization) from J. R. Totter to  
S. R. Sapirie dated March 2, 1964

*Herman M. Roth*  
Herman M. Roth

37072

1129458

APPENDIX "A"

For the Contract Period March 1, 1964 through February 28, 1965.

A-I RESEARCH TO BE PERFORMED BY CONTRACTOR

The Contractor will continue to conduct research on the ecology of fresh-water algae in North Carolina streams. This work will include such approaches as (1) uptake by algae of radioactive phosphorus, (2) use of radioactive sulfur to make radioautographs of colonies of crustose algae, (3) study of the ecology of algal inhabitants of stream rapids, (4) study of the species ecology of selected stream species using an artificial stream apparatus whereby the effects of light, and temperature on a species can be compared in still water or at different current speeds, (5) further studies on primary production in streams, (6) studies on the morphology and life history of crustose species of Chloro-phyceae, (6) study of community relationships in rapids and production of dominant species, and (7) study of the several species of desmids in North Carolina and their distribution in relation to geographic area and major habitat factors.

A-II APPROXIMATE LEVEL OF RESEARCH EFFORT

(a) <u>Contractor Personnel:</u>		Approx. % of time
Dr. L. A. Whitford	Academic	50%
Principal Investigator	Summer	100%
Research Associate		21%
2 Research Assistants		53%
Labor		As Needed

(b) Premises, Facilities, and Materials to be  
Furnished by the Contractor:

Adequate laboratory facilities, equipment, and growth chambers are available to conduct studies in the ecology of fresh-water algae in North Carolina.

A-III ITEMS OF EQUIPMENT TO BE PURCHASED OR FABRICATED BY CONTRACTOR  
COSTING \$500 OR MORE

None

U. S. ATOMIC ENERGY COMMISSION  
**CONTRACT AUTHORIZATION**

DATE

AUTHORIZATION NO.

MAR 21 1964

EM-64-420

I. A. TO

S. R. Sapirie, Manager  
Oak Ridge Operations Office

B. FROM

John K. Totter, Acting Director  
Division of Biology & Medicine, HQ

2. A. CONTRACTOR (Name, Address, Department, etc.)

Department of Botany  
North Carolina State College of  
Agri. & Engineering, Raleigh, N. C.

B. PRINCIPAL INVESTIGATOR(S)

Dr. Larry A. Whitford

3.

NEW CONTRACT  AMENDMENT  RENEWAL

4. TERM OF CONTRACT

3-1-64  
2-28-65

5. CONTRACT NUMBER  
(40-1)-2100

6. PROJECT AGREEMENT NO.

7. RECOMMENDED TYPE OF CONTRACT:

(Fixed-price, cost-type, at option of your office, etc.)

Fixed-price

8. PROPERTY TITLE TO VEST IN:

AEC  CONTRACTOR  
 EITHER (Field Office determination)

9. SECURITY CLASSIFICATION:

Work to be performed is under category I as defined by AEC Manual Appendix 3401.

10. PROJECT TITLE

**STUDIES IN THE ECOLOGY OF FRESHWATER ALGAE IN NORTH CAROLINA**

11. HEADQUARTERS TECHNICAL CONTACT

Mr. Jared J. Davis

12. BUDGET AND REPORTING CLASSIFICATION(S)  
(by subactivity number)

06 05 01

13. FINANCING

BY ALLOTMENT TRANSFER — 06-41-91(24)  
Allotment Transfer Chargeable:

BY FINANCIAL PLAN

MAXIMUM AMOUNT OF AEC FUNDS AUTHORIZED FOR THE PERIOD

\$ \_\_\_\_\_

ESTIMATED OBLIGATION AUTHORITY AVAILABLE FROM PREVIOUS CONTRACT PERIOD

\$ \_\_\_\_\_

NEW OBLIGATION AUTHORITY TO BE PROVIDED FOR IN THE CONTRACT

\$ 17,913

ESTIMATED CONTRACTOR CONTRIBUTION (If applicable)

\$ \_\_\_\_\_

TOTAL AMOUNT OF CONTRACT AUTHORIZED

\$ \_\_\_\_\_

4. SPECIAL PROVISIONS AND INSTRUCTIONS:

The technical aspects of the proposed work have been reviewed and are approved. A need currently exists for the results of the research or other work that is to be undertaken. None of the AEC funds shall be used to confer a fellowship.

Please keep us informed as to any problems encountered in your negotiations, as well as the date of execution of this contract and the amount of funds obligated.

THE FOLLOWING ITEMS ARE APPLICABLE, IF CHECKED:

Headquarters has not made a detailed review of the following expense items, which should be investigated as part of any contract negotiation:

Overhead

General and Administrative

Equipment costs

It is desired that this contract be funded for its entire term.

Transfer allotment to cover the period \_\_\_\_\_ to \_\_\_\_\_ is attached.

**SCOPE:** A good basic ecological study of freshwater algae with emphasis on poorly known flora of streams. Further research will be done to evaluate previous results which indicated higher respiration rate and P<sup>32</sup> uptake in algae growing in swift than slow-flowing water. Knowledge obtained may contribute to improvement of stream productivity and management.

E 2167

MAR 4-1964

1129460

UNITED STATES GOVERNMENT

# Memorandum

TO : **C. L. Dunham, Director  
Division of Biology and Medicine, HQ**

DATE: **November 27, 1943**

FROM : **Herman M. Roth, Director  
Research and Development Division, ORO**

SUBJECT: **RENEWAL OF CONTRACT NO. AT-(40-1)- 2100 WITH NORTH CAROLINA STATE  
OF THE UNIVERSITY OF NORTH CAROLINA AT RALEIGH (DR. L. A. WEITFORD)**

**CRS:LM**

We are submitting for your review and appropriate action the following information concerning the contract which will expire on **February 29, 1944**:

1. Renewal Proposal (2)
2. Progress Report (2)
3. Financial Statement (2)
4. 200-Word Summary (2)

We shall appreciate your advising us of your decision so that we may proceed with the necessary contract action at the earliest possible date.

*Herman M. Roth*  
Herman M. Roth

Enclosure:  
As Listed Above

CC: **C. S. Shoup, w/encl.  
D. S. Zachry, w/progress report  
Alice Brown** ✓

A RENEWAL PROPOSAL  
to  
UNITED STATES ATOMIC ENERGY COMMISSION

CONTRACT NO. AT-(40-1)-2100

Covering the period from March 1, 1964 through February 28, 1965

Requesting support in the amount of \$17,913.00

Title of the Project: Studies in the Ecology of Fresh-water  
Algae in North Carolina

*Larry A. Whitford*  
\_\_\_\_\_  
Larry A. Whitford, Principal Investigator  
Department of Botany and Bacteriology

APPROVED

*H. A. Stewart* ACTING  
\_\_\_\_\_  
R. L. Lovvorn, Director  
North Carolina Agricultural Experiment Station

NORTH CAROLINA STATE OF THE  
UNIVERSITY OF NORTH CAROLINA  
at Raleigh, North Carolina

*Nov. 20, 1963*  
\_\_\_\_\_  
Date

1129462

NOV 20 1963  
1129462

## SUMMARY OF PROPOSED WORK

The work planned is a continuation of last year's work with one added project involving species ecology studies.

The two Investigators plan a few more experiments on the uptake of radio-active phosphorus. They will also investigate the possibility of using radio-active sulfur to make radio-autographs of colonies of crustose algae. <sup>(1)</sup> These would be useful in studies of the ecology of rapids species. <sup>(2)</sup> Most of the time the Investigators will study the species ecology of selected stream species using an artificial stream apparatus which has been devised. With this apparatus the effects of light, and temperature on a species can be compared in still water or at different current speeds. <sup>(3)</sup> Further work on primary production in streams will be continued.

Mr. Gary E. Dillard, Graduate Assistant, will continue his <sup>(4)</sup> studies of the morphology and life history of crustose species of Chlorophyceae but will also devote considerable time to <sup>(5)</sup> the study of community relationships in rapids and production by dominant species. Counts of diatoms collected on glass slides in several streams has been begun. The data will be subjected to statistical analysis.

Near the end of the project period Mr. Dillard plans considerable field work in order to collect in several mountain streams so that data from streams in this area can be included in his study.

Mrs. Yoon C. Kim will continue her study of the species of <sup>5</sup> desmids in North Carolina and their distribution in relation to geographic area and major habitat factors. Collections with habitat data are at hand from all regions of the state but some further

travel to make collections will be done.

Since genera and species new to the state are still being collected a small amount of time will be devoted to their study. One apparently undescribed species of Chlorophyceae is known and more about the distribution and ecology of several other rare species should be learned.

A paper will be prepared for publication including data on the rates of respiration and phosphorus uptake by species in four classes of algae. A second short paper will be prepared describing an artificial stream apparatus which has been devised.

If travel money is available the Principal Investigator plans to attend the Tenth International Botanical Congress in Edinburgh, Scotland in August, 1964. A paper by the two investigators will be read and he will confer with phycologists working in algal ecology and visit the station of the British Fresh-water Biological Station where ecological studies of fresh-water algae are being made.

#### OVERALL PROJECT

Studies in the Ecology of Fresh-water Algae in North Carolina

#### OBJECTIVES:

1. To obtain further data on the species and communities of algae in the rapids of streams together with habitat factors influencing their growth.
2. To continue a floristic and ecological study of the Mesotaeniaceae and Desmidiaceae in North Carolina.
3. To continue work toward a compilation of an algal flora of North Carolina.

JUSTIFICATION:

Work during the past year has demonstrated that lotic species of green algae (Chlorophyceae) respond to a current with increased respiration and mineral uptake in proportion to speed of current, and their response is greater than in case of lenitic species. These data could be of practical importance in the management of streams for fish production and in the concentration and removal of radioactive wastes from streams. This work should be extended to include all important groups of algae if possible. A parallel study of the morphology, distribution and ecology of several little known but important genera of crustose algae would seem important. Data on these species as well as on other important stream species would fill a serious gap in our knowledge of stream ecology and limnology. Data on production in streams, particularly a comparison of production in rapids as compared with that in quiet areas, would be well worthwhile. Little such data is at present available.

The Desmidiaceae and the related Mesotaeniaceae are two of our most important families of fresh-water algae. Knowledge of the distribution, abundance and ecology of these groups, which are abundant in both lenitic and certain lotic habitats, would seem well worthwhile.

Work during spare time toward compiling a complete fresh-water algal flora of the state also seems justified.

EXPERIMENTAL PROCEDURES

A few more experiments on the uptake of radioactive phosphorus in a current as compared with that in still water will be done. More

data is needed on the effect of time on uptake and also on the effect of phosphorus level on rate of uptake. This work will be done in the laboratory using methods previously used. The possibility of making radioautographs of microscopic colonies by using radioactive sulfur will be tried.

Data on rates of growth and production by dominant species in rapids will be collected both by counts of cells and colonies and by dry-weight samples collected on glass or plastic plates.

Further data on the effect of a current and of light on the growth of important species will be collected. Studies of the morphology of several interesting species of Chlorophyceae will be continued using slides placed in streams.

Studies of the effects of light, temperature and a current will be studied in the laboratory using an artificial stream apparatus which has been devised. With this apparatus the separate effect of light and of temperature can be studied.

The study of the distribution of the Mesotaeniaceae and Desmidiaceae in North Carolina will be continued, and habitat factors such as water temperature, depth, pH, and influence of associated species will be noted. A large number of herbarium specimens from the state will be studied also.

Particularly during the winter months, a search will be made for rare and little known species believed to occur in the state.

#### SUBPROJECTS

I. A Study of the Ecology of Species Inhabiting the Rapids of Streams

OBJECTIVES

- a. To determine whether light, temperature, or current speed is most important in determining the presence and abundance of important species in rapids.
- b. To collect data on production by dominant rapids species.
- c. To collect further data on the effect of current speed on distribution of rapids species.
- d. To continue morphological and life history of certain rapids species.
- e. To collect further data on mineral uptake by lotic species of algae.

JUSTIFICATION:

If, as preliminary data indicates, a current has a marked influence in mineral uptake, and lotic species show a greater response to a current; reliable and adequate data on all groups possible which inhabit rapids would seem desirable. In management of streams for fish production it might prove practicable to construct a series of rapids in order to increase basic organic production. The removal of undesirable amounts of radioactivity from streams might be achieved by the construction of weirs or rapids where lotic species of algae would absorb radioactive minerals. Weirs or rapids could be so constructed that the radioactive algae could be harvested for disposal of wastes.

Relatively much less data is at hand on lotic habitats than is available on the plankton community and other lenitic habitats. It would seem that any ecological data would be of general scientific

value as well as for the two practical reasons cited in the paragraph above. A determination of the relation of current speed to distribution of species would be of value in a comparison of different types of streams as well as of practical value in the construction of artificial rapids or weirs. A knowledge of any variation in organic production in various parts of streams would be of similar value.

Several important rapids species are poorly known. Data on the morphology, life history and growth rates of these species would seem valuable for any of the reasons given above.

#### METHODS

a. During the past year an artificial stream apparatus was devised by means of which stream water at controlled temperature, exposed to full daylight can be circulated in a "stream" two meters in length. It is proposed to expose colonies of rapids algae collected on pebbles and glass micro-slides to variations in light temperature and current speed. By using two sets of apparatus two factors can be held constant and the third varied so that it can be determined if this factor is the limiting one. Preliminary tests have indicated that any one of the three can be limiting for certain species. The most favorable light intensity, temperature and current speed will be determined for important lotic species and for several interesting rare species.

b. Counts of individual cells and colonies of algae collected on glass micro-slides in different habitats will be made and the results subjected to statistical analysis. Dry weight samples of

the total algal population from the same habitats will be used to determine total production and for comparison with data from species counts.

c. Further data will be collected on the effect of current on the distribution of species. Special attention will be paid to species occurring in late winter and early spring since almost no data is at hand for these forms.

d. Further data will be collected on several puzzling crustose species of Chlorophyceae. One of these is apparently an undescribed species. Marked seasonal changes in the morphology of Batrachospermum, an important genus in certain streams, has been noted. Species of Batrachospermum and other species will be studied in the artificial stream apparatus.

e. More data will be collected on the effect of time and of phosphorus concentration on the uptake of that element by lotic species of algae.

II. To Continue a Floristic and Ecological Study of the Mesotaeniaceae and Desmidiaceae in North Carolina.

OBJECTIVES:

To record all species in these two important families occurring in the state and their distribution in relation to geographic area and important habitat factors.

JUSTIFICATION:

Desmids are an important element of the flora of the littoral zone and the plankton; and occur to some extent even in smaller streams. An estimated 450-500 species and varieties occur in the

state. Ecological data on most algal communities would be incomplete without the inclusion of desmid species. Several hundred collections, with some ecological data, are already at hand, and the common species have already been identified. Half as many more collections at different seasons and from some of the less accessible areas of the state would permit a complete flora to be compiled and conclusions drawn as to the relation of distribution to season and important habitat factors.

EXPERIMENTAL METHODS:

Detailed microscopic study of the collections already at hand will be made and the desmid flora compiled. Further collections will be made and species studied as far as possible in the fresh condition. These collections will enable conclusions to be drawn as to distribution of species in relation to season and geographic area. Habitat data will be recorded to enable conclusions to be drawn as to distribution in relation to water quality, pH, temperature, light and the algal community occupied by each species. Particular attention will be paid to the distribution of some apparently rare species known to occur in the state and to the meeting and commingling of northern and southern floras of desmids.

III. To Continue Work Toward Completion of an Algal Flora of North Carolina.

OBJECTIVES:

To compile a complete flora of the fresh-water algae of North Carolina.

JUSTIFICATION:

Before good ecological work can be done in an area of any size a knowledge of the species occurring in that area is necessary. Completion of a fresh-water algal flora of the state would enable future ecological work to be undertaken in any algal habitat. A complete record of the flora would also enable workers in the future to record possible changes in relation to changes in physical habitat, weather, climate, radioactivity, etc. Although more than 1,400 species and varieties of fresh-water algae have already been reported from the state, it is estimated the flora is only 60% complete; therefore, considerably more work will be needed to complete a flora.

EXPERIMENTAL METHODS:

Little time will be taken from other projects to work on the flora, but new, rare, and unrecorded species will be identified when found. Except for the Mesotaeniaceae and Desmidiaceae the species of Chlorophyceae have been well worked, therefore attention will be paid chiefly to other groups.

IV. Foreign Travel Request.

Permission is requested for the Principal Investigator to attend the Tenth International Botanical Congress in Edinburgh, Scotland, August, 1964, and travel support in the amount of \$750 is also requested. If granted, a paper entitled "Studies in the Ecology of Some Species of Fresh-water Algae" will be read, and the Investigator will attend Congress sessions on Experimental Ecology, Phycology, and meetings of the International Phycological Society.

He will confer with investigators of aquatic habitats and participate in the post-congress Fresh-water Biology Excursion in the English Lake district and visit the Windermere laboratory of the British Fresh-water Biological Association.

It is believed that attendance at the Congress will be of great value to the Investigator and that facts and ideas obtained will benefit all personnel on the project. This was time of attendance at the recent International Congress of Limnology.

N. C. State will help support the trip to the extent of \$150-200, and has given permission for the trip to be made.

#### BACKGROUND AND STATUS OF PERSONNEL

##### Scientific Personnel:

- |                        |   |
|------------------------|---|
| Senior Investigator    | -- Larry A. Whitford, Professor of Botany, N. C. State College. (See original proposal for biography and bibliography.) 100% of time June, July, August, 50% remainder of year.   |
| Associate Investigator | -- George J. Schumacher, Professor of Biology, Harpur College, State University of New York. (See renewal proposal for 1959-1960 for biography and bibliography.) 100% of time July, August; 25% of time Sept. and Oct. |
| Graduate Assistant     | -- Gary E. Dillard, M. S. Southern Illinois University. Candidate for Ph.D. degree, N. C. State College. 1/2 time 9 mos. 3/4 time June, July and August.  |
| Graduate Assistant     | -- Yoon C. Kim, B. S. and two years graduate work, Seoul National University. Candidate for Ph.D. degree, N. C. State College. 1/2 time 12 months.  |

Other Personnel:

Undergraduate students will be employed as labor for glass-washing and laboratory routine and as occasional field assistants for one day only, without per diem.

Other Financial Assistance:

None.

Materials, Equipment and Facilities:

In addition to adequate equipment and growth chambers listed under previous proposals, 400 sq. ft. of laboratory space is used exclusively for phycology research the year round. Any amount of additional space is available during June, July and August.

Travel:

About 60% of the travel money would be used as in past years; that is, for regular travel to the three study areas by the graduate student working on the ecology of rapids, for collecting desmids in all sections of the state by the other graduate student, and travel by the two investigators at irregular intervals to areas where stream ecology studies are being carried out.

Support for foreign travel in the amount of \$750 is requested to enable the Principal Investigator to attend the Tenth International Botanical Congress in Edinburgh, Scotland in August, 1964. Justification for this travel is given above.

PROPOSED BUDGET

TITLE: Studies in the Ecology of Fresh-water Algae in North Carolina

PROJECT LEADER: Dr. Larry A. Whitford DEPARTMENT: Botany & Bacteriology

ESTIMATED EXPENSES FOR: March 1, 1964 THROUGH Feb. 28, 1965 -  
RENEWAL PROPOSAL

	<u>Requested from AEC</u>	<u>N. C. State College</u>	<u>Total</u>
<b>1. SALARIES</b>			
Principal Investigator (50% 9 mos., 100% June, July, August)	\$2,500.00	\$4,250.00	\$6,750.00
Investigator (100% July, Aug., 25% Sept., Oct.)	2,000.00		2,000.00
Graduate Assistant (50% time for 9 mos., 75% June, July, August)	3,300.00		3,300.00
Graduate Assistant (50% time for 12 mos.)	3,000.00		3,000.00
<hr/>			
Student Help (Undergraduate Assistants)	50.00		50.00
Matching Retirement and Social Security Contributions: 6.8% of \$4,500.00	306.00	289.00	595.00
<b>2. EQUIPMENT</b>			
Water cooled tank with pumps	350.00		350.00
Flow meter	100.00		100.00
<b>3. TRAVEL</b>			
	1,600.00		1,600.00
<b>4. COMMUNICATIONS</b>			
	50.00		50.00
<b>5. PRINTING</b>			
(Cost of publications)	100.00		100.00
<b>6. SUPPLIES</b>			
Electronic parts and tools	50.00		50.00
Chemicals, glassware, lumber, etc.	100.00		100.00
<b>7. TOTAL DIRECT COSTS</b>			
	\$13,506.00	\$4,539.00	\$18,045.00
<b>8. TOTAL INDIRECT COSTS (39.50% salaries and labor)</b>			
	<u>4,407.00*</u>	<u>1,793.00**</u>	<u>6,200.00</u>
<b>9. TOTAL BUDGET</b>			
	\$17,913.00	\$6,632.00	\$24,245.00

\*Overhead based on 39.50% of all salaries and wages  
\*\*Overhead cost assumed by N. C. State

1129474

REPORT ON THE BUDGET

Mar. 1, 1963 to Nov. 30, 1963

Contract No. AT-(40-1)-2100 with U. S. Atomic Energy Commission

Item	Contributed by AEC Expended to Nov. 30	Needed to Feb. 28	Contributed by N. C. State	Total
Salaries and labor	\$8,606.52	\$1,958.00	\$4,272.00*	\$14,836.52
Equipment, supplies and contractual	1,130.19	120.00		1,250.19
Travel and per diem	546.87	100.00		646.87
Overhead**	4,019.00		1,577.00	5,596.00
				<u>\$22,329.58</u>

\*Includes retirement and Social Security contribution of \$272  
 \*\*Overhead charged AEC (15% of direct costs)

Carry-over from last year	\$1.80
Contributed by AEC 1963-64	\$16,494.00
Contributed by NCS 1963-64	5,849.00
	<u>\$22,344.80</u>
Less total estimated expenditures	\$22,329.58
Estimated carry-over 1963-64	<u>\$14.32</u>

Financial Statement approved:

*W. L. Turner*  
 W. L. Turner  
 Business Manager

1129475

## Office Memorandum • UNITED STATES GOVERNMENT

TO : R. G. Humphries, Director  
Contract Division

FROM : Herman M. Roth, Director  
Research and Development Division

SUBJECT: REQUEST FOR CONTRACT ACTION

ORS:LM

DATE: MAR 13 1963

It is requested that you take the necessary steps to process the following described contract action:

1. Nature of Action Requested:

Selection of New Contractor and/ or  
Negotiation of Contract.

Modification of Contract

Number: AT-(40-1)-2100

Contractor: North Carolina State College  
Raleigh, North Carolina

2. Nature of Services to be Covered by Contract: Research

Title: "Studies in the Ecology of Fresh-Water Algae in  
North Carolina"

3. Type of Contract  Lump-Sum  Cost-Type  Other4. Amount to be Obligated by this Contract Action: \$16,494.005. Description of other Changes to be Covered by Contract Action:

Modify contract to provide for the performance of additional research to be completed during the period March 1, 1963 through February 29, 1964. The AEC will support the project in the amount of \$16,494 in new funds.

6. Authority: Form AEC-481 (Contract Authorization) from C. L. Dunham to S. R. Sapirie dated March 1, 1963

*Herman M. Roth*  
Herman M. Roth

APPENDIX "A"

For the Contract Period March 1, 1963 through February 29, 1964.

A-I RESEARCH TO BE PERFORMED BY CONTRACTOR

The Contractor will continue to conduct research on the ecology of fresh-water algae in North Carolina. This work will include such approaches as (1) accumulation of further data on the species and communities of algae in the rapids of streams together with habitat factors influencing their growth, (2) continuation of a floristic and ecological study of the Mesotaeniaceae and Desmidiaceae in North Carolina, and (3) continuation of work devoted to compilation of data on the total algal flora of North Carolina. Among the experimental procedures contemplated in investigation of the ecological relationships of the algae is comparison of the rate of uptake of radioactive phosphorus in a current to that in still water for species of fresh-water Rhodophyceae, Cyanophyceae and possibly Xanthophyceae.

A-II APPROXIMATE LEVEL OF RESEARCH EFFORT

<u>(a) Contractor Personnel:</u>	<u>Approx. % of time</u>
Dr. L. A. Whitford	Academic 50%
Principal Investigator	Summer 100%
Research Associate	25%
2 Research Assistants	47%
Labor	300 hours

(b) Premises, Facilities and Materials to be Furnished by the Contractor:

Adequate facilities are available to conduct studies in the ecology of fresh-water algae in North Carolina. These include laboratory space, growth chambers, boat and motor, boat trailer, research microscope, optical equipment, and pH and flow meters.

<u>A-III EQUIPMENT TO BE PURCHASED OR FABRICATED BY CONTRACTOR</u>	<u>Estimated Cost</u>
1. pH Meter	\$160.00
2. Flow Meter	140.00

A-IV EQUIPMENT TITLE TO WHICH IS TO REMAIN WITH GOVERNMENT

None

A-V SUBSTANTIAL DEVIATIONS

Substantial deviations from the foregoing shall be discussed with and subject to the written approval of the Commission.

UNITED STATES ATOMIC ENERGY COMMISSION  
CONTRACT AUTHORIZATION

2. DATE  
MAR 1 1963

3. NUMBER  
BM-63-399

1. TO  
S. R. Sapirie, Manager  
Oak Ridge Operations Office

FROM  
C. L. Dunham, M.D., Director  
Division of Biology & Medicine

4.  NEW CONTRACT  
 RENEWAL OF

CONTRACT NO.  
AT(40-1)-2100

5. RESPONSIBLE TECHNICAL  
REVIEWER

John Wolfe for  
Frank F. Hooper

6. CONTRACTOR  
NORTH CAROLINA STATE COLLEGE

7. PRINCIPAL INVESTIGATOR

Larry A. Whitford

8. DEPARTMENT  
Botany and Bacteriology

9. PROJECT TITLE  
STUDIES IN THE ECOLOGY OF FRESH-WATER ALGAE IN NORTH CAROLINA

10. RECOMMENDED TYPE  
 FIXED PRICE  
 COST REIMBURSEMENT

11. TERM  
3-1-63 thru 2-29-64

12. FINANCING  
NEW AEC FUNDS, NOT TO EXCEED . . . \$ 16,504  
BALANCE FROM PRIOR TERM . . . . \$  
  
ESTIMATED VOLUNTARY  
CONTRACTOR CONTRIBUTION . . . . \$  
  
TOTAL PROJECT . . . . \$

13. PROPERTY  
TITLE TO VEST IN  AEC  
 CONTRACTOR

14. ALLOTMENT TRANSFER CHARGEABLE  
06-31-91 (24)

15. BUDGET AND REPORTING CLASSIFICATION  
OPERATING COSTS . . . . . 06 05 01  
EQUIPMENT COSTS (IF APPLICABLE) . . . . .

16. SECURITY  
WORK TO BE PERFORMED IS UNDER CATEGORY I  
AS DEFINED IN AEC MANUAL SECTION 3403. "Q" CLEARANCE IS  
REQUESTED FOR

17. REMARKS:  
THE TECHNICAL ASPECTS OF THE PROPOSED RESEARCH HAVE BEEN REVIEWED AND ARE APPROVED. A NEED CURRENTLY EXISTS FOR THE RESULTS OF THE RESEARCH THAT IS TO BE UNDERTAKEN. THE BUDGET INCORPORATED IN THE PROPOSAL HAS BEEN REVIEWED AND IS APPROVED EXCEPT AS INDICATED BELOW. NONE OF THE AEC FUNDS SHALL BE USED FOR CONFERRING A FELLOWSHIP. IF RADIOISOTOPES ARE TO BE USED UNDER THE PROVISIONS OF AEC MANUAL SECTION 3403, THE SAVINGS SHOULD BE CONSIDERED IN THE NEGOTIATIONS.

18. ENCLOSURES

PROPOSAL DATED \_\_\_\_\_  
 NOTIFICATION LETTER DATED MAR 1 1963  
 FORM TO BE RETURNED

0 2184

MAR - 6 1963

1129478

## Office Memorandum • UNITED STATES GOVERNMENT

TO : **C. L. Dunham, Director**  
**Division of Biology and Medicine, Headquarters**

FROM : **Herman M. Roth, Director**  
**Research and Development Division, ORO**

SUBJECT: **RENEWAL OF CONTRACT NO. AT-(40-1)- 2100 - NORTH CAROLINA STATE**  
**COLLEGE (DR. L. A. WHITFORD)**

DATE: **December 6, 1948****CRS:LM**

We are submitting for your review and appropriate action the following information concerning the contract which will expire on **February 28, 1949**:

1. Renewal Proposal ( 4 )
2. Progress Report ( 4 )
3. Financial Statement ( 4 )

We shall appreciate your advising us of your decision so that we may proceed with the necessary contract action at the earliest possible date.

*Herman M. Roth*  
 Herman M. Roth

Enclosure:  
 As Listed Above

CC: **C. S. Sheup, w/encl.**  
**D. S. Zachry, w/progress report**  
**Alice Brown**

REPORT ON THE BUDGET

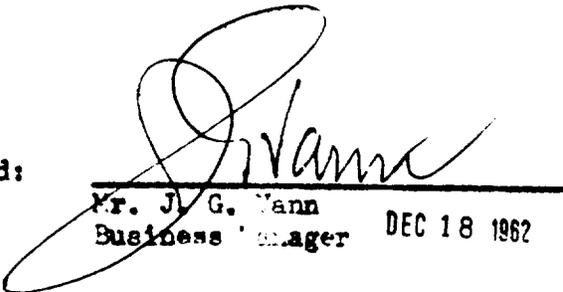
November 30, 1962

Item	Contributed by AEC Expended to Nov. 30	Needed to Feb. 28	Contributed by N. C. State College	Total
Salaries and labor	\$7,465.40	\$1,230.00	\$3,000.00	\$11,695.40
Equipment, supplies and contractual	1,576.73	150.00		1,726.73
Travel and per diem	633.62	150.00		783.62
Overhead*	1,681.10			1,681.10
	<u>\$11,356.85</u>	<u>\$1,530.00</u>	<u>\$3,000.00</u>	<u>\$15,886.85</u>

\*Overhead charged AEC (15% of direct costs).

Carry-over from last year	00.00
Contributed by AEC 1962-63	\$12,897.00
Contributed by NCS 1962-63	<u>3,000.00</u>
Total	\$15,897.00
Less estimated total ex- penditures	\$15,886.85
Estimated carry-over 1962-63	\$10.15

Financial Statement Approved:

  
 Mr. J. G. Mann  
 Business Manager DEC 18 1962

1129480

A RENEWAL PROPOSAL  
to  
UNITED STATES ATOMIC ENERGY COMMISSION

CONTRACT NO. AT-(40-1)-2100

Covering the period from March 1, 1963 through February 29, 1964

Requesting support in the amount of \$16,504

Title of the Project: Studies in the Ecology of Fresh-Water  
Algae in North Carolina

*Larry A. Whitford*

\_\_\_\_\_  
Larry A. Whitford, Principal Investigator  
Department of Botany and Bacteriology

APPROVED

*R. L. Lovvorn*  
\_\_\_\_\_  
R. L. Lovvorn, Director  
North Carolina Agricultural Experiment Station

NORTH CAROLINA STATE COLLEGE OF AGRICULTURE AND ENGINEERING OF THE  
UNIVERSITY OF NORTH CAROLINA  
Raleigh, North Carolina

Nov. 27, 1962  
Date

1129481

(113-20)

DEC - 5 1962

#### SUMMARY OF PROPOSED WORK

The work planned is largely a continuation and expansion of last year's projects. Mr. Gary E. Dillard, Graduate Assistant, will continue a study of the morphology and life history of crustose species of Chlorophyceae which he began last June. He will assist the two investigators in a study of all important species occurring in rapids and important habitat factors affecting them. Particular attention will be paid the effect of current on distribution of species and its effect on mineral uptake and respiration. Radioactive phosphorus will be used in the measurement of mineral uptake and the response of species to current. Work will be continued on primary production in streams, particularly in the rapids of small streams.

If the assistantship being vacated by Mr. Vincent J. Bellis is continued it will be awarded to Mrs. Yoon C. Kim who began a study of the distribution of the Mesotaeniaceae and Desmidiaceae last year without institutional support. This work can only be continued if supported by AEC. Completion of this study is planned within two years.

Somewhat less money is requested for supplies, equipment and travel than last year.

Since we were unable to fill the College-supported assistantship available last year we used considerable undergraduate assistance in laboratory experiments last summer. We found this help so valuable we have asked for approximately \$150 additional labor money for such help next summer.

## OVERALL PROJECT

### Studies in the Ecology of Fresh-water Algae in North Carolina

#### OBJECTIVES:

1. To obtain further data on the species and communities of algae in the rapids of streams together with habitat factors influencing their growth.
2. To continue a floristic and ecological study of the Mesotaeniaceae and Desmidiaceae in North Carolina.
3. To continue work toward a compilation of an algal flora of North Carolina.

#### JUSTIFICATION:

Work during the past year has demonstrated that lotic species of green algae (Chlorophyceae) respond to a current with increased respiration and mineral uptake in proportion to speed of current, and their response is greater than in case of lenitic species. These data could be of practical importance in the management of streams for fish production and in the concentration and removal of radioactive wastes from streams. This work should be extended to include all important groups of algae if possible. A parallel study of the morphology, distribution and ecology of several little known but important genera of cursive algae would seem important. Data on these species as well as on other important stream species would fill a serious gap in our knowledge of stream ecology and limnology. Data on production in streams, particularly a comparison of production in rapids as compared with that in quiet areas, would be well worthwhile. Little such data is at present available.

The Desmidiaceae and the related Mesotaeniaceae are two of our most important families of fresh-water algae. Knowledge of the distribution, abundance and ecology of these groups, which are abundant in both lenitic and certain lotic habitats, would seem well worthwhile.

Work during spare time toward compiling a complete fresh-water algal flora of the state also seems justified.

EXPERIMENTAL PROCEDURES:

Rate of uptake of radioactive phosphorus in a current as compared with still water will be determined for species of fresh-water Rhodophyceae, Cyanophyceae and, if possible Xanthophyceae. Work will be done in the laboratory by methods previously used, but the use of radio-autographs will also be tried. Respiration rates under various conditions will be determined in the laboratory by measuring CO<sub>2</sub> evolution in the dark.

Crustose Chlorophyceae inhabiting rapids will be collected on glass slides and studies made on the morphology and life history of little-known species.

By means of a Pitot type current meter or a thermistor type meter, current will be measured in various parts of rapids and an attempt made to determine the effect of current speed on distribution of species of algae.

Organic production in rapids will be measured by collections on glass slides. Both loss of dry weight on ignition, and a measurement of Chlorophyll a will be tried and the methods compared.

The study of the distribution of the Mesotaeniaceae and Desmidiaceae in North Carolina will be continued, and habitat factors such as water temperature, depth, pH, and influence of associated species will be noted.

A large number of herbarium specimens from the state will be studied also.

Particularly during the winter months, a search will be made for rare and little known species believed to occur in the state.

#### SUBPROJECTS

##### I. A Study of the Ecology of Species Inhabiting the Rapids of Streams.

###### OBJECTIVES:

- a. To determine the effect of a current on lotic species of Rhodophyceae, Cyanophyceae and Xanthophyceae.
- b. To collect morphological and ecological data on crustose and other rapids species.
- c. To determine if current speed influences the distribution of species.
- d. To select a method and collect data on algal production in rapids.

###### JUSTIFICATION:

If, as preliminary data indicates, a current has a marked influence in mineral uptake, and lotic species show a greater response to a current; reliable and adequate data on all groups possible which inhabit rapids would seem desirable. In management of streams for fish production it might prove practicable to construct a series of rapids in order to increase basic organic production. The removal of undesirable amounts of radioactivity from streams might be achieved by the construction of weirs or rapids where lotic species of algae would absorb radioactive minerals. Weirs or rapids could be so constructed that the radioactive algae could be harvested for disposal of wastes.

Relatively much less data is at hand on lotic habitats than is available on the plankton community and other lenitic habitats. It would seem that any ecological data would be of general scientific value as well as for the two practical reasons cited in the paragraph above. A determination of the relation of current speed to distribution of species would be of value in a comparison of different types of streams as well as of practical value in the construction of artificial rapids or weirs. A knowledge of any variation in organic production in various parts of streams would be of similar value.

Several important rapids species are poorly known. Data on the morphology, life history and growth rates of these species would seem valuable for any of the reasons given above.

#### METHODS:

a. Freshly collected specimens of lotic species in all possible important groups will be suspended in radioactive phosphorus solutions in large battery jars, some in still water and some in a current produced by a magnetic stirrer. Uptake of  $P^{32}$  under various conditions will be determined by counts of radioactivity per gram of dry weight. An attempt will be made to use radioautographs to indicate differences in mineral uptake by microscopic, or nearly microscopic cells or colonies.

Fresh specimens will be suspended in the dark in closed flasks and relative rates of respiration determined in still water, in a current and under various other conditions. Carbon dioxide evolution or consumption of oxygen will be used as a measure of respiration rate.

Certain little known crustose Chlorophyceae such as Protoderma, Gongosira, and Pseudulvella will be collected on glass slides. An attempt will be made to find and mark young colonies for continued observation. Growth habit and reproductive stages will be recorded so that these genera can be accurately separated from juvenile stages of filamentous forms which have early crustose stages. Distribution in relation to current speed and other important factors will be recorded. The use of radioautographs to show rate of mineral uptake will be attempted by exposing dried specimens on slides to X-ray or radioautograph film. Preliminary work has indicated that density of image is in proportion to uptake of radioactive phosphorus. It is possible the method will distinguish microscopic or nearly microscopic forms and indicate their relative rates of mineral uptake.

A hand-made Pitot tube current meter will be used to measure speed of current in various parts of rapids and even at different positions around individual rocks. Records of the occurrence and abundance of rapids species in relation to current speed will be made. It is hoped that a satisfactory current meter using thermistors can be devised. If so it will be possible to measure current speed within a small area more accurately. Data on variation in speed in thin layers of water within an area of a few square centimeters would be desirable. This meter would give very precise data on the relation of current speed to distribution of species.

Measurement of production per unit of area in a rapids will be attempted by taking the dry weight increase on standard areas of glass slides over a period of time and recording the loss of dry weight on ignition. Measurement of the amount of chlorophyll a per unit of area

will also be used to measure rate of growth of algae, if possible.

II. To Continue a Floristic and Ecological Study of the Mesotaeniaceae and Desmidiaceae in North Carolina.

OBJECTIVES:

To record all species in these two important families occurring in the state and their distribution in relation to geographic area and important habitat factors.

JUSTIFICATION:

Desmids are an important element of the flora of the littoral zone and the plankton; and occur to some extent even in smaller streams. An estimated 450-500 species and varieties occur in the state. Ecological data on most algal communities would be incomplete without the inclusion of desmid species. Several hundred collections, with some ecological data, are already at hand, and the common species have already been identified. Half as many more collections at different seasons and from some of the less accessible areas of the state would permit a complete flora to be compiled and conclusions drawn as to the relation of distribution to season and important habitat factors.

EXPERIMENTAL METHODS:

Detailed microscopic study of the several hundred collections already at hand will be made and the basic desmid flora compiled. Further collections will be made and species studied as far as possible in the fresh condition. These collections will enable conclusions to be drawn as to distribution of species in relation to season and geographic area. Habitat data will be recorded to enable conclusions to be drawn as to

distribution in relation to water quality, pH, temperature, light and the algal community occupied by each species. Particular attention will be paid to the distribution of some apparently rare species known to occur in the state and to the meeting and commingling of northern and southern floras of desmids.

III. To Continue Work Toward Completion of an Algal Flora of North Carolina.

OBJECTIVES:

To compile a complete flora of the fresh-water algae of North Carolina.

JUSTIFICATION:

Before good ecological work can be done in an area of any size a knowledge of the species occurring in that area is necessary. Completion of a fresh-water algal flora of the state would enable future ecological work to be undertaken in any algal habitat. A complete record of the flora would also enable workers in the future to record possible changes in relation to changes in physical habitat, weather, climate, radioactivity, etc. Although more than 1,400 species and varieties of fresh-water algae have already been reported from the state, it is estimated the flora is only 60% complete; therefore, considerably more work will be needed to complete a flora.

EXPERIMENTAL METHODS:

Little time will be taken from other projects to work on the flora, but new, rare, and unrecorded species will be identified when found. Except for the Mesotaeniaceae and Desmidiaceae the species of Chlorophyceae have been well worked, therefore attention will be paid chiefly to other groups.

Chrysophyceae and Xanthophyceae are abundant in late winter when work on other projects is at a minimum; therefore, some collecting and search for species in these groups will be done at that season. Bacillariophyceae (diatoms) have been least worked of any group. As time allows, permanent slides of the diatom flora will be made to enable future studies of this group.

## BACKGROUND AND STATUS OF PERSONNEL

### Scientific Personnel:

- Senior Investigator -- Larry A. Whitford, Professor of Botany, N. C. State College. (See original proposal for biography and bibliography.) 100% of time June, July, August, 50% remainder of year.
- Associate Investigator -- George J. Schumacher, Professor of Biology, Harpur College, State University of New York. (See renewal proposal for 1959-1960 for biography and bibliography.) 100% of time June, July, and August.
- Graduate Assistant (Proposed continued AEC support) -- Gary E. Dillard, M. S. Southern Illinois University. Candidate for Ph.D. degree, N. C. State College. 1/2 time 9 mos. 3/4 time June, July and August.
- Graduate Assistant (Proposed AEC support) -- Yoon C. Kim, B. S. and two years graduate work, Seoul National University. Candidate for Ph.D. degree, N. C. State College. 1/2 time 9 mos.

### Other Personnel:

Undergraduate students will be employed as labor for glass-washing and laboratory routine and as occasional field assistants for one day only, without per diem. This will amount to about 300 hours for the period.

### Other Financial Assistance:

None.

### Materials, Equipment and Facilities:

In addition to adequate equipment and growth chambers listed under previous proposals, 400 sq. ft. of laboratory space is used exclusively for phycology research the year round. Any amount of additional space is available during June, July and August.

### Travel:

Approximately \$75 is requested for one investigator to attend the AIBS meetings at Amhurst, Massachusetts in August. Other travel will be by private car and will be apportioned to the investigators and graduate students approximately as follows: L. A. Whitford, \$275; G. J. Schumacher, \$300; G. E. Dillard, \$175; Y. C. Kim, \$150.

PROPOSED BUDGET

April 1, 1963 - February 29, 1964

Contract No. AT-(40-1)-2100 with U. S. Atomic Energy Commission

Title: Studies in the Ecology of Fresh-water Algae in North Carolina.

Project Leader: Dr. Larry A. Whitford

	<u>Requested From AEC</u>	<u>N. C. State</u>	<u>Total</u>
1. Salaries			
Principal Investigator (Larry A. Whitford) (50% 9 mos. 100% June, July, August)	\$2,500*	\$4,000*	\$6,500
Investigator (George J. Schumacher) (100% June, July, August)	2,250*		2,250
Graduate Assistantship (Gary E. Dillard) (50% 9 mos. 75% time June, July, August)	3,037		3,037
Graduate Assistantship (Yoon C. Kim) (50% 9 mos.)	2,400		2,400
Labor	375**		375
1 undergraduate (300 hours) \$375***			
Retirement and Social Security	323	272	595
*6.8% of \$4,750 and \$4,000			
2. Equipment	300		300
pH meter \$160			
Flow meter \$140			
3. Travel	900		900
4. Communications	50		50
5. Printing (Cost of publications)	150		150
6. Supplies	<u>200</u>	<u>          </u>	<u>200</u>
7. Total Direct Costs	\$12,485	\$4,272	\$16,757
8. Total Indirect Costs (36.92% of salaries and labor)	<u>4,019</u>	<u>1,577</u>	<u>5,596</u>
9. TOTAL BUDGET	<u>\$16,504</u>	<u>\$5,849</u>	<u>\$22,353</u>

\*\*\* \$1.25 per hour

1129492

1. **Chairman**  
**TO: R. G. Humphries** **Contract Board.** **From: Rev. & Hwy. Div.**

It is requested that the Contract Board take the necessary action to process the following described contract action in accordance with the provisions of Bulletin OR-O&M-19:

2. Nature of Action Requested

Selection of New Contractor and Negotiation of Contract.

Modification of Contract  
 No. AT-(40-1)-2100

Contractor: North Carolina State College  
Raleigh, North Carolina

Review and approval of Contract, Sub-contract or Purchase Order.

Other (Explain) \_\_\_\_\_

Number: \_\_\_\_\_  
 Name: \_\_\_\_\_

3. Nature of Services to be Covered by Contract

Construction  Architect-Engineer  Other  (Explain) Research

4. Funding

Amount to be Obligated by this Contract Action \$ 12,897

Source of Funds

Approved ORO Financial Plan, \_\_\_\_\_ Quarter, Fiscal Year 19\_\_

Project No. \_\_\_\_\_ or, Activity No. 06056

Funds to be Obligated: Allotment No. 1-9 (F.Y. 1962 Funds)

Procurement Directive No. BM-62-416 Dated 3-30-62

Issuing Office One of Bus & Med.

Concurrence in Funding Statement: (signed) \_\_\_\_\_

*A. Emilia*  
 Chief, Budget Branch

5. Project or Activity to be Covered by Contract Action:

Location of Work: \_\_\_\_\_ Construction Directive No. \_\_\_\_\_

Estimated Cost of Work to be Covered by this Contract Action \$ \_\_\_\_\_

Schedule: Date Work to Start \_\_\_\_\_ Estimated Completion Date \_\_\_\_\_

Description of Project or Activity:

(If more space is required use separate sheets and attach hereto)

<p>6. Contract Board Docket No. _____ (To be assigned by Board Secretary)</p>	<p>7. Request Submitted By: (signed) <u>C. S. Shoup</u> Date <u>APR 3 1962</u> e: _____  G. S. SHOUP CHIEF, BIOLOGY BRANCH RESEARCH AND DEVELOPMENT DIVISION</p>
<p>8. <u>Complete Description of Services to be Furnished by Contractor:</u> <b>Headquarters designated research contract</b>  <b>TITLE: "Studies in the Ecology of Fresh-Water Algae in North Carolina"</b>  (If more space is required use separate sheets and attach hereto;)</p>	
<p>9. <u>Description of other changes to be covered by Modification:</u> <b>Modify contract to provide for the performance of additional research to be completed not later than February 28, 1963, with new AEC funds in the amount of \$12,897.</b>  (If more space is required use separate sheets and attach hereto;)</p>	
<p>10. <u>Negotiated Contracts.</u> (Show why it appears desirable to negotiate new contract or to negotiate modification to existing contract)  <b>Form AEC-481 (Contract Authorization) from C. L. Dunham to S. R. Sapirie dated March 30, 1962.</b>  (If more space is required use separate sheets and attach hereto;)</p>	
<p>11. <u>Contracts, Subcontracts, or Purchase Orders Submitted for Review and Approval:</u> (Furnish brief description of action in this space and attach pertinent documents)  <b>None</b></p>	
<p>12. <u>Disputes:</u> <b>Attach a statement summarizing the dispute together with pertinent documents and Background Material.</b>  <b>None</b></p>	

1129494

1103

APPENDIX "A"

TITLE VI

This TITLE VI describes the research program and cost estimates agreed upon between the Commission and the Contractor.

1. PROGRAM

a. Scope and Plan of Approach:

The Contractor will continue research on the ecology of fresh-water algae in the state of North Carolina utilizing radioisotopes such as Phosphorus-32. This research will include such approaches as (1) study of the effects of various environmental factors on the up-take of P-32 by algae, (2) continuation of studies of the flora and ecology of the algae of the littoral zone of ponds and lakes, (3) determination of the thickness of the gradient of diffusion shell around a living organism in a current and in still water, (4) study of the morphology and ecology of crustose species of algae in rapids, and (5) initiation of a floristic and ecological study of North Carolina Desmids.

2. BUDGET

a. Outline of Cost Estimates:

(1) <u>Salaries and Wages:</u>		\$10,400.00
Dr. L. A. Whitford (50% of time 6 mos., full time 3 mos.)	\$4,500.00	
Research Associate	2,250.00	
Research Assistants	3,525.00	
Labor	125.00	
(2) <u>Retirement and Social Security:</u>		240.00
(3) <u>Equipment:</u>		1,100.00
(4) <u>Supplies:</u>		325.00
(5) <u>Communications and Publications:</u>		150.00
(6) <u>Travel:</u>		1,000.00
(7) <u>Overhead (39.45% of Salaries and Wages:</u>		<u>4,103.00</u>
	TOTAL	\$17,318.00

b. Items of property to be procured or manufactured by the Contractor, or to be furnished by the Government, title to which will vest or remain in the Government (see Article V): None

UNITED STATES ATOMIC ENERGY COMMISSION  
CONTRACT AUTHORIZATION

2. DATE  
MAR 30 1962

3. NUMBER  
BM-62-416

1. TO  
S. R. Sapirie, Manager  
Oak Ridge Operations Office

FROM  
C. L. Dunham, M.D., Director  
Division of Biology & Medicine

4.  NEW CONTRACT  
 RENEWAL OF  
  
CONTRACT NO.  
AT(40-1)-2100

5. RESPONSIBLE TECHNICAL REVIEWER  
Dr. Vincent Schultz

6. CONTRACTOR  
NORTH CAROLINA STATE COLLEGE

7. PRINCIPAL INVESTIGATOR  
Dr. Larry A. Whitford

8. DEPARTMENT  
Botany and Bacteriology

9. PROJECT TITLE  
STUDIES IN THE ECOLOGY OF FRESH-WATER ALGAE IN NORTH CAROLINA

10. RECOMMENDED TYPE  
 FIXED PRICE  
 COST REIMBURSEMENT

11. TERM  
6-1-62 thru 2-28-63

12. FINANCING  
NEW AEC FUNDS, NOT TO EXCEED . . . \$ 12,897  
BALANCE FROM PRIOR TERM . . . . . \$  
  
ESTIMATED VOLUNTARY CONTRACTOR CONTRIBUTION . . . . \$  
  
TOTAL PROJECT . . . . . \$

13. PROPERTY  
TITLE TO VEST IN  AEC  
 CONTRACTOR

14. ALLOTMENT TRANSFER CHARGEABLE  
06-21-91(24)

15. BUDGET AND REPORTING CLASSIFICATION  
OPERATING COSTS . . . . . 06 05 01  
EQUIPMENT COSTS (IF APPLICABLE) . . . . .

16. SECURITY  
WORK TO BE PERFORMED IS UNDER CATEGORY I  
AS DEFINED IN AEC MANUAL SECTION 3403. "Q" CLEARANCE IS REQUESTED FOR

17. REMARKS:  
THE TECHNICAL ASPECTS OF THE PROPOSED RESEARCH HAVE BEEN REVIEWED AND ARE APPROVED. A NEED CURRENTLY EXISTS FOR THE RESULTS OF THE RESEARCH THAT IS TO BE UNDERTAKEN. THE BUDGET INCORPORATED IN THE PROPOSAL HAS BEEN REVIEWED AND IS APPROVED EXCEPT AS INDICATED BELOW. NONE OF THE AEC FUNDS SHALL BE USED FOR CONFERRING A FELLOWSHIP. ~~IS-RADIO-ISOTOPES ARE TO BE USED UNDER THE PROVISIONS OF AEC MANUAL 3410. THE SAVINGS SHOULD BE CONSIDERED IN THE NEGOTIATIONS.~~

18. ENCLOSURES  
 PROPOSAL DATED \_\_\_\_\_  
 NOTIFICATION LETTER DATED 3/30/62  
 FORM TO BE RETURNED

APR 2 1962

C 2592

112949b

UNITED STATES GOVERNMENT

# Memorandum

TO : C. L. Dunham, Director  
Division of Biology and Medicine, Headquarters

DATE: February 21, 1962

FROM : Herman M. Roth, Director  
Research and Development Division, Oak Ridge Operations

SUBJECT: RENEWAL OF CONTRACT NO. AT-(40-1)-2100 - NORTH CAROLINA STATE COLLEGE  
(DR. LARRY A. UNITED)

## ORIGIN

We are submitting for your review and appropriate action the following information concerning the contract which will expire on May 31, 1962:

1. Renewal Proposal (A)
2. Progress Report (A)
3. Financial Statement (A)
4. 200-Word Summary (Has been requested)

We shall appreciate your advising us of your decision so that we may proceed with the necessary contract action at the earliest possible date.

*Herman M. Roth*  
Herman M. Roth

Enclosure:  
As Listed Above

CC: C. S. Sheup, w/encl.  
D. S. Lashry, w/progress report  
Alice Brown ✓

A RENEWAL PROPOSAL

to

UNITED STATES ATOMIC ENERGY COMMISSION

CONTRACT NO. AT-(40-1)-2100

Covering the period from June 1, 1962 through February 28, 1963

Requesting support in the amount of \$12,888.41

Title of the Project: Studies in the Ecology of Fresh-Water  
Algae in North Carolina

*Larry A. Whitford*

Larry A. Whitford, Principal Investigator  
Department of Botany and Bacteriology

APPROVED:

*R. L. Lovvorn*

R. L. Lovvorn, Director  
North Carolina Agricultural Experiment Station

NORTH CAROLINA STATE COLLEGE OF AGRICULTURE AND ENGINEERING OF THE  
UNIVERSITY OF NORTH CAROLINA  
Raleigh, North Carolina

FEB 12 1962

Date

1129498

## SUMMARY OF PROPOSED WORK AND BUDGET

Two sub-projects of last year will be continued. Preliminary results in the study of variations in current in various parts of rapid streams and its effect on communities of algae are interesting. This work will be continued using radio-active phosphorus ( $P^{32}$ ) as an indicator of mineral uptake. If, as is expected, we get a state-supported graduate assistant, fairly extensive experiments will be initiated. However, not all of these can be completed within one year. We expect to study first the effect of various current speeds on mineral uptake. The response of limnetic species as compared to related lotic species to a current will be investigated. We expect also to study the effect of several other habitat factors such as temperature, light, and pH on the rate of mineral uptake in a current and in still water.

Study of the ecology of algae of the littoral zone of three types of ponds under investigation by Mr. V. J. Bellis, Graduate Assistant, will be continued to obtain a complete year's data. He will begin organizing his data for an MS thesis late in the project year.

The possibility of determining the thickness of a diffusion shell in still and moving water will be investigated using cylinders of gelatin or agar suspended in radio-active phosphorus ( $P^{32}$ ) solutions. Radio-autographs of sections of the cylinders may indicate the thickness of the diffusion shell under various habitat conditions.

If we are awarded another graduate assistantship, a graduate student will begin a study of the morphology and ecology of crustose algae on rocks in rapids. This study will give badly needed data on the ecology and relationships of a number of common but little-known rapids species.

Another graduate student, who is entering the department, will be put on a floristic and ecological study of the desmids in North Carolina. Only a small

amount of travel support is asked for the study of this abundant and important group.

We are asking for two AEC-supported graduate assistantships, but we expect to have three and possibly four graduate students assisting the two investigators in ecological studies of North Carolina algae.

A salary of \$5,500 (\$2,500 to be supplied by AEC) is proposed for the principal investigator for the nine-month project. This is full salary for the three summer months and half salary (supplied by North Carolina State College) for six months. A salary of \$2,250 for an Associate Investigator for the three summer months; \$1,917 for one graduate assistant, (10 months, M. S. level); \$1,600 for one graduate assistant (8 months, Ph.D level); approximately \$300 travel expense for three graduate assistants; \$1,000 for a research microscope; \$325 for supplies; and \$150 for printing and communications is proposed. Included in the travel request of \$1,000 is approximately \$250 for travel by the two investigators to attend the International Limnology Congress in Madison, Wisconsin during August, 1962. At this meeting, a joint paper will be presented on the use of radio-active phosphorus in studies of stream limnology.

## OVERALL PROJECT

### Studies in the ecology of fresh-water algae in North Carolina

#### OBJECTIVES:

1. To obtain further data on the species and communities of algae in the rapids of streams together with the habitat factors influencing their growth.
2. To complete a floristic and ecological study of the algae of the littoral zone of lakes and ponds.
3. To initiate a floristic and ecological study of the Mesotaeniaceae and Desmidiaceae in North Carolina.

#### JUSTIFICATION:

In previous studies we have obtained data indicating that the growth of algae in stream rapids is remarkably fast, due in part to the effect of a current. We have also found that there are a number of crustose species that are abundant in most rapids the year round which are little known. Data on the morphology, ecology and even the taxonomy of several species is almost entirely lacking. Data on these crustose species as well as detailed ecological data on important filamentous species of rapids would fill a serious gap in our knowledge of stream ecology and limnology.

Completion of an entire year's data on the floristics and ecology of the algae of the littoral zone of ponds would also fill a definite need.

The Desmidiaceae and the related Mesotaniaceae are two of our most important families of fresh-water algae. Knowledge of the distribution, abundance, and habitat relations of these groups, which are abundant in both limnetic and certain lotic habitats, would seem to be well worth while.

EXPERIMENTAL PROCEDURES:

By means of "planted" glass slides, the growth of colonies of crustose algae in rapids will be followed from spore germination to maturity, if possible. Further studies of the effect of current and of other habitat factors such as temperature, light, and pH on the mineral uptake and growth of rapids species will be made by means of radio-active phosphorus in the laboratory. An attempt will be made to determine the thickness of the "diffusion shell" around organisms by means of radio-autographs of small gelatin cylinders immersed in radio-active solutions under various conditions.

By means of a study of hundreds of herbarium collections of desmids, plus study of further collections from selected areas of the state, the distribution of species in relation to the major habitat factors will be determined.

SUBPROJECTS

- I. A Study of the Effect of Various Environmental Factors on the Uptake of Radio-active Phosphorus ( $P^{32}$ ).

OBJECTIVES:

There is theoretical evidence that the effect of a current in promoting the uptake of gases and minerals becomes marked at speeds above 15/cm. sec. It is intended to prove or disprove this theory. It is planned, also, if a graduate assistant is available to investigate the response of limnetic species to a current as compared with closely related lotic species, and to measure the effect of several other habitat factors such as temperature, light, and pH on mineral uptake.

JUSTIFICATION:

Recent work has demonstrated (Whitford, 1960 and Whitford and Schumacher, 1961) that a current has a pronounced effect on mineral uptake and respiration in a lotic species of green algae and that there are a number of species of algae

which will grow only in a current. Limnologists do not, as yet, recognize the importance of a current; and, furthermore, additional precise and specific data are needed on a number of species. It is important to establish whether the response to a current is related more to species or to environmental factors.

EXPERIMENTAL PROCEDURE:

One or more species of filamentous algae will be exposed to radio-active phosphorus solutions in still water and running water at various speeds in the laboratory, and the uptake of  $P^{32}$  will be measured. A limnetic species and a closely related lotic species will be compared with each other in the same apparatus. If graduate assistance is available, the effect of light, temperature and pH of solutions will be compared.

II. Completion of a Study of the Flora and Ecology of the Algae of the Littoral Zone of Ponds and Lakes.

OBJECTIVES:

To finish a complete year's data on the seasonal variation in the flora of three selected ponds and lakes with some comparison of the flora with other ponds and lakes in the region. Also, to obtain a complete set of data on light penetration, water temperature, dissolved oxygen, pH and some data on mineral content of the experimental ponds and lakes. The material will be organized for an M. S. thesis.

JUSTIFICATION:

1129503  
Relatively little work has been previously done on the flora and especially the ecology of the littoral zone, particularly in the southeast. The data obtained will be of much use to phycologists and limnologists everywhere, and it will be the first set of such data in the southeast.

EXPERIMENTAL PROCEDURE:

Bi-weekly or monthly (in case of the distant lake) data will continue to be taken in selected micro-habitats in three experimental ponds and lakes, and similar data at times in other bodies of water.

III. Investigation of a Method of Determining the Thickness of the Diffusion Shell  
by Means of Radio-autographs.

OBJECTIVES:

To determine the thickness of the gradient of diffusion (the diffusion shell) around a living organism in a current and in still water.

JUSTIFICATION:

The thickness of the diffusion shell has an important effect on the exchange of materials between an organism and its environment. The effect of a current is related to this thickness. Determination of the thickness of the shell in a current as compared with still water will enable predictions of the response of organisms to certain environmental conditions.

EXPERIMENTAL PROCEDURE:

Small cylinders of a non-absorptive material (probably cork) will be covered with gelatin or agar and submerged in radio-active solutions for various times and under a number of conditions such as in still water and a current. Radio-autographs of thin sections of the gelatin will be made in an attempt to determine the distance of and relative amount of diffusion into the gelatin. If results warrant, the loss of radio-active diffusible material from impregnated cylinders under various conditions will also be measured. It is assumed that the gelatin cylinders will behave like natural pectic sheaths around algal filaments and somewhat like naked living cells.

IV. Initiation of a Study of the Morphology and Ecology of Crustose Species of  
Algae in Rapids.

OBJECTIVES:

To determine whether certain important crustose organisms attached to rocks in rapids are distinct species or merely growth-forms of other species, and to study their development and ecology.

JUSTIFICATION:

During the cooler seasons especially, rock in rapids in most portions of this state are covered with or have abundant colonies of crustose algae. We have not

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been able to identify some species, others appear to be growthforms of well-known filamentous algae, and details of morphology and life history of some are entirely lacking. Such species occur in each of the following classes: Chlorophyceae, Chrysophyceae, Rhodophyceae, and Cyanophyceae. It is of great importance that we obtain knowledge on the taxonomy, morphology, and ecology of these species.

The problem of these plants is an extremely fascinating and important one; and it is believed that the proposed graduate assistant, for whom support is asked, would do excellent work on it. We believe, furthermore, that both from the standpoint of the development of new methods and value of results, this is the most worth-while project we are proposing.

EXPERIMENTAL PROCEDURE:

It is proposed that the investigators direct a graduate student in a several-year study of these species. Glass micro-slides will be introduced into many habitats where such species grow. Plants becoming established on these slides will be carefully studied in the field and in the laboratory and compared with naturally established plants on rocks. It is hoped that colonies can be studied, marked, and the slides returned to the habitat for further development. Plants collected on slides will be kept under various conditions in the laboratory, and transplants from one habitat to another will be made in the field. The complete life history and seasonal relations of species which can be successfully observed will be studied.

It is hoped that, later, radio-autographs along with conventional photographs of colonies can be used for study and comparison of response to environmental conditions.

V. Initiation of a Floristic and Ecological Study of North Carolina Desmids.

OBJECTIVES:

To obtain a knowledge of the distribution, habitat, and seasonal relations of all species of Mesotaeniaceae and Desmidiaceae growing in North Carolina, and to determine if there is a relationship between the presence of a species and

important habitat factors.

JUSTIFICATION:

The Mesotaeniaceae and Desmidiaceae are two of the most important families of fresh-water algae, and they are well represented in the North Carolina flora. A knowledge of the distribution of species in the state would be a worth-while contribution to our knowledge of southern floras. We have at hand a herbarium of about 2,000 collections of fresh-water algae from the state, many of which were collected by AEC Project support, and many of which contain species of desmids. It would seem worth while for AEC to support a study of this flora to the further extent of a small amount of travel.

EXPERIMENTAL PROCEDURE:

Identification of all species of desmids in the herbarium will be undertaken together with an attempt to correlate the presence of species with habitat factors and season. Some further collecting in selected areas at all seasons will be done in order to fill gaps in our collections and to cover previously unworked areas. It is estimated that 400 to 600 miles of travel during each of the next two years will be desirable in order to complete the necessary collecting. Somewhat more data on habitat factors will also be taken than those which are at present available.

REFERENCES

- Whitford, L. A., 1960. The Current Effect and Growth of Fresh-water Algae. Trans. Amer. Micro. Soc. 79: 302-309
- Whitford, L. A., and G. J. Schumacher, 1961. Effect of Current on Mineral Uptake and Respiration by a Fresh-water Alga. Limnology and Ocean 6: 423-425
- Whitford, L. A., and G. J. Schumacher. Ecological Studies of Algae in North Carolina Streams. (in M. S. 90 pp.)

BACKGROUND AND STATUS OF PERSONNEL

Scientific Personnel

- Senior Investigator -- Larry A. Whitford, Professor of Botany, N. C. State College. (See original proposal for biography and bibliography.)
- Associate Investigator-- George J. Schumacher, Professor of Biology, Harpur College, State University of New York. (See renewal proposal for 1959-1960 for biography and bibliography.)
- Graduate Assistant -- Vincent J. Bellis, Jr., Graduate Student and Candidate for the degree of Master of Science, N. C. State College.
- Graduate Assistant (Proposed support by AEC) -- Gary E. Dillard, M. S. Southern Illinois University (June 1962). Candidate for Ph.D. degree, N. C. State College.
- Graduate Student -- Yoon K. Chang, candidate for the Ph.D. degree, N. C. State College.
- Graduate Student (Probable) -- Carol L. Crow, Candidate for M. S. Degree, N. C. State College.

Other Personnel

Students will be employed as labor for glass-washing and laboratory routine and as occasional field assistants for one day only, without per diem. This will amount to about 100 hours for the period.

Other Financial Assistance

None.

Materials, Equipment and Facilities

In addition to the laboratory facilities and growth chambers listed under previous proposals, 400 sq. ft. of laboratory space will be used exclusively for phycology research after June 1, 1962.

Travel

Approximately \$250 is requested for the two investigators to attend the International Limnology Congress at Madison, Wisconsin in August, 1962. Other travel will be by private car and will be apportioned to the investigators and graduate students approximately as follows: L. A. Whitford, \$175; G. J. Schumacher, \$100; V. J. Bellis, \$150; G. E. Dillard, \$150; Y. K. Chang, \$100; and C. L. Crow, \$50.

1129507

## PROPOSED BUDGET

TITLE: Studies in the Ecology of Fresh-Water Algae in North Carolina

PROJECT LEADER: Dr. Larry A. Whitford

DEPARTMENT: Botany and Bacteriology

ESTIMATED EXPENSES FOR June 1, 1962 THROUGH February 28, 1963 - RENEWAL PROPOSAL

	<u>Requested from AEC</u>	<u>N. C. State College</u>
1. SALARIES		
Principal Investigator (50% 9 mos., 100% June, July, August)	\$ 2,500.00	\$ 3,000.00
Investigator (100% June, July, August)	2,250.00	
Graduate Assistant ( $\frac{1}{2}$ time for 8 mos.)	1,600.00	
Graduate Assistant ( $\frac{1}{2}$ time for 10 mos.)	1,917.00	
Student Help (Undergraduate Assistants)	125.00	
Matching Retirement and Social Security Contributions:		
6.8% of \$2,500	170.00	
3.125% of \$2,250	70.31	
2. SUPPLIES	325.00	
EQUIPMENT	1,100.00	
3. TRAVEL	1,000.00	
4. COMMUNICATIONS AND PUBLICATIONS	150.00	
	<hr/>	<hr/>
DIRECT COSTS	\$ 11,207.31	\$ 3,000.00
OVERHEAD	<u>1,681.10*</u>	<hr/>
TOTAL	<u>\$ 12,888.41</u>	<hr/> <hr/>

\* Overhead charged to AEC 15% of direct costs.

1129508

PROPOSED BUDGET

AEC

TITLE: Studies in the Ecology of Fresh-Water Algae in North Carolina.

PROJECT LEADER: Dr. Larry A. Whitford. DEPARTMENT: Botany and Bacteriology.

ESTIMATED EXPENSES FOR June 1, 1962 THROUGH February 28, 1963 - RENEWAL PROPOSAL.

	<u>Requested from AEC</u>	<u>N. C. State College</u>	<u>Total</u>
<b>1. SALARIES</b>			
Principal Investigator (50% 6 mos., 100% June, July, August)	\$ 2,500.00	\$ 2,000.00	\$ 4,500.00
Investigator (100% June, July, August)	2,250.00		2,250.00
Graduate Assistant ( $\frac{1}{2}$ time for 9 mos.)	1,800.00		1,800.00
Graduate Assistant ( $\frac{1}{2}$ time for 9 mos.)	1,725.00		1,725.00
<hr/>			
Student Help (Undergraduate Assistants)	125.00		125.00
Matching Retirement and Social Security Contributions:			
6.8% of \$2,500	170.00		170.00
3.125% of \$2,250	70.31		70.31
<b>2. SUPPLIES</b>	325.00		325.00
<b>EQUIPMENT</b>	1,100.00		1,100.00
<b>3. TRAVEL</b>	1,000.00		1,000.00
<b>4. COMMUNICATIONS AND PUBLICATIONS</b>	150.00		150.00
	<hr/>	<hr/>	<hr/>
DIRECT COSTS	\$11,215.31	\$ 2,000.00	\$13,215.31
OVERHEAD	1,682.30*	2,420.50**	4,102.80***
	<hr/>	<hr/>	<hr/>
TOTAL	\$12,897.61	\$ 4,420.50	\$17,318.11
	<hr/> <hr/>	<hr/> <hr/>	<hr/> <hr/>

\*Overhead charged to AEC, 15% of direct cost.  
 \*\*Overhead cost assumed by N. C. State College.  
 \*\*\*Overhead based on 39.45% of all salaries and wages.

1. TO: R. G. Humphries Chairman Contract Board. From: Res. & Dev. Division

It is requested that the Contract Board take the necessary action to process the following described contract action in accordance with the provisions of Bulletin OR-O&M-19:

2. Nature of Action Requested

Selection of New Contractor and Negotiation of Contract.

Modification of Contract No. AT-(40-1)-2100

Contractor: North Carolina State College Raleigh, North Carolina

Review and approval of Contract, Sub-contract or Purchase Order.

Other (Explain) \_\_\_\_\_

Number: \_\_\_\_\_  
Name: \_\_\_\_\_

3. Nature of Services to be Covered by Contract

Construction

Architect-Engineer

Other

(Explain) Research

4. Funding

Amount to be Obligated by this Contract Action : 8,883.00

Source of Funds

Approved ORO Financial Plan, \_\_\_\_\_ Quarter, Fiscal Year 19\_\_

Project No. \_\_\_\_\_ or, Activity No. 06 01 18

Funds to be Obligated: Allotment No. 4415024 (F.Y. 19\_\_ Funds)

Procurement Directive No. \_\_\_\_\_ Dated \_\_\_\_\_

Issuing Office Div. of Biology & Medicine

Concurrence in Funding Statement: (signed) [Signature]  
Chief Budget Branch

5. Project or Activity to be Covered by Contract Action:

Location of Work: \_\_\_\_\_ Construction Directive No. \_\_\_\_\_

Estimated Cost of Work to be Covered by this Contract Action \$ \_\_\_\_\_

Schedule: Date Work to Start \_\_\_\_\_ Estimated Completion Date \_\_\_\_\_

Description of Project or Activity:

(If more space is required use separate sheets and attach hereto)

<p>6. Contract Board Docket No. _____ (To be assigned by Board Secretary)</p>	<p>7. Request Submitted By: (signed) <u>C. S. Shoup</u> Date <u>MAR 20 1962</u> C. S. SHOUP CHIEF, BIOLOGY BRANCH RESEARCH AND DEVELOPMENT DIVISION</p>
<p>8. <u>Complete Description of Services to be Furnished by Contractor:</u>  Headquarters designated research contract  TITLE: "Studies in the Ecology of Fresh-Water Algae in North Carolina"  (If more space is required use separate sheets and attach hereto:)</p>	
<p>9. <u>Description of other changes to be covered by Modification:</u>  Modify contract to provide for the performance of additional research to be completed not later than May 31, 1962, with new AEC funds in the amount of \$8,883.  (If more space is required use separate sheets and attach hereto:)</p>	
<p>10. <u>Negotiated Contracts.</u> (Show why it appears desirable to negotiate new contract or to negotiate modification to existing contract)  Form AEC-481 (Contract Authorization) from H. D. Bruner to S. R. Sapirie dated March 23, 1961.  (If more space is required use separate sheets and attach hereto:)</p>	
<p>11. <u>Contracts, Subcontracts, or Purchase Orders Submitted for Review and Approval:</u> (Furnish brief description of action in this space and attach pertinent documents)  None</p>	
<p>12. <u>Disputes:</u> Attach a statement summarizing the dispute together with pertinent documents and Background Material.  None</p>	

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APPENDIX "A"

TITLE V

This TITLE V describes the research program and cost estimates agreed upon between the Commission and the Contractor.

1. PROGRAM

a. Scope and Plan of Approach:

The Contractor will continue the studies of fresh-water algae utilizing radioisotopes. These studies will include investigations in such areas as (1) floristics and ecology of the algae of the littoral zone of lakes and ponds, (2) study of the speed in various portions of streams as compared with movement of total water mass, (3) study of the diurnal variations in dissolved oxygen and carbon dioxide in selected streams, and (4) organization of data and preparation of a paper on the ecology of algae in North Carolina streams.

2. BUDGET

a. Outline of Cost Estimates:

(1) <u>Salaries and Wages:</u>		\$10,200.00
Dr. L. A. Whitford (50% of time 9 mos., full time 3 mos.)	\$5,625.00	
Research Associate	2,250.00	
Research Assistant	2,200.00	
Labor	125.00	
(2) <u>Equipment:</u>		300.00
(3) <u>Supplies:</u>		300.00
(4) <u>Printing and Publications:</u>		100.00
(5) <u>Travel:</u>		700.00
(6) <u>Indirect Costs</u> (37.15% of Salaries and Wages):		<u>3,789.00</u>
	TOTAL	\$15,389.00

- b. Items of property to be procured or manufactured by the Contractor, or to be furnished by the Government, title to which will vest or remain in the Government(see Article V): None

UNITED STATES ATOMIC ENERGY COMMISSION  
CONTRACT AUTHORIZATION

2. DATE **MAR 23 1961**

1. TO

S. R. Sapirie, Manager  
Oak Ridge Operations Office

FROM

H. D. Bruner, M.D., <sup>Acting</sup> Deputy Director  
Division of Biology and Medicine

*H. D. Bruner - 3010*

3. NUMBER

**BM-61-396**

4.  NEW CONTRACT  
 RENEWAL OF

CONTRACT NO.  
**AT(40-1)-2100**

5. RESPONSIBLE TECHNICAL REVIEWER

**Vincent Schultz**

6. CONTRACTOR

**North Carolina State College**

8. DEPARTMENT

**Department of Botany**

7. PRINCIPAL INVESTIGATOR

**Larry A. Whitford**

9. PROJECT TITLE

**STUDIES IN THE ECOLOGY OF FRESH-WATER ALGAE IN NORTH CAROLINA**

10. RECOMMENDED TYPE

FIXED PRICE  
 COST REIMBURSEMENT

FINANCING

NEW AEC FUNDS, NOT TO EXCEED . . . \$ **8,883**  
BALANCE FROM PRIOR TERM . . . . . \$

ESTIMATED VOLUNTARY CONTRACTOR CONTRIBUTION . . . . . \$

TOTAL PROJECT . . . . . \$

11. TERM

**6-1-61 thru 5-31-62**

13. PROPERTY

TITLE TO VEST IN  AEC  
 CONTRACTOR

14. ALLOTMENT TRANSFER CHARGEABLE

**06-11-91(24)**

15. BUDGET AND REPORTING CLASSIFICATION

OPERATING COSTS . . . . . **06 01 08**  
EQUIPMENT COSTS (IF APPLICABLE) . . . . .

16. SECURITY

WORK TO BE PERFORMED IS UNDER CATEGORY I  
AS DEFINED IN AEC MANUAL SECTION 3403. "Q" CLEARANCE IS REQUESTED FOR

**NO**

17. REMARKS:

THE TECHNICAL ASPECTS OF THE PROPOSED RESEARCH HAVE BEEN REVIEWED AND ARE APPROVED. A NEED CURRENTLY EXISTS FOR THE RESULTS OF THE RESEARCH THAT IS TO BE UNDERTAKEN. THE BUDGET INCORPORATED IN THE PROPOSAL HAS BEEN REVIEWED AND IS APPROVED EXCEPT AS INDICATED BELOW. NONE OF THE AEC FUNDS SHALL BE USED FOR CONFERRING A FELLOWSHIP. IF RADIOISOTOPES ARE TO BE USED UNDER THE PROVISIONS OF AEC MANUAL 7510, THE SAVINGS SHOULD BE CONSIDERED IN THE NEGOTIATIONS.

18. ENCLOSURES

PROPOSAL DATED \_\_\_\_\_  
 NOTIFICATION LETTER DATED \_\_\_\_\_  
 FORM TO BE RETURNED

**B 2921**

**MAR 27 1961**

1129513

RENEWAL PROPOSAL

For the period May 1, 1961 to April 30, 1962

under

CONTRACT NO. AT-(40-1)-2100

U. S. ATOMIC ENERGY COMMISSION

with

NORTH CAROLINA STATE COLLEGE, RALEIGH, NORTH CAROLINA

Title

STUDIES IN THE ECOLOGY OF FRESH-WATER ALGAE IN NORTH CAROLINA

Subprojects

- (1) Floristics and Ecology of the Algae of the Littoral Zone of Lakes and Ponds.
- (2) A Study of Current Speed in Various Portions of Streams as Compared with Movement of Total Water Mass.
- (3) A Study of Diurnal Variations in Dissolved Oxygen and Carbon Dioxide in Selected Streams.
- (4) Organization of Data and Preparation of a Paper on The Ecology of Algae in North Carolina Streams.

Current Request from AEC:

\$8,883

Prepared by Larry A. Whitford,  
Principal Investigator, Jan. 20, 1961

*Larry A. Whitford*

approved for the Agricultural Experiment Station by \_\_\_\_\_

1129514

## SUMMARY OF PROPOSED WORK AND BUDGET

A study of approximately two years duration will be initiated on the floristics and ecology of algae in the littoral zone of lakes and ponds. The proposed Graduate Assistant, Vincent J. Bellis, Jr. will carry out this study under the direction of the investigators. Variations in the floras of the chief lake and pond types will be correlated with the important habitat factors by means of collections at regular intervals along transects.

A study of the relation of current speeds to algal communities in different streams and various parts of the same stream will be made by means of several instruments including pairs of thermistors. This is a short-time study in relation to habitat and community data already at hand.

Diurnal variations in dissolved gases will be studied in various portions of selected streams in an attempt to correlate any variations with algal communities; and the data will also be used in an attempt to compare organic production in different streams, and different communities in the same streams.

In addition to work on the two above subprojects, the two investigators will organize data and prepare a paper on the ecology of algae in North Carolina streams. If this is not completed by September 1 it will be completed during the fall of 1961.

A salary of \$5,625 (\$2,250 to be supplied by AEC) is proposed for the Principal Investigator, who will devote full time to the project for the three summer months and half time for the remainder of the year; \$2,250 for the Associate Investigator for the three summer months; and \$2,200 for the Graduate Assistant, for half-time work on the project for twelve months. Equipment in the amount of \$300, chiefly storage cabinets and current measuring devices, is proposed, and \$300 for supplies

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including photographic materials, glassware, and other small items. The sum of \$700 is proposed for travel and per diem for the three persons, and \$125 for labor.

#### Overall Project

Studies in the Ecology of Fresh-water Algae in North Carolina.

#### Objectives:

1. To complete the first phase of studies on the ecology of algae in streams, and prepare a paper for publication.
2. To initiate a floristic and ecological study of the algae of the littoral zone of lakes and ponds in North Carolina.

#### Justification:

We have data at hand from a three-year over all study of stream ecology. It is believed, however, that some additional data on variations in current in various portions of streams and in different kinds of streams are needed for correlation with data on communities. Data are also needed on actual organic production in various portions of streams and types of streams. Once this data is accumulated there is adequate material for a fairly comprehensive paper on the ecology of algae in North Carolina streams.

There has been relatively little work done on the algal flora of the littoral zone of lakes and ponds in this state or in the southeastern United States, and almost nothing on the ecology of algae of the littoral zone. A floristic and ecological study of this habitat would fill a gap in our knowledge since such studies have been, or are being made, of the phytoplankton community and of the communities of algae in North Carolina streams.

## Subprojects

- (1) Floristics and Ecology of the Algae of the Littoral Zone of Lakes and Ponds.

### Objectives:

To collect and identify the species of algae in the littoral zone of the major types of lakes and ponds in North Carolina, and relate variation in the floras to season and other important ecologic factors.

### Justification:

Preliminary work by the two investigators in this region has indicated that there is a rich and varied flora in the littoral zone of lakes and ponds; and that the flora varies with season and lake type. A complete list of the species in this community would add to the fresh-water algae known in the state. A study of variation in the floras with season and lake type would also contribute much to our knowledge of the ecology of fresh-water algae in this region, and to algal ecology generally.

### Experimental Procedure:

The procedure would include a preliminary sampling of a number of ponds in each alleged ecological type to determine if there is a real difference in the flora. This would be followed by setting up transects from the shore-line to the limit of algal growth (or the center of the pond) in one or more lakes or ponds of each type; and systematic regular sampling of the algae along each transect. Environmental data on such factors as water temperature, light penetration, pH, and dissolved gases would be taken. An Ekman dredge would be used to collect uniform bottom

samples at different depths. A Secchi disk and photo-electric cell would be used to measure light penetration, and "planted" microslides would be tried as a uniform substrate for collection of attached algae growing at different depths.

At the end of the study an attempt would be made to correlate variation in the flora with seasonal and other environmental factors.

The proposed graduate assistant would do most of this work under supervision of the two investigators.

It is estimated that eighteen months to two years would be needed to complete this study.

(2) A Study of Variations in Current in Different Situations in Streams as Compared with the Movement of Total Water Mass.

Objectives:

To collect data which will indicate whether there is a relation between current speed and the occurrence of attached communities of algae.

Justification:

Field observations and laboratory work has indicated that a current greater than 15 cm. (1/2 ft.) per second is an important habitat factor for some algal communities. Current data taken in the field in a large number of situations and several stream types are needed to confirm or disprove our current-effect theory.

Experimental Procedure:

Since the data most desired is that on current speed very close to attachment surfaces, it is proposed to use a pair of small thermistors for such measurements. Thermistors give accurate rapid measurements of current within a small area. It is hoped we can measure current within one millimeter of rock or wood surfaces

in streams. Other methods will also be used, such as Pitot tubes or Bentzel velocity tubes. For measuring total water movement, wiers (on brooks) and mechanical current meters will be used.

After preliminary work and calibrations, it is estimated that adequate data can be taken within one or two weeks.

(3) Diurnal Variations in Dissolved Oxygen and Carbon Dioxide in Selected Streams.

Objectives:

To obtain further data on the possible variation in oxygen content of water in various situations such as rapids, pools, colonies of algae, etc., and diurnal variations which occur.

Justification:

The occurrence of certain species of plants and animals in certain portions of streams only, has been attributed to variations of temperature and dissolved oxygen. Data is needed to support or disprove this theory. We have some data on this point but more is needed.

Diurnal variation of dissolved oxygen and carbon dioxide in a stream has been used to calculate total organic production. We should like to obtain such data to indicate the relative productivity of stream types with different algal floras.

Experimental Procedure:

By means of a small rubber-bulb suction apparatus already in use, samples of water from selected, precise portions of streams will be taken in standard oxygen bottles and analyzed for free CO<sub>2</sub> and for dissolved oxygen, by standard methods.

Surface samples of water taken in the afternoon and the late hours of darkness will be analyzed for dissolved CO<sub>2</sub> and oxygen and the average rate of photosynthesis calculated. Thus the

productivity of green plants in different streams can be compared.

Since we have some data already, and only a comparison of the productivity of stream types is desired at this time, two or three weeks' work should give enough data for present requirements. Next year further data might be taken, including such data for the littoral zone of lakes and ponds.

(4) Organization of Data and Preparation of a Paper on the Ecology of Algae in North Carolina Streams.

Objectives:

To organize data for a final scientific report, and to prepare a paper for publication on the ecological part of our work on North Carolina streams.

Justification:

Fairly voluminous data on the communities of algae in N. C. streams, together with data on seasonal relations and habitat factors have been accumulated during the past three and one half years. We believe the data is complete enough (or will be by mid-summer) to warrant publication.

Procedure:

It is proposed for both investigators to use all spare time to begin organizing the data in early summer and to devote full time to organizing and writing a paper from the data during the last month or six weeks of the summer. It is hoped the paper can be submitted to a journal (probably Ecological Monographs) by late summer or fall of 1961.

References

- Hoskin, Charles M. 1959. Studies of oxygen metabolism of streams of North Carolina. Inst. Marine Sci. 6: 186-192.

- Odom, Howard T. 1960. Ecological potential and analogue circuits for the ecosystem. Amer. Scientist 48: 1-8.
- Odom, Howard T. 1957. Metabolism of a laboratory stream microcosm. Inst. Marine Sci. 4: 115-133.
- Odum, Howard T., Paul R. Burkholder, and Juan Rivero. 1959. Measurements of productivity of turtle grass flats, reefs, and the Bahia Fosforescente of southern Puerto Rico. Inst. Marine Sci. 6: 159-170.
- Odum, Howard T. and Charles M. Hoskin. 1958. Comparative studies on the metabolism of marine waters. Inst. Marine Sci. 5: 16-46.
- Whitford, L. A. 1960. Ecological distribution of fresh-water algae. The Pymatuning Symposia in Biology, Spec. Pub. No. 2.
- Whitford, L. A. 1960. The current effect and growth of fresh-water algae. Trans. Amer. Mic. Soc. 79: 302-309.
- Whitford, L. A. and George J. Schumacher. \_\_\_\_\_. Effect of a current on mineral uptake and respiration by a fresh-water alga. (Submitted for publication) Limnology and Oceanography.

#### Background and Status of Personnel

##### Scientific Personnel:

- Senior Investigator -- Larry A. Whitford, Professor of Botany, N. C. State College. (See original proposal for biography and bibliography.)
- Associate Investigator -- George J. Schumacher, Associate Professor of Biology, Harpur College, State University of New York. (See renewal proposal for 1959-1960 for biography and bibliography.)
- Graduate Assistant -- Vincent J. Bellis Jr., Graduate Student and Candidate for the degree Master of Science, N. C. State College.

##### Other Personnel:

Students will be employed as labor for glass-washing and laboratory routine and as occasional field assistants for one day only, without per diem. This will amount to about 100 hours for the year.

#### Other Financial Assistance

None

#### Materials, Equipment and Facilities

In addition to facilities listed in the original proposal, the department now has four growth chambers, each 6 x 6 x 12 ft. with control of light, temperature, and humidity, which can be used for laboratory studies of algae.

#### Travel

An estimated 5,500 to 6,000 miles will be traveled by private car. This will be about equally divided between the Graduate Assistant and the two Investigators, and will be for the purpose of collecting algae and recording ecological data in the littoral zone of ponds, and collecting data on the current speed and dissolved gases in selected streams in Coastal Plain, Piedmont, and Mountain regions.

PROPOSED BUDGET

Studies in the Ecology of Fresh-water Algae in North Carolina

A. E. C. Contract No. AT-(40-1)-2100

Project Leader: Larry A. Whitford, Department of Botany and Bacteriology

Estimated expenses for the first year of an anticipated two year period:

	<u>Requested from AEC</u>	<u>N. C. State College</u>	<u>Total</u>
1. Salaries and Wages			
Principal Investigator 50% for nine months, full time, June, July, Aug.	\$2,250	\$3,375	\$5,625
Investigator, full time June, July, August	2,250	--	2,250
Graduate Assistant, beginning	2,200	--	2,200
Labor	125	--	125
2. Supplies	300	--	300
Equipment	300	--	300
3. Travel	700	--	700
4. Printing and publications	100	--	100
Direct Costs	<u>\$8,225</u>	<u>\$3,375</u>	<u>\$11,600</u>
Overhead	658*	3,131**	3,789***
TOTAL	<u>\$8,883</u>	<u>\$6,506</u>	<u>\$15,389</u>

\* Overhead charged to A. E. C., 8% of direct costs.

\*\* Overhead cost assumed by N. C. State College.

\*\*\* Overhead based on 37.15% of all salaries and wages

Financial provisions of this agreement approved

  
Business Manager

1129523

1. Chairman  
 TO: R. G. Humphries Contract Board. From: Res. & Dev. Div.

It is requested that the Contract Board take the necessary action to process the following described contract action in accordance with the provisions of Bulletin OR-O&M-19:

2. Nature of Action Requested

Selection of New Contractor and Negotiation of Contract.

Modification of Contract

No. AT-(40-1)-2100

Contractor: North Carolina State College  
Raleigh, North Carolina

Review and approval of Contract, Sub-contract or Purchase Order.

Other (Explain) \_\_\_\_\_

Number: \_\_\_\_\_

Name: \_\_\_\_\_

3. Nature of Services to be Covered by Contract

Construction  Architect-Engineer  Other  (Explain) Research

4. Funding

Amount to be Obligated by this Contract Action \$ 4,398.00

Source of Funds

Approved ORO Financial Plan, \_\_\_\_\_ Quarter, Fiscal Year 19\_\_

Project No. \_\_\_\_\_ or, Activity No. 6180

Funds to be Obligated: Allotment No. 06-0-9/24 (F.Y. 1960 Funds)

Procurement Directive No. DM-60-458 Dated 4-13-60

Issuing Office Div of Res & Med.

Concurrence in Funding Statement: (signed) \_\_\_\_\_

*O. Miller*

Chief, Budget Branch

5. Project or Activity to be Covered by Contract Action:

Location of Work: \_\_\_\_\_ Construction Directive No. \_\_\_\_\_

Estimated Cost of Work to be Covered by this Contract Action \$ \_\_\_\_\_

Schedule: Date Work to Start \_\_\_\_\_ Estimated Completion Date \_\_\_\_\_

Description of Project or Activity:

(If more space is required use separate sheets and attach hereto:)

<p>6. Contract Board Docket No. _____ (To be assigned by Board Secretary)</p>	<p>7. Request Submitted By: (signed) <i>C. S. Shoup</i> Date: APR 21 1960 C. S. SHOUP CHIEF, BIOLOGY BRANCH RESEARCH AND DEVELOPMENT DIVISION</p>
<p>8. <u>Complete Description of Services to be Furnished by Contractor:</u> Headquarters designated research contract TITLE: "Studies in the Ecology of Fresh-Water Algae in North Carolina"  (If more space is required use separate sheets and attach hereto:)</p>	
<p>9. <u>Description of other changes to be covered by Modification:</u> Modify contract to provide for the performance of additional research to be completed not later than May 31, 1961. The AEC will contribute \$4,398. The Contractor will contribute \$4,960, and the estimated unexpended balance is \$111.  (If more space is required use separate sheets and attach hereto:)</p>	
<p>10. <u>Negotiated Contracts.</u> (Show why it appears desirable to negotiate new contract or to negotiate modification to existing contract)  Form AEC-481 (Contract Authorization) from C. W. Shilling to S. R. Sapirie dated April 13, 1960.  (If more space is required use separate sheets and attach hereto:)</p>	
<p>11. <u>Contracts, Subcontracts, or Purchase Orders Submitted for Review and Approval:</u> (Furnish brief description of action in this space and attach pertinent documents)  None</p>	
<p>12. <u>Disputes:</u> Attach a statement summarizing the dispute together with pertinent documents and Background Material.  None</p>	

11324

1129525



UNITED STATES ATOMIC ENERGY COMMISSION  
CONTRACT AUTHORIZATION

2. DATE APR 13 1960

3. NUMBER  
BM-60-458

1. TO S. R. Sapirie, Manager  
Oak Ridge Operations Office

FROM C. W. Shilling, M.D. Deputy Director  
Division of Biology and Medicine

4.  NEW CONTRACT  
 RENEWAL OF 3rd  
  
CONTRACT NO.  
AT(40-1)-2100

5. RESPONSIBLE TECHNICAL  
REVIEWER  
Vincent Schultz

6. CONTRACTOR  
North Carolina State College

7. PRINCIPAL INVESTIGATOR  
Larry A. Whitford

8. DEPARTMENT  
Department of Botany & Bacteriology

9. PROJECT TITLE  
Studies in the Ecology of Fresh-Water Algae in North Carolina

10. RECOMMENDED TYPE  
 FIXED PRICE  
 COST REIMBURSEMENT

11. TERM  
6-1-60 thru 5-31-61

12. FINANCING  
NEW AEC FUNDS, NOT TO EXCEED . . . \$ 4,398  
BALANCE FROM PRIOR TERM . . . . \$  
  
ESTIMATED VOLUNTARY  
CONTRACTOR CONTRIBUTION . . . . \$  
  
TOTAL PROJECT . . . . \$

13. PROPERTY  
TITLE TO VEST IN  AEC  
 CONTRACTOR

14. ALLOTMENT TRANSFER CHARGEABLE  
06-01-91(24)

15. BUDGET AND REPORTING CLASSIFICATION  
OPERATING COSTS . . . . . 6180  
EQUIPMENT COSTS (IF APPLICABLE) . . . . .

16. SECURITY  
WORK TO BE PERFORMED IS UNDER CATEGORY I  
AS DEFINED IN AEC MANUAL SECTION 3403. "Q" CLEARANCE IS  
REQUESTED FOR  
**NO**

17. REMARKS:  
THE TECHNICAL ASPECTS OF THE PROPOSED RESEARCH HAVE BEEN REVIEWED AND ARE APPROVED. A NEED CURRENTLY EXISTS FOR THE RESULTS OF THE RESEARCH THAT IS TO BE UNDERTAKEN. THE BUDGET INCORPORATED IN THE PROPOSAL HAS BEEN REVIEWED AND IS APPROVED EXCEPT AS INDICATED BELOW. NONE OF THE AEC FUNDS SHALL BE USED FOR CONFERRING A FELLOWSHIP. IF RADIO-ISOTOPES ARE TO BE USED UNDER THE PROVISIONS OF AEC MANUAL 7510, THE SAVINGS SHOULD BE CONSIDERED IN THE NEGOTIATIONS.

18. ENCLOSURES  
 PROPOSAL DATED \_\_\_\_\_  
 NOTIFICATION LETTER DATED \_\_\_\_\_  
 FORM TO BE RETURNED

A 3596  
APR 15 1960

1129527

RENEWAL PROPOSAL

For the Period May 1, 1960 to April 30, 1961

A.E.C. Contract No. AT-(40-1)- 2100

Prepared by L. A. Whitford, Principal Investigator, January 1960

Approved for the Agricultural Experiment Station by

1. Title:- Ecology of Algae in North Carolina Streams

2. Institution and Department:- N. C. State College, Raleigh, North Carolina  
Department of Botany and Bacteriology

3. Scope of Proposed Research:-

It is proposed to:

1. Collect data on the numbers of both net and nanoplankton of the rivers and larger streams. Due to rainy weather and high water such data was not obtained last year. Such information is vital to this ecological study.

2. Study the algal communities of river shore and bottom. High water last year interfered with the collection of these data also

3. Collect some further data on the early stages of communities on rocks in streams by means of "planted" glass slides. Some interesting and apparently significant results are being obtained by this method.

4. By means of radio-active phosphorus it is planned to study the up-take of this element by algae in still and running water. Data at hand support the theory that a current promotes the exchange of materials between an organism and its environment. It is hoped that the exact reason for this effect can be established, and also data on the effect of various current speeds obtained.

5. It is hoped that time will allow the collection of data on possible variation in dissolved  $O_2$  and  $CO_2$  in various habitats in the same stream.

1129528

CONTRACTS

6. Some time will be taken to organize data obtained for the final scientific report and a paper on the ecology of stream algae in North Carolina.

Time will probably not allow a study of changes in river flora as the water becomes salty near the seacoast.

4. Scientific Personnel:-

Senior Investigator -- Larry A. Whitford, Professor of Botany, N. C. State College. (See original proposal for biography and bibliography.)

Associate Investigator -- George J. Schumacher, Associate Professor of Biology, Harpur College, State University of New York. (See renewal proposal for 1959-1960 for biography and bibliography.)

5. Other Personnel:-

Students will be employed as labor for glass-washing and laboratory routine and as occasional field assistants for one day only, without per diem. This will amount to about 75 hours for the year. A technician may be employed for 10 to 20 hours to make counts on radio-active material.

6. Budget:-

Salaries and Wages

L. A. Whitford - 50% of time, 8 months	\$2,900	
Full time, June, July and August	1,500	
G. J. Schumacher - full time, June, July and Aug.	1,500	
Laboratory assistants and technicians	125	
	<u>\$6,025</u>	\$6,025
Travel and per diem		600
Supplies		150
Radio-active materials		300
		<u>\$7,075</u>

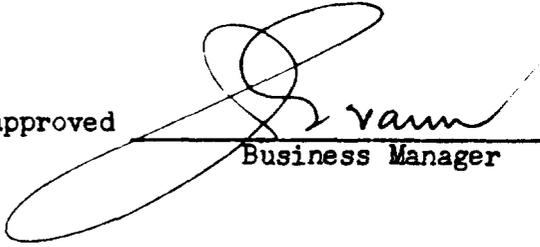
In addition there are indirect costs. The basis for computing them is shown in the following summary.

	<u>Contributed by N. C. State College</u>	<u>Contributed by AEC</u>
Direct costs		
Salaries and labor	\$ 2,900	\$ 3,125
Equipment and supplies*	--	450
Travel and per diem	--	600
<hr/>		
Total direct costs	\$ 2,900	\$ 4,175
Overhead (39.74% of total salaries)	2,394	
AEC (8% of above)	- 334	334
<hr/>		
Total Costs	\$ 4,960	\$ 4,509

Of a total budget of \$9,469 the Atomic Energy Commission is requested to furnish \$4,509

\* This includes an estimated \$300 for radio-active materials.

Financial provisions of this agreement approved

  
Business Manager

REPORT ON THE BUDGET

Item	Contributed by AEC		Contributed by N. C. State College	Total
	Expended to Jan. 15	Needed to May 1		
Salaries and labor	\$3,056.00	\$3,096.00	\$2,900.00	\$5,996.00
Equipment, suppl. and contractual	402.98	437.98	-----	437.98
Travel and per diem	649.92	899.92	-----	899.92
Overhead	<u>395.00</u>	<u>395*</u>	<u>2,061.00**</u>	<u>2,456.00</u>
	\$4,503.90	\$4,828.90	\$4,961.00	\$9,789.90

\* Overhead charged to AEC (8% of direct costs)

\*\* Overhead assumed by N. C. State College

Carry-over from last year	\$ 36.04
Contributed by AEC 1959-60	4,904.00
Contributed by N.C.S. 1959-60	<u>4,961.00</u>
Total	\$9,901.04

Less estimated total ex- penditures	<u>- 9,789.90</u>
Estimated carry-over 1959-60	\$111.14

INCIDENT REPORT

1. Serious Incidents  
None
2. Fires, Explosions, etc.  
None
3. Other Property Damage Accidents  
None
4. Personal Injuries  
None

Larry A. Whitford  
Investigator

George J. Schumaker  
Investigator

February, 1960

1129531

1. TO: J. R. Moore Chairman Contract Board From: Res. and Dev. Div.

It is requested that the Contract Board take the necessary action to process the following described contract action in accordance with the provisions of Bulletin OR-O&M-19:

2. Nature of Action Requested

- Selection of New Contractor and Negotiation of Contract. Modification of Contract No. AT-(40-1)-2100 Contractor: North Carolina State College Raleigh, North Carolina. Review and approval of Contract, Sub-contract or Purchase Order. Other (Explain)

3. Nature of Services to be Covered by Contract

Construction Architect-Engineer Other (Explain) Research

4. Funding Amount to be Obligated by this Contract Action \$ 4,904.00

Source of Funds

Approved ORO Financial Plan, Quarter, Fiscal Year 19... Project No. or, Activity No. 6180 Funds to be Obligated: Allotment No. 06-91-91(24) F.Y. 1959 Funds Procurement Directive No. BM-59-345 Dated 4-6-59 Issuing Office Dir of Bus. & Med.

Concurrence in Funding Statement: (signed) [Signature] Chief, Budget Branch

5. Project or Activity to be Covered by Contract Action:

Location of Work: Construction Directive No. Estimated Cost of Work to be Covered by this Contract Action \$ Schedule: Date Work to Start Estimated Completion Date Description of Project or Activity:

(If more space is required use separate sheets and attach hereto)

<p>6. Contract Board Docket No. _____ (To be assigned by Board Secretary)</p>	<p>7. Request Submitted By: (signed) _____ Date: APR 13 1959 Title: _____ C. S. SHOUP CHIEF, BIOLOGY BRANCH RESEARCH AND DEVELOPMENT DIVISION</p>
<p>8. <u>Complete Description of Services to be Furnished by Contractor:</u> Headquarters designated research contract TITLE: "Studies in the Ecology of Fresh-Water Algae in North Carolina"  (If more space is required use separate sheets and attach hereto:)</p>	
<p>9. <u>Description of other changes to be covered by Modification:</u> Modify contract to provide for the performance of additional research to be completed not later than May 31, 1960. The AEC will contribute \$4,904, the Contractor will contribute \$5,066, and the estimated unexpended balance is \$426.  (If more space is required use separate sheets and attach hereto:)</p>	
<p>10. <u>Negotiated Contracts.</u> (Show why it appears desirable to negotiate new contract or to negotiate modification to existing contract)  Memorandum from C. W. Shilling to S. R. Sapirie dated April 6, 1959  (If more space is required use separate sheets and attach hereto:)</p>	
<p>11. <u>Contracts, Subcontracts, or Purchase Orders Submitted for Review and Approval:</u> (Furnish brief description of action in this space and attach pertinent documents)  None</p>	
<p>12. <u>Disputes:</u> Attach a statement summarizing the dispute together with pertinent documents and Background Material.  None</p>	

6663

1129553

APPENDIX "A"

TITLE III

This TITLE III describes the research program and cost estimates agreed upon between the Commission and the Contractor.

1. PROGRAM

a. Scope and Plan of Approach:

The Contractor will continue studies of the plankton of the larger streams of North Carolina. Both net and nannoplankton will be sampled, and an attempt will be made to distinguish between the true plankton or euplankton and the tychoplankton derived from algae of shore and bottom, and to relate variations in plankton to type of stream and other habitat factors. A set of collections from each river will be obtained. Communities of river shore and bottom will be studied. Sampling of smaller streams will be done to check on community relations and test validity of classification of streams as to types. Mountain streams will be sampled. Data on production will be obtained. Colonization and growth studies on planted slides will be carried out.

2. BUDGET

a. Outline of Cost Estimates:

(1) <u>Salaries and Wages:</u>	\$ 6,100.00
Dr. L. A. Whitford ( $\frac{1}{2}$ time 9 mos., full time 3 summer mos.)	\$4,400.00
Research Associate	1,500.00
Labor	200.00
(2) <u>Equipment and Supplies:</u>	310.00
(3) <u>Travel:</u>	1,500.00
(4) <u>Overhead</u> (40.76% of salaries and wages):	<u>2,486.00</u>
	Total       \$10,396.00

b. Items of property to be procured or manufactured by the Contractor, title to which will vest in the Government (see Article V): None

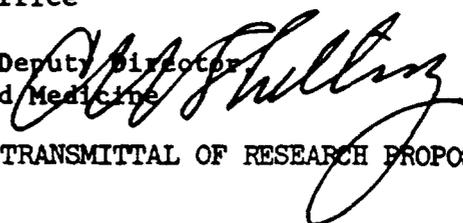
UNITED STATES ATOMIC ENERGY COMMISSION  
 WASHINGTON, D. C.

Contract Authorization No. BM-59-345

TO : S. R. Sapirie, Manager  
 Oak Ridge Operations Office

APR 6 1959

FROM : C. W. Shilling, M.D., Deputy Director  
 Division of Biology and Medicine



SUBJECT : FUND AUTHORIZATION AND TRANSMITTAL OF RESEARCH PROPOSAL FOR  
 CONTRACT NEGOTIATION

REFERENCE : AEC 102/16 APPROVED OCTOBER 7, 1953, AS IMPLEMENTED BY MEMORANDUM  
 TO MANAGERS, OPERATIONS OFFICES, DATED OCTOBER 23, 1953, JOINTLY  
 SIGNED BY THE DIRECTORS OF THE DIVISIONS OF RESEARCH AND BIOLOGY  
 AND MEDICINE.

SYMBOL : BMES:JNW

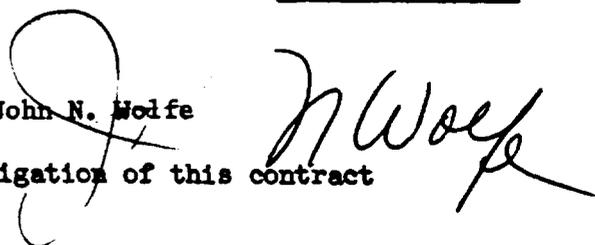
The research proposal described below has been approved by the  
 Division of Biology and Medicine, funds are available, and you  
 are authorized and requested to negotiate a contract in  
 accordance with the following terms and conditions:

1. Institution: North Carolina State College
2. Investigator (s): Larry A. Whitford
3. Title: Studies in the Ecology of Fresh-Water  
 Algae in North Carolina

4. ( ) New Contract, (X) Renewal of Contract No. AT(40-1)2100

5. Duration: 6-1-59 thru 5-31-60

6. AEC Technical Representative: John N. Wolfe



7. Funds are authorized for the obligation of this contract  
 as follows:

<u>Allotment No.</u>	<u>Budget Category</u>	<u>Previous</u>	<u>Amount This Action</u>	<u>Total</u>
06-91-91(24)	6180	-	\$4,904	\$4,904
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

J 3502

APR 8 1959



NORTH CAROLINA STATE COLLEGE  
SCHOOL OF AGRICULTURE • RALEIGH, N. C.

THE DIVISION OF BIOLOGICAL SCIENCES  
BOTANY

February 11, 1959

Dr. C. S. Shoup  
Chief, Biology Branch  
Research and Development Division  
U. S. Atomic Energy Commission  
Oak Ridge, Tennessee

Subject: CONTRACT NO. AT-(40-1)-2100

RE: ORS:JDB

Dear Dr. Shoup:

In our proposed budget for 1959-60 the allocation and application of salary monies is as follows:

Senior Investigator -----\$4,400.00  
(Larry A. Whitford)

Full time at \$500 per month for June, July and August.  
One-half time at \$322.22 per month for nine months.

Associate Investigator-----\$1,500.00  
(George J. Schumacher)

Full time at \$500 per month for June, July and August.

Labor-----\$ 200.00

Part-time undergraduate student labor at \$1.00 per hour for routine laboratory and field work during the school year. Typical activities include washing glassware, labelling and indexing collections, and assistance in handling the boat and motor in the field.

The use of radioisotopes during this project period is not contemplated unless the work proceeds unusually well. Radioisotopes could very profitably be used in certain phases of our work and if time can be found, it is proposed to ask for supplementary funds in the amount of \$960.00 through a supplementary proposal next fall or winter.

Yours very truly,



Larry A. Whitford  
Associate Professor of Botany

LAW:db

Cc: Mr. J. G. Vann

1129537

1959 FEB 15 11 33 AM

CONTRACTS - 21(NCSC)

OAK RIDGE CHEMICALS  
REC

J 1453

FEB 13 1959

Renewal Proposal

to

U. S. Atomic Energy Commission

ECOLOGY OF ALGAE IN NORTH CAROLINA STREAMS

Total budget	\$10,291
Requested support	5,330

Submitted by:

North Carolina State College of Agriculture and Engineering  
of the University of North Carolina  
Raleigh, North Carolina

*Larry A. Whitford*

Larry A. Whitford  
Principal Investigator  
Associate Professor of Botany

*C. H. Bostian*

C. H. Bostian  
Chancellor  
N. C. State College

*W. D. Carmichael, Jr.*

W. D. Carmichael, Jr.  
Vice President and Finance Officer  
University of North Carolina

Date Submitted: 1/30/59

1129538

RENEWAL PROPOSAL  
ON  
CONTRACT NO. AT-(40-1)-2100  
U. S. ATOMIC ENERGY COMMISSION  
RESEARCH AND DEVELOPMENT DIVISION

(For the period May 1, 1959-May 1, 1960)

It is proposed to continue the study of the plankton of the larger streams of the state. Both net and nannoplankton will be sampled in each from near the headwaters down to the state border or to salt water. An attempt will be made to distinguish between the true plankton or euplankton and the tychoplankton derived from algae of shore and bottom, and to relate variations in plankton to type of stream and other habitat factors. A complete set of collections from each river, for each of the four seasons at least, is needed.

As time allows, communities of river shore and bottom will be studied.

Further sampling of smaller streams is also planned to check on community relations and test the validity of our classification of streams into types. Such habitat factors as dissolved gases and variations in current speed will also be studied. Collections in mountain streams in early spring are also needed. A collecting trip in the mountains is planned for April.

To complete a satisfactory stream study, data on production is needed. If possible, quantitative studies will begin sometime this year. Colonization and growth on planted microslides will be studied along with weight samples of fresh and dried collections.

An interesting problem which probably will not be attacked this year is the change in river flora as the water becomes salt near the seacoast.

Scientific Personnel

Senior Investigator: Larry A. Whitford, Associate Professor of Botany, N. C. State College (See original proposal for biography and bibliography).

Associate Investigator: George J. Schumacher, Assistant Professor of Botany, Harpur College, N. Y. State University. Dr. Schumacher was accepted as Associate Investigator last spring after the resignation of Dr. John L. Blum. Dr. Schumacher is the author of four papers on fresh-water algae and is joint author of two other scientific papers. For four summers he made a survey of the algae in the Alleghany and Susquehanna Rivers in New York.

Professional bibliography of George J. Schumacher

Schumacher, George J., 1952. The Phytoplankton of Whatcom County, Washington. Madrono 11.

Muenschler, W. C. and G. J. Schumacher, 1953. List of weeds of New York. Cornell Ext. Bulletin 891.

\_\_\_\_\_ and G. J. Schumacher, 1955. Weeds (revision) 560 pages. Macmillan.

Schumacher, G. J., 1956. A qualitative and quantitative study of the plankton algae in southwestern Georgia. Amer. Midl. Nat. 56.

\_\_\_\_\_, 1958. Algae of the Alleghany River. In press.

\_\_\_\_\_, 1958. Algae of the Susquehanna River. In press.

The data for the last two papers were collected under a four-year grant from New York State Science Service and the State Museum, and deals with the algae of the Alleghany and Susquehanna Rivers and their basins in New York.

1129540

Budget

	Contributed by N. C. State College	Contributed by AEC
<hr/>		
Direct costs		
Salaries and labor	\$2,900.	\$3,125.
Equipment and supplies	-----	310.
Travel and per diem	-----	1,500.
<hr/>		
Total direct costs	\$2,900.	\$4,935.
Overhead (40.76% of total salaries)	<sup>2486</sup> \$2,456.	
AEC (8% of above)	-395.	395.
<hr/>		
Total costs	\$4,961.	\$5,330.

Of a total budget of \$10,291 the Atomic Energy Commission  
is requested to furnish \$5,330.

1129541

**Office Memorandum • UNITED STATES GOVERNMENT****TO :** J. W. Ould, Jr., Assistant General Counsel      **DATE:** May 12, 1958**FROM :** John R. Moore, Director, Contract Division**SUBJECT:** REQUEST FOR MODIFICATION TO CONTRACT AT-(40-1)-2100 -  
NORTH CAROLINA STATE COLLEGE**SYMBOL:** ACD:BSH

Please prepare an appropriate modification to the subject contract to provide for additional research to be completed not later than May 31, 1959, with new funds in the amount of \$4,865. This action is covered by Contract Authorization No. BM-58-430, dated May 1, 1958, in the amount of \$4,865.

A Request for Contract Action dated May 9, 1958, from the Research and Development Division is enclosed for your use.



John R. Moore

**Enclosures:**

1. Request for Cont. Action
2. Budget
3. Resume'
4. Cont. Auth.
5. Renewal Proposal

**CC:** L. D. MacKay  
C. S. Shoup  
A. Brown, w/encls. 1, 2 & 4

1. TO: J. R. Moore Chairman Contract Board From: Res. and Dev. Div.

It is requested that the Contract Board take the necessary action to process the following described contract action in accordance with the provisions of Bulletin OR-O&M-19:

2. Nature of Action Requested

Selection of New Contractor and Negotiation of Contract.

Modification of Contract No. AT-(40-1)-2100

Contractor: North Carolina State College Raleigh, North Carolina

Review and approval of Contract, Sub-contract or Purchase Order.

Other (Explain) \_\_\_\_\_

Number: \_\_\_\_\_  
Name: \_\_\_\_\_

3. Nature of Services to be Covered by Contract

Construction  Architect-Engineer  Other  (Explain) Research

4. Funding

Amount to be Obligated by this Contract Action \$ 4,865.00

Source of Funds

Approved ORO Financial Plan, \_\_\_\_\_ Quarter, Fiscal Year 19\_\_

Project No. \_\_\_\_\_ or, Activity No. 6180

Funds to be Obligated: Allotment No. 26-9164 F.Y. 1954 Funds)

Procurement Directive No. DM-SK-430 Dated 5-1-54

Issuing Office House of Bio & Med.

Concurrence in Funding Statement: (signed) Asmiller  
Chief, Budget Branch

5. Project or Activity to be Covered by Contract Action:

Location of Work: \_\_\_\_\_ Construction Directive No. \_\_\_\_\_

Estimated Cost of Work to be Covered by this Contract Action \$ \_\_\_\_\_

Schedule: Date Work to Start \_\_\_\_\_ Estimated Completion Date \_\_\_\_\_

Description of Project or Activity:

(If more space is required use separate sheets and attach hereto)

<p>6. Contract Board Docket No. _____ (To be assigned by Board Secretary)</p>	<p>7. Request Submitted By: (signed) _____ Date: <u>MAY 9</u> 1958 Title: _____ C. S. SHOOP CHIEF, BIOLOGY BRANCH RESEARCH AND DEVELOPMENT DIVISION</p>
<p>8. <u>Complete Description of Services to be Furnished by Contractor:</u> Headquarters designated research contract TITLE: "Studies in the Ecology of Fresh-Water Algae in North Carolina"  (If more space is required use separate sheets and attach hereto)</p>	
<p>9. <u>Description of other changes to be covered by Modification:</u> Modify contract to provide for additional research to be completed not later than May 31, 1959, with new funds in the amount of \$4,865.  (If more space is required use separate sheets and attach hereto)</p>	
<p>10. <u>Negotiated Contracts.</u> (Show why it appears desirable to negotiate new contract or to negotiate modification to existing contract)  Memorandum from C. W. Shilling to S. R. Sapirie dated May 1, 1958.  (If more space is required use separate sheets and attach hereto)</p>	
<p>11. <u>Contracts, Subcontracts, or Purchase Orders Submitted for Review and Approval:</u> (Furnish brief description of action in this space and attach pertinent documents)  None</p>	
<p>12. <u>Disputes:</u> Attach a statement summarizing the dispute together with pertinent documents and Background Material.  None</p>	

OK  
5/11

2729

1129544



NORTH CAROLINA STATE COLLEGE  
DEPARTMENT OF BOTANY  
RALEIGH, NORTH CAROLINA.

Contract No. AT-(40-1)-2100

DR. LARRY A. WHITFORD  
ASSOCIATE PROFESSOR OF BOTANY  
PROJECT LEADER.

STUDIES OF THE ECOLOGY OF FRESH-WATER ALGAE IN  
NORTH CAROLINA.

The Contractor will continue studies of the algal flora of the smaller streams in the Piedmont and Coastal Plain, with reference to natural conditions and naturally-occurring species of interest in the general problem of land disposal of radioactive materials and environmental contamination. Mountain streams will be sampled that are of similar size to those of the Piedmont and plains area, and the ecological studies will include consideration of the communities and their dominants with records of light, water temperature, pH, chemical quality of water, dissolved gases, etc. Special attention will be given to the taxonomy of the fresh-water diatoms as well as the algae, and the effect of stream current on the algae. A temporary laboratory will be set up at the Highlands Biological Laboratory for 2-3 weeks in June for studies of mountain streams, and studies on diatoms will be made during a short visit to the Academy of Natural Sciences of Philadelphia, probably in the fall or winter.

C. D. Shoup

1129546

UNITED STATES ATOMIC ENERGY COMMISSION  
WASHINGTON, D. C.

Contract Authorization No. EM-58-430

TO : S. R. Sapirie, Manager  
Oak Ridge Operations Office

FROM : C. W. Shilling, M.D., Deputy Director  
Division of Biology and Medicine

SUBJECT : FUND AUTHORIZATION AND TRANSMITTAL OF RESEARCH PROPOSAL FOR  
CONTRACT NEGOTIATION

REFERENCE : AEC 102/16 APPROVED OCTOBER 7, 1953, AS IMPLEMENTED BY MEMORANDUM  
TO MANAGERS, OPERATIONS OFFICES, DATED OCTOBER 23, 1953, JOINTLY  
SIGNED BY THE DIRECTORS OF THE DIVISIONS OF RESEARCH AND BIOLOGY  
AND MEDICINE.

SYMBOL : BMES:JNW

MAY 1 1958

The research proposal described below has been approved by the  
Division of Biology and Medicine, funds are available, and you  
are authorized and requested to negotiate a contract in  
accordance with the following terms and conditions:

- ✓ 1. Institution: North Carolina State College
- ✓ 2. Investigator (s): Larry A. Whitford
- ✓ 3. Title: Studies In The Ecology Of Fresh-Water Algae  
In North Carolina
4. ( ) New Contract, (X) Renewal of Contract No. AT(40-1)2100
- X 5. Duration: <sup>6-1-58</sup> 6/1/57 thru <sup>5-31-59</sup> 5/31/58
6. AEC Technical Representative: John N. Wolfe *J. N. Wolfe*
7. Funds are authorized for the obligation of this contract  
as follows:

<u>Allotment No.</u>	<u>Budget Category</u>	<u>Previous</u>	<u>Amount This Action</u>	<u>Total</u>
06-81-91(24)	6180		\$4,865	\$4,865

H 4301

MAY 5 - 1958

1129547

8. It is suggested that in the best interests of the government the following type contract be negotiated: Lump-sum

9. It is requested that the title to any capital equipment procured under this contract shall be vested with:

( X ) the contractor; ( ) the government.

10. If radioisotopes are to be used in this research, it is requested that the savings available to the contractor under the Radioisotope Research Support Program (Ref. AEC Manual Chapter 7510) be considered in the negotiation of the amount to be funded under this contract.

11. Other comments:

12. Security Requirements:

In accordance with the provisions of Chapter 3403 of the AEC Manual and the requirements of the Declassification Guide, it has been determined that the following security precautions should be taken in connection with the proposed research contract:

Since there is essentially no chance for the development of restricted data, this project has been placed in Category I as defined in Chapter 3403 of the AEC Manual.

13. Reports: ( X ) Reports are to be required as provided for by "Revised Guide for the Submission of Research Proposals" dated February 8, 1954.

( ) Special reports instructions are as follows:

Enclosures: ( X ) "A" - Proposal, dated March 1958 & Revised Mar 20, 1958  
( X ) "B" - Notification letter, dated MAY 1 1958  
( ) "C" - Other correspondence, \_\_\_\_\_ letters

Distribution:

Addressee: Original (w encl.)      Division File: Yellow copy (w encl.)  
1st copy (w encl.)                      Pink copy (w/o encl.)  
2nd copy (w encl.)

Branch File: White copy (w encl.)

Program Analysis Branch:

White copy (w/o encl.)

NORTH CAROLINA STATE COLLEGE  
SCHOOL OF AGRICULTURE • RALEIGH, N. C.

THE DIVISION OF BIOLOGICAL SCIENCES  
BOTANY

March 20, 1958

Dr. C. S. Shoup, Chief  
Biology Branch  
Research and Development Division  
U. S. Atomic Energy Commission  
Oak Ridge, Tennessee

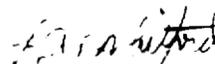
Subject: Contract No. AT-(40-1)-2100

Dear Dr. Shoup:

Enclosed is the corrected budget sheet for our Renewal Proposal.  
I am very sorry to have made such a careless mistake.

I wish to confirm my statement on the telephone today that Dr. George Schumacher of Harpur College, State University of New York, has agreed to work with me for the next two summers as replacement of Dr. John L. Blum who recently resigned. Dr. Schumacher is a Cornell University PhD (fresh-water algae). He has published three papers and has a fourth in manuscript. He has worked for the past two summers on the limnology of streams in New York State. His PhD thesis was on the phytoplankton of some Georgia ponds. He should be thoroughly familiar with the algal flora of the southeastern states.

Yours very truly,



L. A. Whitford  
Associate Professor of Botany

LAW:db

Enclosure

1129549

Complete budget for

RENEWAL PROPOSAL

ON

CONTRACT NO. AT-(40-1)-2100

U. S. ATOMIC ENERGY COMMISSION

RESEARCH AND DEVELOPMENT DIVISION

MAR 24 1958

<u>Item</u>	<u>Contributed by AEC</u>	<u>Contributed by N. C. State College</u>	<u>Total</u>
Salaries and labor	\$ 3,200.00	\$ 2,900.00	\$ 6,100.00
Equipment			
Miscellaneous and expendable supplies and repairs	300.00	--	300.00
Photographic materials	50.00	--	50.00
Travel and per diem	1,900.00	--	1,900.00
<b>Total direct costs</b>	<b>\$ 5,450.00</b>	<b>\$ 2,900.00</b>	<b>\$ 8,350.00</b>
Overhead	436.00*	2,066.83**	2,502.83
<b>TOTAL</b>	<b>\$ 5,886.00</b>	<b>\$ 4,966.83</b>	<b>\$ 10,852.83</b>

\* Overhead charged to AEC (8% of direct costs)

\*\* Overhead (incidental costs) assumed by N. C. State College equals 41.03% of salaries and wages less overhead charged to AEC.

1129550

NORTH CAROLINA STATE COLLEGE  
SCHOOL OF AGRICULTURE • RALEIGH, N. C.

DIVISION OF BIOLOGICAL SCIENCES  
BOTANY

March 14, 1958

Dr. C. S. Shoup, Chief  
Biology Branch  
Research and Development Division  
U. S. Atomic Energy Commission  
Oak Ridge, Tennessee

Subject: Contract No. AT-(40-1)-2100

Dear Dr. Shoup:

Enclosed are complete budget reports both on the project this year and the proposed budget for next year. These include the exact figures given in the mimeographed annual report and renewal proposal with the contribution of N. C. State College added in each case. You will note that overhead in each case is figured at about 41% of salaries and wages. The College charges to AEC, however, only 8 or 8.5% of total direct cost and contributes the remainder, in incidental costs, to the project.

I should like to revise upward slightly the costs to the end of the contract period over my estimate of March 1, which was actually made about a month ago. We need one more small item of equipment costing about \$50 and I should like to spend about \$100 more on travel than allocated. I have found several extremely interesting streams recently which I should like to visit frequently during the spring maximum of algal growth. This revision will still leave slightly over \$1,000 to carry over into next year's budget. This amount can largely be accounted for through the saving of \$300 in salary last summer when I was forced to employ an Assistant Investigator instead of an Associate, at a saving of more than \$600 because the College elected to assume more of the overhead than was agreed on in the original proposal.

In regard to the budget for the coming year, the College has agreed to charge AEC only 8% of direct costs as overhead and assume the difference between this amount and 41.03% of salaries and wages.

I am enclosing a copy of a letter of resignation from Dr. John L. Blum. Dr. Blum's resignation, while personally regrettable to me, is not a serious blow to our work. He came down last summer for a short visit and helped formulate final plans for the project. His advice has been valuable and I still consider him the best man I know of as an associate on ecology of stream algae, but I have already contacted three other phycologists of experience and know that I can get one of them if the renewal project is approved.

1129551

MAR 17 1958

Dr. C. S. Shoup

-2-

March 14, 1958

These people are: Dr. George Schumacher, Ph.D., Cornell University, who has worked on the phytoplankton in Georgia and Florida streams in New York State; Dr. Mary Gidica, who has worked on stream ecology in Pennsylvania and Virginia; and Duke University, who did his thesis on the ecology of algae in this state.

I hope that this gives you the information.

Associate Professor of Botany

cc: Mr. J. G. Vann

Enclosures

LAW:k

1129552

College Report on the Budget

Account No. 17-(40-1)-3100

RESEARCH

ATOMIC ENERGY COMMISSION

Item	Expended March 31, 1954	Contributed by AEC Total (estimated) for year	Contributed by N. C. State College	Total
Salaries and labor	\$2,767.32	\$2,067.52	\$3,000.00	\$5,767.52
Travel	544.30	704.20	100.00	1,348.50
Supplies, etc.	303.60	100.00	40.00	440.00
Equipment	1,941.67	1,991.67	--	1,991.67
Overhead	570.00	570.00 *	1,318.00 **	1,888.00
<b>TOTALS</b>	<b>\$6,157.09</b>	<b>\$6,533.49</b>	<b>\$4,418.00</b>	<b>\$10,951.49</b>

Estimated carry-over to next year \$1,472.51.

\* Overhead charged to AEC (8.5% of direct costs).

\*\* Overhead (incidental costs) assumed by N. C. State College. Equals 32% of salaries less overhead charged to AEC.

Canisius College  
Buffalo 8, N.Y.

C  
O  
P  
Y

Department of Biology

March 1, 1958

Dr. Larry A. Whitford  
Department of Botany  
Division of Biological Sciences  
School of Agriculture  
North Carolina State College  
Raleigh, N. C.

Dear Dr. Whitford:

I greatly regret that, due to causes unforeseen in the spring of 1957, I must inform you that it will be impossible for me to take part in the work which you have planned under a grant from the Atomic Energy Commission.

During the first two months of this year my wife's health has fluctuated, as a result of a difficult delivery, to such an extent that my project of removing the family to Raleigh for the summer now seems entirely unfeasible. I have furthermore encountered difficulty in arranging the summer's work to be done under a grant from the National Science Foundation to Canisius College, and for which I am responsible.

Much as I regret having to step out of the North Carolina project, I find that this move is necessitated by both of the above situations. I sincerely hope that you are able to replace me with a suitable associate, and that the project on the ecology of North Carolina algae will prove to be a most successful and instructive one.

Sincerely yours,

s/  
John L. Blum  
John L. Blum  
Professor of Biology

1129554

MAR 17 1958

H 2504

RENEWAL PROPOSAL  
ON  
CONTRACT NO. AT-(40-1)-2100  
U. S. ATOMIC ENERGY COMMISSION  
RESEARCH AND DEVELOPMENT DIVISION

It is proposed to continue the study of the algal flora of the smaller streams in the Piedmont and Coastal Plain which was begun last August. Streams from brook to creek in size will be given most of the attention. Mountain streams of similar size will be sampled the coming summer for their flora. It is believed sampling for a full calendar year will be necessary in order to get a record of the flora.

A more detailed study of selected streams in each of the three geographical areas (Mountain, Piedmont, and Coastal Plain) will be made. These studies will be of an ecological nature, with emphasis on the communities and their dominants together with a record of such important habitat factors as light, water temperature pH, chemical quality of water, dissolved gases, etc.

Special attention will be given in spare time to certain problems such as the taxonomy of fresh-water diatoms, and the effect of current on stream algae.

It is proposed to set up a temporary laboratory at the Highlands Biological Station for two to three weeks in June and work on the Mountain streams from that point. It is believed that considerable saving in both time and travel cost can be made in this way.

It is also planned for both investigators to work for a few days on diatoms at the Academy of Natural Sciences of Philadelphia. This will probably be in the fall or winter.

Scientific Personnel

Senior Investigator: Larry A. Whitford, Associate Professor of Botany, W. C. State College (See original proposal for biography and bibliography)

Associate Investigator: John L. Blum, Professor of Biology, Canisius College  
(See original proposal for biography and bibliography)

1129555

Budget

Salaries	
Senior Investigator	\$1,500
Associate Investigator	1,500
Labor	200
Equipment	
Misc. and expendable supplies and repairs	300
Photographic materials	50
Travel and per diem	<u>1,900</u>
Total Direct Costs	5,450
Overhead (8% of direct costs)	<u>436</u>
Contributed by N. C. State College: Salary	<u>2,900</u>
Total	\$8,786

Approval

*Larry A. Whitford*

---

Larry A. Whitford  
Senior Investigator

*H. T. Scofield*

---

H. T. Scofield  
Head of Botany

*D. B. Anderson*

---

D. B. Anderson  
Head, Division of Biological Sciences

*R. L. Lovvorn*

---

R. L. Lovvorn, Director of Research  
School of Agriculture

*J. G. Vann*

---

J. G. Vann  
Business Manager, N. C. State College

*C. H. Bostian*

---

C. H. Bostian  
Chancellor, N. C. State College

## Office Memorandum • UNITED STATES GOVERNMENT

TO : J. W. Ould, Jr., Assistant General Counsel

DATE: June 12, 1957

FROM : John R. Moore, Director, Contract Division

SUBJECT: REQUEST FOR PREPARATION OF NEW CONTRACT WITH NORTH CAROLINA STATE COLLEGE

SYMBOL: ACC:BSH

Please prepare a new contract with North Carolina State College for a period of one year beginning June 1, 1957, with AEC funds in the amount of \$7,705. Designate Dr. Larry A. Whitford as Senior Investigator and include provisions for compliance with AEC Manual Chapter 7510. This action is covered by Contract Authorization No. BM-57-360, dated May 17, 1957, in the amount of \$7,705.

A Request for Contract Action from the Research and Development Division is enclosed for your use.

*John R. Moore*  
John R. Moore

## Enclosures:

1. Request for Cont. Action
2. Budget
3. Resume'
4. Cont. Auth. No. BM-57-360
5. Proposal

CC: L. D. MacKay  
C. S. Shoup  
A. Brown, w/encls. 1, 2 & 4

1. TO: J. R. Moore Chairman Contract Board From: Res. & Dev. Div.

It is requested that the Contract Board take the necessary action to process the following described contract action in accordance with the provisions of Bulletin OR-O&M-19:

2. Nature of Action Requested

- X Selection of New Contractor and Negotiation of Contract. North Carolina State College Raleigh, North Carolina
Modification of Contract No. Contractor:
Review and approval of Contract, Sub-contract or Purchase Order.
Other (Explain)
Number: Name:

3. Nature of Services to be Covered by Contract

Construction Architect-Engineer Other X (Explain) Research

4. Funding Amount to be Obligated by this Contract Action \$7,705.00

Source of Funds

Approved ORO Financial Plan, Quarter, Fiscal Year 19
Project No. or, Activity No. 6130
Funds to be Obligated: Allotment No. 06-71-91(24) Y. 1957 Funds)
Procurement Directive No. B7M-57-360 Dated 5-17-57
Issuing Office Div. of Biology & Medicine

Concurrence in Funding Statement: (signed) A Miller Chief, Budget Branch

5. Project or Activity to be Covered by Contract Action:

Location of Work: Construction Directive No.
Estimated Cost of Work to be Covered by this Contract Action \$
Schedule: Date Work to Start Estimated Completion Date
Description of Project or Activity:

(If more space is required use separate sheets and attach hereto:)

<p>6. Contract Board Docket No. _____ (To be assigned by Board Secretary)</p>	<p>7. Request Submitted By: (signed) _____ Date: _____ Title: _____ C. S. SHOUP CHIEF, BIOLOGY BRANCH RESEARCH AND DEVELOPMENT DIVISION</p> <p style="text-align: center;">JUN 6 1957</p>
<p>OK A 6/10</p>	<p>8. Complete Description of Services to be Furnished by Contractor: Headquarters designated research contract TITLE: "Studies in the Ecology of Fresh-water Algae in North Carolina"  (If more space is required use separate sheets and attach hereto:)</p>
	<p>9. Description of other changes to be covered by Modification: New contract for a period of one year beginning June 1, 1957, with AEC funds in the amount of \$7,705. Designate Dr. Larry A. Whitford as Senior Investigator. Include provisions for compliance with AEC Manual Chapter 7510.  (If more space is required use separate sheets and attach hereto:)</p>
	<p>10. Negotiated Contracts. (Show why it appears desirable to negotiate new contract or to negotiate modification to existing contract) Memorandum from C. W. Shilling to S. R. Sapirie, dated May 17, 1957.  (If more space is required use separate sheets and attach hereto:)</p>
	<p>11. Contracts, Subcontracts, or Purchase Orders Submitted for Review and Approval: (Furnish brief description of action in this space and attach pertinent documents) None</p>
	<p>12. Disputes: Attach a statement summarizing the dispute together with pertinent documents and Background Material. None</p>

28824

1129560

BUDGET FOR NEW CONTRACT - DR. LARRY A. WHITFORD  
FOR PERIOD 6-1-57 - 5-31-58

(1) <u>Salaries and Wages:</u>		\$ 6,150.00
Dr. L. A. Whitford ( $\frac{1}{2}$ time for 9 mos. Full time for 3 mos.)	\$4,400.00	
Research Associate	1,500.00	
Labor	250.00	
(2) <u>Equipment:</u>		2,150.00
(3) <u>Travel:</u>		1,300.00
(4) <u>Overhead</u> (41.03% of Salaries and Wages):		2,523.35
		<hr/>
	TOTAL	\$12,123.35*

\* *It is recognized*  
~~\*recognize~~ that the project may receive additional support as outlined in  
the Contractor's proposal to the ~~AEC~~ *Commission*.

The AEC's contribution to the above budget will be \$7,705.

1129561

NORTH CAROLINA STATE COLLEGE  
DEPARTMENT OF BOTANY  
RALEIGH, NORTH CAROLINA.

RESUME'

Dr. Larry A. Whitford, Project Leader.

STUDIES IN THE ECOLOGY OF FRESH-WATER ALGAE  
IN NORTH CAROLINA.

C  
The contractor will undertake studies directed toward use of radioisotopes in (1) identifying the possible relationships between phosphorus compounds and phytoplankton pulses in ponds and lakes; (2) will study the ecology of stream algae in relation to habitat and incident light, stream flow, dissolved gases, minerals, and other factors, and (3) will study relationship of growth to stream current, including problems of diffusion gradient of nutrient and other materials.

C. S. Shoup

1129562

UNITED STATES ATOMIC ENERGY COMMISSION  
WASHINGTON, D. C.

Contract Authorization No. BM-57-360

MAY 17 1957

TO : S. R. Sapirie, Manager  
Oak Ridge Operations Office

FROM : C. W. Shilling, M.D., Deputy Director  
Division of Biology and Medicine *C. W. Shilling*

SUBJECT : FUND AUTHORIZATION AND TRANSMITTAL OF RESEARCH PROPOSAL FOR  
CONTRACT NEGOTIATION

REFERENCE : AEC 102/16 APPROVED OCTOBER 7, 1953, AS IMPLEMENTED BY MEMORANDUM  
TO MANAGERS, OPERATIONS OFFICES, DATED OCTOBER 23, 1953, JOINTLY  
SIGNED BY THE DIRECTORS OF THE DIVISIONS OF RESEARCH AND BIOLOGY  
AND MEDICINE.

SYMBOL : BMES:JNW

The research proposal described below has been approved by the  
Division of Biology and Medicine, funds are available, and you  
are authorized and requested to negotiate a contract in  
accordance with the following terms and conditions:

1. Institution: North Carolina State College
2. Investigator (s): Larry A. Whitford
3. Title: Studies in the ecology of fresh-water algae in North  
Carolina

4.  New Contract, ( ) Renewal of Contract No. \_\_\_\_\_

5. Duration: One year from date of contract

6. AEC Technical Representative: Dr. John N. Wolfe *J. N. Wolfe*

7. Funds are authorized for the obligation of this contract  
as follows:

<u>Allotment No.</u>	<u>Budget Category</u>	<u>Amount</u>		<u>Total</u>
		<u>Previous</u>	<u>This Action</u>	
<u>06-71-91(24)</u>	<u>6130</u>	<u>_____</u>	<u>\$7,705</u>	<u>\$7,705</u>
<u>_____</u>	<u>_____</u>	<u>_____</u>	<u>_____</u>	<u>_____</u>
<u>_____</u>	<u>_____</u>	<u>_____</u>	<u>_____</u>	<u>_____</u>

**CONTRACTS**

G 4461

MAY 20 1957

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- 8. It is suggested that in the best interests of the government the following type contract be negotiated: Lump-sum
- 9. It is requested that the title to any capital equipment procured under this contract shall be vested with:

(X ) the contractor; ( ) the government.

- 10. If radioisotopes are to be used in this research, it is requested that the savings available to the contractor under the Radioisotope Research Support Program (Ref. AEC Manual Chapter 7510) be considered in the negotiation of the amount to be funded under this contract.

11. Other comments:

12. Security Requirements:

In accordance with the provisions of Chapter 3403 of the AEC Manual and the requirements of the Declassification Guide, it has been determined that the following security precautions should be taken in connection with the proposed research contract:

Since there is essentially no chance for the development of restricted data, this project has been placed in Category I as defined in Chapter 3403 of the AEC Manual.

- 13. Reports: (X ) Reports are to be required as provided for by "Revised Guide for the Submission of Research Proposals" dated February 8, 1954.

( ) Special reports instructions are as follows:

Enclosures: (X ) "A" - Proposal, dated UNDATED  
 (X ) "B" - Notification letter, dated MAY - 1954  
 ( ) "C" - Other correspondence, \_\_\_\_\_ letters

Distribution:

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NORTH CAROLINA STATE COLLEGE  
SCHOOL OF AGRICULTURE • RALEIGH, N. C.

THE DIVISION OF BIOLOGICAL SCIENCES  
BOTANY

May 31, 1957

Dr. C. S. Shoup, Chief  
Biology Branch  
Research and Development Division  
U. S. Atomic Energy Commission  
Oak Ridge, Tennessee

Dear Dr. Shoup:

Re: ORS:EMM

Item 1

The approximate fraction of time represented by each of the budget salary figures is given below. The entire \$2,900 item is approximately one-half the salary of the principal investigator during the regular school year. This represents time to be spent in making collections and taking habitat data during autumn, winter and spring. These data are necessary to complete the study on a year-round basis.

Budget A.E.C.

Salaries

Senior Investigator (L. A. Whitford)	\$1,500
Full time, 3 months, June, July and August	
Associate Investigator (J. M. W. Hayek)	1,500
Full time, 3 months, June, July and August	
Labor (College students)	250
Per hour, part time, at \$1.00 to \$1.25	

Contributed by North Carolina State College

Salary

Senior Investigator (L. A. Whitford)	\$2,900
Approximately one-half time for the months September through May. Estimate twenty hours weekly. This represents less than half the College salary for this period.	

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Dr. C. S. Shoup, Chief  
May 31, 1957  
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Item 2

It is entirely agreeable to us that the overhead rate for this proposal be at the prevailing rate for other Government contracts, which is 41.03% of direct personal service cost in the project. The rate you mention of 45.36% was the rate established by the Government for our overhead computations two years ago. This proposal was computed on the basis of 15% of total direct cost rather than the higher rate on personal service cost only. These rates are not much out of line in relation to each other.

Yours very truly,



L. A. Whitford  
Associate Professor of Botany

LAW:jhg



---

J. G. Vann, Business Manager  
North Carolina State College

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## A RESEARCH PROPOSAL

For submission to the Division of Research

U. S. Atomic Energy Commission

### Title of the project

Studies in the Ecology of Fresh-water Algae in North Carolina

### Institution and department in which the work would be done

Department of Botany, North Carolina State College, of the University  
of North Carolina

### Scientific background

A record of the flora of a region, together with data on the natural factors affecting its abundance and distribution, is of fundamental scientific value. It can also be of much practical value in many fields, among them the following: the choice and use of agricultural lands, conservation of wild life, future settlement and development. A knowledge of the ecology of aquatic areas, likewise, will be of enormous value in the future in studies of fisheries biology, water use and conservation, and waste disposal. In order properly to evaluate the effect of wastes from atomic reactors, and other like installations; as well as those from industrial and domestic sources, such studies are imperative.

Aquatic ecology has been neglected in comparison to the ecology of upland areas, and this is particularly true of the southeastern United States. In this area not a single exhaustive ecological study has as yet been made of an inland water area.

A review of the fairly voluminous European literature on fresh-water algae indicates that most of it is floristic, and even in this field, the number of recent papers proves that the flora is not completely known. Only during the past twenty years have ecological studies become frequent. Most of these are on the phytoplankton of lakes. The number of papers on the ecology of stream algae is still comparatively few. Two investigators in the British Isles and perhaps a half dozen on the continent have contributed most of them.

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In this country likewise, several hundred papers on the fresh-water algal flora have appeared but certain groups have been relatively neglected. Only one algal flora of any inland area of considerable size has been published, (Prescott, 1951). In the southeast, the fresh-water algae in North Carolina are best known, but even in this state certain groups have been incompletely investigated. Although nearly 900 species and varieties are known to occur here, this is less than half the estimated total flora. The local species in certain groups such as diatoms, which are very abundant in streams, are unknown.

A few lakes in the United States have been, or are being, studied intensively. The classic studies begun by Birge and Juday (1904-1938) on the Wisconsin lakes and studies by many investigators on Lake Erie and a few other northern lakes and ponds are well known. The ecology of streams, however, and especially the algal ecology, has been scarcely touched in this country (Blum, 1956).

Study of the fresh-water algal flora in the southeastern states began with the excellent early paper of Bailey (1851), but for the next 80 years, with two exceptions, only scattered records of species were made in papers from other regions. Wollé (1884, 1887, 1894) reported many collections from the southeast, and Poterat (1883) published a short list of desmids from a single county in North Carolina. After 1930, lists of species and annotated lists with some notes on habitat factors became frequent, (Silva, 1948). The species of certain taxonomic and habitat groups are now well known. Almost nothing has been done on the flora and ecology of streams. There are only two ecological papers on the fresh-water algae of the southeast, those of Schumacher (1956) and Whitford (1956).

These facts indicate the great need for completion of floristic studies and a continuation of ecological studies of fresh-water algae in this region. As pointed out above, there can be no adequate future evaluation of the effect of radiation,

nor the long-time effects of any other natural factors on biological populations without a detailed knowledge of today's populations and the habitat factors bearing on them.

#### Work in Progress

The writer of this proposal has a herbarium of over 3,000 personal collections of fresh-water algae made throughout the southeastern states. Most of the collections are from North Carolina. He has had under way for nearly ten years a study of the phytoplankton of lakes and ponds in the state. This study has been supported to the extent of about two thousand dollars by North Carolina State College and the North Carolina Agricultural Experiment Station. The floristic part of the work is nearly complete but further support of a study of some of the important habitat factors affecting phytoplankton is needed.

Although several hundred collections from streams in North Carolina are in the writer's herbarium, there has been no systematic collecting in streams, and only field notes on distribution and habitat are at hand. The only work so far on streams, except general collecting, has been the preparation of about one hundred permanent diatom slides.

#### Literature Related to the Proposal

In the bibliography below, two excellent recent reviews of literature are cited instead of a lengthy list. These are the reviews of Prescott (1956) and of Blum (1956). Literature on the fresh-water algae in the southeast, most of it taxonomic or floristic, is cited by individual papers.

Abbott, W. 1957. Unusual phosphorus source for phytoplankton algae. *Ecology* 38: 152.

\* Blum, J. G. 1956. The ecology of river algae. *Botanical Review*: 22: 291-341

Hutchinson, G. E. 1944. Critical examination of the supposed relationship between phytoplankton periodicity and chemical changes in lake waters.

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- \* Extensive bibliography.

#### Literature on Fresh-water Algae in the Southeast

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#### Scientific scope of the proposed research

During the first summer it is proposed to study (1) the possible relationship between phosphorus compounds and phytoplankton pulses. There is laboratory evidence for such a relationship (Rhode, 1948), but data from field studies are inconclusive. Hutchinson (1944) has reviewed this problem. There is recent evidence (Abbott, 1957) that complex polyphosphates in colloidal matter in suspension may be directly available to phytoplankton organisms. Therefore, it is planned to sample both soluble and adsorbed phosphorus compounds in at least four ponds or lakes at weekly intervals and to try to relate changes in available phosphorus to variations in phytoplankton. At least two Coastal Plain ponds, where colloidal materials are low, and two Piedmont ponds, where clay colloids are abundant, will be sampled. Phytoplankton counts will be made at weekly intervals. It is planned to have the phosphorus analyses done on a fee basis since this will be cheaper.

As pointed out by Ruttner (1952), "Of great interest both theoretically and practically is the question, much discussed recently, of how a lake reacts to changes in its nutrient spectrum, \*\*\*\* Investigations of this sort give hope for deep insight into the material mechanism of our lakes, entirely apart from their significance for fisheries." The proposed study could well prove or disprove the phosphorus theory.

During the first year it is also proposed (2) to finish collecting data on the species and seasonal relations of phytoplankton of lakes and ponds in the state and to prepare the material for publication. Work has been in progress on this community

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over a period of ten years, but a little more data on ponds and lakes in the upper Piedmont and Mountain areas are needed. These data will be taken during the spring and early summer. It is not to be presumed that such fundamental problems as the reasons for variations in productivity have been solved, nor that accurate figures on the annual crop of the principal lakes and ponds are at hand. There are enough data to make an ecological classification of the lakes and ponds of the state and compare the standing crop at different seasons (the curve of numbers) with that of lakes and ponds in other parts of this country and in Europe. It is hoped that these data will throw some light on the more fundamental problems of aquatic ecology.

An investigation of (3) the ecology of stream algae will be started by setting up sampling stations for a study of the algal flora of the smaller streams of the Coastal Plain and Piedmont. Three streams (two brooks and a small creek) in each region will be studied. The summer flora can be recorded and a start made in measuring such important habitat factors as temperature, incident light, stream flow, and pH. Since the algal flora changes markedly with the season, study of the flora will be continued during the whole of the first year. A more detailed study of the habitat factors including such things as dissolved gases, minerals, etc. will have to wait until the second summer. It will not be possible to do more than a little preliminary sampling of streams in the Mountain area during the first year. This will be the first such study in the southeast and apparently the second for the United States. (Blum, 1953).

From the study it is believed that improved methods for estimation of the standing crop as well as for the total production in streams will be worked out. It is hoped that at least a comparison between the productivity of the very numerous lotic (or running-water) habitats with the much less numerous but generally larger lenitic (still-water) habitats can be made. Perhaps a partial solution of some of

the problems relating to algal communities, such as types of communities, and successional relationships, can be achieved. Detailed knowledge of the stream flora of this region will be gained, and such problems as the relative productivity of swift and slow streams, a matter now in question, will be solved.

Work is already in progress on the effect of current on the growth of stream algae. The effect of current is generally recognized as an important habitat factor in streams, but it is apparently little understood and often neglected in limnological studies. Evidence of increased growth in running water has already been obtained. Further work is planned on the effect of current on the diffusion gradient between an organism and the surrounding water. The use of radio-active materials in this study is contemplated. Determination of the critical speed of water movement will be made. It is hoped that a current meter can be developed to measure speed of movement within one millimeter of a plant surface. Most of the investigation of this problem will be done in the laboratory during the regular school year.

As Blum (1956) has said, "The fact that algae colonize so dangerous a habitat as flowing water suggests that they can be provided something unique in this habitat. \*\*\*\* The explanation for the improved growth in rapid water has proven elusive, however." The apparent fact that running water produces a steep diffusion gradient may provide this elusive explanation. From this study adequate proof for this theory should be forthcoming.

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if the project is continued during the second and third years, it is planned to study the algal flora of several Mountain streams, make a more detailed study of the habitat factors in all streams under investigation and if possible, study the phytoplankton of three of the larger rivers in the state.

Scientific personnel

Senior Investigator: Larry A. Whitford, Ph.D., Associate Professor of Botany, North Carolina State College. Twenty years experience teaching aquatic botany, limnology and hydrobiology. Wide field experience collecting aquatic plants in this state and the southeast.

One summer collecting possible drug plants, for the Bureau of Plant Industry, United States Department of Agriculture, 1934. Two and one-half years during the last war with the United States Public Health Service, Malaria Control in War Areas in North Carolina, Louisiana and Mississippi, 1943-45.

Lecturer in Hydrobiology at the Mountain Lake Biological Laboratory of the University of Virginia, 1952. Research Associate at the University of Florida on a Naval Research Grant for the study of Florida springs and spring streams, 1953. One summer with the North Carolina Agricultural Experiment Station on a study of the phytoplankton of fertilized and unfertilized ponds. Consultant for many years for several state agencies on the control of algal nuisances.

Author of nine papers on the fresh-water algae of the region, and another paper and a leaflet on other phases of aquatic botany.

Fellow, A.A.S., Vice President, The Phycological Society of America, member of American Society of Limnology and Oceanography, Ecological Society, Botanical Society of America, American Microscopical Society, North Carolina Academy of Science.

Full time would be devoted to the project during the months of June, July and August. Spare time only would be used during the school year since he is a full-time teacher. In the past, five to ten hours per week have been devoted to similar studies.

Professional Bibliography of

L. A. Whitford

- Whitford, L. A. 1929. The algae of Lake Raleigh; an ecological study. M. S. thesis North Carolina State College, (unpublished) pp 1-60, pl. 16.
- \_\_\_\_\_ 1936. New and little known algae from North Carolina. Jour. Elisha Mitchell Sci. Soc. 52: 93-98.
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- \_\_\_\_\_ 1943. The fresh-water algae of North Carolina. Jour. Elisha Mitchell Sci. Soc. 59: 131-170.
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- \_\_\_\_\_ 1950. Some fresh-water<sup>algae</sup> from Mississippi. Castanea 15: 117-123.
- \_\_\_\_\_ 1951. (Revised 1955) Weed control in farm ponds. Mimeographed leaflet. pp 1-5.
- \_\_\_\_\_ 1956. The communities of algae in the springs and spring streams of Florida. Ecology 37: 434-442.
- \_\_\_\_\_ 1956. Additions to the fresh-water<sup>algae</sup> in North Carolina. Trans. Amer. Mic. Soc. 75: 196-203.
- \_\_\_\_\_ 1956. A theory on the formation of cypress knees. Jour. Elisha Mitchell Sci. Soc. 72: 79-83.

Associate Investigator, Richard E. Norris, Ph.D. Instructor in Botany,  
University of Minneapolis, Minnesota.

Several years experience teaching taxonomy of fresh-water algae.

Research in culturing and radiation experiments on algae, flagellate algae  
of Minnesota.

Two publications:

Journal of Experimental Botany. 6: 64

Univ. California Pub. Botany 28: 251

Dr. Norris would devote full time to the project during the months of June,  
July and August and part time during the following school year to prepare material  
for publication.

Should Dr. Norris be unable to accept the position as Associate Investigator,  
the following investigator can be obtained:

Assistant Investigator, John M. W. Hayek, M.S., Teaching Assistant and Graduate  
Student, State University of Iowa, Iowa City, Iowa.

Graduate Assistant and Lecturer in Biology, University of Toledo, 1952-53;  
Research Assistant, 1954-55; Teaching assistant, 1955-56; State University of Iowa.

Did research in botany on a research grant at Stone Laboratory of Hydrobiology,  
of the Ohio State University summers of 1953 and 1954, and took courses in fresh-  
water algae and aquatic flowering plants.

At present finishing work toward Ph.D. at State University of Iowa, Iowa City,  
Iowa.

Has had at least one year's experience each in teaching general Botany and  
morphology of the algae.

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Mr. Hayek has one publication (with R. M. Hulbary):

Hayek, J. M. W. and Hulbary, R. L. 1956. A survey of soil diatoms.  
Proc. Iowa Acad. Sci. 63: 327-338.

Consultant (first year) Associate Investigator (second and third years)

John L. Blum, Ph.D. Professor of Biology, Canisius College, Buffalo, New York

Leading investigator in this country of stream algae.

Author of nine papers and joint author of another on the taxonomy and ecology of fresh-water algae. One of these papers is a comprehensive review of the ecology of river algae, on a world-wide basis.

Professional bibliography of John L. Blum

Blum, John L. 1951. Notes on the Vaucheriaceae with particular reference to western New York. Bul. Torrey Bot. Club. 78: 441-448.

\_\_\_\_\_ 1953. The Ecology of algae growing in the Saline River, Michigan with special reference to pollution. Doc. Thesis, Univ. Michigan.

\_\_\_\_\_ 1953. The racemose Vaucheriae with inclined or pendent oogonia. Bul. Torrey Bot. Club. 80: 478-497.

\_\_\_\_\_ 1954. Two winter diatom communities of Michigan streams. Mich. Acad. Sci. Art. Let. 39: 3-7.

\_\_\_\_\_ 1954. Evidence for a diurnal pulse in stream phytoplankton. Science. 119: 732-733.

\_\_\_\_\_ 1955. A new marine Vaucheria from Australia. Amer. Jour. Bot. 42: 713-717.

\_\_\_\_\_ 1956. Zygnemataceae of western New York. Mich. Acad. Sci., Art. Let. 41: 3-19.

\_\_\_\_\_ 1956. The application of the climax concept to algal communities of streams. Ecology 37: 604-605.

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Blum, John L. 1956. The ecology of river algae. Bot. Review 22: 291-341.

\_\_\_\_\_ and Conover, J. T. 1953. New or noteworthy Vaucheriae from New England salt marshes. Biol. Bul. 105: 395-401.

In addition to the scientific personnel mentioned above, the services of qualified chemists in college or state laboratories would be obtained on a fee basis for phosphorus analyses. Investigation has indicated this is the cheapest method of obtaining such analyses.

Other Personnel would include only part time undergraduate assistants to clean up laboratory, wash glassware, index collections and the like.

Other financial assistance. None from non-university or federal sources.

Materials, equipment and facilities furnished by North Carolina State College:

Adequate laboratory and working space. Over 600 sq. feet on a year-round basis and unlimited space in summer.  
Photographic laboratory and darkroom with equipment worth \$4,000.  
Spencer research microscopes with achromatic lenses. All required.  
Spencer Model 370 microscope lamps.  
Camera lucidas.  
Graflex and Leica cameras and equipment.  
Electric centrifuges.  
Ekman dredge.  
Oxygen samplers.  
Plankton and dip nets.  
Surber stream sampler.  
Secchi light penetration apparatus.  
Water telescopes.  
Weston photometers for incident light measurement.  
Coleman pH electrometer.  
Photospectrometer  
together with most of the necessary small equipment such as thermometers, field pH sets, and the like.

Travel and other items Considerable travel will be involved because of the diversity of algal flora which is related to the geology of the state. There is a marked difference between the Coastal Plain and Piedmont regions and enough variation within each region to make it necessary to locate sampling stations many miles apart.

The nature of the microscopic flora makes it necessary to transport most of the collections to a permanent laboratory for study, and the rapidity with which the flora changes character during the season makes it necessary to sample at fairly frequent intervals.

The three major items of equipment in the budget are:

1. Several storage cabinets. These are necessary because of the numerous small items of equipment, and large number of pieces of glassware needed, and for the storage of the numerous collections. (\$500)
2. A set of apochromatic lenses and a ribbon-filament lamp. These are necessary because the diatoms, the major group of organisms in the stream study, require the best of optical equipment for their identification. (\$600)
3. A portable, small boat with a light boat trailer and motor are an obvious necessity for lake and stream sampling. (\$500)

Budget

	<u>First Year</u>	<u>Second Year</u>	<u>Third Year</u>
<b>Salaries</b>			
Senior Investigator	\$1,500	\$1,500	\$1,500
Associate Investigator	1,500	1,500	1,500
Labor	250	250	250
<b>Equipment</b>			
Boat and motor	350	—	—
Boat trailer	150	—	—
Optical equipment	600	—	—
Storage cabinets	500	—	—
Misc. & expendable supplies & repairs	200	200	200
Field equipment	300	—	—
Photographic mat'ls.	50	50	50
Travel <del>██████████</del>	1,300	2,000	2,000
Overhead	1,005	825	825
	<hr/> \$7,705	<hr/> \$6,325	<hr/> \$6,325
Contributed by North Carolina State College; Salary	2,900	2,900	2,900
From Faculty Research Fund	200	—	—
	<hr/> Total \$10,805	<hr/> \$9,225	<hr/> \$9,225

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Approval

Larry A. Whitford

Larry A. Whitford  
Senior Investigator

H. T. Scofield

H. T. Scofield  
Head of Botany

H. T. Scofield, acting

D. B. Anderson  
Head, Division of Biological Sciences

D. W. Colvard

D. W. Colvard, Dean  
School of Agriculture

J. G. Vann

J. G. Vann  
Business Manager, N. C. State College

Carey H. Boston

C. H. Boston  
Chancellor, N. C. State College