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PROCEEDINGS OF THE TENNESSEE ACADEMY OF SCIENCE 1984

DIANE R. NELSON, SECRETARY T.A.S.
East Tennessee State University

TENNESSEE ACADEMY OF SCIENCE EXECUTIVE COMMITTEE MEETING

April 13, 1984

The Executive Committee Meeting of the Tennessee Academy of Science was called to order by President Robert L. Wilson at 7:00 p.m. C.S.T. in Room D-7, Tennessee State University Building, Nashville, on April 13, 1984. Members present were Robert L. Wilson, President; William H. Ellis, President-Elect; Diane R. Nelson, Secretary; R. K. Flectcher, Treasurer; Gus Tomlinson, Journal Editor; Richard J. Raridon, Director of the Collegiate Division; William N. Pafford, Director of the Junior Academy; Bernard W. Benson, Director of the Visiting Scientists Program; David Yarbrough, Thomas Byrne, and Ernest Blythe, Members-at-Large.

The minutes of the November 1983 Executive Committee Meeting and the Annual Business Meeting were published in the January-April 1984 issue of the Journal. They were approved as printed by a motion passed unanimously.

The Treasurer's report was published in the January-April 1984 issue of the Journal. Discussion was postponed until the budget proposal was discussed under New Business.

The Editor, Gus Tomlinson, presented the following report:

"A complete report on 1983 Journal activities, including a list of manuscripts received, published and rejected for the year, was given at the November meeting and published in the April 1984 issue of JTAS. These data will not be repeated in this brief report. Instead, this will simply be an update of what has transpired since November.

The January and April issues for 1984 were combined into a single issue as per Executive Committee instructions last year. Contributors are being notified that quarterly issues will begin again as of this April and continue on that basis until further notice.

The April 1984 issue includes sections on the new President of TAS, annual proceedings from the November meeting, new member lists for 1983, abstracts of research reports which were given at the annual meeting, plus regular manuscripts in Zoology, Botany, Geology-Geography and Physics.

Eight new manuscripts have been received since the November report was made. One manuscript has been rejected since November and 5 have been returned to authors for major revision.

As of April 1, 1984, 18 manuscripts are in the accepted but unpublished category. Ten to twelve of these are expected to be included in July 1984 issue.

The highlight of this short report is to acknowledge that JTAS is back on schedule and primed for four quarterly issues per year after two years of uncertainty due to budget difficulties in 1981 and 1982."

The Editor's report was accepted.

The Director of the Visiting Scientists Program, Bernard Benson, presented the following report:

"OPERATION

Visits Requested to Date—70 (39)*
Visits Completed—44 (27) [includes 2 cancellations and 15 declined by Visiting Scientists]
Visits Outstanding—26 [7 completed except for Visitation Report]
Students contacted to Date—3809 (1775)
Teachers Participating—80 (37)
Classes Involved—83 (52)

*Last year's figures

ROSTER

Number of Visiting Scientists on Current Roster—82 (includes 26 new for 83-84)
Number of Visiting Scientists Who Did Not Respond to Last Year's Request—18
Number of Visiting Scientists Who Declined 1983-84 Invitation—8
Recently Recruited TVA Visiting Scientists—18

BUDGET

A review of expenditures to date indicates that the year end expenditures as of June 30 will be less than the $4,000 budgeted."

The Director's report was accepted.

The Director of the Junior Academy, William Pafford, presented the following report:

"Arrangements are now being finalized for the spring meeting of the Tennessee Junior Academy of Science in Nashville, Tennessee. The meeting is scheduled for April 13 at West End Middle School. All members of the Tennessee Academy are invited to attend. A special feature of this year's program will be the recognition of three outstanding science teachers in the state. Papers will be presented during the times of 9:30-11:30 AM and 1:00-3:00 PM, with the outstanding science teachers to be recognized at 11:30 AM. We are especially indebted to Bob Bryson, Metro Science Coordinator, for helping to arrange the meeting and locate a suitable facility.

A total of 45 papers from seven different schools was received this year. This compares with 48 papers from eleven schools last year. We have invited 22 students to present their papers at the annual meeting. Participants will be reimbursed at the rate of 20¢ per mile for travel, along with a meal allowance. Since no participant lives more than 200 miles away from Nashville, however, overnight lodging will not be necessary. The three outstanding teachers to be honored will also be reimbursed for travel expenses.

As of this date a total of only $354.36 has been expended from the 1983-84 Junior Academy budget. This does not include any of the expenses for the spring meeting, however, or publication of the *Annual Handbook*. These are the major items in the Junior Academy budget.

It is anticipated that total expenses of the Junior Academy this year will be in the range of $3,000-$3,500. This includes expenses of the spring meeting and publication of the *Handbook*. Additionally, there will be secretarial costs associated with both the spring meeting and production of the *Handbook*. Some of these costs will be incurred prior to April 13."

Dr. Pafford also reported that Gus Tomlinson was a judge for the Junior Academy meeting, although his name was omitted from the program. Since publicity for the winners of the Distinguished Teacher Awards was lacking, a motion was passed that Dr. Benson would obtain a news release from John Bennett, State Department of Education, and Dr. Morris, Dr. Tomlinson, and Dr. Benson would make arrangements for a photograph of the teacher from each area to be used for publicity in the local newspaper. The Director's report was accepted.

The Director of the Collegiate Division, Richard J. Raridon, presented the following report:

"Only 3 papers were presented at the Fall 1983 Meeting of the Collegiate Division, partly due to the early date for submission of papers. Dr. Prem S. Kahlon presided at the meeting. Three regional meetings are planned for Spring 1984 under the direction of Dr. Charles J. Biggers, MSU, Dr. James X. Corgan, APSU, and Dr. Robert G. Ziegler, LMU."

The Secretary reported that the 1984 Call for Papers will include a statement that Collegiate Division abstracts submitted after the deadline will not be included in the printed program, but can be presented at the meeting. The Director's report was accepted.

As delegate to the Association of Academics of Science and to Section X of AAAS, Richard J. Raridon reported that the 1984 meeting would not be held until Memorial Day weekend; therefore, his report will be given at the November meeting.

No reports were received from John Bennett, the representative of the State Department of Education, or from the Standing Committees.

OLD BUSINESS

The 1984 meeting of the Academy will be held at UT-Knoxville. Dr. James Caponetti, Botany Dept., will be Chairman of Local Arrangements.

NEW BUSINESS

1. Dr. Wilson will contact Dr. Clay Chandler to obtain a formal invitation to meet at MTSU in 1985. Dr. Tomlinson will contact Dr. Don Ramage for a formal invitation to meet at Belmont College in 1986.

2. Dr. Nelson reported that Dr. Charles Jenner. UNC-Chapel Hill, donated $100 to the Tennessee Academy of Science for being the first state academy to pass a resolution promoting interdisciplinary teaching about the global problems of population growth, resource depletion, and environmental degradation. The money will be used for the general session speakers at the 1984 Annual Meeting.

3. The Treasurer's report and the following budget for 1984-85 were adopted:

Balance on hand as of June 30, 1983	$ 8,365.32
Total Receipts since June 30, 1983	31,423.08
Total Disbursements since 6-30-83	13,621.71

Projected 1984-85 Disbursements:

President's Office	$ 100.00
Secretary's Office	400.00
Treasurer's Office	1,500.00
Jr. Academy of Science	3,200.00
Visiting Scientist Program	4,500.00
Journal	14,000.00
Research Grant (AAAS)	500.00
Annual Meeting	1,900.00
Collegiate	1,000.00
Board Meeting Expenses	1,200.00
Expenditures Through TTU Account	
	$28,300.00

Projected Receipts:

Interest Income	$ 1,500.00
Library Subscriptions	1,850.00
Memberships	6,000.00
Page Charges	2,050.00
State of Tennessee	15,000.00
Annual Meeting Fees	1,200.00
Contributions	200.00
A.A.A.S.	500.00
	$28,300.00

Breakdown of Holdings:

American Bank and Trust - Checking Interest Account	$ 6,298.54
American Bank and Trust - Money Market Account	20,009.42
TTU Account	133.10
Total Holdings as of 4/13/84	$26,441.06

The meeting was adjourned at 10:00 p.m. C.S.T.

TENNESSEE ACADEMY OF SCIENCE EXECUTIVE COMMITTEE MEETING November 15, 1984

The Executive Committee Meeting of the Tennessee Academy of Science was called to order at 7:10 p.m. by President Robert L. Wilson in Room 202 of the University Center at the University of Tennessee-Knoxville. Present were Robert L. Wilson, President; William H. Ellis, President-Elect; Gordon Morris, Past President; R. K. Fletcher, Treasurer; Diane R. Nelson, Secretary; William Pafford, Director of the Junior Academy; Bernard W. Benson, Director of the Visiting Scientists Program; Richard J. Raridon, Director of the Collegiate Division; Geraldine Farmer, State Department of Education; Thomas E. Byrne and Ernest W. Blythe, Jr., Members-at-Large; and James Caponetti, Local Arrangements Committee.

The Secretary, Diane R. Nelson, had mailed printed copies of the Minutes of the April 1983 Executive Committee Meeting. A motion to accept the minutes as printed was accepted unanimously.

The Treasurer, R. K. Fletcher, presented his audited report, which appears elsewhere in these proceedings along with the report of the Auditor. Both reports were accepted by a motion passed unanimously.

The Editor, Gus Tomlinson, submitted the following report, which was presented by the Secretary:

"Since the annual meeting in November 1983, three issues of JTAS have been published. The January issue was combined with the April issue, but the July and October issues were separate as we returned to quarterly publications. In addition to the regular inclusions such as proceedings, abstracts, new member lists, news events, etc., 30 regular manuscripts were published. The breakdown by subject area for the 1984 published manuscripts is as follows:

Zoology	14
Botany	5
Environmental Sciences	3
Chemistry	2
Physics	1
Genetics	1
Historical	1
General Medical Sciences	1
Geology-Geography	1
General Sciences	1
Total	30

Nine manuscripts, not yet accepted for publication, were carried over from last year in author revision status. Twenty-nine new manuscripts were received this year as compared to 28 in 1983. Two manuscripts have been rejected this year upon the recommendation of sectional editors. The current status, following receipt of some papers and publication of others during the year, is that 12 accepted manuscripts are on hand, 7 of which are designated for January 1985 publication.

In terms of budget, the Editor is responsible for editorial costs in preparing issues for publication and for billing authors for page costs. These were:

Issue	Editorial costs	Page Invoices to Authors
Jan-April	$885.00	$345. (since 2/3 Proceed.)
July	887.50	645.
October	895.00	430.

Receipt of author page cost checks and payments of the substantial publication and mailing costs at Curley Printing Company are under the direct supervision of the Treasurer of TAS and do not come through the Editor's office."

The Editor's report was accepted.

The Editor also requested permission to enter into an agreement with University Microfilms International to handle requests for back copies of the Journal. A motion to accept his recommendation was passed unanimously.

The Director of the Visiting Scientists Program, Bernard Benson, presented the following report:

"The following represents a summary of the 1983-84 fiscal year:

1) A data summary for the 1983-84 academic year is attached as is a summary of expenses for the 1983-84 fiscal year. This profile also contains data for the previous year as a basis for comparison. To date, 47 visits have been requested for the 1984-85 academic year.
2) At its last meeting the Board of the Tennessee Academy of Science approved a recommendation to expand the roster to include TVA scientists and to provide services to junior high and middle schools. A new roster was sent to all high schools in Tennessee in September, 1984. The roster is sent to junior high and middle schools upon request.
3) The 1984-85 roster contains a total of 82 visiting scientists compared to 77 visiting scientists in the 1983-84 roster. This increase represents an attempt to recruit visiting scientists from within TVA. A total of 25 scientists from within TVA were recruited.
4) For the past 4 years the operation of the Visiting Scientists Program through the Center for Environmental/Energy Education at UTC has been underwritten by the Center. The Center is now operating under a maintenance contract from TVA at one half the initial funding rate. With the expansion of the Visiting Scientists Program, it is estimated that 3/8 of the Center's secretary's time is spent on VSP business. Based on a monthly salary of $903.50 ($244.88 fringe), I am requesting approval of an additional $3083 to bring the level of support for secretarial assistance up to the amount required for a secretary to work 3/8 time with the Program.

   Concomitantly, I am requesting that TVA provide funding to support an intern or graduate assistant to work with the Program to assure adequate monitoring of this expanding program.
5) A budget for the 1984-85 FY is attached. This budget does not reflect the recommendation set forth in item 4 above."

OPERATION 1983-84	
Visits Requested -	80 (39)*
Visits Cancelled -	7 (2)

Visits Declined -	25 (15)
Visits Completed -	48 (22)
Classes Involved -	120 (52)
Students Contacted -	5430 (1775)
Teachers Participating -	107 (37)

* *Last year's figures*

The Director's report was accepted, without approval for additional funds for secretarial assistance. Discussion was held on the need for additional funds, and various options were suggested. Further discussion will be held at the April budget meeting.

The Director of the Collegiate Division, Richard J. Raridon, presented the following report:

"Three Collegiate Division meetings were held during the spring of 1984. The Eastern Regional Meeting was held at King College on March 31, under the direction of Dr. Robert G. Ziegler of LMU. Eight papers were presented by students from 3 schools. The Middle Regional Meeting was held at Tennessee Tech on April 28, under the direction of Dr. James X. Corgan of APSU. Twenty papers were presented by students from 4 schools. The Western Regional Meeting was held at Memphis State on May 5, under the direction of Dr. Charles J. Biggers of MSU. Fifteen papers were presented by students representing 3 schools. A total of five papers have been received for the Fall meeting of the Collegiate Division." The Director's report was accepted.

The Director of the Junior Academy, William N. Pafford, presented the following report:

"The Tennessee Junior Academy of Science met in April 1984 at West End Middle School. Twenty-two students were invited to present their papers. A special feature of last year's program was the presentation of Outstanding Teacher awards to three outstanding science teachers in Tennessee. Commissioner of Education Robert L. McElrath presented the awards.

Abstracts of all papers presented at the April meeting were published in the *1983-84 Handbook and Transactions,* with the top five being edited and published in their entirety. The outstanding female presenter was Ms. Julie Underwood, of Dickson County High School; the outstanding male presenter was Mr. Ronald Ballard, also of Dickson County High School. These two students were nominated for one-year honorary memberships in AAAS. They will receive both *Science* and *Science 84* for one year.

Total expenses of the Junior Academy were about $2,670 for 1983-84. (Some funds were encumbered prior to the end of the fiscal year for publication and mailing of the *Handbook,* and not all expenses have been cleared as of this date.)

A total of $3200 is being requested from the Tennessee Academy for 1984-85, plus $500 which has been received from Tennessee Eastman Company that is designated for the Junior Academy Program. The total budget proposed is therefore $3700. We do anticipate additional expenses over last year's expenditures, as such items as stationery, postage, and various office supply items must be replenished."

The Director's report was accepted.

As delegate to the National Association of Academics of Science and to Section X of AAAS, Richard J. Raridon presented the following report:

"I attended the AAAS meeting in New York City on May 24-29, 1984, and represented TAS on the Section X Committee. The discussion there centered around what symposia the section might sponsor at next year's meeting. I also represented TAS at the meeting of the National Association of Academies of Science. This was a one-day symposium entitled "Turf: Protection versus Excellence in Science and Mathematics Education". The papers presented will be published in the proceedings which each Academy officer will receive. A proposed title for next year's symposium is "Future Educational Delivery Systems: The Computer Age in Education"."

The report was accepted. Dr. Raridon was reappointed for another three-year term, beginning June 1, 1985.

President Wilson presented standing committee reports from the respective chairpersons as follows:

1. Auditing Committee: The Chairperson, Eugene A. Kline, submitted the following letter from the auditor, James F. McKinnie:

"I have examined the receipts and disbursements records of the Tennessee Academy of Science for the fiscal year ended June 30, 1984, and, in my opinion, the attached Cash Receipts and Disbursements statement correctly reflects the cash position of the organization at June 30, 1984. The entire accounting system appears to be well maintained and cared for meticulously.

I also prepared a Return of Organization Exempt from Income Tax, including a Schedule A. This form 990 must be filed with the Internal Revenue Service no later than November 15, 1984. This form was delivered to Dr. R. K. Fletcher, Jr., Treasurer."

The committee's report was accepted.

2. Fellow's Committee: The Chairperson, Julian T. Darlington, sent the following nominations for Fellows:

Dr. Fred J. Alsop, East Tennessee State University
Dr. Ernest W. Blythe, Jr. University of Tennessee at Martin
Dr. Thomas E. Byrne, Roane State Community College
Dr. Armin L. Clark, Murray State University
Dr. John W. Harris, Tennessee Technological University
Dr. Michael L. Kennedy, Memphis State University
Dr. Richard G. Stearns, Vanderbilt University

A motion was passed to approve the nominees as Fellows of the Academy and to present them to the membership at the annual Business Meeting.

3. Membership Committee: The Chairperson, Clay Chandler, sent the following report:

"On 23 August, each member was contacted by the chairman, urged to recruit new members, and sent six membership applications.

Dr. Boehms recruited one new member, obtained renewal of another and contacted every department of sciences at Austin Peay. Dr. Kopp of geology at UTK informed all faculty in the department of TAS goals and issued an application for membership to Dr. G. M. Clark. Dr. Meyer of UTCHS contacted approximately 20 colleagues and distributed membership applications to them. Dr. McDowell of UTC spoke with at least 10 persons about membership and three of these received applications. Dr. Wilson of TSU recruited three members: Dr. Ed Risby, Dr. James Campbell and Mr. William Cumming. I recruited three faculty members and three graduate students at MTSU."

The committee's report was accepted. The Secretary read a letter from Mildred Perry, who sent a check for Life Membership. The Treasurer announced that Joe Middlebrooks had also become a Life Member. A motion was passed to issue Certificates of Membership and to print the names of new Life Members in the Journal. New members will be presented for acceptance by the membership at the annual Business Meeting.

4. Necrology Committee: The Chairperson, Albert L. Myers, reported no deaths; however the Treasurer reported the death of Dr. J. L. Fowler, former head of the Physics Dept. ORNL, and on the UT staff after retirement.

The committee's report was accepted.

5. Nominating Committee: The Chairperson, Gordon Morris, presented the following proposed slate of officers for next year:

President: Dr. William Ellis, Austin Peay State University
President-Elect: Dr. David Yarbrough, Tennessee Technological Univ.
Secretary: Dr. Diane Nelson, East Tennessee State University
Treasurer: Dr. R. K. Fletcher, Tennessee Technological University

The proposed slate of officers was approved unanimously and will be presented to TAS members at the annual Business Meeting.

6. Research Committee: The Chairperson, Prem Kahlon, sent the following report:

"I am submitting a preliminary report of the Research Committee for the year 1984-85. The Research Committee submitted a research proposal for AAAS to the President of the Academy on May 9, 1984 along with the Annual Report for the year 1983-84 to be transmitted to the AAAS. Unfortunately the report did not reach Dr. Wilson and hence another application was submitted that was probably too late to be considered for funding.

The Research Committee was informed that the Academy has set aside a sum of $500 for the use of secondary school students for the research projects. The Committee advertised the availability of funds in the TAS Journal and have received a large number of applications requesting funds in excess of $1000. The deadline for receiving applications is still one week away.

The Committee will meet on November 16, 1984, immediately following the last paper of the Botany Section to review applicatons and recommend awards.

The final report will be given orally at the Business Meeting."

A motion was passed for the Academy to support up to $1000 for the research projects. The committee's report was accepted.

7. Resolutions Committee: The report is to be submitted at the Business Meeting.

8. Local Arrangements Committee: James Caponetti, UTK, discussed local arrangements for the meeting and informed the committee that his co-chairperson, Paul Wishart, had entered the hospital for surgery. William Ellis, Program Chairperson, stated that the number of papers being presented had increased to 92 from 72 the previous year (>25% increase). Times for the presentations were added to the program for convenience. The Secretary reported a significant increase in the number of exhibitors for the meeting. A motion was passed to authorize the Secretary to request commensurate donations from exhibitors at future T.A.S. meetings. The Executive Committee thanked these individuals for their efforts on behalf of the Academy.

OLD BUSINESS

The Academy will meet at Middle Tennessee State University in 1985 and Belmont College in 1986. Dr. Ellis will solicit an invitation from the Jackson area for 1987. An invitation has been received from Tennessee Tech; the Academy will meet there in 1988. In 1990, the 100th Meeting of the Academy will be held at UT-Chattanooga; Dr. Morris, Dr. Ellis, and Dr. Wilson were appointed as a committee to begin making arrangements for the meeting.

NEW BUSINESS

Ms. Geraldine Farmer, State Dept. of Education, will work with Dr. William Pafford on the Distinguished Teachers Awards, which will be presented at the Junior Academy meeting in April.

A motion was passed to add a new By-Law (Section 12): To present a paper at the Annual Meeting, at least one author of the paper must be a member of the Academy. This motion will be presented to the Membership at the Business Meeting. A membership application and notice of the requirement will be included in the 1985 Call for Papers.

A motion was passed to require a registration badge for admission to Section Meetings. This information will be included in the Call for Papers and in the memo to Section Chairpersons.

A suggestion for higher page charges for non-members publishing in the Journal will be discussed at the April budget meeting.

A motion was passed to authorize the Treasurer to arrange for a display of our Journal at the meeting of the American Library Association Conference in Washington, D.C.

Dr. William Ellis and Dr. Diane Nelson were appointed to update the Constitution and By-Laws of the Academy to be published in the Journal.

A motion was passed to limit reimbursement for travel expenses for the Executive Committee according to the State guidelines.

The meeting was adjourned at 9:35 p.m. E.S.T.

THE NINETY-FOURTH MEETING OF THE TENNESSEE ACADEMY OF SCIENCE
November 16-17, 1984
The University of Tennessee-Knoxville

The annual meeting of the Tennessee Academy of Science, Inc., was held November 16-17, 1984, at the University of Tennessee-Knoxville. Dr. James Caponetti and Dr. Paul Wishart were Co-Chairpersons of Local Arrangements. Dr. William Ellis, Austin Peay State University, was Program Chairperson. Over 200 individuals registered for the meeting.

The General Session was held in the Auditorium, University Center, on Friday morning beginning at 9:30 a.m. E.S.T. The Program Chairman, Dr. William Ellis, presided over the session. The Academy was welcomed by Mr. Homer Fisher, Executive Vice-Chancellor for Business, Planning, & Finance. Dr. Alvin H. Nielsen, Professor Emeritus of Physics, UTK, explained that the General Session was a Hertel Event supported by the University of Tennessee Research Corporation. The theme of the session was "Issues in Environmental Education." Speakers were Dr. Otis L. Graham, Jr., Distinguished University Professor, The University of North Carolina-Chapel Hill; Dr. Herbert Charles Jones, III, Tennessee Valley Authority, Knoxville; Mr. Martin E. Rivers, Tennessee Valley Authority, Knoxville; and Mr. David Lloyd Scott, Mobile Co. Public Schools, Mobile, Alabama. A reception was held for Dr. Fred H. Norris at the Greenhouse behind Hesler Biology Building; the Greenhouse was named in honor of Dr. Norris. Section meetings were held Friday afternoon in the University Center; 86 papers were presented as listed in the program. The Annual Business Meeting was held in the Shiloh Room, University Center, at 5:00 p.m. E.S.T.

The Annual Banquet was held in the Hermitage Room, University Center, beginning at 7:00 p.m. E.S.T., Friday evening. President Robert L. Wilson presided. The speaker was a National Sigma Xi Lecturer, Dr. Fred Alsop, Chairman and Professor of Biological Sciences, East Tennessee State University. The title of his address was "Trekking with a Wildlife Photographer."

The Collegiate Division held its meeting on Saturday morning at 9:00 a.m. E.S.T. in the Shiloh Room, University Center. Dr. Richard J. Raridon presided and five papers were presented by college students.

ANNUAL BUSINESS MEETING
November 16, 1984

The Annual Business Meeting of the Tennessee Academy of Science, Inc., was called to order by President Robert Wilson at 5:00 p.m., E.S.T. in the Shiloh Room, University Center, The University of Tennessee-Knoxville, on November 16, 1984. The President determined that a quorum was present.

The reports of the Secretary, Treasurer, Editor, and Directors of the three educational programs were similar to those presented the previous evening at the Executive Committee Meeting. All reports were approved by passed motions and will be recorded in the Minutes.

The Secretary reported individuals who had applied for membership in the Academy in 1983-84, including Life Members Mildred Perry and Joe Middlebrooks. A motion to accept the new members was passed.

The Secretary read the reports of the Auditing Committee and Membership Committee. The reports were approved and will be recorded in the Minutes.

The Secretary read the names of the Fellows nominees presented to the membership by the Executive Committee. A motion was passed that the nominees be elected Fellows of the Academy.

The Chairperson of the Necrology Committee, Albert Myers, presented the name of Dr. J. L. Fowler, a member of the Academy who had passed away. Dr. Fowler was the former head of the Physics Dept., ORNL, and was on the UT staff after his retirement. Dr. Myers asked the audience for a moment of silence in tribute. The report was approved.

The Secretary presented the report of the Nominating Committee. The President asked for further nominations from the floor; there were none. A moton was passed to accept the nominees, and the Secretary was instructed to cast one vote which would represent the unanimous election of William H. Ellis as President, David Yarbrough as President-Elect, Diane R. Nelson as Secretary, and R. K. Fletcher as Treasurer.

The Secretary announced that the Research Committee awarded $1,000 to the following students for research projects:

NAME OF STUDENT	SCHOOL	REQUEST	AWARD
JEREMY BELK	PLEASANT HILL	$ 100	$ 100
MARY CALDWELL	PLEASANT HILL	180	50
JESSICA GAYHART	PLEASANT HILL	110	36
SHANA HOWELL	STEWART COUNTY	100	50
MARGARET PATU	STEWART COUNTY	165	50
STACY PRICE	STEWART COUNTY	87	25
TONYA STEPHEN	STEWART COUNTY	298	75
DONNIS CATHEY	STEWART COUNTY	197	50
ANNA SHIFFLETT	STEWART COUNTY	283	100
JAMES MILLIKEN	STEWART COUNTY	376	50
CLAY C. CHERRY	STEWART COUNTY	121	50
MARK PRINCE	CENTRAL HIGH (CAMDEN)	380	100
BERT FISCHER	CENTRAL HIGH (CAMDEN)	171	50
DONNA DWYER	MCKENZIE HIGH	37	37
TAMMYE SCOTT	MCKENZIE HIGH	26	26
SHARON ELLIS	MCKENZIE HIGH	7	7
TAMMY CHESSER	MCKENZIE HIGH	12	12
KATHY COBB	MCKENZIE HIGH	5	5
ANGELA DUNN	MCKENZIE HIGH	10	10
LISA LANGFORD	MCKENZIE HIGH	10	10
AMELIA DALTON	MCKENZIE HIGH	14	14
ALEXANDER KOMIVES	HILLWOOD HIGH	93	93
	TOTAL	$2,782	$1,000

The following Resolution Committee report was received and read at the Annual Banquet:

RESOLUTION OF APPRECIATION

"WHEREAS, the Tennessee Academy of Science, including the Collegiate Division, is enjoying a most pleasant, profitable, and well-organized series of meetings at the University of Tennessee - Knoxville and

WHEREAS, the success of these meetings has resulted mainly from the efforts of the officers of the Academy; the Chairpersons of the respective sections; the Local Arrangements Committee Co-Chairpersons Dr. James D. Caponetti and Dr. Paul Wishart representing UT-Knoxville; the Program Chairperson, Dr. William Ellis; from financial support of the General

Session by the University of Tennessee Research Corporation in the form of the Hertel Event Award of $500.00 to the Academy through an application by Dr. James D. Caponetti; from the recognition given the meetings by the press, television and radio stations; from the general hospitality of the host institution, the University of Tennessee - Knoxville and its Chancellor, Dr. Jack Reese,

BE IT RESOLVED, therefore, that the Tennessee Academy of Science expresses its sincere appreciation to these and all others who have contributed to the success of these meetings."

The resolution was accepted.

OLD BUSINESS

The Academy will meet at MTSU in 1985, Belmont College in 1986, the Jackson area in 1987, TTU in 1988. In 1990 the 100th Meeting of the Academy will be at UTC.

NEW BUSINESS

The new By-Law passed by the Executive Committee was presented to the membership and was passed unanimously. To present a paper at the Annual Meeting, at least one author of the paper must be a member of the Academy.

A registration badge will be required at future meetings for admission to the Section Meetings.

The meeting was adjourned at 5:30 p.m. E.S.T.

TENNESSEE ACADEMY OF SCIENCE
CASH RECEIPTS AND DISBURSEMENTS
For Year Ended June 30, 1984

TREASURER'S REPORT

Cash Balance, July 1, 1983		$ 8,414.16
Receipts:		
State of Tennessee	$19,000.00	
Membership dues and subscriptions	5,964.00	
Library subscriptions	1,910.00	
Interest earned	1,623.04	
Journal page charges	1,170.00	
Contributions	965.00	
Registration and exhibitor's fees	630.00	
AAAS Grant	500.00	
Banquet fees	424.00	
Miscellaneous receipts	2.94	
Total Receipts		32,188.98
Total Cash Available		$40,603.14
Disbursements:		
Printing and publications	$11,882.90	
Visiting Scientist Program	3,191.38	
Tennessee Junior Academy of Science	2,489.13	
Board Meeting	1,421.62	
Treasurer's office expense	1,339.27	
Banquet expense	732.15	
Research grants	500.00	
Collegiate division	471.80	
Annual meeting	384.22	
Secretary's office expense	330.06	
AAAS meeting	300.00	
Audit fee	150.00	
President's office expense	33.50	
Total Disbursements		23,226.03
Cash Balance, June 30, 1984		$17,377.11

Receipts	$32,188.98
Disbursements	23,226.03
Cash increase	$ 8,962.95
Cash Balance, July 1, 1983	8,414.16
Cash Balance, June 30, 1984	$17,377.11

REPORT OF THE AUDITOR

Executive Committee
Tennesee Academy of Science

I have examined the receipts and disbursements records of the Tennessee Academy of Science for the fiscal year ended June 30, 1984, and, in my opinion, the attached Cash Receipts and Disbursements statement correctly reflects the cash position of the organization at June 30, 1984. The entire accounting system appears to be well maintained and cared for meticulously.

I also prepared a Return of Organization Exempt from Income Tax, including a Schedule A. This Form 990 must be filed with the Internal Revenue Service no later than November 15, 1984. This form was delivered to Dr. R. K. Fletcher, Jr., Treasurer.

Sincerely,

James F. McKinnie, M.B.A.
Accountant
Cookeville, Tennessee

TENNESSEE ACADEMY OF SCIENCE
NEW MEMBERS 1983-1984

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JOURNAL OF THE TENNESSEE ACADEMY OF SCIENCE

VOLUME 60, NUMBER 2, APRIL, 1985

ABSTRACTS PRESENTED AT THE ANNUAL MEETING

BOTANY SECTION

FREDERICK T. WOLF, *Presiding*

Morphogenesis in Several Cultivars of Boston Fern, THOMAS E. BYRNE, Roane State Community College, J. D. CAPONETTI, Botany Dept. University of Tennessee, Knoxville.

Stolon tips from sporophytes of *Nephrolepis exaltata* c.v. 'bostoniensis' and its cultivars *N. exaltata* c.v. 'scotti' and *N. exaltata* c.v. 'dwarf boston' were aseptically cultured on Murashige Fern Multiplication Medium modified by the addition of 2,4-dichlorophenoxyacetic acid (2,4-D) 0.5-4.0 mg/l. Callusing occurred in the apical and lateral buds of the stolon tips in four to six weeks. Histological sections demonstrated that the callus originated from the provascular tissue of the apical meristems of the stolon buds. Basal medium with 3% sucrose and 0.5 mg/l 2,4-D produced the greatest increase in fresh weight of subcultured callus tissue in all cultivars. Organogenesis into shoots and roots from undifferentiated callus tissue occurred on basal medium with combination of $5x10^{-7}$M kinetin (K) plus $5x10^{-7}$M naphthalene acetic acid (NAA), 10^{-6}M K plus 10^{-5}M NAA and 10^{-6}M K plus $5x10^{-7}$M NAA in 12 weeks. Attempts to induce organogenesis with indole-3-acetic acid (IAA) and isopentenyl adenine (2ip) produced only roots at all hormone levels tested.

Some new Tennesse Distribution Data for Ranunculus flabellaris, EDWARD W. CHESTER and KEVIN SOUZA, Austin Peay State University

Ranunculus flabellaris Rafinesque, the Yellow Water Crowfoot or Buttercup, is of limited distribution in Tennessee and considered to be a threatened species there. To determine the current status of the species in Tennessee, all known sites of occurrence were determined by collating information from the literature, various heritage data bases, and herbarium specimens. Each site from the four previously known counties (Franklin, Lake, Obion, Robertson) was visited and the status of the site and population, if present, evaluated. Field work revealed the presence of *R. flabellaris* in three other counties: Coffee, Grundy, and Montgomery. While the Tennessee distribution is more extensive than previously thought, the species is habitat restricted and threatened status warranted.

Aureolaria virginica: Beyond the written word. G. J. CANTRELL, JR., Department of Biology, Memphis State University.

In his 1935 monograph *Scrophulariaceae of Eastern Temperate North America,* Francis W. Pennell recognizes eleven species in the hemiparasitic genus *Aureolaria* Raf. Specimens in the Linnaean Herbarium (LINN) of two species, *A. pedicularia* (L.) Raf. (= *Gerardia p.* L.) and *A. flava* (L.) Farwell (= *Gerardia f.* L.), have been accepted historically as the types for these respective taxa. The third LINN specimen, labeled *"Rhinanthus virginica",* has not been considered to be the type of *A. virginica* (L.) Pennell by the most recent authors (*i.e.,* Blake, 1918; Pennell, 1928, 1935). They have agreed that, after careful examination, the handwriting on the herbarium sheet is not that of Linnaeus but that of his son. In *Species Plantarum,* Linnaeus used the Gronovian description citing a Clayton specimen, number 168, and indicated it to be "an imperfectly known species" (Stearn, 1957:162). These facts, particularly the handwriting analyses, were used by Blake and, later, by Pennell to support their view that this specimen was a later addition to LINN and, therefore, not available to Linnaeus until after 1753. Upon personal examination of the specimen, this author determined it to be of some other taxon within the presently circumscribed genus *Rhinanthus* L. Though not yet identified to species, the Linnaean specimen of *"Rhinanthus virginica"* can be dismissed from any consideration in the typification, or representation, of *Aureolaria virginica* (L.) Pennell without relying upon handwriting analysis or upon speculation as to the time of its placement into LINN as was done by Blake and Pennell.

Disjunct Phanerogams Associated with Isolated Stands of Arbor Vitae (Thuja occidentalis L.) *in Tennessee and Kentucky,* EDWARD E. C. CLEBSCH and GARY L. WALKER, University of Tennessee.

To date, ten species of phanerogams are noteworthy in their association with *Thuja* stands in the southern, discontinuous part of its range. *Carex eburnea* is associated throughout. *Cypripedium reginae, Rhamnus alnifolia,* and *Pachystima canbyi* are strictly associated with *Thuja. Acer spicatum* outside the mountains is mostly associated with *Thuja. Rhamnus lanceolata, Spiranthes lucida, aenus glaucus, Taxus canadensis,* and *Smilacina stellata,* rare in the range or rare with *Thuja,* occur with *Thuja* but beyond it as well. All of these species are calciphiles.

The numerous literature references to native *Thuja in North Carolina remain undocumented by specimens or by field sightings by living botanists.*

Multiplication of Soybean Germplasm by Enhanced Axillary Branching, S. BHATTI and P. S. KAHLON, Tennessee State University

There has been a tendency to attempt plant multiplication by exploiting the phenomena of enhanced axillary branching. Although multiplication is slow, the method has broad applicability among plant species. The plants obtained are genetically less variable. The present study was carried out to examine soybean cultivars for regenerative ability when shoot-tips were used as explants. Shoot-tips were removed from two week old 'Corsoy' seedlings and one, two and three week old 'Sprite' seedlings and inoculated on different combinations of auxins and sytokinins. Regenerative ability was determined by the number of shoot-buds formed. The results showed that the shoot-tips obtained from one week old Sprite seedlings formed callus as well as an average of two shoot-buds per culture. Shoot-tips obtained from two week old Sprite seedlings had less than one shoot-bud per culture. The inocula from three week old seedlings formed an average of three leafy shoots per culture. (USDA/CR grant #7903-1-PS2).

A Study of PEG Induced Water Stress in Soybean Cultures, JOYCE MCCULLER, T. M. CURRY and P. S. KAHLON, Tennessee State University.

Cultured cells of soybean (*Glycine max* (L.) Merrill) cvs. 'Davis' and 'Hill' were used to study the effect of polyethylene glycol (PEG) on cell growth. Varying concentrations of PEG (m.wt. ▶ 8,000) were added to cells grown in MS media to simulate water stress. When the culture reached exponential phase, 10mls of cells were removed from each concentration every third day and filtered on Whatman No. 8 filter paper. Fresh and dry weights of cells were taken. The osmotic potential of the supernatant was measured using a 5100 C Vapor Pressure Osmometer. The results showed that the addition of PEG to the culture up to the 25% level increased cell growth as measured by fresh and dry weight. (USDA/CR Grant #7903-1-PS2).

Proline Accumulation in Stressed Soybean Cells, T. M. CURRY and P. S. KAHLON, Tennessee State University.

Whole plants accumulate proline when exposed to stressed conditions. The purpose of this study was to determine if stressed soybean cells in culture accumulate proline. Soybean cells in suspension were stressed using 5 different levels of NaCl in Murashige-Skoog media supplemented with 2,4-dichlorophen-oxyacetic acid. The concentrations of NaCl used were: 0%, 0.1%, 0.25%, 0.50% and 0.75%. The amount of proline which accumulated in these cultures was determined using the photometric test of Chinard (1952, J. Biol. Chem. 199-91-95). Results show that in the cultivar 'Hark' proline accumulated in NaCl stressed cells as the amount of NaCl was increased and also as exposure time was increased. (USDA/CR grant #7903-1-PS2).

Auxin and Dormancy of Epiphyllous Buds in Bryophyllum calycinum. D. F. HOUCK, T. M. ANDRADE, and M. D. MILLER, Southern College, Collegedale, TN.

Leaves of *Bryophyllum calycinum* contain dormant marginal buds which are released from dormancy when leaves are detached. To investigate possible correlative control plants were either decapitated or ringed with the anti-auxin triiodobenzoic acid around number one internodes or petioles. Although these treatments released lateral buds, no epiphyllous buds were released from dormancy. To investigate auxin-activity level changes within leaves methanolic extracts were prepared, purified, and separated by paper chromatography to isolate acidic indoles. Chromatogram Rf strips were bioassayed by the *Avena* coleoptile straight growth test. The results indicated an auxin-activity level of 25 ng IAA-equivalent per gram of fresh leaf tissue and no significant difference in leaves detached for two days. After four days bud break from dormancy had commenced, and leaf auxin-activity was increased to 115 ng IAA-equivalent per gram, probably due to the developing buds.

This research suggests that auxin-activity localized within leaves maintains the dormancy of epiphyllous buds and remains at a constant level until bud break from dormancy.

Acknowledgement is made to Research Corporation for financial support.

Appalachian Range Potential Landmarks, H. R. DESELM, The University of Tennessee.

Natural areas in the Appalachian Ranges (Ridge and Valley and Blue Ridge Provinces) have been examined as potential National Landmarks as part of a National Park Service study. With the southern end of the Blue Ridge largely excluded about 200 sites were recommended and 134 were examined. Eleven general kinds of forest communities were seen. A pine-scrub savanna occurs at the Pine Bush near Albany, New York. Ten kinds of dry and four kinds of wet shrub, grass or moss-lichen vegetation were seen. Some sites contained rare and/or relict biota. A few contained mag-

nificent scenery but unspoiled vegetation was extremely rare.

Ecology in the People's Republic of China — Observations and Perspectives, J. F. MCCORMICK, The University of Tennessee.

Ecology is a significant and rapidly expanding component of university curricula and research institutes. Applied ecology plays an important role in formulating government policies regarding agriculture, land use and environmental assessment. Fundamental differences in our social and political systems are reflected by significant differences in basic and applied ecology in our two countries. For example, the abundance of inexpensive manpower has enabled Chinese ecologists to explore underground properties of terrestrial ecosystems to a degree that would exhaust our budgets and patience. Maintenance of herbaria and botanical gardens is likewise impressive. On the other hand, Chinese ecologists have yet to fully explore ecological theories and technologies developed in the west during the period of their cultural revolution. Perhaps most significantly, differences in the intensity of land use provide different challanges and opportunities in basic and applied ecology. All differences between our two countries are further exaggerated if one travels throughout China alone and during the winter.

Some Observations Concerning Applied Microbiology in the Peoples Republic of China, FREDERICK T. WOLF, Vanderbilt University.

Topics to be mentioned include the fermentations producing soy sauce, beer and mai tai, Biogas (methane) is produced from animal waste. Activities of the Academia Sinica Institute of Microbiology in Beijing include taxonomy of fungi, taxonomy of bacteria, virology, ecology of microorganisms, fermentation, enzyme production, genetics, and maintenance of a culture collection. Methods of production of Shii-take *(Lentinus edodes)* at the Edible Fungi Institute of the Shanghai Academy of Agricultural Sciences are described.

CHEMISTRY SECTION

DAVID R. HAWKES, *Presiding*

Determination of Cannabinoid Metabolites in Human Urine Using Thin-Layer Chromatography, JUDITH M. BONICAMP Middle Tennessee State University.

Δ^9-Tetrahydrocannabinol is metabolized primarily to 11-nor-Δ^9-tetrahydrocannabinol-9-carboxylic acid (Δ^9-THC-COOH) which is found in urine in both free and conjugated forms. Classical TLC has become a commonplace analytical tool for separation and identification of marijuana and its metabolites, but the clasical procedures are complicated and require considerable time. Instead, we have used a simplified and accelerated TLC system for separating and identifying Δ^9-THC-COOH. The TLC system, Toxi-Lab® Cannabinoid (THC) Screen, relies on the ability of TLC to separate Δ^9-THC-COOH from a sample extract, and the subsequent reaction of that metabolite with two detection reagents, Fast Blue BB/diethylamine vapors and 1 M hydrochloric acid. The commercial TLC method has additional advantages over classical TLC: disposable extraction tubes, insertable sample application discs, and prestandardized chromatograms. The cost for 50 tests is about $450.

I thank Analytical Systems, Division of Marion Laboratories, Inc., Laguna Hills, CA, and the MTSU Department of Chemistry and Physics for support of this work.

A Thermistor/VIC-20 Microcomputer Game Port Interface HARVEY BLANCK, Austin Peay State University

Determination of the heat of solution of a substance is an experiment common to many physical chemistry lab books. The boring part of this experiment which involves monitoring the temperature as it returns to its initial value may be readily replaced by a computer. The VIC-20 has two A/D converters in which the digitized readings (0-255) are dependent upon the time required to charge a 0.001 μf capacitor. (These A/D converters are used with game port paddles.) The charging time varies with the setting of a potentiometer connected between the capacitor and 5 VDC. While a thermistor may be used in place of the paddle potentiometer it might not have an appropriate sensitivity. By using an operational amplifier with a Wheatstone bridge a sensitivity of approximately 0.002 degree/computer digit can be obtained. The computer also controls a heater and measures the time.

The Limited Shelf Life of Sodium Hydrosulfite, or Why There Is No Such Thing as a Free Lunch. MARTIN V. STEWART, MARISSA EVANS, and SCOTT J. SMITH, Middle Tennessee State University.

A quantitative study of the methylation of hydroquinones by dimethyl sulfate in aqueous sodium hydroxide solution containing hydrosulfite anion as an antioxidant has shown that product yield depends on the relative nucleophilicity of the starting material [TAS Annual Meeting, Volunteer State, Nov. 1983]. Current results using newly purchased samples of sodium hydrosulfite differ slightly from initial data acquired from a very old sample. An analysis of these reagents was conducted by traditional redox titration against indigo, a technique found to be unexpectedly difficult [TAS Collegiate Meeting, Austin Peay, April 1984]. While fresh samples were found pure, the older one was largely decomposed. However, the product yields observed in the kinetic study were not greatly affected because the nucleophilicities of the decomposition products are nearly the same as that of the original hydrosulfite. Acknowledgement is made to the donors of The Petroleum Research Fund, administered by the American Chemical Society, and the MTSU Subcommittee on Research for financial support.

Cholesterol Synthesis in Rabbit Lens, N. T. DO, S. M. REDMON, B. ALBERS-JACKSON, Tennessee Technological University.

Cholesterol is one of the major lipids in mammalian lens. The synthesis of cholesterol by rabbit lens has been investigated using ^{14}C acetate. Lenses from eight week old New Zealand white rabbits were incubated in Medium 199 containing 110 microcuries ^{14}C acetate and gentamicin under a humidified atmosphere of 88% nitrogen, 7% oxygen, and 5% carbon dioxide for two hours at 33.8° Celsuius. The lenses were subjected to alkaline hydrolysis and the nonsaponifiable fraction extracted. The nonsaponifiable fraction was further separated using thin layer chromatography on silica gel G plates with petroleum ether:diethyl ether: glacial acetic acid (75:25:1) as the solvent system. The bands were visualized using iodine vapors, photographed and scraped from the plate. Measurement of the radioactivity of the various bands showed the greatest incorporation in squalene and lanosterol two precursors of cholesterol.

Incorporation of ^{14}C-Galactose and ^{14}C-Acetate Into Rabbit Lens SUZY J. SLAUGHTER, V. CAROL BELL, BARBARA ALBERS-JACKSON, and ROBERT T. SWINDELL. Tennessee Technological University, Cookeville, Tennessee 38505.

Rabbit lenses were incubated in organ culture with ^{14}C-galactose and in ^{14}C-acetate for periods of 12 hours. Gangliosides were extracted using the Folch-Suzuki methods, purified by dialysis, and analyzed by thin-layer chromatography. Six radioactive bands, including the origin were observed. Tentative identification of these bands as GM_3, GM_2, GM_1, GD_{1a}, and GT was made by comparison with authentic standard gangliosides. The greatest galactose incorporation occurred in GM_2 and GD_{1a}. The greatest acetate incorporation accurred in the simpler gangliosides, GM_3 and GM_2. Metabolic implications of these results will be discussed.

Synthesis and Enzymatic Activity of 1-0-Alkyl-2-Acetyl-sn-Glycero-3-Thiophosphocholine, MIKE DUNN, ROBERT T. SWINDELL, Tennessee Technological University, Cookeville, Tennessee 38505.

Synthesis of 1-0-alkyl-2-acetyl-sn-glycero-3-thiophosphocholine is described. Chimyl alcohol is treated with trityl chloride/pyridine to form the 3-0-trityloxy compound(II). Compound II is acetylated, the protective trityloxy group removed and the thiophosphocholine moiety introduced using choline tosylate and thiophosphoryl chloride. Reaction of (I) with phospholipase A_2 was used to determine stereochemical purity. Potential biological roles of (I) will be discussed.

ENGINEERING SECTION

DAVID YARBROUGH, *Presiding*

Finding Environmental Problems, J. T. MASON, Tennessee Technological University.

Limited application of the U.S. Army's Record Search Program has indicated sources of information to identify potential environmental problems by reviewing historical records.

A review of public records available from city to state level was accomplished for the region surrounding Cookeville, Tennessee. Concentrating on the immediate vicinity it was found that some potentially valuable information is not useful because of the way it has been recorded and filed in the past. Other information appears to be extremely useful even though the original intent had nothing to do with environmental concerns.

Research is continuing to determine how easy it will be to extract the information and how significant the results will be.

Manganese Oxidation Related to the Releases from Dams and Reservoirs, J. A. GORDON and W. P. BONNER.

Manganese is frequently present in streams originating from deep, stratified, anoxic lakes and reservoirs. Potable water treatment plants located downstream from the impounding structures occasionally experience operational difficulties and/or increased treatment costs because of this phenomenon.

This paper will report on field and laboratory studies of manganese oxidation. The field studies were conducted on the Duck River below Normandy Dam, Tennessee, and resulted in the development of a useful model of manganese oxidation as a function of flow and time-of-travel. Laboratory studies were conducted to determine the mechanics of manganese oxidation. Large volume reactor studies (250 l reactors) were used to allow manganese to solubilize naturally at zero DO for several months. These

were then exposed to the atmosphere and the manganese oxidation process followed.

Small volume (250 ml reactors) studies involved the oxidation of $MnSO_4$ in Normandy Lake water using seed material scraped from stones in the Duck River. In some studies, the pebbles from the river were included in the flasks. Only the flasks containing "seed" from the river stones or the pebbles experienced oxidation. Control flasks experienced no manganese oxidation.

Finally, the results of the lab scale studies using a five-foot tall "trickling filter" to oxidize manganese will be presented. An overall model of the mechanics of manganese oxidation will be presented.

Use of Solar Energy For Wastewater Disinfection, TALBERT N. EISENBERG, Research Assistant Center for the Management, Utilization and Protection of Water Resources, Tennessee Technological University, Cookeville, Tennessee 38505 and E. JOE MIDDLEBROOKS, Provost and Vice President for Academic Affairs, Tennessee Technological University, Cookeville, Tennessee 38505

Dye sensitized photooxidation is a physicochemical process capable of disinfecting wastewater effluent. A trace quantity of sensitizer added to the wastewater absorbs visible light. The absorbed light energy is then transferred from the sensitizer to molecular oxygen, resulting in the formation of singlet molecular oxygen. Singlet oxygen is a strong oxidant similar to ozone and is thought to disinfect by inactivating reduced functional groups inside the cell.

Bench scale studies were conducted to determine the disinfection potential of dye sensitized photooxidation. Total and fecal coliform values of the treated wastewater were monitored over time under different operating conditions. The effects of mixing, dye concentration, pH, light intensity, effluent depth, and detention time on disinfection were determined. Results from the bench scale studies will be used to design and operate four pilot scale photooxidation disinfection units.

Decolorization of Kraft Mill Effluent with Cation Surfactants. JOHN D. SCHOOLFIELD, Department of Civil Engineering, Tennessee Technological University, Cookeville, Tennessee 38505 and K. L. ROBERTS, Department of Civil Engineering, Tennessee Technological University, Cookeville, Tennessee 38505.

The surfactants cetol (cetyl dimethyl benzyl ammonium chloride) and alum were evaluated for removing color from highly colored Kraft paper mill effluent. Treatments utilizing cetol alone, alum alone, and cetol and alum together were evaluated for color removal, sludge settling and volume, sludge dewatering, and flotation.

Alum removed 98.0% of the color, but only within a narrow pH range, and produced a voluminous sludge. Cetol removed 99.4% of the color over a very wide pH range with extremely low sludge volumes, but residual turbidities and sludge resistances to dewatering were high. Various mixtures of alum and cetol removed 100% of the color, but exorbitant sludge volumes were generated at 100% removal. The alum/cetol dose of 400/1300 mg/l alum/cetol, however, removed 99.8% of the color and maintained low sludge volumes, low turbidity, and low resistance to sludge dewatering. Flotation tests demonstrated that flotation was not a viable clarification method for these treatments.

Metering Systems for Compressed Natural Gas. PURNA R. SAGGURTI, Senior Executive Engineer, Nu-Fuel Industries, Inc., Loretto, TN 38469.

Conventional Orifice and Venturi meters fail to prove effective for the metering of high pressure gas. Three metering processes are used for measuring the flow of Compressed Natural Gas (3600 psi) used as an alternative to gasoline in the automotive sector. The use of thermodynamic equations and analytic correction factors to measure flow is the cheapest and the least accurate method. The more sophisticated Mass flow meters and Turbine flow meters with microprocessors are not only accurate metering systems but are also good energy management systems. A study of the problems involved in the handling of high pressure natural gas, the effect of its varied composition and the regulatory requirements of various States gives us an insight into the importance of accurate flow metering systems and its potential to change the Compressed Natural Gas Market.

Prediction of Vapor-Liquid Equilibrium Data From Heats of Mixing. NAN CHIOU and D. W. YARBROUGH, Department of Chemical Engineering, Tennessee Technological University.

The composition of a vapor phase in equilibrium with a liquid of known composition can be predicted from heat of mixing data once a model for the excess gibbs free energy is specified. This paper examines the use of "local concentration models" for use with two component systems. Predicted equilibrium vapor phase calculations for systems with maximum heats of mixing from 50 to 400 cal/mole will be discussed.

Diffusion in Solids with Application to Material Degradation. GEORGE R. BUCHANAN, Professor of Civil Engineering, Tennessee Technological University.

Coupled deformation-diffusion theories are enjoying increased attention from researchers in mechanics of materials. In particular. mathematical continuum descriptions of the strengthening or weakening along grain boundaries and interphase boundaries for either metallic or ceramic polycrystalline materials are being modeled numerically.

The author is currently working with researchers at the Los Alamos National Laboratory on computer modeling of coupled deformation-diffusion processes. The progress and recent developments of that research is the subject of this paper.

Debris Impact on Earth-Orbiting Spacecraft. DALLAS G. SMITH, Professor of Civil Engineering, Tennessee Technological University, Cookeville, TN 38505.

The accumulation in recent years of Earth-orbiting space debris leads to some important new design considerations. Some 5,000 orbiting objects, many of them explosion fragments, are currently being tracked. Many objects too small to track are known to exist. Future collisions of these objects with each other are predicted. Each collision will be explosive, ejecting thousands, perhaps millions, of new orbiting objects, in turn increasing the frequency of future collisions. The debris population will thus grow and may become "self-regenerative." As a result, a large space structure planned for several years on earth-orbit has a significant probability of impact by debris objects. Protection against such large high-velocity objects may require severe structural measures. Thus debris impact could be one of the prime considerations in the structural design of large, earth-orbiting spacecraft. Curbing the addition of man-made objects by international agreement could help solve the problem.

Low Density Concrete as a Thermal Insulation. DAVID W. YARBROUGH, Tennessee Technological University.

The thermal conductivities of low density concretes made with perlite have been measured in the temperature range 20°C to 32°C using an unguarded heat flow apparatus. Perlite concretes with densities from 709 to 1066 kg/m^3 were formed in rectangular slabs with approximate dimensions 193 × 396 × 41 mm and cured for at least 28 days. Thermal conductivities from 0.22 W/mK at 709 kg/m^3 to 0.39 W/mK at 1066 kg/m^3 were measured and these values are significantly less than a typical value of 1.87 W/mK for 2400 kg/m^3 concrete. Compressive strength tests on representative specimens showed values from 10 to 50% of conventional concrete. The perlite concretes that were tested have application, therefore, as non-load bearing thermal insulation.

Power Plant Ash Utilizaiton as Construction Material. DR. NATH. S. PARATE, Associate Professor & Head, Geotechnical, Tenn. State University, Nashville.

The use of powerplant ash has been studied in the laboratory and in the field on various types of projects. Successful applications and satisfactory performance of number of projects throughout the United States are on record. Fly ash has been used for road pavements, parking lots, airport access roads, repair and maintenance, controlled low strength concrete materials, sinkhole/subsidence backfill and grouting projects.

The engineers, scientists and utility executives and governmental agencies throughout the world have focussed their attention to the utilization of powerplant ash as byproduct. A recent forecast by U.S. National Ash Association for the years 1985 and 1990 indicates that the coal burnt by the utilities will be 778 MT & 1100 MT respectively. The Ash production and utilization will be 90 and 125 MT and 40,50 MT respectively.

During these days the Federal Highway Agency, Environmental Protection Agency and the Electric Utilities are encouraging the efforts of using powerplant Ash as construction materials. The behavior and properties of the Ash produced during coal combustion varies considerably depending upon specific methods and technology of pollution control processes, boiler unit and performances, type of coal, transportation and storage.

Lime Fly Ash-Aggregate (LFA) Experience for I-440 Pavement Construction in Nashville, Tennessee. DR. NATH. S. PARATE, Associate Professor & UN Consultant, Department of Civil Engineering, Tennessee State Univ.

The growth of coal-fired power plants in U.S.A. is increasing the amount of resulting wastes such as flyash. Flyash disposal has become a costly, evergrowing problem. Because of recent efforts towards economic utilization of flyash as construction material, it is now categorized as "byproduct." It is estimated that by the year 2000, these byproducts will total several million tons per year. Byproduct utilization assumes greater importance with the increasingly adverse impact of nuclear power plants.

Since 1982, particular efforts are being made in Tennessee for using lime-flyash-aggregate mixtures (LFA) for road construction. The recent demonstration project in Scott county was quite successful and encouraging. This paper briefly discusses the characteristics of TVA flyash, and also describes the various operational and material quality control procedures used during the construction of a part of I-440. LFA mixing, blending, spreading and compaction techniques are presented in this study. The resulting cost of energy savings are also discussed.

The above work served the basis for a graduate thesis. It is established that the use of LFA mixtures as road construction material in Tennessee is

PHYSICS & ASTRONOMY

C. J. EMERSON, *Presiding*

Does Spacetime Have a Boundary or an Edge? F. L. CULP, Tennessee Technological University.

A brief report will be given on some recent speculations based on the union of general relativity theory and the uncertainty principle on the development of our universe. In particular, the effect of the uncertainty principle on the singularities of the big bang and the big crunch, as described by relativistic models of the universe, will be qualitatively discussed. Finally, the possibility of predicting Hubble's law from the uncertainty principle will be considered.

Simulation of High-Energy Ion Extraction Accelerators. M. A. BELL and J. H. WHEALTON, Oak Ridge National Laboratory*, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee 37831.

The problem of simulation of high-energy ion extraction accelerators, used in the heating of confined plasmas in fusion reactors, is discussed. The essential parameters involved in predicting accelerator performance are examined. These parameters include accelerator electrode configuration (shapes and spacings), the density of the ion beam current, and the boundary conditions present. Some of the computation methods used to solve the nonlinear Poisson-Vlasov equations involved in accelerator modeling are outlined.

*Operated by Martin Marietta Energy Systems, Inc. under contract DE-AC05-840R21400 with the U.S. Department of Energy.

Waves and Particles: Animation on a Microcomputer. ERIC T. LANE, The University of Tennessee at Chattanooga.

The dynamic presentation of moving waves and particles enhance student interest and understanding. Standing waves, group velocity, and the Doppler effect come clear using animation graphics on an Apple Microcomputer, as does particle motion of an ideal gas and diffusing particles. Bring a blank disk for a copy of the software to use in your classes.

Modeling Heat Flow in the Ground. C. J. EMERSON and V. C. MEI, Oak Ridge National Laboratory*, Martin Marietta Energy Systems, Inc., Oak Ridge, TN.

Computer models have been developed to simulate heat flow near a ground-coupled heat exchanger. These models will be discussed briefly and their underlying assumptions will be examined. Conclusions based on parametric studies using the models will be outlined.

*Operated by Martin Marietta Energy Systems, Inc. for the U.S. Department of Energy under contract number DE-AC05-84OR21400.

A Crystal Grow Experiment in Spacelab 3, E. SILBERMAN, Fisk University.

Triclycine sulfate (TGS) is a material of theoretical interest, as the prototype order-disorder ferroelectric and of industrial interest as the most sensitive pyroelectric infrared dector. Crystals of TGS will be grown in the microgravity environment of Spacelab 3, to be flown next January. The grow process will be recorded holographically, for later reproduction in the laboratory. The crystals will be characterized optically, thermally and electrically for comparison with Earth grown crystals. The problems that had to be solved in order to grow the crystals in the absence of gravity will be discussed and the equipment built to perform the characterization will be described.

SCIENCE-MATH TEACHERS SECTION

JOHN R. FREEMAN, *Presiding*

Vandermonde Matrix and the Laplace Transform. JAMES J. JOHNSON, The University of Tennessee at Martin.

The purpose of this paper is to show by using Laplace transforms how one may solve systems of equations where the coefficient matrix is a Vandermonde matrix.

A Problem in Geometric Optics. MARVIN TIDWELL, Tennessee Technological University.

In the treatment of the refraction of light, some textbooks include a sketch which indicates the appearance of an underwater object as viewed by an observer in air. Most of the books show the observer looking vertically downward into the water. A survey of more than twenty introductory physics textbooks reveals that only three of them show an observer looking obliquely through the water surface, and only one of the three has a correct figure. This paper discusses that problem.

The Niche: Computer Assisted Instruction. R. G. LITCHFORD and E. T. LANE, The University of Tennessee at Chattanooga.

Study of the Ecological Niche concept is approached in several ways. Each textual seciton is supported by computer graphics, animation, and test procedures. The students are tutored through the historical development of the ecological niche concept. Contemporary works are reviewed. Examples of ecological niche studies which utilize locally available materials are presented to completion. The objectives of the tutorial lead the students to a better understanding of the ecological niche and prepares them for additional studies of population and community dynamics. This tutorial package is prepared for Conduit and has received financial support from The Center of Excellence in Computer Applications, UTC Grant number R04106022-B04997533.

Opportunities for Travel/Research with Earthwatch. CHARLOTTE C. FREEMAN, Girls' Preparatory School.

Participation in field research as a member of an Earthwatch team offers opportunities to teachers, students, and other interested persons to travel, contribute to an on-going research project, and learn by hands-on experience. Students can receive college credit and career training. Researchers are able to submit funding proposals for a wide variety of projects. Information about two past expeditions and current opportunities will be presented.

Wind Energy: An Audio-Visual Production. R. G. LITCHFORD, The University of Tennessee at Chattanooga, and M. M. LEBLANC, J. S. OBERJOHN, and F. J. TURANO, Miami University, Oxford.

Butler Rural Electric Cooperative (BREC), Hamilton, Ohio, and its members are seeking methods for reducing peak-load demands on their system. Our study was an effort to establish the feasibility of using wind energy conversion systems (WECS) in southwestern Ohio as a supplementary electrical energy source. BREC also requested a slide-tape presentation for viewing by its members. The A-V portion of the study has since been converted to VHS video tape. Results of the study will be discussed, followed by a presentation of the slide tape show.

MEDICAL SCIENCES SECTION

R. DEAN BLEVINS, *Presiding*

*Quantitation of Substance P in the Heart and Dorsal Root Ganglia by Using the Enzyme-linked Immunosorbent Assay**. K. H. DURKEE, M. W. HOUGLAND and A. E. HOUGLAND, East Tennessee State University.

For the past decade the enzyme-linked immunosorbent assay (ELISA) has been used in diagnostic microbiology to quantitate antigens, antibodies and toxins; whereas neuropeptides have been quantitated by other methods, notably RIA. The purpose of this study was to adapt the ELISA for quantitating the neuropeptide, substance P (SP), and to apply this procedure for quantitating SP after treating guinea pigs with capsaicin, a substance known to deplete SP.

The ELISA method of Stjernschantz, et al. (J. Neurochem. 38: 1323, 1982) was followed with modifications. Microtiter wells coated with synthetic SP conjugated to poly-D-glutamic acid were reacted with rabbit anti-SP preincubated with either a known amount of synthetic SP or tissue extract. Treated wells were incubated with goat anti-rabbit IgG tagged with alkaline phosphatase. The enzyme substrate, p-nitrophenyl phosphate, was used to produce a yellow product with an absorbency read at 405 nm. The value of SP concentration in tissue extracts was extrapolated from the standard curve.

Guinea pigs were injected with various doses of capsaicin in the ventricular myocardium. Lumbar, upper thoracic and lower cervical dorsal root ganglia (DRG), atria and ventricles were removed and processed for ELISA and for immunocytochemistry to support the findings of the ELISA. Control values for SP in the heart and DRG were comparable to those reported for RIA. Dorsal root ganglia from the three regions responded differently to capsaicin. Substance P levels in lumbar DRG remained fairly constant while those of the cervical and thoracic regions demonstrated a dose response. At the maximal depletion dosage (173 ug/kg) the SP concentration decreased 72.3% in cervical ganglia and 45.5% in thoracic ganglia. Maximal depletion was achieved in the atria (56.1%) at the 173 ug/kg dosage and in the ventricles at the 159 ug/kg dosage. The absence of depletion from lumbar DRG coupled with depleiton particularly from lower cervical DRG and, to a lesser extent, from thoracic DRG suggests the presence of a sensory neuronal pathway from the heart to the upper cervical and lower thoracic spinal cord. *Supported by awards from the Research and Development Committee, East Tennessee State University.

Localization of Alcohol Dehydrogenase in Blastema Tissue. J. L. ROBERTSON and D. I. PAV, East Tennessee State University.

In rabbit ear blastema tissue, tetrazolium stain was used to indicate those cells with active alcohol dehydrogenase enzyme. Rabbits were fed 12% ethanol and then nine mm. holes were cut in their ears under local anesthesia. Growth rates of the blastema tissue were monitored to compare the

effect of alcohol diet on healing tissue with similarly treated, water-fed control animals. During the healing period tissue was removed from the blastema and compared to the pre-surgery ear tissue. Histochemical localization of alcohol dehydrogenase in pre-surgery ear tissue was observed to be stronger and in the cells of the regenerating blastema. As a model for the indirect study of fetal alcohol syndrome this work suggests that an enzyme factor may be important in understanding the cause of some of the symptoms related to this serious problem.

Demonstration of Prostaglandin E-2 in the Region of Delayed Type Hypersensitivity Reaciton in Mice Immunized with Sheep Erythrocytes. B. R. JENNINGS, H. MINCER, B. BIZZINI, A. FEDINEC, V. SNIDER and T. LOCKEY. U.T.C.H.S., Pathology, Memphis, TN. and Institut Pasteur, Paris, France.

The immunoregulator prostaglandin E-2 (PgE-2) has been demonstrated in the region of delayed type hypersensitivity (DTH) reactions in mice, using immunohistochemical techniques. Extensive PgE-2 has also been demonstrated on nerve fibers in various histological preparations. Variations in the distribution of PgE-2 staining in immune and non-immune animals will be reported.

Animals treated with anti-pge prior to challenge have a suppression of the antibody response, but DTH seems to be affected to a lesser degree. This alteration in immunity was noted in animals treated with the immunostimulatory extract, *Corynebacterium granulosum*.

The Use of Avidin-Biotin Complexes to Demonstrate Mast Cells in Histological Staining. VICTORIA SNIDER, B. R. JENNINGS, H. MINCER and T. LOCKEY, U.T.C.H.S., Pathology, Memphis, TN.

A method of staining mast cells in histological sections has been developed which depends on fixation in 70% ethanol for 24 hours. Following fixation the sections are labeled with avidin-biotinylated peroxidase complexes. The peroxidase substrate solution, hydrogen peroxide and 3-amino-9-ethylcarbazole, is then added. The entire antibody complex is made visible by addition of this chromogenic substrate solution which reacts with the peroxidase label at the sites of antigen localization in the tissue. The effects of various combinations of formalin and ethanol and fixation times to obtain optimal staining will be presented.

Augmentation of Immunity to Sheep Erythorocytes in the Mouse by a Delipidated Fraction of Corynebacterium granulosum. T. LOCKEY, B. R. JENNINGS, A. FEDINEC, B. BIZZINI, H. MINCER and V. SNIDER. U.T.C.H.S., Pathology, Memphis, TN. and Institut Pasteur, Paris, France.

Augmentation of the immune response by a delipidated fraction of *Corynebacterium granulosum* in mice using sheep erythrocytes as an antigenic stimulus has been demonstrated. This augmentation was demonstrated by an increase in the hemagglutination response as well as an increase in delayed type hypersensitivity (DTH). Intensification of the inflammatory response in the region of DTH was demonstrated by immunohistochemical methods.

Central-Peripheral Dopaminergic and Noradrenergic-Cholinergic Interaction and Behavior in Mice. ALEXANDER C. WELLS and THOMAS SLAUGHTER III, Department of Biological Sciences, Tennessee State University, Nashville, Tennessee 37203.

The interaction between central-peripheral dopaminergic and noradrenergic-cholinergic involvement and behavior in mice has been investigated. Pilocarpin 10 mg/kg, arecoline 40 mg/kg, hexabarbital 50 mg/kg, barbital 300 mg/kg, atropine methyl bromide 20 mg/kg and atropine sulfate were administrated either subcutaneously (s.c) or intraperitoneally (i.p.). Aeqeous solutions of drugs were administrated in a volume of 0.01 intraperitoneally or 0.005 ml/g body weight subcutaneously. Control animals were hydration controls, physiological saline being used as "sham" injections in place of drug administration according to the need created by the experimental design. The result obtained appear to show that the interaction between central-peripheral dopaminergic and norepinergic-cholinergic may play a role in arousal as judged from the latent time of loss of righting reflex at one extreme to locomotor stimulation at the other. It is concluded that a dopaminergic-noradrenergic-cholinergic interaciton of the muscarinic type exists in the brain and may have a function in the control of arousal. A similar interaction exists in the peripheral sympathetic nervous system. This study was supported by an ONR Grant from the Department of Defense awarded to A. C. Wells.

A Study of the Central Depressant Action of Pentobarbital, Carbaryl, Atropine Methyl Bromide and Atropine Sulfate in Relationship to Alterations in Brain, Heart, Liver, Kidney Norepinephrine and Dopamine. ALEXANDER C. WELLS and DAVID RODGERS, Department of Biological Sciences, Tennessee State University, Nashville, Tennessee 37203.

The relationship between the alterations in the brain, heart, liver, kidney norepinephrine (NE), dopamine (DA) and the central nervous system (CNS) depressant action of pentobarbital, the carbamate (carbaryl) and atropinium agents (atropine methyl bromide and atropine sulfate) has been investigated in male Sprague-Dawley mice.

With pentobarbital, carbaryl and the atropinium agents, a close correlation was observed between the decrease in brain DA and NE and the depth of CNS depression observed, although in the heart there was an elevation of NE and a decrease of DA. In the liver, the NE was observed to show a slight rise and then a slight fall, while the level of DA observed showed a close correlation between the depth of CNS depression observed. The kidney revealed a markedly decrease in the levels of NE and DA.

It is thus concluded that the CNS depressant activity of these compounds is mediated by a central-peripheral acetylcholine (ACh) mechanism and a decline in (NE) and (DA). The possibility of CNS depression causing a decrease in brain, heart, liver and kidney norepinephrine and dopamine are discussed. This investigation was supported by: A SEA/CR Grant from the US Department of Agriculture awarded to A. C. Wells.

Bone Marrow Transplantation in a Canine Model of Human MPS I. R. M. SHULL, The University of Tennessee.

Deficiency of the lysosomal enzyme α-iduronidase is responsible for the disease known as mucopolysaccharidosis I (MPS I) in man, dogs, and cats. Clinical signs in man and animals are similar and include stunted growth, skeletal deformities, corneal clouding, enlarged liver and spleen, and central nervous system disease. Enzyme replacement trials have been unrewarding, thus prompting new attention on allotransplantation of bone marrow as a potential treatment. While this has been shown to reverse some clinical signs in the few children which have been transplanted, the critical question of its effectiveness within the central nervous system remains unresolved. The focus of the canine study, therefore, is to evaluate changes within the central nervous system of affected dogs which receive bone marrow transplants from nonaffected littermates. The potential for reversal of mental retardation in affected children may exist if enzyme levels are found to increase and MPS levels decrease within the CNS of transplanted dogs.

Predictive Correlations for the Toxicity of Selected Substituted Pyridines. T. W. SCHULTZ, College of Veterinary Medicine, The University of Tennessee.

Linear relationships between chemical structure and biological response (BR) have been explored for a series of 20 4-position pyridines (C_5H_5N) using 7 substituent constants (MR, $^1X^V$sub, Pi, Ha, Hd, R, F) Based on r-square values, shape/size terms (MR, $^1X^V$) and hydrophobic/hydrophilic terms (Pi, Ha, Hd) are more important in describing BR than are electronic terms (R, F). Molar refractivity (MR), a corrected molar volume term and the ability to accept hydrogen (Ha) are the most important terms in describing BR. The mathematical model:

$$\log BR = 0.0612(MR) - 0.5061(Ha) - 1.0906 \qquad n=18$$

explains 88.8% of the observed variability in BR. Two compounds 4-vinylpyridine and 4-nitropyridine are outliers and more toxic than predicted. 4-Vinylpyridine is an alkylating agent for sulfhydyl groups in amino acids and proteins. The bilateral symmetry of the para oriented 4-nitropyridine enhances the formation of the highly toxic nitroxy-free radical. Funded by USEPA Grant Agreement R-810791-01-0.

Observing Delta-9-Tetrahydrocannabional and Electrical Self-Stimulation of the Brain in ICR Mice. R. D. BLEVINS[1] and H. E. CRISWELL.

The effects of 3.5, 7, and 14 mg of Delta-9-Tetrahydrocannabinol/kg of body weight were studied in female International Cancer Research (ICR) mice using the shuttlebox paradigm for electrical intracranial self-stimulation of the brain (ICSS) and examining the effects of delta-9-THC on threshold for ICSS utilizing an auto-titration procedure. Intraperitoneal injections of delta-9-THC were given 20 minutes prior to the placing of the mice in the shuttlebox. In the shuttle paradigm, mice independently controlled stimulus duration (ON times) and time between stimuli (OFF times). Delta-9-THC was shown to produce a dose dependent increase in the OFF times in the shuttle paradigm while having no appreciable effect on the ON times. This suggested a decrease in the sensitivity of the limbic system to rewarding electrical stimulation. This effect was confirmed in a second experiment which showed a statistically reliable increase in threshold for ICSS as measured by the auto-titration procedure. [1]Division of Health Sciences, Department of Biological Sciences, Box 22, 690A, East Tennessee State University, Johnson City, Tennessee 37614-0002; Department of Psychology, Box 21, 970A, East Tennessee State University, Johnson City, Tennessee 37614-0002.

Purification of Alpha-L-Iduronidase from Human Saliva. JAMES E. MASTERS and J. KENNETH HERD, East Tennessee State University.

Alpha-L-iduronidase is being purified from human saliva in an attempt to support the hypothesis that differences between secreted iduronidase in seminal fluid and intracellular iduronidase in organ homogenates are due to posttranslational processing of the intracellular enzyme. Whole human saliva, freshly collected on ice was adjusted to pH 6.0 in 0.01M sodium phosphate buffer in 0.15M NaCl. Proteins were precipitated with 90% saturated ammonium sulfate at 4°C. When such precipitates were reconstituted, more than 99% of the iduronidase activity was recovered. The specific activity of iduronidase in reconstituted ammonium sulfate precipitated whole saliva was 3X greater than that of fresh whole saliva when both were tested at the