

PROCEEDINGS OF THE TENNESSEE ACADEMY OF SCIENCE FOR 1963

JAMES L. WILSON, SECRETARY
Belmont College, Nashville, Tennessee

MEETINGS OF THE EXECUTIVE COMMITTEE FEBRUARY MEETING

The Executive Committee of the Tennessee Academy of Science was called to order by President Henry C. Allison at 7:15 PM in the Dean's Conference Room at Tennessee Polytechnic Institute, Cookeville, on February 1, 1963. Members present were Henry C. Allison, Norman Campbell, William G. Downs, Jr., James J. Friauf, Willard B. Jewell, and Myron S. McCay. Roger Rusk, Visiting Scientist Program Director, was present also.

A motion passed that the minutes of the Executive Committee Meeting and the Annual Business Meeting be approved as corrected.

The Secretary reported having received 22 applications for Academy membership. A motion passed that these applicants be elected. Eighty-six names were removed from the membership list, most of which were dropped for non-payment of dues. The active membership is at present about 900. The Secretary reported \$206.46 in the AAAS (American Association for the Advancement of Science) Research Fund.

The Treasurer summarized his report, stating that the full report would be printed in the April issue of the JOURNAL.

The Past-president reported that he sent several letters to appropriate people concerning the anti-evolution law. He also pointed out that there is a need for continuity in certain Academy committees.

The President stated that the Executive Committee and Section Chairman should campaign actively to secure new Academy members.

The President-elect stated that he had no report.

The Editor of the Journal reported as follows:

Transfer of the editorship and the editorial office of the JOURNAL of the Tennessee Academy of Science has required a large amount of work. Through several telephone conversations and a trip to Knoxville on January 5th, most of the work, problems, and questions involved in the transfer have been resolved. The files and office of the JOURNAL are now located in the Department of Biology at Vanderbilt. There yet remains the moving of the back issues of the JOURNAL to Nashville. Storage space for these has been obtained in the Joint University Library.

The firms of Cullom and Ghertner, Baird-Ward, and Curley Printing Company were contacted relative to printing the JOURNAL. After considerable negotiation, the printing of the April issue was awarded to the Curley Printing Company at a cost of not more than \$925.00 for 1,200 copies of a 40 page issue. This serves as a trial issue to assist in establishing cost. Other printers will be contacted for bids. It is hoped a lower price can be established.

A free-of-charge service for having addressograph plates made and for addressing the JOURNAL envelopes has not been found. Charges range from 1 to 1½ cents per envelope for addressing and from 7½ to 15 cents each for making addressograph plates. Added to the cost of mailing the JOURNAL

is the cost of a new Second-Class Permit for which all preliminary steps have been completed with the Postmaster at Nashville.

The manuscript for the April issue of the JOURNAL has been edited, and most of it is typescript ready for the printer. The issue will contain photographs and biographical sketches of the new President and Editor, the 1962 Proceedings of the Academy, the Treasurer's and Auditors' reports for 1962, Abstracts of Papers presented at the 1962 Meetings of the Kentucky-Tennessee Society for Microbiology, some News Items of Tennessee Science, and, it is hoped, two short research papers. Business with advertisers for this issue has not been completed.

Eleven manuscripts are now on hand for future issues of the JOURNAL. They are distributed as follows: Medical Sciences, 1; Botany, 1; Zoology, 3; Mathematics, 2; Science: Mathematics Teaching, 1; Chemistry, 2; Geology, 1. An effort is being made to publish papers representing the various areas of science and engineering. This equal emphasis on all disciplines will require the cooperation of section editors, officers, and other members.

According to the Constitution and Bylaws, the Editor shall be assisted by an Editor of the News of Tennessee Science. For some time, no such editor has been appointed. It is believed that the circulation of scientific news to the members of the Academy is a very important function of the JOURNAL and it is the desire of the Editor that a person be found who will conscientiously assume and discharge such duties.

Through the efforts of Dr. Graham DuShane, the Editor has been accepted as a member of the Conference of Biological Editors. The publications, activities, and meetings of this organization (the next meeting to be held March 18-20 at the Library of Congress in Washington) will be helpful to the Editor and he hopes aid in the steady improvement of the JOURNAL.

A motion passed that the Secretary's minutes be regarded as the official record of the Academy and the Executive Committee, and that a reading of the minutes be reviewed at the Annual Business Meeting of the Academy.

A motion passed that the Editor recommend to the President the name of a person to serve as Editor of *News of Tennessee Science*, such Editor to be appointed by the President and that approval of the appointment be hereby given.

The Sponsor of the Collegiate Division presented the following report:

The Annual Meeting at George Peabody College for Teachers on November 24, 1962, attracted the largest attendance in the history of the Collegiate Division. About one hundred students were present for the various sessions.

The officers for 1962-63 were:

President: James Karas, Memphis State University
Vice-President: Garrett Ashers, Tennessee Polytechnic Institute

Secretary-Treasurer: Annette Clark, Tusculum College
Reporter: Wendell Bunch, Carson-Newman College
Editor of *Collegiate Scientist*: LuEllen Bailey, Memphis State University

Regional meetings are being planned as follows: the Eastern Region meeting is planned for May 11 at Lincoln Me-

morial University, Harrogate; the Middle Region meeting is planned tentatively for April 20 at Nashville; and the meeting for the Western Region is planned for April 20 at Martin. Further plans of the Division include publication of the *Collegiate Scientist* with one or two issues to be published this spring. A meeting to evaluate the activities made possible by the National Science Foundation grant will be held May 18, 1963, in Nashville.

The Sponsor of the Tennessee Junior Academy of Science presented the following report:

Activities of the Tennessee Junior Academy of Science (TJAS), for 1962 were reported to the Executive Committee at the Annual Meeting held at George Peabody College, November, 1962. Plans for the TJAS program in 1963 are nearing completion. The following meeting dates and places should be recorded: Regional Science Day Programs, February 23; State Science Day Program, Peabody College, March 23; Junior Science Honors Day, ORNL, June 7.

At the Annual Meeting of the Tennessee Academy of Science, November 24, 1962, information and announcements regarding the TJAS program were presented by members of the Advisory Council. Eight distinguished science teacher nominations were made. Regrettably, two nominations did not reach the Sponsor in time to be presented to the Executive Committee at that meeting.

On December 26, 1962, the TJAS Sponsor served as Chairman of the Standing Committee on Junior Academies of the Academy Conference at the Philadelphia meeting of AAAS. At this meeting the Standing Committee presented the first program of the AAAS National Junior Academy of Science. Twenty-two papers were given in the two sessions of this program; participants were from nine states and the District of Columbia. Tennessee was ably represented by Robert Leon Carney of Isaac Litton High School, Nashville, and by A. G. Kasselberg of East High School, Memphis. The Sponsor will assist the Academy Conference Executive Committee in Atlanta on February 15 in making plans for this AAAS program at Cleveland in 1963. A better meeting time and wider state academy representation are in prospect for the future.

Copies of the TJAS information booklet, "A Handbook for Teachers", have been mailed to all high school science teachers. This novel brochure was prepared by Professor Robert L. Wilson and published by Bob Bradshaw. It contains instructions for full participation in TJAS programs, including a model constitution for TJAS Chapters prepared by Dean Gordon Pennebaker.

TJAS has received a cordial invitation to send representatives, both students and teachers, to the NATIONAL SCIENCE EDUCATION EXPOSITION and the NATIONAL SCIENCE SEMINARS at Albuquerque, May 6-11, 1963. These new science-education programs will be held concurrently with the NATIONAL SCIENCE FAIRS-INTERNATIONAL. Participants will be guests of Albuquerque and its school patrons on this occasion. The only expense for a participant will be that for transportation. The Seminars will be conducted by a staff of internationally-known research scientists, including 8 Nobel Laureates. TJAS has asked for an indication of interest from high schools. Louisiana Junior Academy plans a special train for their representatives; Illinois expects to send 1000 students and teachers.

Revision of the proposed TJAS budget for 1963-64 was requested by the National Science Foundation (NSF) in December, 1962. Two significant changes should be noted: (1) NSF now disallows funds for Junior High School Division activities, holding that the quality of such "Science research" does not warrant the use of limited national funds in that way; and (2) the total prospective budget, provided by NSF, will amount to no more than \$10,500.

In view of the impending budgetary reductions for 1963-64, TJAS is faced with curtailment of its programs or improvement of its operating efficiency. The latter prospect was discussed at some length with one of the NSF officials recently. While no specific funds may be allotted to junior high school representatives, it may be possible for existing funds to provide encouragement to youthful scientists by

means of "group transportation" plans for TJAS Council members and high school teachers. A second prospective economy, in the opinion of the NSF official, may result from the selection of a central meeting place for the annual TJAS State Science Day program. This logically raises the question of possible annual meetings in Nashville for the Junior Scientists. A third saving in time, effort and funds was suggested by the NSF representative. In some state academies NSF permits the directors of programs to serve as disbursing officers for grant funds. The only expense for fund-handling then becomes that for a single annual audit of the account by a Certified Public Accountant.

In view of the obvious financial curtailment faced by TJAS in the immediate future due to increased competition from new state junior academies for federal aid, it seems well to propose the creation of a new science promotion agency for the State of Tennessee. Guided by the successful experience of the Washington (DC) Academy of Science, it is recommended that TAS propose the organization of *The Tennessee Joint Council for Science Education*, composed of: The Tennessee Academy of Science; The Tennessee Mathematics Teachers Association; The Tennessee Science Teachers Association; The Tennessee Society for Professional Engineering; The Tennessee Medical Society; all engineering clubs and chapters in Tennessee; other science-oriented organizations. As in Washington, D.C., the Council representing these groups of scientists would assist and encourage the programs of: Tennessee Junior Academy of Science; Tennessee Science Talent Search; Science Clubs, or TJAS Chapters; other approved, broad-interest science programs. The advantages of such combined efforts would be (a) more adequate financial support for existing programs, (b) opportunity for science-training participation among medical and engineering professions, and (c) more effective student-teacher-industry association.

The Director of the Visiting Scientist Program presented a progress report, in which he reviewed the various forms used in carrying out the program, the current budget, and next year's proposal to the National Science Foundation.

The meeting adjourned at 11:00 P.M. to meet the next morning at 9:00 AM.

The meeting was called to order at 9 AM, February 2, by the President. Dr. Friauf recommended Dr. Richard Stevenson as Editor of the News of Tennessee Science, stating that he would carry out these duties until Dr. Stevenson could assume them in September.

Motions passed that each of the following recommendations of the President be approved:

1. Dr. Don Claypool succeed Dr. Albert Myers as Collegiate Sponsor.
2. Dr. Myron S. McCay continue as TJAS Sponsor.
3. Professor Roger Rusk continue as Chairman of the Visiting Scientist Committee.
4. Dr. Willard B. Jewell, Chairman, with Dr. James Ward and Dr. Gordon Carlson, serve as a committee to study the overall question of indirect costs, finances relative to the JOURNAL, and the general overall financial problem concerning the Academy.

The following motions passed:

1. That the President be instructed to investigate and take necessary action to revitalize the Engineering Section.
2. That requests for expenses not covered by direct costs from grant directors be routed through the President for approval; that he in turn approve, disapprove, or get the approval of the Executive Committee to authorize payment.
3. That the sponsors of TJAS and Collegiate Division check with the National Science Foundation concerning use of grant funds for cost of publication of papers in the Academy JOURNAL.
4. That if funds are not available from the National Science Foundation, papers of the TJAS and Collegiate

Division will not be published.
5. That the Executive Committee express appreciation to the administration of Tennessee Polytechnic Institute for inviting the Committee to meet at their institution.
The meeting adjourned at 12:00 noon.

NOVEMBER MEETING

The Executive Committee of the Tennessee Academy of Science was called to order by President Henry C. Allison at 7:30 PM in room C-2309 of the Anatomy Department at Vanderbilt Medical School, Nashville, on November 15, 1963. Members present were Henry C. Allison, James W. Ward, William G. Downs, Jr., James L. Wilson, G. H. Lundberg, C. L. Baker, W.B. Jewell, Richard Stevenson, Elsie Quarterman, Norman Campbell, Don Claypool, and Myron S. McCay. James L. Major, Chairman of the Science Talent Search Committee, was present also.

A motion passed that the minutes of the February Executive Committee meeting be approved as corrected.

The Secretary reported having received 110 applications for Academy membership, including the 22 applications reported at the February meeting. A motion passed that the remaining 88 people be elected. A total of 107 names were removed from the membership list, most of which were dropped for non-payment of dues. The active membership now stands at 956, compared to 953 reported last November.

The Treasurer reported \$6,710.00 on hand, including savings accounts. The details of the report were discussed, and the Treasurer recommended consolidation of savings accounts into a single savings account. The foregoing recommendation and the Treasurer's report were accepted.

Dr. Jewell, Past-president and Chairman of a Special Committee on Finances, presented a copy of the report of the committee to each member present. The report was discussed in detail. A motion was passed that the report be tabled until other reports were made.

The President reported that Dr. G. H. Lundberg was appointed Editor of the JOURNAL to replace Dr. J. J. Friauf, who resigned because of illness. Dr. Ferris U. Foster of Tennessee Polytechnic Institute was asked to assume the chairmanship of the Auditing Committee to replace Dr. Lundberg. Mr. James B. Delano of Tullahoma assumed his duties as Chairman of the Engineering Section to organize a program for the 1963 annual meeting. No papers have been presented in this section during the past two years.

The President reported on a meeting he attended at the National Science Foundation in Washington, D.C. He stated that the Tennessee Academy received a larger allocation of funds for the support of its programs than has been received by any other state academy. He added that the National Science Foundation highly praised the program of the Tennessee Academy.

The President-elect and Program Chairman reported that the program for the annual meeting was at the printers.

The Editor reported that the October issue of the Journal was in press at Curley Printing Company. He stated that work had been begun on the January issue.

The Director of the Reelfoot Lake Biological Station reported that a class of 16 from Austin Peay State University and two classes from Southwestern College visited the Station in the late spring. During the summer extended investigations were made by a graduate student from East Tennessee State University, and by faculty members from Sesser Community School, Carbondale, Illinois, North Carolina State College, Raleigh, and Spalding Institute, Peoria, Illinois.

The Sponsor of the Collegiate Division, Dr. Don Claypool, gave the following report:

Dr. Claypool commended Dr. Albert Myers highly for the fine job he did as sponsor. He reported that three regional directors for the Collegiate Division have been appointed; Brother J. George Carney for West Tennessee, Dr. John R. Warren for the Middle Section, and Dr. Thomas M. Hill for East Tennessee. He reported that the 1963 NSF budget was about one-third more than last year and the one submitted for 1964-65 is essentially the same as the present one. The budget was \$4,309 for total direct costs and \$342 for indirect costs, giving a total budget of \$4,651. Each regional director was allowed a certain allocation for state meetings. If it is not used, it is re-allocated to regional meetings. The first call on travel and per diem allocation is to students who present papers, second call is to regional and state officers, and remaining funds may be used by other students attending the meetings.

The Tennessee Collegiate Scientist will be distributed at the meeting and appended to it will be abstracts of papers presented last year.

The Sponsor of the Junior Academy presented and discussed various topics concerning Junior Academy activities.

The President presented a copy of a progress report of the visiting Scientist Program.

The Chairman of the Science Talent Search Committee presented the 1963 report of the committee.

The following motions passed:

1. That the report of the Special Committee on Finances be accepted.
2. That the directors of projects present a budget to cover cost of items not included in direct costs which are considered essential to the project.
3. That the application of Mr. Horace Traylor, President of Zion College, Chattanooga, for Academy membership be approved.

The meeting adjourned at 11:00 PM to meet November 29.

The Executive Committee reconvened at 8:15 AM on November 29 in the Student-Faculty-Alumni Center at the University of Chattanooga. Members present were Henry C. Allison, James W. Ward, William G. Downs, Jr., James L. Wilson, G. H. Lundberg, W. B. Jewell, Richard Stevenson, Norman Campbell, Don Claypool, and Myron S. McCay. In addition, C. P. Keim, James L. Major, and Roger Rusk were present.

Minutes of the November 15 Executive Committee Meeting were approved.

A motion passed that the Secretary make corrections in the application for membership forms before new cards are printed.

The Secretary read two letters of invitation concerning the 1964 Annual Meeting of the Academy. After some discussion a motion passed that the 1964 Annual Meeting of the Academy be held at Memphis State University. Dr. Keim renewed the invitation

from the Oak Ridge National Laboratory for the Academy to meet there in 1965.

Dr. Keim discussed several matters concerning printing of the Academy JOURNAL. He stated that the Oak Ridge Laboratory would be happy to aid in the preparation of plates of technical papers since those are difficult for the Nashville printer to handle. Dr. Keim reported that recently he served on a National Science Foundation panel which reviewed programs of Junior Academies and of those reviewed the Tennessee Junior Academy of Science received the highest rating.

Dr. Jewell, Chairman of the Nominating Committee, presented the slate of Academy officers for 1964.

Dr. Claypool, Sponsor of the Collegiate Division, presented a written report which he discussed.

Dr. McCay, a member of the Fellows Committee, presented the report for Dr. Wolf, Chairman. Eleven members were selected to become Fellows and a motion passed that the Executive Committee recommend that their names be presented at the Annual Business Meeting.

Professor Rusk, Director of the Visiting Scientist Program, discussed problems which arise in the operation of the program. He stated that a proposal for 1964-65 had been submitted to the National Science Foundation.

A motion passed that Dr. McCay present the names of those who will receive the Distinguished Teacher Awards at the Annual Business Meeting.

Mr. Major, Chairman of the Science Talent Search (STS) Committee, presented and discussed a budget of \$390 for operation of the Science Talent Search.

The meeting adjourned at 9:55 AM.

THE SEVENTY-THIRD MEETING

The seventy-third meeting of the Tennessee Academy of Science was held November 29-30, 1963, at the University of Chattanooga. Kenneth Fry was Chairman of the Committee on Local Arrangements and James W. Ward, Vanderbilt School of Medicine, was Program Chairman.

Two hundred eight persons registered for all sections of the Academy on Friday in the lobby of Hunter Hall. The General Session, Henry C. Allison presiding, was held Friday morning in Room 104, Hunter Hall. Five papers were presented.

Section meetings of the Senior Academy, with the exception of the Science-Mathematics Teachers Section, were held Friday afternoon in various rooms of Hunter Hall. The Annual Business Meeting was held at 4:30 PM Friday in Room 104 Hunter Hall.

The Annual Dinner, attended by 109 persons, was held in the Georgia Room of the Patten Hotel at 7:00 PM Friday. Dr. Robert T. Lagemann, Head of the Physics-Astronomy Department at Vanderbilt University, Nashville, spoke on "Radiocarbon Dating."

An Advisory Council Meeting of the Junior Academy and an Executive Council Meeting of the Collegiate Division were held at 9:00 PM Friday.

The Executive Council of the Junior Academy met at 7:30 AM Saturday for breakfast in Bretske Hall.

Registration for the Collegiate Division took place on Saturday morning at 8:30 AM in the lobby of Hunter Hall. At 9:00 AM the Collegiate Division met in Room 407 Hunter Hall for presentation of papers.

The Science-Mathematics Teachers Section met at 9:00 AM in Room 304, Hunter Hall, for presentation of papers.

ANNUAL BUSINESS MEETING OF THE ACADEMY

The Business Meeting of the Academy was called to order in Room 104, Hunter Hall, at 4:30 PM November 29, by President Henry C. Allison. The minutes of the Business Meeting of 1962 and the minutes of the Executive Committee meeting were approved.

The Secretary reported that 125 applications for membership had been received and that 107 names have been removed from the membership list, most of which were dropped for non-payment of dues. The present membership is 971 compared to 953 at this time last year. A motion was passed that the 125 applicants be elected to membership in the Academy.

The Editor presented his report, and the Treasurer's Interim Report was read by the Secretary. Both reports were approved.

The Director of the Reelfoot Lake Biological Station presented his report which was approved.

The Director of the Visiting Scientist Program reported that announcements of the program were distributed much earlier this year. He stated that about 100 requests had been received and some visits had been made. He gave a progress report concerning the program for this year and summarized last year's program.

The Academy Conference and AAAS Representative reported as follows:

The AAAS asked that academies assume complete responsibility for the welfare of students sent to the Junior Scientists Assembly meeting in Cleveland on December 26. Also they asked that the academies do three things: 1. have parents sign a release agreement, 2. take out insurance, and 3. provide entertainment.

The Academy Conference sent a questionnaire concerning financial support to a number of the academies. The results from the 38 that responded are as follows: three received appropriations from the state; six received aid from the state in publications; 22 received grants from NSF; and 7 others received NSF grants not directly related to academy activity. Annual dues for 11 were \$3, dues for 6 were \$2, 7 had endowment funds, and 17 received gifts from corporations.

The Conference made some suggestions and recommendations. Each academy is asked to submit an annual report of the academy activities. The most successful junior academies do not meet annually with the senior academies, but have separate meetings. It is recommended that science fairs and collegiate academies be independent of the senior academies. Lecturers in the visiting scientists' programs should be, in general, people engaged in research rather than in teaching.

One afternoon was spent on a taxation problem which is of concern to the Academy. The meeting was attended by a representative of the Department of Internal Revenue. In order to be exempted from payment of taxes by the Internal Revenue Department and by the State, and at the same time conform to the law, a specified set of rules must be followed. The Constitution and Bylaws of the Academy must state its purposes and include in the statement that it is

a charitable organization. There must be some provision in the Constitution for the dissolution of funds if the Academy should be disbanded. When a request for a charter is submitted, it is best to consult an attorney. Certain information, such as an itemized financial record of the organization must be submitted. Other items requiring consideration are exemption from state sales tax and federal income tax and freedom to receive gifts as a charitable organization. It takes about two years to get a charter; a fee of \$2 a year must be paid to keep the charter active.

Dale Wolfe gave a report of an informal discussion between past presidents of the AAAS. It was suggested that for local participation in science activities, the State Academy is the best qualified organization. The AAAS activities can and should be expanded through the Academy. The AAAS will contribute money, support, and leadership to help develop local activities in science. It now gives small research grants and a few subscriptions to the AAAS Journal.

The Chairman of the *Science Talent Search Committee* reported that the 36 winners for 1963 came from 26 schools located in various parts of the state. He stated that plans are underway for a complete survey of former winners, and that winners for the past four years have been given a tour, banquet, and lecture at the Oak Ridge Nuclear Laboratories.

The *Chairman of the Membership Committee* stated that he appreciated the efforts of the members of his committee and he pointed out that more "interested" members are needed.

The *Chairman of the Research Committee* presented the following report:

During the year 1963, three applications for support of research were received by the research committee. The total amount requested was \$880. The amount disbursed was \$438.46.

Two grants were made. One was to Sister Joseph Maria Cambron of Memphis, in the amount of \$170, to assist in the purchase of photomicrographic equipment with which to study the "effects of drugs on polyoma virus in vitro and in vivo." The other was to Dr. Huldreich H. Kuhlman, Southern Missionary College, Collegedale, in the amount of \$268.46, to purchase supplies and hire assistants in order to continue studies of the "Longevity of the cestode, *Hymenolepis microstoma*, in the definitive host, *Mus musculus*."

All the funds available from the AAAS (\$384.6) were awarded by the Committee. Each recipient of funds has been asked to submit a report by the end of the calendar year 1963.

Dr. McCay, a member of the *Fellows Committee*, presented the report for Dr. Wolf, Chairman, who was not present. The following names of members of the Academy recommended by the Executive Committee were submitted for election as follows:

Conrad W. Bates, Chattanooga
Robert J. Bradshaw, Jr., Chattanooga
Wilbur K. Butts, Chattanooga
Mrs. Azilee J. Cabellero, Signal Mountain
Mrs. Evelyn Dooley, Columbia
Mrs. Burt R. Francis, Kingston Springs
Arthur W. Jones, Knoxville
Miss Eleanor McGilliard, Chattanooga
Albert L. Myers, Houston, Texas
Fred H. Norris, Knoxville
James L. Wilson, Nashville,

A motion passed to approve them as Fellows.

The *Chairman of the Nominating Committee* proposed the following slate of officers:

President: James W. Ward, Vanderbilt University, Nashville
President-Elect: Frank H. Barclay, East Tennessee State University, Johnson City

Secretary: James L. Wilson, Belmont College, Nashville

Treasurer: William G. Downs, Jr., Tennessee Polytechnic Institute, Cookeville

Since there were no nominations from the floor, with the unanimous consent of the members present, the Secretary was instructed to cast one ballot representing the vote of the members present.

The *Chairman of the Resolutions Committee* submitted three resolutions (printed separately following the minutes of this meeting). A motion passed to approve the resolutions.

The following names of teachers were read and recommended to receive Distinguished Teacher awards:

Mrs. Helen Bell, Dyersburg High School, Dyersburg
Mr. James T. Elizer, Haywood County High School, Brownsville
Mrs. Joanne D. Rogers, Brainerd High School, Chattanooga
Mrs. Jewell Tinker, Jackson Junior High School, Jackson

A motion passed to approve these for Distinguished Teacher Awards.

The *Chairman of the Necrology Committee* made note of the passing of Dr. Graham DuShane, Mr. Roscoe Nunn, and Dr. Clair L. Worley. A motion passed to have the above names entered on the minutes as an expression of the sense of loss to the Academy of these loyal members.

A motion passed that the Secretary write Mrs. John F. Kennedy expressing the deepest regrets of the Academy members and the deep sense of loss both to her and to all of us on the death of her husband, John F. Kennedy.

The Annual Business Meeting adjourned at 5:45 PM.

REPORT OF THE RESOLUTIONS COMMITTEE OF THE TENNESSEE ACADEMY OF SCIENCE, 1963

WHEREAS, the Tennessee Academy of Science, including the Collegiate Division and the Junior Academy of Science, are enjoying a most pleasant, profitable, and well-organized series of meetings at the University of Chattanooga, and

WHEREAS, the success of these meetings has resulted from the efforts of the officers and sponsors of these organizations, the chairmen of the respective sections, the members of the Committee on Local Arrangements, Kenneth Fry, Chairman, H. G. McDowell, Mary Rucker, and Larry Fincher, from the recognition given the meetings by the local press, radio and television stations, and from the generous hospitality of our host institution,

BE IT RESOLVED, therefore, that the Tennessee Academy of Science express its gratitude and sincere appreciation to these and all other individuals who have contributed to the success of these meetings.

WHEREAS, Dr. Albert L. Myers has served faithfully and effectively as sponsor of the Collegiate Section of the Tennessee Academy of Science for a number of years during which time that section has grown and generated real interest in the colleges and universities of the state, and

WHEREAS, Dr. Myers has left the state to assume another position,

Be It Resolved, therefore, that the Tennessee Academy of Science express its gratitude and sincere appreciation to him for a job well done.

WHEREAS, the Tennessee Department of Education recognizing the efforts of the Tennessee Academy of Science to stimulate interest in science in the public schools of Tennessee and to aid high school science teachers did make a grant of \$3000 to the Tennessee Academy of Science for the current year,

BE IT RESOLVED, therefore, that the Tennessee Academy of Science express its sincere appreciation to the State Department of Education for this grant.

BE IT FURTHER RESOLVED that these resolutions be included in the minutes of the Tennessee Academy of Science and published as a part of the Proceedings of this meeting and that copies be sent to Dr. LeRoy A. Martin, President of the University of Chattanooga, to Dr. Kenneth Fry, Chairman of the Committee on Local Arrangements, to Dr. Albert L. Myers, and to the Tennessee Commissioner of Education, the Honorable Howard Warf.

Respectfully submitted by the Resolutions Committee:

Richard Stevenson
H. G. McDowell
Edwards W. Burke, Jr., Chairman

EIGHTEENTH ANNUAL

TENNESSEE SCIENCE TALENT SEARCH—1963

Sponsored and Financed by the Tennessee Academy of Science

Director: Mr. James L. Major, *Chairman, STS Committee and Physics Teacher, Clarksville High School, Clarksville, Tenn.*

Winners of the Tennessee Science Talent Search
*National recognition in the Westinghouse Science Talent Search

Barton, James Clyde, Oak Ridge H.S., Oak Ridge, "Chemical Abscission and Phytochrome Stimulation in Wheat."

Batchelor, Donald Byron, Bradley Central H.S., Cleveland, "A Magneto-hydrodynamic Plasma Jet."

Beale, David Brooks, Hickman County H.S., Centerville, "Relationships Between Roots and Powers."

Bingham, Fletcher Royce, Tennessee H.S., Bristol, "Comparative Feeding Behavior of Warblers."

*Carney, Robert Spencer, Jr., White Station H.S., Memphis, "Nerve and Muscle Tissue Responses to Alternating Current."

*Casini, Michael Peter, Christian Brothers H.S., Memphis, "Use of Turtle Red Blood Cells in Hemagglutination Test."

Cryer, James Michael, Smyrna H.S., Smyrna, "Vulnerability of Glass to Attack by Alkalis."

*Culver, David Alan, Oak Ridge H.S., Oak Ridge, "Effects of Infrared and Ultraviolet Light on Germination and Growth of Lettuce Plants."

*Emerick, Phillip Terry, Treadwell H.S., Memphis, "Measurement of Luna Formations."

Evans, William Dayton, Jr., Clarksville H.S., Clarksville, "Fuel Cells."

Foster, Charles Stephen, Christian Brothers H.S., Memphis, "The Magnetic Susceptibility Balance."

Gallagher, William Edward, The Webb School, Bell Buckle, "The Relationship between Metabolism, Ingestion and Thyroxin."

Gladney, Thomas Harold, Notre Dame H.S., Chattanooga, "The Auto-Draftsman."

Harrison, George Edgar III, McCallie H.S., Chattanooga, "Coordinate Bond in the Copper (II) Ion."

Hendrix, Karen Ann, Holladay H.S., Holladay, "Intravenous Saline Effects—An Osmotic Function."

Kasselberg, Alfred Guy, East H.S., Memphis, "Construction and Characteristics of the Silicon Solar Cell."

*Kitchens, Charles Herschell, Messick H.S., Memphis, "Petrology and Structural Aspects of Precambrian Sills in the Pony Gneiss of South London Hills, Madison County, Montana."

Lyle, Laurie Hurst, Clarksville H.S., Clarksville, "Effect of Radiation on Chicken Embryos."

Mundt, Frederick Douglas, Central H.S., Fountain City, "Preservation of Mushrooms by Drying."

Munn, Everett Edward, Tullahoma H.S., Tullahoma, "A Particle Accelerator."

Newman, Danny Martin, Isaac Litton H.S., Nashville, "A Digital Computer for Class Demonstration."

*Newton, Shirley Louise, Treadwell H.S., Memphis, "Is Irradiation of Seeds Beneficial to Plant Growth?"

Norton, Russell Monk, Oak Ridge H.S., Oak Ridge, "The Effect of Subzero Temperatures on Yeast."

Pangle, Victor Clayton, Notre Dame H.S., Chattanooga, "Quantitative Analysis of Boiler Water to Determine Iron Content."

Reed, John Jewell, Dyersburg H.S., Dyersburg, "Effects of Polarization on Antenna Gain."

Reid, Lawrence Henry, Dobyns-Bennett H.S., Kingsport, "The Irradiation of Cattle Sperm."

Resch, William Albert III, Dobyns-Bennett H.S., Kingsport, "The Optical Maser."

Riordan, Lawrence Patrick, Oak Ridge H.S., Oak Ridge, "Oxide Films on Niobium."

*Savage, Serena, Oak Ridge H.S., Oak Ridge, "Color and Eye Adaptation."

Seay, James Cleveland, Hillsboro H.S., Nashville, "Diffusion Cloud Chamber."

Shier, Roger Alan, Smyrna H.S., Smyrna, "Electroplating of Copper."

*Teague, Benjamin Harrison III, Oak Ridge H.S., Oak Ridge, "Non-Standard Matrix Operations."

Todd, Walker Fowler, Murfreesboro Central H.S., Murfreesboro, "The Effects of Weather in Murfreesboro for the Years 1960-1963."

Weatherly, William Paul, Hillsboro H.S., Nashville, "Calorimetry."

Whisman, Frank Charles, Oakhaven H.S., Memphis, "Two-Phase Materials."

Yates, Jacques Frank, Father Bertrand H.S., Memphis, "Matter and Forces in Fluids."

GENERAL SESSION

Friday, November 29, 10:00 AM
Room 104, Hunter Hall
Henry C. Allison, Chairman

The Problems in Writing a Biography. Jacob W. Shapiro, George Peabody College for Teachers.

The speaker offered an outline of the problems and pleasures realized in the preparation of the biography

entitled, *Growth of a Philosophy*: Hanor A. Webb. Dr. Webb, Professor-Emeritus, George Peabody College for Teachers, a past President of the Tennessee Academy of Science, was an active member of the Science Talent Search Committee of the Academy.

The Orins-NSF-AEC Summer Institutes in Radioecology, Edward E. C. Clebsch, University of Tennessee and Oak Ridge Institute of Nuclear Studies.

The sponsorship, objectives, and program of the continuing summer institute in radioecology are described. Forty-two college teachers and researchers have now participated in the two year old program held at the Special Training Division of the Oak Ridge Institute of Nuclear Studies. During the seven week programs, participants were given a general orientation to the subject matter area, were given the basic training in physics and chemistry necessary to an understanding of radioisotope technology, and were given practice in handling of isotopes and were allowed to apply their newly acquired techniques to ecological experiments. The impact of the program on Tennessee science is evaluated.

The Laser, Paul Griffin and George K. Werner, Oak Ridge National Laboratory.

Protoplasmic Streaming, Robert A. Rinaldi, University of Tennessee.

Different types of protoplasmic streaming are illustrated by motion picture films. The concept of active sliding which was advanced by Huxley and Hanson (1955) are reviewed. Then, the streaming which is present in *Nitella* and *Chara* are discussed from the viewpoint of Kamiya (1959). Protoplasmic motion which is displayed by *Allogromia laticollaris* is illustrated and discussed relative to recent electron microscopy and the concept of active sliding of one molecule on another as being a basic prerequisite for biological motion.

Research for the Promotion of Space Technology, H. J. Ramm, ARO, Inc., Arnold Air Force Station, Tennessee.

Space Technology has created a multitude of problems which require extensive research, pushing the limits of the state-of-the-art. Behavior of gases at temperatures up to 20,000°K of materials down to space temperatures and pressures; electric particle acceleration for low massflow-high thrust units and simulation of space conditions in the laboratories are a few of these problems.

At the AEDC about 50 research projects are presently underway in these areas. The following studies are described as typical examples:

1. Determination of properties of arc generated plasmas by spectroscopic and probe methods.
2. Gas adsorption studies for the improvement of high speed pumping of large volumes in the ultra-high vacuum field.
3. Determination of radiation characteristics of solid deposits of condensed gases.
4. MHD acceleration of high density gases and problems of removal of electrical propulsion fuels from test chambers.

Particularly critical items are pointed out in conclusion.

SECTION MEETINGS

Friday, November 29, 1:30 PM

BOTANY SECTION

Room 406, Hunter Hall

William H. Ellis, Chairman

Some Plants of Special Interest Recently Collected in Tennessee. A. J. Sharp, University of Tennessee.

Sanguisorba canadensis which has not been reported from Tennessee was found in the Doe River Gorge of Carter County in May 1963. It has a rather restricted range south of the glacial boundary.

Cypripedium reginae and *Meehania cordata* have been found respectively in Claiborne and Hancock Counties. Gattinger had reported them respectively from Polk County and Middle Tennessee. *Aconitum uncinatum* which recently has been found in Hickman County is rare and had previously been collected in Claiborne, Davidson and Knox Counties.

The Effects of 2,4-D and 2,4,5-T on the Growth Rate of Parmelia isidiosa. Haskell C. Phillips, Ausitt Peay State College.

Plants of *Parmelia isidiosa* were saturated with commercial preparations of 2,4-D and 2,4,5-T diluted 1:280. Those treated with 2,4,5-T showed no gross morphological change during the 5 1/2 months study period. One third to 2/3 of the center of each 2,4-D treated plant died and sloughed off the substrate. The average radial growth rate of the 2,4,5-T treated plants was 29.1% less than that of the controls while that of the 2,4-D treated plants was 32% less than the controls.

Erratum—Pilosa (Chrysopsis Pilosa Nutt). Paul L. Hollister, Tennessee Polytechnic Institute.

Previously, notes, progress reports, and one published paper have dealt with this genus, more especially with the species *pilosa* since 1958. The work started with a "population explosion", observed over a period of years.

In all previous reports the resulting populous species of this area was considered to be *C. pilosa* Nutt. Recent work done at the Brooklyn Botanical Garden and at the University of Kansas requires a correction.

This populous species, called "robust" by a well-known botanist, was found to be too hairy to be a member of the species in question. In addition, local specimens were perennials whereas *pilosa* is reported (various sources) as an annual.

Chromosome counts (Harms, U. of Kansas) of seedlings from this area gave the 2N number 36. *C. pilosa* (same source) has a 2N count of 8 while the basic number for the genus is (2N) 18. Hence our local "robust" species is a tetraploid which is best to be considered *C. camporum*. (In some of the older editions, and in the most recent revision of Britton and Brown, this species has been considered as a variety of *C. villosa*.)

Revised notations are in order for all herbarium specimens, at least in the eastern half of this state, particularly those previously marked *C. pilosa*.

Bryocology of Fallen Logs in the Southern Appalachian Spruce-Fir Zone. Daniel H. Norris, University of Tennessee.

From 1958 to 1963 the bryocology of the southern Appalachian spruce-fir zone was studied by the author. Presented here will be that portion of the research concerned with the bryophytes of decaying logs. A total of 720 logs in various stages of decay were sampled in the Great Smoky Mountains National Park. Cover percentage and rudimentary ecological data were tabulated for six quadrats (4 dm²) per log. Results indicate that bryophyte community composition is primarily influenced by (1) time of falling of the tree (before or after bark loss); (2) position on log (on top or on the side; downslope end or upslope end); and (3) chance factors of bryophyte dissemination. Elevation and shading seem to be of lesser significance. The bryophyte communities on rotten logs differ radically from those of surrounding soil and these differences persist long after virtual loss of identity of the log. The communities described in an earlier cursory study by Cain and Sharp are found to be a valid construction.

Survey of Karyotype Differences in Trillium by Means of Differential Stain Reaction. R. B. Channell, Vanderbilt University

Karyotype analyses of natural populations of eight diploid species of Eastern North American *Trillium* were made from root-tip cells. The differential staining reaction of the Feulgen technique was employed, following cold pre-treatment of the tissue. The staining patterns of the various chromosomes were analyzed and compared to those previously reported for the Japanese *T. kamschatcicum*, the only diploid species of Northeastern Asia. The data reveal certain similarities and differences between each of the American species and the Japanese one. Chromosomes B, C and E in all the American species were found to differ from chromosomes B, C and E in *T. kamschatcicum* and collectively to exhibit features unique to American *Trilliums*. These features may reflect differences in the evolutionary history of the genus in the two geographical areas.

Karyotype Analyses of Trillium in Southeastern United States. James Louis Bass III, Ichiro Fukuda and Yoshimichi Kozuka, Vanderbilt University.

Karyotype analyses of several species of *Trillium* were carried out by means of the differential Feulgen staining reaction of chromosomes after cold pre-treatment. The species included *T. cernuum*, *T. erectum*, *T. erectum* var. *albiflorum*, *T. grandiflorum*, *T. Gleasoni*, *T. lanceolatum*, *T. recurvatum*, and *T. staminiatum*. Three types of accessory chromosomes were found in *Trillium erectum* var. *albiflorum* and *T. Gleasoni*. The patterns of differential chromosome segments showed similarities and dissimilarities among the species and also among populations of the same species from different localities. The degree of homogeneity in the chromosome set and frequency distribution of accessory chromosomes appear to be influenced by breeding behavior and suggest a basis for determining evolutionary relationships among the species.

Occurrence of Triploidy in Trillium Gleasoni. Yoshimichi Kozuka, Robert B. Channell and Ichiro Fukuda, Vanderbilt University.

In general, *Trillium* species in North America are

reported to be diploid. One exception is the report by Sparrow (1950) of the occurrence of two triploids in a sample of 800 individuals of *Trillium erectum* from North Carolina. Another exception is reported here.

Chromosomal analysis of a population of *Trillium Gleasoni* from Ashland City, Cheatham Co., Tennessee, revealed two triploid plants out of a sample total of seventeen individuals. By means of the differential Feulgen stain reaction, following cold pre-treatment, it was determined that the two triploids had different origins. Exhibiting different staining patterns in chromosomes B and D, these triploid plants originated either from hybridization between diploid and tetraploid individuals or from fertilization within a diploid population involving one reduced and one unreduced gamete. Since no tetraploid individuals were found, the latter origin is tentatively favored.

Revision of the Red Maple Section of Acer in Eastern North America, excluding Acer saccharinum L. William H. Ellis, The University of Tennessee.

During 1962 and 1963, biosystematic studies within Section Rubra of *Acer* in eastern North America, excluding *Acer saccharinum*, were made. The results indicate that this complex is represented by three natural taxa within the entire range. These taxa were analyzed and seemed to be most satisfactorily placed in the following entities: *Acer rubrum* L. var. *rubrum*, *Acer rubrum* var. *tridentatum* Wood, and *Acer Drummondii* Hook. and Arn.

The morphological characteristics which were of significance in distinguishing the three taxa are: leaf pubescence, leaf margins, number of major veins, width of leaves, length of both the upper lateral and terminal lobes, length of samaras, width of samara wings and seed lengths. Supporting data were also derived from chromatographical, anatomical, cytogenetical, ecological and distributional studies.

A Cyto-geographical Analysis of Ornithium aquaticum. John W. Grear, Jr., Vanderbilt University.

Ornithium aquaticum L., comprising a monotypic genus, occurs in aquatic habitats such as bogs and streams in the following physiographic provinces of the eastern United States: Coastal Plain, Piedmont, Blue Ridge, Ridge and Valley, and Appalachian Plateau.

Varying chromosome numbers for *Ornithium* have been reported in the literature, which suggest that some correlation might exist between chromosome number and geographical distribution.

A cytological study, based on representatives of 24 widely situated populations, revealed that the 2n chromosome number is 26 and invariable, that the position of the majority of the centromeres is median (isobrachial) and that a pair of chromosomes has clearly discernable satellites.

Quantitative karyotype information was calculated and expressed in various graphic forms, including a histogram and ideogram. No correlations were found to exist between karyotypic features and the population sample.

Calcium Levels in Leaves in Relation to Altitude and Latitude. H. R. DeSelm, University of Tennessee.

Collections of the leaves of red maple, yellow birch

hydrangea and the tops of jewelweed were made in 1959 between Knoxville and Clingman's Dome. The first and second were also collected enroute to La Toque. P. Q. Royal Shanks collected pine, aspen, balsam poplar, and white spruce between Fairbanks, Alaska, and southern Montana.

Mean calcium levels in the various taxa vary from about 3000 ppm in pine to 18000 ppm in hydrangea. Changes with latitude vary from -160 ppm to -600 ppm per degree, and -830 ppm to -2000 ppm per 1000 foot increase in elevation.

Introgresive Hybridization in a Robinia Population. Roberta Pinson Bashor, East Tennessee State University.

A variable population of *Robinia* on Holston Mountain in northeastern Tennessee is analyzed by means of polygonal graphs. These are interpreted as showing that introgression is occurring and that the probable direction of gene flow is from *R. hispida* toward *R. pseudo-acacia*.

It is suggested that two varieties of *R. pseudo-acacia* may be due to introgression of genes from *R. hispida*.

It is further suggested that additional work aimed at clarifying the pathways of speciation in the southeastern *Robinias* is desirable.

The Effects of Initial Population Size on the Rate of Reproduction of Unicellular Green Algae. Jimmie G. Minchey, Tennessee Polytechnic Institute.

Estimates of Dry Matter and Macronutrient Content in Eastern White Pine. (*Pinus strobus* L.) Edward E. C. Clebsch, University of Tennessee.

Fifty-nine branches from thirty-four trees form the basis of estimation of needle and branch dry weight and nutrient element content. Analyses of calcium, magnesium, potassium, and phosphorus content of small samples from these branches and boles allow for the estimation of tree mineral content. Volume estimates of bole segments and total bole and the bulk density of bole wood are included. Growth of the trees is estimated from annual rings, and average annual increments of dry matter and mineral materials are calculated.

Status and Distribution of Cimicifuga rubifolia Kearney. Gwynn W. Ramsey, The University of Tennessee.

Preliminary investigations on the genus *Cimicifuga* have revealed a number of taxonomic problems within the group. *Cimicifuga rubifolia* Kearney appears to be distinctly different from *C. cordifolia* Pursh which appears to be a biotype within *C. americana* Michx. The range of *C. rubifolia* has been extended beyond that in published records. It has been found in 9 additional counties in Tennessee, increasing the number of counties to 13; Scott County, Virginia, possibly being a state record. It is found also in Ash County, N. C. and Pope County, Illinois.

Implications in Uptake of Heavy Metal Ions by Yeast Cells. Brother Edward, F.S.C. and Sister Adrian Marie, O.P., Christian Brothers College and Siena College.

A yeast cell will bind and absorb metal ions in competition with organic ligands. Earlier workers have

shown that the stability of metal chelates is a function of the chelate ring size and that the binding of the heavy metal ion to the yeast cell membrane is rapid and reversible and obeys the derivations of the mass law. By using yeast cells instead of resin, we are combining the methods of these investigators to make possible a better understanding of the effect of organic acids on the uptake of metal ions by and of active transport into the yeast cell. The ions are either bound by anionic groups to the cell surface in a reversible equilibrium, or the ions may be actively absorbed into the cell by a metabolic process which requires active transport of the ion. Comparison of the stability constants of the organic ligands obtained in the presence of the resin with those in yeast give new information on the relative amounts of ion bound to and absorbed into the yeast cell.

Early Apical Meristem Structure in Yucca Glauca Nutt. James M. Moore, University of Tennessee at Martin.

In the embryo the shoot apex is only a small cluster of cells. In a seedling and young adult it is asymmetrical, except near its base, appearing cone-like when viewed in the plane of the cotyledonary slit, but dome-like when viewed in a plane at right angles to the cotyledonary slit.

The five zones characteristic of the aerial shoot apex are established by the time the emergent seedling is about 15 mm long. These include (1) a layered tunica, (2) a corpus, (3) a flank-meristem, (4) a rib-meristem and (5) a zone below the flank meristem and lateral to the rib meristem. As the aerial apex increases in size, periclinal divisions in the outer corpus become fewer, resulting in the establishment of additional self-maintaining layers. In the young adult aerial apex these appear to vary from 2 to 3.

The structure of the rhizome apex is basically similar to that of the aerial shoot apex.

Piney—A Botanical Preserve. Arthur Meyer, Bryan College, Dayton, Tennessee.

Bryan College is the recipient of a tract of rugged land on the eastern edge of the Cumberland Plateau. In this gorge of Little Piney Creek are found virgin white pine, hemlock, and tulip trees, and a variety of other native plants.

The area is being used by Bryan's botany classes and will be used more if access roads are developed. The College invites botanical groups from other colleges and universities of the state to visit Piney.

Environmental Control of Germination of Seeds of Helenium Amarum. Donald Caplenor, George Peabody College.

A study was made to determine the effect of light and temperature upon germination of seeds of the common bitterweed. Light did not appear either to stimulate or inhibit germination. The effect of constant temperatures depended upon duration of storage. Fresh seeds germinated best without statistically significant differences at 11°C, 15°C, and 19°C. Extended storage resulted in (1) general loss of viability, (2) increase in the optimum temperature for germination, and (3) decreased temperature sensitivity, especially

decreased inhibition by higher temperatures. Altering temperatures did not generally increase the percentage of germination. These reactions are interpreted as ecologic adaptations, probably selected originally as desert conditions, but rendering the plants highly successful in disturbed areas throughout the southeastern U.S. The adaptation specifically allows establishment of seedlings in the autumn, and growth through the winter when competitors are virtually absent.

CHEMISTRY SECTION
Room 408, Hunter Hall
Raymond G. Wymer, Chairman

Investigations on the System UO₃-Li₂O-SO₃-D₂O; Liquid-Liquid Immiscibility and Critical Phenomena, 300-410°C.* Ernest V. Jones and William L. Marshall, Oak Ridge National Laboratory.

Temperatures for the appearances of critical phenomena (where liquid \equiv vapor) and liquid-liquid immiscibility were determined in the condensed system UO₃-Li₂O-SO₃-D₂O at concentrations of SO₃ from 0.05 to 1.0 molal, molal ratios, R= Σ (metallic oxides):SO₃, from 0 to 1.0 and at molal ratios, R(MO)=UO₃:Li₂O, of 3:1, 1:1, and 1:3. Critical phenomena were observed at temperatures from 374 to 410°C for solutions of R varying from 0 to between 0.2 and 0.5 depending upon R(MO) and the molality of SO₃. At higher values of R, boundaries of liquid-liquid immiscibility were observed at temperatures between 300 and 400°. As R approached unity and mSO₃ decreased, precipitation of a solid phase occurred before the temperatures of liquid-liquid immiscibility were reached. Based on these data and information obtained previously on the systems UN₃-SO₃-D₂O and Li₂SO₄-D₂SO₄-D₂O, isotherms were drawn to describe boundary limits of liquid-liquid immiscibility, critical phenomena, and appearance of solids in the system UO₃-Li₂O-SO₃-D₂O.

*This paper is based upon work performed at Oak Ridge National Laboratory which is operated by Union Carbide Corporation for the U. S. Atomic Energy Commission.

Effect of Pressure on Liquid-Liquid Immiscibility in The System UO₂SO₄-H₂O and Liquid-Supercritical Fluid Equilibria in The System UO₂SO₄-H₂SO₄-H₂O: 290-430°C, 75-1800 Bars.* James S. Gill and William L. Marshall, Oak Ridge National Laboratory.

By making use of a visual method, the effect of hydrostatic pressures up to 1800 bars in raising the temperature, in the vicinity of 300°C at saturation vapor-pressure, of second-liquid phase formation in the system UO₂SO₄-H₂O for solutions varying from 0.14 to 4.5 molal in UO₂SO₄ was found to be $+0.075^\circ$ per bar. One exploratory run each on a solution of UO₂F₂ and H₂O, and of CuSO₄, H₂SO₄ and H₂O, both of which show liquid-liquid immiscibility near 320° gave values of $(\partial t/\partial p)$ at constant composition of $\sim +0.10$ and $+0.11$, respectively. Since $(\partial U/\partial p)$ at a constant density of 0.712 for liquid H₂O at 300° is $+0.093^\circ$ per bar, the temperature of liquid-liquid immiscibility appears to show a strong dependency on solvent density, or more specifically on the dielectric constant times the absolute temperature which depends strongly on density. The effect of pressures up to 330

bars on the temperature of second-liquid phase formation from the supercritical fluid UO₂SO₄-H₂O near 400° was found also to correspond approximately to $(\partial U/\partial p)$ at constant density for H₂O at the same initial pressure, the value being in the vicinity of $+0.4^\circ$ per bar. In some additional experiments the vapor-pressures for the deliquescence of solid UO₂SO₄ hydrate were found to vary from 120 bars at 345° to 305 bars at 425°.

*This paper is based upon work performed at Oak Ridge National Laboratory, which is operated for the U. S. Atomic Energy Commission by Union Carbide Nuclear Corporation.

Hydrogen Isotope Effect on the Metalation of Thiophene. David A. Shirley and Kenneth R. Barton, University of Tennessee.

Currently experimental mechanisms for the reaction of metalation of aromatic substrates by *n*-butyllithium involve the breaking of the carbon-to-hydrogen bond in the rate determining step of the process. This should provide a hydrogen isotope effect, and a value of k_H/k_T of about 6 was found by Gronowitz and Halvarson, *Arkiv Kemi*, 8, 343 (1955). This value seemed too low for a protophilic attack by an incipient butyl anion, and the experimental results by the earlier workers seemed probably to be in error on the low side. We have redetermined the value for k_H/k_T and have also determined the k_H/k_D value with the results indicated. Also shown are calculated values for loss of the carbon-to-hydrogen bond stretching energy at the transition state.

	Found	Calculated
k_H/k_T	12-20	17
k_H/k_D	6.6 ± 0.3	6.6

These values are in line with the protophilic attack mechanism.

New Fluoride Compounds Predicted from Cation Size Considerations—Synthesis and Properties. G. M. Hebert and T. N. McVay, Oak Ridge National Laboratory.¹

Crystals of some ten new complex fluoride compounds, predicted to be equilibrium phases by Thoma,² were prepared and characterized. Intermediate compounds were crystallized from binary mixtures of the alkali fluorides with the alkaline earth fluorides, and from sodium fluoride with rare-earth trifluorides. As predicted, it was possible to prepare RbF·SrF₂, CsF·BaF₂, and CsF·CaF₂ at high temperatures from the components. Cubic and hexagonal NaF·MF₃ phases were also prepared, verifying the prediction³ that the NaF-YF₃ system is a model for the NaF-MF₃ (where M = Sm—Lu) systems. The existence of thirty new pure crystal phases in NaF-MF₃ systems may be inferred from the verification of the existence of 5 NaF·9SmF₃ and 5 NaF·9LuF₃ as well as from discovery of the occurrence of cubic and hexagonal forms of NaF·SmF₃ and NaF·LuF₃. Hexagonal forms of the 1:1 NaF·MF₃ compounds, NaF·LaF₃, NaF·CeF₃, and NaF·NdF₃, were also prepared.

Fusion and thermal gradient quenching experiments used in preparing the compounds are described. Thermal, optical, and x-ray diffraction data for some compounds were obtained.

Operated by Union Carbide Corporation for the U. S. Atomic Energy Commission.

²R. E. Thoma, *Inorg. Chem.* 1, 220 (1962).
³R. E. Thoma et al., *Inorg. Chem.* 2, 1005 (1963).
A Column Method for Measurement of Solubilities at High Temperatures. Solubility of Silver Chloride in HCl Solutions from 25 to 200°C. Richard J. Raridon and Kurt A. Kraus, Oak Ridge National Laboratory.

Packed column techniques and equipment which were used previously for ion exchange equilibria at elevated temperatures and high pressures have been adapted for the measurement of solubilities. The effluent from a column bed of radioactive salt was kept at the temperature of the column and analyzed in a flowing system by scintillation counting methods.

The solubility of AgCl has been measured from 25 to 200°C in HCl solutions from 0.01M to 3.06M. For $m_{HCl}=3.06$, there is an indicated sixtyfold increase in solubility from 25 to 200°C, while for $m_{HCl}=0.01$, there is an indicated seventeen hundredfold increase for the same temperature change. The apparent heats of solution for AgCl are found to be constant for each m_{HCl} ; the values ranged from 6.5 kcal for $m_{HCl}=3.06$ to 11.9 kcal for $m_{HCl}=0.01$.

Chemistry in Fused Salt Processing. M. R. Bennett, Oak Ridge National Laboratory.

Fused fluoride salt mixtures are suitable solvents for the high-temperature processing of nuclear fuels by volatility methods. In these solvents, uranium-bearing fuel elements can be dissolved by gaseous hydrofluoride, and more than 99.9% of the dissolved uranium can be recovered from the solvent as volatile UF₆ by direct fluorination.

Dissolution rates of various metals and metal oxides are directly related to HF solubility. In some cases, dissolution proceeds either by acid-metal reaction or by metathesis with certain of the fluoride salt constituents. For example, thorium reacted with ZrF₄ at 600°C in a salt mixture of 34-26-40 mole percent LiF-NaF-ZrF₄.

Due to the corrosivity of HF and F₂ gases, special container materials are required. Nickel and Inor-8 are among the more suitable. Also, cathodic and hydrogen protection are being studied as possible means of decreasing corrosion.

ENGINEERING SECTION
 Room 208, Hunter Hall
 James B. Delano, Chairman

Current Trends in Engineering Materials Education. Ben. C. Sparks, The University of Tennessee.

One of the fastest-moving changes taking place in engineering education today is in the field of engineering materials, or materials science. This can be attributed to two stimuli: the advanced research connected with the needs of modern engineering, and the relegation of routine materials testing to competent engineering technicians.

The first apparent trend in modern engineering materials courses is to include materials other than linear elastic materials, such as plastic, viscoelastic, and thixotropic. The second most important trend is that material behavior is now explained on the basis of inter-

atomic forces, intermolecular bonds, and elementary dislocation theory. Moreover, complex states of stress, both two-dimensional and three-dimensional, are considered, and the accepted theories of failure are discussed. Time and temperature dependencies also are treated. Noticeable in its absence is the study of production processes.

The Goals of Engineering Mechanics Courses in Modern Engineering Curricula. A. Mathews, University of Tennessee.

In order to understand the current situation and trends in engineering education one must have some appreciation of the historical event called the "Industrial Revolution" and must accept the fact that the world is now in the midst of a similar event termed the "Technological Revolution". Although it may seem that engineering curricula are the whims of university faculties, they are indeed the response to the economic, social, and technical demands of our society.

Engineering Mechanics which includes the study of solid and fluid mechanics and the nature and properties of materials constitutes a firm foundation for engineering design, research and development. It is the responsibility of those who teach mechanics to select and present the contents of their courses so as to prepare all engineering students to complete satisfactorily their formal studies and to continue their professional development after graduation. In addition all engineering curricula, including mechanics, must be flexible to keep abreast of the rapid changes of the "Revolution".

Engineering Aspects of the ORNL Approach in Controlled Thermonuclear Research. J. F. Potts, Jr., Oak Ridge National Laboratory*.

ORNL is one of the four large research centers at which the USA CTR effort is concentrated. The present efforts involve various approaches to confining, heating and sustaining a sufficiently hot collection of light isotopes, such as deuterium and tritium, that the vast controlled fusion energy conversion potentiality can be demonstrated. At Oak Ridge we are concentrating mostly on direct current approaches to the problems, employing high energy particle injection and trapping in a large high density magnetic field in a high vacuum region.

Some of the basic problems of physics and engineering will be reviewed in connection with describing the major research machines employed at Oak Ridge, such as DCX-1, DCX-2 and ELMO.

*Operated by Union Carbide Corporation for the U. S. Atomic Energy Commission.

Demonstration of the Disposal of Radioactive Waste in Salt. W. J. Boegly, Jr., Oak Ridge National Laboratory*.

The culmination of the ORNL studies on the disposal of radioactive wastes into underground salt formations is the design, construction, and operation of a field demonstration in a Lyons, Kansas, salt mine. This experiment will use 14 Engineering Test Reactor fuel assemblies to simulate the heat and radiation anticipated in solidified wastes to be produced by the proposed high-level waste treatment processes. The canned fuel assemblies will be transported in a shielded

carrier to the mine, lowered unshielded down a specially constructed waste shaft to a mobile underground transporter, and transferred to storage holes in the mine floor. The experiment will last for two years, during which time the fuel assemblies will be exchanged for fresh elements three times to increase radiation dosage to the salt and check out handling equipment. The design of the handling systems, the experimental layout, and the anticipated results will be presented.

*Operated by Union Carbide Corporation for U. S. Atomic Energy Commission.

Some Aspects of Granular Hopper Flow. Robert M. LaForge, University of Tennessee.

This is a study of the movement pattern of granular free-flowing materials within a bin as particles approach a hopper opening and are discharged by gravity. Contrary to popular opinion it has been found that there is movement of particles along the surface of the hopper adjacent to the discharge point, and that the rate of this motion is influenced by (1) the slope (measured from the horizontal) of the hopper surfaces, and (2) friction between the particles and the hopper surface. When these factors retard the movement of particles toward the opening because of low values of hopper slope or high friction coefficient, or both, the main stream of vertical discharge through the opening experiences less interference around the periphery due to particles moving from the sides. The result is a larger effective area of opening and a corresponding increase in rate of discharge.

Counter-current Liquid-Liquid Extraction by Exploiting the Induced Underflow Effect in the Stacked-Clone Contactor. M. E. Whatley, Oak Ridge National Laboratory.

The induced underflow effect, an inherent characteristic of liquid cyclones which amounts to a counter-current flow at the underflow port, forms the basis for a new kind of liquid-liquid solvent extraction contactor. This contactor, the stacked-clone contactor, employs hydroclones (liquid cyclones) and pumps in a cascade. The high shear field, the high centrifugal field, and the natural circulation pattern of the hydroclones work together to form an effective extraction stage without requiring gross settling. Experimental models have been built to explore design parameters. A unit with a 1.5-in.-1D hydroclone, a stage length of 5 in., and a recirculating rate per stage of 3 gal/min will develop between 60 and 80% stage efficiency at a total throughput of 4 liters/min, extracting uranyl nitrate from a 1M sodium nitrate aqueous solution into 18% TBP in Amsco. The residence time per theoretical stage is less than 4.5 sec in the experimental unit, and residence times less than 2.5 sec are feasible. The stacked-clone contactor may be employed in the processing of very highly radioactive solutions where radiation damage to the solvent is significant.

Cryogenic Vacuum Pumping and its Application at High Flows. J. R. Milillo and C. C. Prunty, ARO, Inc., Arnold Air Force Station.

High altitude testing of propulsion systems requires large volumetric pumping rates for small mass flows of propellant gases. Three types of pumps in general

use for obtaining pressures below one atmosphere are rotary, diffusion and ejector pumps. The mass flow capability of these pumps at low pressure is very small. A cryopump provides a simple and efficient means for obtaining the high volumetric flow rates required for high altitude testing. The cryopump depends on the effective removal of a gas by its solidification on the surface which is cooled by a cryogenic fluid. Commonly used cryogenic fluids are liquid hydrogen, liquid nitrogen and both gaseous and liquid helium.

A cryogenic system capable of propulsion testing at simulated altitudes of 300,000 feet is the Cold Wall Vacuum Chamber at the Propulsion Wind Tunnel Facility of the Arnold Engineering Development Center. The Chamber has 130 square feet of liquid nitrogen cooled surface area giving a pumping capacity of two million cubic feet per minute.

GEOLOGY-GEOGRAPHY SECTION
 Room 306, Hunter Hall
 Helmut Wedow, Jr., Chairman

Some "Lost" Tennessee Mineral Localities. Robert A. Laurence, U. S. Geological Survey, Knoxville.

Deposits of beryl in Greene County, fluorite in Cumberland County, tetrahedrite in Monroe County, and cerussite in Campbell County have been reported in the literature, but attempts to verify these have been unsuccessful.

False Fronts on Limestone and Dolomite Bluffs in the Tennessee Valley Area. John M. Kellberg, Geological Branch, Tennessee Valley Authority.

In the Tennessee Valley many limestone and dolomite bluffs along major streams, especially those on the undercut slopes of bends, prove to be only veneers of rock behind which solution has progressed to depths that may extend lower than the adjacent stream channel. Among the possible causes for the development of these false fronts are: (1) rapid runoff of water over the exposed face while behind it slow percolation of ground water results in solution; (2) case-hardening of the bluff face on exposure to the atmosphere; or (3) a combination of (1) and (2). The attitude of the bedding apparently is not a controlling factor.

In the Tennessee Valley area experience has proved the necessity for thorough sub-surface exploration well behind the face of limestone and dolomite bluffs before approving them for dam abutments, bridge abutments, or quarry sites.

The Availability of Ground Water in the Western Highland Rim, Tennessee. Gerald K. Moore and Roy H. Bingham, U. S. Geological Survey, Nashville.

The Western Highland Rim of Tennessee includes, for the purposes of this report, 10 counties east of the Tennessee River and is underlain mostly by limestones, cherts, and siltstones of Mississippian age. The source for nearly all ground water in the Mississippian formations is local precipitation. The direction of ground-water movement is from the uplands toward the valleys, then down the valleys, and sooner or later the ground water is discharged into surface streams.

An inventory of selected wells in the Western Rim indicates that the factors which determine ground-water

occurrence and productivity are:

(1) Thickness of the residuum overlying the bedrock—this factor has a direct relationship with the amount of water which is stored in the residuum and which supports pumping from wells in the dry summer and fall months.

(2) Type of bedrock—whether the rock is soluble or insoluble. If the formations are relatively insoluble, most ground water occurs in the residuum.

(3) Depth below land surface—very little potable water is found below 300 feet.

(4) Topography—the broad uplands and wide stream valleys are the most productive areas for ground water.

and (5) Structure—usually more water is found in structural lows than in structural highs.

The yield of most springs in the Western Highland Rim is less than 50 gpm (gallons per minute) but a few springs yield more than 1000 gpm. These yields are an indication of the amount of water which probably could be obtained from wells in favorable nearby areas. Large amounts of water can be obtained from wells in the Western Rim but large amounts cannot be obtained everywhere.

Regional Unity of Middle Tennessee. Milos Sebor, Tennessee Polytechnic Institute.

An attempt is made to verify the physical and socioeconomic equilibrium of the central part of Tennessee and to evaluate its present practical meaning. Does this area actually possess a coherence that would permit us to call it a geographic region?

Several concepts of Middle Tennessee are brought to discussion, such as legal and administrative definitions, the US Census divisions, climatic and physiographic provinces, and the common concept, based upon historical tradition.

Geographic inquiry oriented to an applied earth science reveals the presence of several agencies working against the unity of this area. Middle Tennessee belongs to two major physiographic provinces—Central Uplands and the Appalachians; the climate is to a great extent under topographic control; geographic influence of Nashville goes beyond the limits of Middle Tennessee; and two other conurbations, Knoxville and Chattanooga, located outside, act as peripheral centrifugal factors. Only the core part, the Nashville Basin, represents a clear-cut physical and socioeconomic subregion.

But it is rather the need for meaningful and manageable planning regions that breaks the unity of Middle Tennessee, a spatial division with very limited administrative functions which remains, today, a historical expression of regional consciousness.

Facies Relations of Rome Formation and Conasauga Group of Tennessee to Equivalent Subsurface Rocks in Kentucky and Virginia. Leonard D. Harris, U.S. Geological Survey, Knoxville.

The Rome Formation and Conasauga Group or Shale were deposited in a northwest transgressive phase of the Early, Middle, and Late Cambrian seas in Tennessee, Virginia, and Kentucky. These formations crop out in southwestern Virginia and adjacent parts

of Tennessee but are not exposed in Kentucky. Data from deep test wells in central and eastern Kentucky show that sandstone of the Rome is, by lateral gradation, a facies equivalent of approximately the lower half of the Conasauga Group of northeastern Tennessee. The Rome probably ranges in age from Early Cambrian in eastern Tennessee to Middle Cambrian in central Kentucky.

Elevation of the Chickamauga Limestone to Group Status in East Tennessee. George D. Swingle, University of Tennessee.

A maze of stratigraphic nomenclature has gradually evolved for rocks of chiefly Middle Ordovician age, but including also beds of Upper Ordovician age, in East Tennessee. No fewer than 59 names including group, formation, member, lithologic unit and non-committal terms have been applied to the rock sequence. With additional detailed study of these rocks, characterized by marked facies changes across and along strike, it is reasonable to assume that many new names will be proposed and that additional names from other areas will be applied here thus adding to the existing complexity. In an attempt to bring some order out of this confusion, it is proposed that a framework be erected into which the controversial rocks with their numerous problems of subdivision and nomenclature can be grouped. It is proposed that the rank of the well established Chickamauga formation be elevated to group status including all of the sequence between the Knox Group and the Sequatchie (or Juniata) formation.

The Geophysical Log: A Valuable Tool in Studying Underground Rocks. Roy H. Bingham and Gerald K. Moore, U.S. Geological Survey, Nashville.

Geophysical logging is one of the primary methods of exploring drilled wells. Geophysical logging in Tennessee usually consists of obtaining electric or gamma-ray logs of wells, although several other types of logs may be made commercially.

Electrical logs record the self-potential and the resistivity values of rocks in terms of depth; the gamma-ray log measures the natural radiation given off by radioactive minerals in the rock layers. These logs are influenced by many different properties and the differences in the properties of various rock formations are indicated on the log. Contacts between different types of rocks are usually shown in detail because of variations in their properties.

Geophysical logs may be used to locate and define subsurface formations because the logs provide an accurate and detailed record of the boundaries between rock units. In subsurface geologic studies the logs are especially useful in determining the depth, thickness, areal extent, and structure of formations. The number of logs needed for adequate subsurface coverage varies according to the complexity of the geology and the accuracy which is needed for any particular project or program.

Geologic Features Related to the Post-Knox Unconformity in Sequatchie Valley, Tennessee. Robert C. Milici and Helmuth Wedow, Jr., Tennessee Division of Geology, Knoxville, and U.S. Geological Survey,

Knoxville.

The Sequatchie anticline in Sequatchie Valley, Tennessee, exposes about 800-1,000 feet of Knox Group (Upper Cambrian and Lower Ordovician) overlain unconformably by Murfreesboro Limestone (Middle Ordovician). Erosion channels or sinkholes on the Knox are filled with impure limestone, dolomite, and Knox are filled that are pre-Murfreesboro in age. The calcareous shale that are pre-Murfreesboro in age. The upper 400 feet of the exposed Knox strata is thick-bedded, fine-grained dolomite which overlies interbedded massive calcilitite and fine- to coarse-crystalline dolomite. Coarse breccias near the contact between these units are believed to have formed by collapse resulting from deep solution related to the Early Ordovician karst-producing conditions indicated by the sinkholes at the top of the Knox. Similar deep-solution karst features occur in the upper part of the Knox Group elsewhere in the southern Appalachian Valley, generally where thick-bedded, fine-grained dolomite is underlain by a significant thickness of massive limestone.

MATHEMATICS SECTION

Room 303, Hunter Hall

Ralph C. Boles, Chairman

The High School JETS Program. Richard Wright, Tennessee Polytechnic Institute.

An Experimental Study with Programmed Instruction. James F. Key, Middle Tennessee State College.

Programmed instruction as a way of teaching has provoked considerable controversy in recent years. Its role in pedagogy, though far from crystallized, may be firming up as a result of extensive classroom research now underway.

The author is involved in an experimental study at Middle Tennessee State College using an empirically developed programed booklet on quadratic equations. A preliminary study was conducted at the Demonstration School, George Peabody College for Teachers, to provide the empirical basis for the booklet. The experimental study, underway at the freshman college level, seeks to answer some of the questions concerned with the nature and potentialities of programed instruction in the teaching of mathematics.

Concerning High-Subgroups. Reginald Mazeret, Tennessee Polytechnic Institute.

In an Abelian p-group, G' is defined to be the subgroup consisting of all elements of infinite height. A High-Subgroup H is defined to be a Subgroup Maximal with respect to the property H intersection $G'=0$.

This paper proves that if an Abelian p-group has exactly p High-Subgroups, then all of the High-Subgroups are isomorphic.

*A Mathematical Model of Hypervelocity Impact** Ray Kinslow**, Tennessee Polytechnic Institute.

A mathematical model is derived for a better understanding of the nature of fractures caused by hypervelocity impact. A digital computer is used to determine the values of stresses produced by spherical stress waves in solid targets as a result of impact.

*Supported by the Arnold Engineering Development Center, AFSC, USAF, under Contract No. AF 40 (600) 1000 with ARO, Inc.

** Consultant, ARO, Inc., Arnold Engineering Development Center.

Relative Importance of Different Subjects in Mathematics to Practicing Engineers as Determined by a Questionnaire Survey. Walter W. Graham, Vanderbilt University.

Summary of conclusions: Concerning the 20 subjects listed in the questionnaire the data received showed that certain subjects in mathematics are of significantly more importance to practicing engineers than are other subjects. This relative importance varied from one division of engineering practice to another. Mathematics as a whole was significantly more important to Electrical Engineers than to Civil, Chemical or Mechanical Engineers.

MEDICAL SCIENCE SECTION

Room 209, Hunter Hall

Allan Bass, Chairman

*The Presence of a Cholate Activated Lipase in Dog Serum**. William Traxel, Robert L. Hamilton, Jr., and Virgil S. Lequire, Vanderbilt School of Medicine.

The immediate appearance of clearing factor lipase (CFL) or lipoprotein lipase in the plasma of man and experimental animals following intravascular heparin injection is well documented. Bile salts have been reported as inhibitory to this lipase system. During a study of CFL inhibitors, it was observed that the addition of sodium cholate to dog post-heparin plasma augmented rather than inhibited lipolytic activity. Subsequently, it was found that addition of commercial bile salts to normal dog serum *in vitro* resulted in the appearance of lipolytic activity. Neither bile salts nor serum showed evidence of lipolytic activity when tested singly. Serum alone released less than 1.0 mEq/L/FFA/45 minutes whereas the addition of bile salts to serum released an average of 20.34 mEq/L/FFA/45 minutes. Activity was found in the dog and cat, but not in the rat, rabbit, goat or human. The assay system which supported linear kinetics during the incubation period consisted of a triglyceride substrate, a FFA acceptor and a suitable buffer.

Factors to be discussed include the activating ability of different bile salts, activating concentration of bile salt, pH optimum, inhibitors, the use of various substrates, heat lability, and possible physiologic significance of the cholate activated lipase (CAL) of dog serum.

*This investigation was supported in part by PHS HE-01570-10 from the National Heart Institute.

Six Years of Bio-medical Studies at TPI. Wm. G. Downs, Jr., Tennessee Polytechnic Institute.

Beginning in the spring of 1957 various studies, primarily in the area of the effects of physiological stress on the blood, blood-forming organs and endocrine system, have been conducted by a succession of superior biology "majors", both undergraduate and graduate students.

Results have been presented at a number of national scientific meetings and in State Academies of Science, including this one, with publication of papers and abstracts in appropriate journals.

Of the students involved in these studies, sixteen have gone on to graduate work in anatomy, pharmacology or physiology, and twelve others are working

as research assistants or responsible technicians in research in related fields. Nine graduate students are at present in these departments at Vanderbilt, as are three research assistants. Other medical schools where such students are now in residence are the University of Mississippi, University of Kentucky and Louisiana State University.

It is believed that this experiment points a way to providing much-needed research-scholars and teachers in medical science, and would merit detailed study by national scientific bodies.

Autochthonous Hydatid Disease in Tennessee. B. H. Webster, M.D., 420 Mid State Medical Center, Nashville.

Hydatid Disease is not an unfamiliar disease in North America, but occurs most frequently in immigrants or in those who have acquired the infection in endemic areas abroad.

Only 40 well-documented cases of autochthonous Hydatid Disease in the United States have been found in the medical literature. The cosmopolitan distribution is discussed. No published reports from Tennessee have been found. However, the disease is not reportable. The Statistical Division of the Tennessee Department of Health reports no mortality from Echinococcosis in the past 10 years.

The taxonomy, life cycle, parasitology, morbid anatomy, prognosis, and therapy are outlined.

Three well-documented cases from Middle Tennessee are presented.

It is likely that Hydatid Disease is more prevalent than is suspected. Cognizance of this disease entity and more search for such endozoic disorders may be rewarding to clinicians.

2 x 2 slides showing the parasite in toto, scolices, daughter cysts, primary and secondary hepatic and pulmonary lesions will be shown.

Pulmonary Microcirculation as Seen by Soft X-Rays in Vitro. James E. Leathers, John T. Reeves and Mervyn B. Quigley, University of Kentucky Medical Center.

Contact microradiography is a relatively new technique which has recently been applied to the study of the pulmonary microcirculation by the present authors. The lungs of healthy young adult rabbits were injected via the pulmonary artery and/or the pulmonary veins with a fine suspension of barium sulfate and fixed in formalin. Fifty to one hundred μ thick slices of these injected lungs were floated on to a fine grain photographic emulsion. This emulsion is capable of resolving 2000 lines/mm.. The resultant microradiogram was examined under a light microscope. By this technique, pulmonary arterioles were clearly visualized, as was their drainage into the capillaries and the pulmonary venules.

The arterioles generally showed a progressive decrease in size from large vessels to capillaries. Arteriolar branching occurs at relatively constant intervals and usually at right angles from the parent vessels. These latter branches are short and break up into capillary nets. Capillary networks originated from one or more arteriole "feeder vessels" and branched and anastomosed

around several alveoli before emptying into small venous radicals. The venules characteristically joined the larger veins at acute angles. In contrast to the orderly decrease in size of the vessels on the arterial side as they formed the capillary beds, the capillaries joined immediately to form relatively large vessels on the venous side.

These preliminary observations have shown clear differences in the anatomical arrangement of the pulmonary arterial and venous systems. Furthermore, the capillary networks are arranged in such a manner that it seems likely that a single red blood cell may have to traverse several alveolar nets in its passage from arteriole to venule.

It is clear that microradiography is a potentially important tool in the study of the microcirculation.

Studies of the Effect of Calcium Deficiency on Pentobarbital-Induced Sleeping Time in the Rat. Paul Joiner and Leon Hurwitz, Vanderbilt School of Medicine.

Month-old male rats were fed a calcium-free test diet for one month. Similar rats were pair-fed the standard Purina rat chow. At the end of this time, the "low-calcium" rats showed typical signs of calcium deficiency, although at no time were there signs of tetany.

After a month on the different diets, each group of rats was given 20 mg Pentobarbital Sodium/Kg i.p. The 20 rats on the calcium-free diet slept an average of 58.2 ± 5.5 (S.E.) minutes as compared with an average of 26.0 ± 2.7 (S.E.) minutes for the pair-fed controls.

Barbital did not have this difference in sleeping time for the two groups.

Administration of EDTA, which complexes divalent cations, lengthened the pentobarbital sleeping time in normal adult male rats. When calcium gluconate was given along with the barbiturate, the sleeping time of the EDTA-dosed rats was shortened.

*Hydrolysis of Lactoylcholine (LCh) and Acetylcholine (ACh) by Horse Serum Cholinesterase**. Eve C. White and B. V. Rama Sastry, Department of Pharmacology, Vanderbilt School of Medicine.

Published literature of the cardiovascular dynamics of cholinesters and atropine-like agents, the naturally occurring cholinesters and the specificity of cholinesterases (ChE), indicates that the parasympathetic neuro-transmitter may be a mixture of cholinesters. LCh may satisfy the requirements of one of the transmitters (Sastry et al., 130:346, 1960). Therefore, the reaction kinetics of the hydrolysis of DL-LCh and ACh by purified horse serum ChE have been studied by standard Warburg techniques, and the activity-pS curves have been compared. The pS-activity curve of DL-LCh is bell-shaped with a pS optimum of 2.0. This indicates that DL-LCh would inhibit the enzyme at high substrate concentrations. The activity-pS curve of ACh does not exhibit a pS optimum between the pS values (3.0-1.5) studied in the present investigation. At pS 2.0 DL-LCh is hydrolysed at a rate 3.5 times faster than that of ACh by horse serum ChE. Our results indicate that there are significant differences in the interaction between the active groups of ChE and

those of LCh and ACh because the activity-pS curve of ACh intersects that of DL-LCh.

*Supported by USPHS Research grant No. 1 R01 NB-04699-01. *Factors Affecting the Renal Excretion of Cs¹³⁷ in the Dog**. Mary B. Martin and B. V. Rama Sastry, Vanderbilt School of Medicine.

Cs¹³⁷ forms during uranium and plutonium fission, and is one of the hazardous by-products of various uses of nuclear energy. Therefore, we have investigated the factors influencing the renal excretion of Cs¹³⁷ to find methods to increase its excretion. Adult female mongrel dogs (8-12 kg) were anesthetized with pentobarbital (initial dose 35 mg/kg, i.p.; maintenance dose 35 mg/kg, i.v.; during 6 hours), and Cs¹³⁷ was administered through the left femoral vein. Blood and urine samples were collected from right femoral vein, and both of the cannulated ureters respectively. Our results indicate that loading the dogs with sodium chloride raises the serum level of Cs¹³⁷ and also increases its excretion. The excretion pattern of Cs¹³⁷ administered as a solution in isotonic saline differs from Cs¹³⁷ administered in isotonic Cs¹³⁷Cl. Ace-tazoleamide (AZ) (250 mg/kg) increases the excretion of Cs¹³⁷ which could be blocked by meralluride (26 mg/kg) indicating that AZ increases Cs¹³⁷ secretion in the dog.

*Supported by AEC contract No. AT-(40-1)-3066.

PHYSICS-ASTRONOMY SECTION

Room 307, Hunter Hall

Brother George Carney, Chairman

*The Determination of Plasma Temperatures**. Ray Hefferlin, Southern Missionary College.

Operational definitions of "plasma" and "temperature" are suggested, and a review of the various direct and indirect methods of measuring plasma temperatures is given. Limitations and variations of these methods are pointed out and illustrated with examples from areas of physics currently of interest. The use of the relative emission line intensity method to obtain temperatures from free-burning arcs and from a seeded plasma jet is described as a final example and as a report of work being done at this laboratory.

*Supported by the National Science Foundation. *Regular Solids in N Dimensions.* Cecil G. Phipps, Tennessee Polytechnic Institute.

In one dimension, a line segment can have any positive real number as its length. In two dimensions, a regular polygon can have any positive integer as the number of its sides. In three dimensions, there are only five regular solids. Space of any higher dimension always has two such regular solids. The two-dimensional triangle can be extended to the three-dimensional tetrahedron with triangular faces. Likewise, solids can be extended to any number of dimensions. This paper discusses the properties and relations of these figures. The circle and sphere can also be extended to higher dimensions. The formulas for the volumes and surfaces of these are given.

Search For Ultra Short Period Variable Stars. Edward W. Burke, Jr., King College.

During the summer of 1963 a search was made for variable stars with periods less than four hours at

Louisiana State University. The observatory at L. S. U. houses a twelve inch refractor telescope which was utilized to work out a scheme for roughly and quickly determining the period of a variable photographically. When the equipment had been put in order and tested to assure that it would detect this variability, a systematic study was made of fourteen suspicious stars. None of these was a variable with a period as short as the type sought.

Phase Shift Analysis of Differential Scattering of Neutrons from O Spin Nuclei. Mary J. Mader, J. F. Agnew*, and J. L. Fowler, Oak Ridge National Laboratory.

A Fortran code, written to compute differential cross sections for neutron scattering from O-spin nuclei as a function of scattering phase shifts up to $g_{7/2}$, has been incorporated into a search routine to obtain a fit to experimentally measured cross sections. The resulting combined code which averages the theoretical curves over the energy spread of experimental measurements uses matrix operations to adjust several phase shifts simultaneously in order to arrive at a minimum in the sum of the weighted squares of deviations between experimental points and theoretical values. The good resolution differential cross section measurements of neutrons scattered from Pb²⁰⁸⁽¹⁾ are being analyzed with this code. If as many as four scattering phase shifts are adjusted simultaneously, it is necessary to be very close to the minimum in order to have the calculations converge.

*Co-op student from Virginia Polytechnic Institute, Blacksburg, Virginia.

J. L. Fowler, *Bull. Am. Phys. Soc.* 8, 82 (1963).

Acceleration of Projectiles by Pulsed Magnetic Fields. F. L. Culp, Tennessee Polytechnic Institute.

An investigation to determine the significant parameters involved in the acceleration of metallic projectiles when subjected to pulsed magnetic fields was conducted. Cylindrical shaped projectiles of aluminum and brass were employed in this investigation. The pulsed magnetic fields were produced by discharging a bank of condensers through coils of various inductances. With bank energies on the order of 10¹⁰ ergs peak fields on the order of 10⁵ gauss were produced, resulting in projectile velocities of 200 to 1600 cm./sec. for projectiles whose mass values lay in the range of 5 to 80 grams. It was found that for projectiles of a given metal and for damped oscillating magnetic fields velocity varies directly with the peak magnetic flux and inversely with the logarithmic decrement. It was found also that velocity varies directly with the diameter of the projectile cross section when all other factors are held fixed. These results were shown to be consistent with the predictions of simple energy considerations.

The Study of Physics at Austin Peay State College. M. R. Mayfield, Austin Peay State College.

A mild play on words is employed in a description of the acquiring of space and furnishings for the Physics Study and Reading Room presently in early use at Austin Peay State College. Student response to this unique facility is discussed briefly as are some as-

pects of the recently instituted SUPER (Special Undergraduate Physics Experimental Research) Plan.

ZOOLOGY SECTION

Room 407, Hunter Hall

Richard Stevenson, Chairman

The Anatomy of the Phoenix. Perry C. Holt, Virginia Agricultural Experiment Station, Virginia Polytechnic Institute, Blacksburg.

The theme of the XVth International Congress of Zoology was "The reunion of Zoology from its separate specialties". All phases of zoology were covered in plenary sessions, symposia, and sections of contributed papers. Five percent of the approximately 700 papers presented at the Congress were devoted to zoogeography. An attempt to relate zoogeography to the other zoological specialties reveals that the data of zoogeography is primarily non-zoological. These data are those of geology and geography. Zoogeography, however, in turn contributes its findings in an important way to the central specialties of zoology. Zoogeography is an important part of the anatomy of the Phoenix; if excised, the bird would perhaps survive, but it could not fly.

Some selected examples show that information concerning the distribution of little studied invertebrate groups is one of the most important remaining contributions which zoogeography can make to zoology.

Chromosomal Polymorphism in Drosophila Robusta Populations on Unaka Mountain, Tennessee. Herbert C. Armentrout, Oak Ridge National Laboratory and East Tennessee State University.

Salivary chromosome analysis was made of 812 F₂ female larvae from wild females of *D. robusta* collected at 15 stations on Unaka Mountain, Tennessee. The complete structural karyotype was determined for each of the female larvae from which the mean index of free crossing over was calculated for the sample taken at each collecting station.

Several of the samples of *D. robusta* from Unaka Mountain showed a relatively high degree of free recombination, which characterized them as either marginal or intermediate populations in spite of the fact that the Unaka Mountain area is well within the center of the range of the species. With some exceptions there were indications that the amount of free recombination increased at higher altitudes. The effects of the changed ecology in the Unaka Mountain area were also suggested as contributing factors for the increased amount of free recombination.

Studies in Crossing over in Hybrids of Drosophila Virilis and Drosophila Americana. Richard Stevenson, East Tennessee State University.

Among some species of *Drosophila* there appears to be a relationship of centromere-number and total genetic length of the chromosome complement. *D. melanogaster*, for example, with its eight centromeres, has a total genetic length of 280 map units. *D. virilis*, with 12 centromeres, has a total genetic length of 788 map units.

The present study was undertaken to test the hypothesis that there is increased linkage with decreased centromere-number. A series of crosses involving the

two closely related species, *D. virilis* and *D. americana*, and their hybrids yielded females homozygous for the *virilis* fifth chromosome, and having in their karyotypes 11, 10, 9, and 8 centromeres. The *virilis* fifth chromosomes were heterozygous for a series of mutants. Backcrosses of these hybrid females to *virilis* males homozygous for the mutants yielded linkage data that clearly showed a linear relationship of centromere-number to the genetic length of the chromosome segment carrying these mutants.

The exact nature of this "centromere effect" is still being investigated, but the results of the experiments are the basis of some speculations regarding its evolutionary significance.

Intergradation in the Ringneck Snake, Diadophis punctatus (Linnaeus), in Eastern Tennessee. R. M. Johnson and J. F. Webb, Tennessee Polytechnic Institute.

Blanchard in 1942 included the ringneck snakes of eastern Tennessee in the subspecies *Diadophis punctatus edwardsi*, and subsequent authors have accepted this designation. Johnson in 1958 presented evidence that the population of ringneck snakes of eastern Tennessee, especially the portion south of the Little Tennessee River, is taxonomically intermediate between *D. p. edwardsi* and *D. p. punctatus*. This paper presents data from additional samples of ringneck snakes from eastern Tennessee. These data corroborate the earlier work of Johnson and support the contention that the ringneck-snake population of southeastern Tennessee is best designated as *D. p. punctatus* x *p. edwardsi*.

*Immunoelectrophoresis in Taxonomic Studies—A Preliminary Report**. Charles W. Foreman, University of the South.

Anti-mouse serum was produced by three successive injections two weeks apart of 1 cc of *Peromyscus gossypinus* serum plus 5 cc of Freund's complete Ajuvant intramuscularly into a rabbit. The sera of *Sigmodon hispidus*, *Tamias striatus*, and five species of *Peromyscus* were compared immunoelectrophoretically using the above antiserum. About 12 precipitin arcs were distinguished in *P. gossypinus* sera, and the number of arcs decreases as phylogenetic relationship becomes more remote, with *Tamias* producing a single peculiarly shaped precipitin arc.

*This work was done at Pfeiffer College, Misenheimer, North Carolina and was supported by the National Science Foundation—NSF-G17636.

Uptake and Elimination of Cobalt-60 by Crayfish. C. Wymer Wiser and D. J. Nelson, Middle Tennessee State College and Oak Ridge National Laboratory.

Comparative studies of Co⁶⁰ uptake by living and dead crayfish (*Cambarus longulus longirostris* Ort.) indicated about one-half of the accumulation was by adsorption and one-half by absorption. Most of the absorbed Co⁶⁰ was deposited in the exoskeleton and 95% of the body burden was lost at molting. Large animals accumulated more Co⁶⁰ than small ones but the uptake per gram was greater in the small crayfish, indicating the importance of surface adsorption phenomena.

Rates of accumulation, measured by biological half-

times, were 70 hours for small animals and 66 hours for large ones living in a continuously renewed medium. The half-time for accumulation by dead crayfish was about three times that for live crayfish.

The half-times for elimination by crayfish dosed by solution exposure were 37 days for small and 70 days for large ones. Elimination by crayfish dosed by injection was more rapid.

Cobalt-60 occurred at low and equal levels in blood, muscle, and gonads while higher concentrations were found in the gut, hepatopancreas and integument.

The Effects of Rotenone on Aquatic Insect Populations and the Evaluation of their Recovery. James D. Little, Tennessee Polytechnic Institute.

In October, 1962, a trout management research program was initiated with the application of rotenone, in sufficient concentration to eradicate all fish populations, in Pine Creek, Dekalb County, Tennessee. Because of the importance of aquatic insects as food organisms to trout, it was considered necessary to evaluate the effect of this application of rotenone on the insect populations. The bottom-dwelling insect populations were sampled before, one week after, and one year after the rotenone was applied to the stream. This paper presents a comparison of the qualitative and quantitative analyses of these samples.

Some Notes on the Hemoglobins of the Developing Chick Embryo. R. C. Fraser, University of Tennessee.

There are two hemoglobins in the 5-day chick embryo as determined electrophoretically. One of these is unlike any found in older embryos. Starting in embryos of 7 days of incubation (at the time when erythrocytes of the definitive cell line appear) the number of hemoglobins increases to three, a number maintained throughout the remainder of development. There are, however, changes in relative concentration of these proteins during embryogeny.

One of the hemoglobins changes its ionic nature rather sharply with a change in pH. Its position changes in relation to one of the other hemoglobins, when subjected to electrophoresis at both low and high pH.

A preliminary examination has revealed different amino acid constitutions of the three hemoglobins. Presumably the "fickle" respiratory protein contains an amino acid with an exposed side group with a pK value between 6 and 7.

The Toxicity and Storage of Some Pesticide Residues in Chick Embryos. O. L. Adams and J. M. Mallette, Tennessee A. and I. State University.

We are investigating the teratogenic effects of various chlorinated hydrocarbons and phosphorus containing pesticides injected into the yolk sac prior to and during incubation. Our preliminary observations indicate the following aberrant effects: lack of differentiation of various organs (liver, spleen, thymus), absence of eyes, and twisted beaks. These effects were noted only in 5% of the animals injected. Ninety-five per cent of the animals were normal when hatching occurred and have developed to maturity. Fertile eggs which were injected with the solvent used to dissolve the compounds and uninjected fertile eggs were used as controls.

The Role of Phenothiazine, Compazine and Thora-

zine on the Development of Chick Embryos. J. M. Mallette and O. L. Adams, Tennessee A. and I. State University.

Injections of the three teratogenic agents prior to and during incubation induced the following anomalies: non-cartilaginous limbs, malformed eyes and abnormal vascular pattern throughout the viscera. Some 15% of the chicks with these deformities have hatched and survived to maturity.

The respective LD₅₀ doses at 48 hours of incubation were (1) phenothiazine between 18.75 and 25.00 mg/egg weight, with a mortality rate of 98%±0.01; (2) compazine 15.00 and 20.00 mg/egg weight, with a mortality rate of 70%±0.03; (3) thorazine 20.00 and 28.00 mg/egg weight, with a mortality rate of 55%±0.03. All injections were made into the yolk sac. Uninjected eggs and fertile eggs injected with the solvent of each tranquilizer were used as controls.

A Study of the Teratological Effects of Vitamin A and Trypan Blue Used in Combination. R. D. Blevins and T. M. Johnson, King College.

Studies of teratological defects have been hampered by the high embryonic reabsorptions. High dosages usually prove lethal. Mild dosages do not cause a significant abnormality rate. Both Vitamin A and Trypan Blue have been used as teratogens and produced similar defects. It was hoped that a small dosage of these drugs in combination could be used to produce a rate of abnormalities comparable to an equivalent dose of the individual drugs.

The Sherman Strain of rat was used. Dosages of Vitamin A and Trypan Blue were injected intraperitoneally, and the animals sacrificed on the twentieth day post-injection. Implantation sites and abnormalities were recorded.

The drugs used conjunctively produced fewer reabsorptions; also, an increase in percentage of abnormalities occurred. For equivalent dosages, the percentage abnormalities and reabsorptions, respectively, were: Trypan Blue: 23% and 40%, Vitamin A: 15% and 33%, conjunctively: 37% and 21%. Results indicate that the drugs were more effective conjunctively than either used singly.

Pathogenicity Test of Acanthamoeba sp. in Mesocricetus Auratus. George Mallory Giffe, Jr., George Peabody College.

This series of experiments dealing with the possible pathogenicity of Neff's strain of *Acanthamoeba* sp. was stimulated by the work of Culbertson in which various strains of *Acanthamoeba* were introduced into mice, monkeys, guinea pigs, rabbits, and dogs. Culbertson demonstrated pathological effects in untreated animals and in animals pretreated with cortisone acetate. In the present series of experiments previously untreated hamsters were used.

Acanthamoeba sp. cells in physiological saline were administered intranasally, intraperitoneally, proximal spinally, and orally to twelve of the twenty animals. The remaining eight animals being the controls were given physiological saline minus the amoeba cells.

None of the twenty animals died, and none demonstrated apparent pathological effects during the period

of observation. All of the twenty test animals were autopsied and studied histologically. After collecting, examining, and correlating the pertinent data it was determined: (1) that the strain of *Acanthamoeba* sp. used did not cause terminal effects, (2) that this amoeba did not demonstrate pathological effects under the conditions of this study in the hamsters tested.

The Uro-genital System of the Ambystomidae. C. L. Baker and W. W. Taylor Jr., Southwestern College.

The urodelean uro-genital system sets the stage for the evolution of the anamniotes into the higher vertebrates. The prominent epididymis has modified renal tubules of the sexual or genital mesonephros and is demarked from the secretory or definitive meso-metane-phric kidney. Sperm pass from the testis through the vasa efferentia to a longitudinal (Bidder's) duct thence through connecting (afferent epididymidal) tubules to the coiled units of the epididymis. Numerous transverse (efferent epididymidal) tubules connect the epididymis to the wolffian (sperm or mesonephric) duct. The more posterior of these tubules appear to pass through the definitive kidney, but they are definitely non-secretory. The wolffian duct is emancipated from urine transport as numerous urinary tubules converge into a single short ureter that opens into the cloaca through the urino-genital papilla. This system is rather uniform in various Ambystomidae and is of phylogenetic significance in relating the various families of urodeles.

A Preliminary Report of Recent Foreign Game Bird Introduction Studies. Joe Hardy, State Game and Fish Commission.

Age and Growth of Smallmouth Buffalo, Ictiobus bubalus (Rafinesque), in Watts Bar Reservoir, Tennessee. Robert E. Martin, Tennessee Polytechnic Institute.

Age and growth of smallmouth buffalo, *Ictiobus bubalus* (Rafinesque), was determined from measurements and scale samples from commercial catches from Watts Bar Reservoir. Fish ranged from four to fifteen years of age with the largest number from year class six, the youngest year class completely vulnerable to commercial gear. Survival rate was 49 per cent for year class six, 35 per cent for seven, 26 per cent for eight, and 19 per cent for nine.

Weight increased 100 grams with each centimeter length increase for fish exceeding 31 cm in total length. Absolute growth rates were determined. The species characteristically exhibited the largest relative growth during the second year of life. Conditions for growth evidently had improved for the previous six years as was indicated by an increase in total length attained at the end of succeeding years. Growth compensation was evident during the fourth and fifth years of life.

Ecology of the Introduced Clam Corbicula in Tennessee. Ralph M. Sinclair, Principal Biologist Tennessee Stream Pollution Control Board.

The introduced clam *Corbicula* was first collected in the Western Hemisphere from the north bank of the Columbia River in 1938. By 1957 it was found in the Ohio River Basin, and since that time has migrated extensively throughout the Tennessee River Basin.

Its response to this introduction has been typical of other introduced species. There is a close parallel to the related Zebra Clam *Dreossena* which overran Europe in less than 100 years.

Corbicula has adapted to a variety of substrates and stream conditions. The effect on our native benthos has been negligible compared to that of the Zebra Clam in Europe.

The Cladocera of Taylor Creek, White County, Tennessee. W. L. Smith and C. D. Bassett, Tennessee Polytechnic Institute.

A qualitative investigation was conducted on the Cladocera of the limnetic zone of Taylor Creek, White County, Tennessee. Water samples of 5 liters each were taken from depths of 10 feet intervals from the surface at 8 collecting stations established at 1000 feet intervals from the point where Taylor Creek enters Center Hill Reservoir. These samples were passed through a plankton net and the concentrate examined microscopically. A list of the species found in the creek is given and their distribution discussed.

Amoeboid Motion. Robert A. Rinaldi, University of Tennessee.

Amoeboid motion in *Amoeba proteus* will be illustrated by motion picture films and pictographs. Pictographs are single, time exposure photographs of the moving amoeba. However, the granules of the amoeba have been made more contrasting for recording on photographic film by utilizing darkfield microscopy. The general results indicate that there is a forward flow of plasmasol through the plasmagel tube of an advancing pseudopod of *Amoeba proteus*. There is a lack of a fountain zone at the anterior end sufficient to pull the organism forward. Further, it appears that the motion is explained best by using those concepts advanced by S. O. Mast (1926) to explain amoeboid motion. All of this data will be correlated to the active sliding concept which was advanced by Noburo Kamiya (1959) as a conjecture to explain motion in amoeboid organisms with a modification of Mast's original idea.

SCIENCE-MATHEMATICS TEACHERS SECTION

Room 304 Hunter Hall

Conrad W. Bates, Chairman

Theme: Enrichment Programs in Science and Mathematics for Youth.

I. The National Science Seminars, Albuquerque, 1963: A Student's Evaluation, (Panel Discussion) Linda Henderson, Tina Mooney, Steve Turner, Red Bank High School; A Secondary Teacher's Evaluation, Joe Summers, Memphis; A College Professor's Evaluation, H. G. McDowell, University of Chattanooga.

II. Summer Enrichment Programs Offered by Colleges and Universities: The Purdue Biological Science Program, Summer, 1963, Susan Kampmeier, Chattanooga High School; The JESSI Program for Boys at Clemson College, Mike Kelley, Red Bank High School, The JESSI Program for Girls at T.P.I., Charlyne Wolff and Sarah Tate, Red Bank High School.

III. How the Tennessee Academy of Science is Helping to Enrich the Science and Mathematics Programs in Our High Schools. Myron S. McCay, University of Chattanooga.